waterlines

an international journal of water, sanitation and waste

Rainwater harvesting

PRACTICAL ACTION Publishing

Volume 33 · Number 2 · April 2014

Field report

Roofwater harvesting on the coastal islands of Guinea-Bissau: rainwater tank construction adapted to the local context

HANS HARTUNG and PAUL AKKERMAN

The Republic of Guinea-Bissau in West Africa is not a well-known country. The islands in the south-west are part of a flat and 'salty' coastal landscape with severe drinking water problems. The NGO 'Iagu Limpo – Tabanka San' (Clean Water – Healthy Village) has adapted cement water tanks – called Balanta tanks – to the context in this part of the world. Using clay blocks as a stable and inexpensive formwork avoids the problem of an unstable mould and thus reduces materials needed. More than 1,000 of these tanks exist in Guinea-Bissau and numbers are increasing fast. A MAPP (Method of Assessment of Projects and Programmes) exercise has shown the importance users attach to the tanks; they are an integral part of their lives. People appreciate them as a source of clean water for drinking, whereas water for other purposes (such as cleaning, washing) usually comes from wells (often with brackish water). Readers interested in this innovative and simple way to build and spread rainwater tanks can join training courses or send masons to work with trained masons in Guinea-Bissau.

Keywords: roofwater harvesting, Guinea-Bissau, islands, Balanta tank, thatched roofs, formwork with clay blocks, MAPP

THE REPUBLIC OF GUINEA-BISSAU is a country in West Africa, not well known by many people in the development sector. Wikipedia gives us a short overview: it is bordered by Senegal to the north and Guinea to the south and east, with the Atlantic Ocean to its west. It covers 36,125 km^2 (nearly 14,000 square miles) with an estimated population of 1.6 million.

Guinea-Bissau's GDP per capita is one of the lowest in the world. More than two-thirds of the population lives below the poverty line. The economy depends mainly on agriculture (rice in the coastal areas); fish, cashew nuts, and groundnuts are its major exports. A long period of political instability has resulted in depressed

Hans Hartung (hansfhartung@googlemail.com) is an independent water and energy consultant with more than 30 years' experience in the sector. He is associated to FAKT (Stuttgart, Germany) and is a former vice-president of IRCSA, the International Rainwater Catchment Systems Association. Paul Akkerman (info@degevuldewaterkruik.nl) has been working with farmers in Guinea-Bissau for 25 years. Since 2005 he has been adapting rainwater harvesting as an important source of drinking water for the population. He has initiated the construction of more than 1,000 rainwater tanks in the country and is now instrumental in spreading the technology in Gambia, Senegal, Burkina Faso, and DR Congo.

http://dx.doi.org/10.3362/1756-3488.2014.017, ISSN: 0262-8104 (print) 1756-3488 (online)

economic activity, deteriorating social conditions, and increased macroeconomic imbalances.

Despite lowering rates in surrounding countries, cholera was reported in November 2012 to be on the rise. A 2008 cholera epidemic in Guinea-Bissau affected 14,222 people and killed 225. In June 2013, 20 people died on the island of Catunco and half the population of 3,500 fled for fear of getting infected.

The Joint Monitoring Programme for Water Supply and Sanitation (WHO/UNICEF, 2013) estimates that only 54 per cent of the rural population were using improved drinking water sources. In the villages, it seems that even this low number is exaggerated, as many handpumps are out of order.

In this article, we concentrate mainly on the islands off the south-west coast of Guinea-Bissau in the province of Tombali, i.e. the islands of Widekea, Caiar, Catunco, Samka, and Cataban. They are part of a long, flat, and 'salty' coastal landscape between the River Gambia in the north and Conakry in the south. Balanta people from the coast started to inhabit the islands at the beginning of the last century. They found abundant fish in the coastal waters and the place ideal for growing rice. The biggest problem was drinking water. Only brackish water is left in the dry season and fresh water had to be taken by canoe from the mainland. The water problem is reflected in the name of one of the islands: Widekea – no water!

Rainwater harvesting is the only appropriate solution for the drinking water problem in the area, as groundwater is scarce and mostly brackish.

The Balanta tank

The Balanta tank, as used on the islands and in the whole of Guinea-Bissau for rainwater harvesting from roofs, is a development on its own. Tank building by the NGO 'Iagu Limpo – Tabanka San' (Clean Water – Healthy Village) started in 2003 and went through several stages. Trials with underground tanks and bamboo reinforcement led to unreliable results; however, much experience had been gained.

The ferro-cement tank concept of East Africa (as used mainly in Kenya and later in Tanzania and Uganda) was finally combined with elements of Thai jar clay

Figure 1 The clay blocks for the formwork

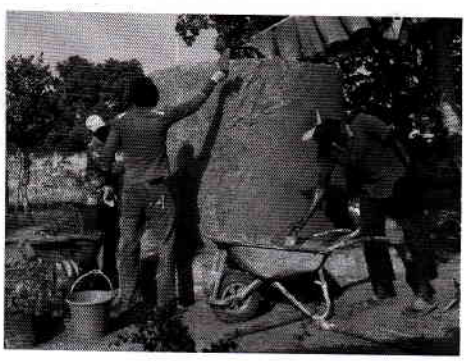

Figure 2 Tank under construction: the first layer of mortar is applied

formwork. People in Guinea-Bissau not only use clay for their houses, but also make characteristic pots and are very familiar with working with clay.

Therefore, the formwork of the 5,000-litre tanks (standardized to this size by now) is made with clay blocks of about 40 cm x 15 cm x 15 cm, the same as for building houses. The clay is mixed with some water and pressed into a wooden box by hand. The blocks dry for a week before they are placed on a newly made concrete foundation. They are given a smooth shape with a pure sand cover. Three layers of mortar (one part cement to three parts sand) follow. Because the formwork made from the clay blocks is stable, the thickness of the tank wall can be controlled well. The blocks are taken out when the layers are stable and more layers are added on horizontal and vertical wraps of mild steel wire. Cement slurry on the inside ensures water tightness. The cover is made separately and has a weight of about 200 kg. Eight men lift it on to the cylindrical tank, while at the same time two experienced men control its position from the inside.

The tank has an inner diameter of approximately 2 m and a wall height of at least 1.7 m. It is built in seven consecutive days (usually two or three tanks close to each other are built at the same time). Only nine sacks of cement (50 kg) are used and 10 kg of steel wire; therefore fewer materials are used compared with the ferro-cement tanks, as known in East Africa. The formwork there consists of weldmesh, chicken wire, and sewn-on sacks. This makes the formwork unstable, requiring thicker layers of mortar to make up for the unevenness.

Figure 3 Lifting the tank cover on to the tank

The cost of a tank is approximately €220 for 'outside' materials and labour. The future owners will have to contribute upfront the equivalent of €55 (of which €38 is to be paid in cash). Additionally, they have to provide the clay blocks for the formwork, the sand, and water.

The contribution by the tank owners has been gradually increased, but the tanks are still subsidized. If we look around the world, we find that investment in drinking water infrastructure is subsidized (e.g. in Europe) while consumers pay for operational cost, rehabilitation, and extension of the original investment. In Guinea-Bissau – a country with one of the world's lowest GDPs – drinking water infrastructure, in this case water tanks, is also currently subsidized, by funds from benevolent organizations.

Technological choices for sustainable drinking water supply are very limited on the islands and rainwater harvesting is the most appropriate and cost-effective

Table 1 Guinea-Bissau tank/Balanta tank, 5,000 litre, 2013

	CFA[1] each	*CFA one tank*	*Euro one tank*
Materials			
9 bags cement	6,000	49,500	83.16
10 kg steel wire	1,000	10,000	15.40
7.5 m wire netting		5,000	7.70
8.0 m plastic sheet	500	4,000	6.16
small material	500	1,000	1.54
		69,500	*113.96*
Tools			
1 wheelbarrow	45,000		
Various tools (spade, levelling instr.)	55,000		
Total tools for 25 tanks	100,000	4,000	6.16
		4,000	*6.16*
Transport			
Transport	8,000	8,000	12.32
		8,000	*12.32*
Labour and coordination			
1 mason	25,000	25,000	38.50
2 helpers	7,500	15,000	23.10
1 coordinator	15,000	15,000	23.10
material for administration		2,000	3.08
		55,000	*87.78*
Total for one Balanta tank **5,000 L**		*136,500 CFA*	*€220.22*
Contribution of owner (with tap, in consultation with owner) 20 barrows sand 130 blocks of clay 600 L water			€55 (of which €38 in cash)

Note: 1 €1 = 656 West African CFA francs (exchange rate on 19 March 2014)

Figure 4 Family and neighbours are happy with their tank

option. Table 1 gives an overview of the materials needed for tank construction in Guinea-Bissau and the associated costs.

The investment for one tank is thus €0.04 per litre volume of the tank, giving a good service for more than 10 years.

The tanks give a big economic impulse to the private sector:

- material and tools are bought on the local market;
- transport is also bought on the local market;
- local masons obtain jobs and receive thorough technical training.

More than 1,000 tanks have been built since 2003, of which 250 are on the islands mentioned.

Assessment of tank utilization with MAPP

Table 2 shows some basic data on population and ethnic grouping as well as on tanks constructed in 2013 and requested for 2014 for the villages/towns where the MAPP assessment has been made. Data are based on fact sheets from 'Iagu Limpo – Tabanka San'

Table 2 Basic data on population and tanks constructed in 2013/requested for 2014 for three island villages

Criteria	*Widekea (Village Fatima) (Island)*	*Samka & Cataban Ntunda (Island)*	*Québo (Mainland)*
Population	800	460	7,000
Ethnic group	Balanta	Balanta	Fula
Water problem	Wells in bad condition, partly salty water Water problems in wells for 7 months of the year	6 months per year without water from wells with mostly salty water	Little water available in the wells from March to June, rocks prevent deepening of the wells
Rainwater tanks (end of 2012)	16	50	46
Tanks repaired 2012	11 leakage due to bad sand	–	8 (2 at lid, 3 at wall, 3 at foundation)
Tanks constructed 2013	12	14	14
Tanks requested for 2014	32	24	50

For an assessment of the tanks as viewed by their users, MAPP (Method of Assessment of Projects and Programmes; Neubert, 2009) was used in order to get a better insight into the value systems of the users and their own evaluation of development efforts. MAPP is a participatory evaluation method working with discussion groups and reflecting the perceived key social processes in a community. Three sites were chosen (see Table 2) and the following tools were used at each site:

- *Lifeline.* Identification of good and bad years of the site.
- *Identification of local criteria for social development.*
- *Influence matrix.* Attribution of impacts and comparison of project activities with the identified criteria.

Results

There were between 30 and 50 people present at each site of the assessment. Elder men often led the discussion but, when specifically addressed, women voiced their concerns very clearly.

Quality of life on the islands is largely dependent on climatic conditions such as rainfall for rice production. In comparison to the islands villages, people in Quebo depend mostly on cashew and are more pessimistic.

In order to determine quality of life, four main criteria were used: economy (sources of income); access to resources; information and communication; and freedom and autonomy. In discussion with the community, 3 to 5 sub-criteria were determined which defined the main social criteria.

For people on all visited sites, access to potable water is important. They also put a lot of emphasis on access to health services – the difficulty in accessing the regional hospital was mentioned many times, especially by the people from the islands. Transport for access to markets was also rated as important for these two villages.

Within the criteria 'information and communication' school enrolment plays an important role. People also value access to a mobile phone network very highly.

The last category consists of, 'freedom and autonomy', was interpreted very differently in the different sites visited.

The influence matrix showed that rainwater tanks and the mobile network were rated as the most important 'project' activities for the villages. People insisted that not only do they need drinking water, they also need water for cleaning and washing and asked for help in increasing the number of wells for non-drinkable water. Latrines were also rated as important and mentioned a few times during the discussions. The exercise has allowed the people of the three sites to see the (few) development efforts of their villages. They especially saw the importance of drinking water and how much it helps them compared with other projects and how it has a positive influence on many of the criteria that they value.

Conclusions

The rainwater tanks are an integral part of life for the families who own one. People appreciate them very much as a source of clean water for drinking, whereas water for other purposes (such as cleaning, washing) usually comes from wells (often with brackish water).

Water from tanks is especially valued during the second half of the dry season (starting from February) when many wells dry up or have very little water. At times such as these, water from the tanks is very often the only source of drinking water. Rainwater is especially liked for its good taste, its cleanliness, and its availability at the house (in the tank).

Figure 5 Collecting water from thatch

Figure 6 Collecting water from thatch with wooden gutters

Contrary to many beliefs, people collect water from (mostly) thatched roofs in a traditional way (binding the ends of the thatch together), collecting it in available vessels and then storing it in the tank. They use wide gutters as well. The brown colour disappears during storage. Reliable data on bacterial water quality for thatched-roof water are not yet available. However, the bacterial count decreases significantly after a rain event as evidenced in the literature and our own earlier tests (see for example Heyworth et al., 2006). The author compared a sample of more than 1,000 school children who were regular consumers of tank rainwater. They were at no greater risk of gastroenteritis than those who drank treated mains water.

The construction quality of the tanks is good. Leaks are reported to representatives, as part of a monitoring system. Statistics show that 18 per cent of the tanks needed some kind of mostly small repair; experience in repairing lies with the masons. Monitoring of the construction quality is important to make masons responsible for their work; their remuneration is dependent on good performance.

An efficient and cost-effective organization has been developed. The work is directly benefiting the future users, who are involved from the beginning.

The Balanta tank is technically mature, cheap, and simple and contributes to solving drinking water problems. In the coastal region of Guinea-Bissau, with more than 100,000 inhabitants, every household with a kitchen would benefit from such a tank. Balanta tanks can also supplement existing and often scarce water supply elsewhere as people often use different water sources for different water needs at different times of the year.

Training courses in Burkina Faso, The Gambia, and the Democratic Republic of Congo have spread the idea to other countries.

If you are interested in this innovative and simple way to build and spread rainwater tanks you can contact the authors. You can see how the tanks are built in Guinea-Bissau or, even better, join one of the eight-day training courses. Or you can send masons to work alongside the trained masons. More information is available at <www.degevuldewaterkruik.nl>.

References

Heyworth, J., Glonek, G., Maynard, E.J., Baghurst, P.S. and Finlay-Jones, J. (2006) 'Consumption of untreated tank rainwater and gastroenteritis in young children in South Australia', *International Journal of Epidemiology* 35: 1051–8 <http://dx.doi.org/ 10.1093/ije/dyl105>.

Neubert, S. (2010) 'Description and examples of MAPP: Method for Impact Assessment of Programmes and Projects', [online] Bonn: German Development Institute <www.ngo-ideas.net/MAPP/> [accessed 19 March 2014].

WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation (2013) *Progress on Sanitation and Drinking-Water: 2013 Update*, [pdf] <www.wssinfo.org/fileadmin/user_upload/resources/JMPreport2013.pdf>[accessed 19 March 2014].