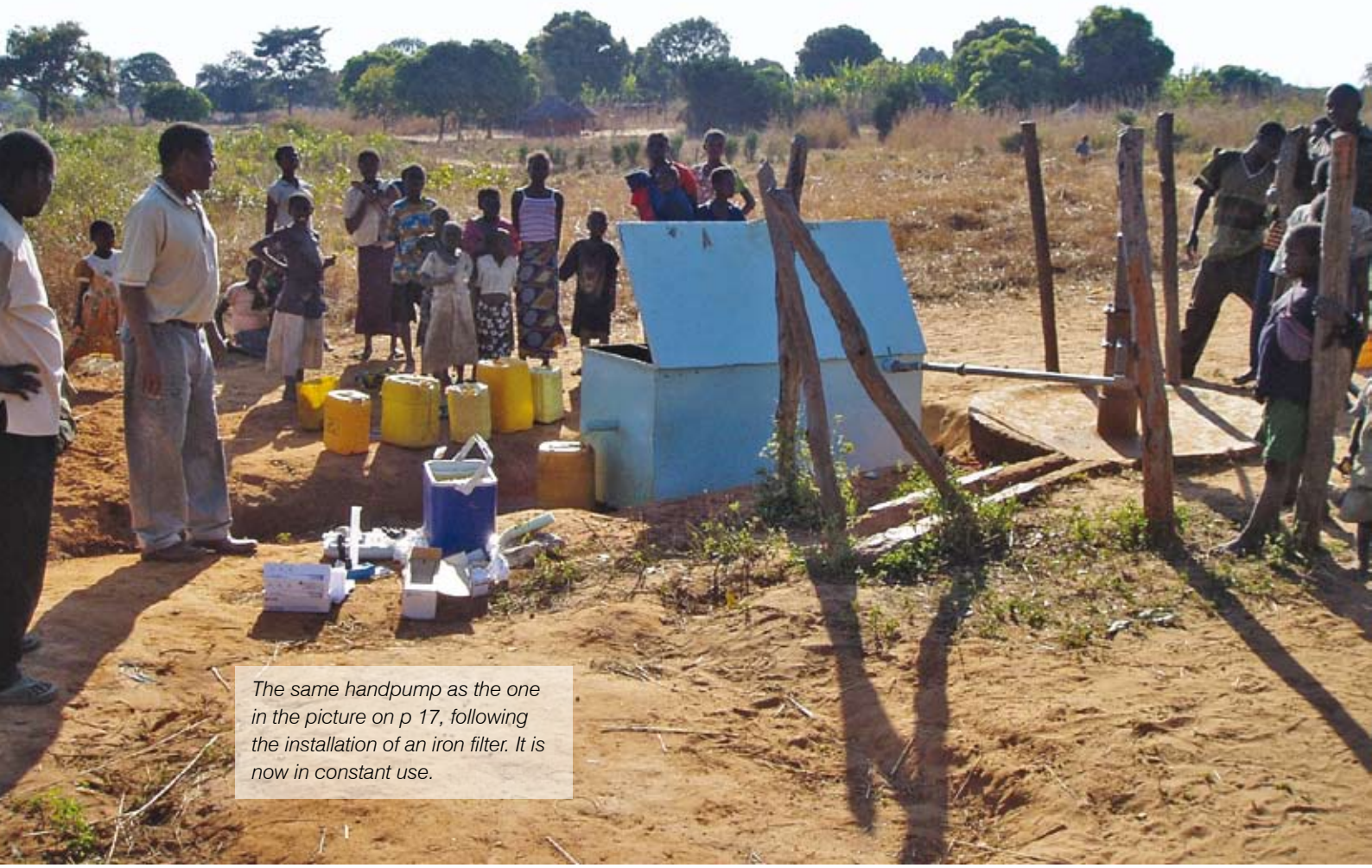
Bad Tasting Groundwater Tackled



The same handpump as the one in the picture on p 17, following the installation of an iron filter. It is now in constant use.

Groundwater rich in iron poses a serious challenge in many parts of the world, especially in rural areas where communities often have to depend on this water as the only safe supply. A recently completed project in Zambia investigated possible solutions in this regard. By Max Karen and Jim Anscombe.

Iron is an essential element in human nutrition and, depending on factors such as age, sex and physiological status, the daily requirement for iron ranges from 10 to 50 mg/day. According to the World Health Organisation, iron concentrations of 1 to 3 mg/ℓ can be acceptable for people drinking anaerobic groundwater.

However, these high levels of iron can cause discolouration of the water, and can impart an unpleasant taste as well as cause stains on food and laundry. This results in people returning to unprotected sources, which increases the risk for waterborne diseases, such as cholera and diarrhoea.

The issue of high levels of iron found in groundwater resources in parts of North Western Zambia was highlighted during the North Western Province Rural Water Supply Project. An initial hydrogeological survey indicated that large numbers of boreholes contained high levels of iron.

Within the project area levels of iron above 1 mg/ℓ were found to cause

discolouration. At levels of iron above 2 mg/ℓ many boreholes were found to have been abandoned by the local communities and health centres where they were constructed as a means of safe water supply.

Two solutions were put forward. The first was to carry out a study of existing iron filtration methods around the world. The results of this study were used to design a filter specifically for the project area. This filter was then installed and assessed in terms of its ability to reduce iron and performance in terms of ease of operation and maintenance.

"At levels of iron above 2 mg/ℓ many boreholes were found to have been abandoned by the local communities."

The iron levels from the inlet to the filter were monitored regularly using portable iron photometers. The levels were further quantified during a trace element sampling programme carried out in order to identify if there were any other potentially toxic elements contained in the groundwater. The results were analysed at the British Geological Survey laboratories at Wallingford, in the UK. All tests indicated that the filter removed iron to well below acceptable limits.

The second solution was geophysical. During the in-house geophysical siting programme, boreholes with high iron levels were surveyed using resistivity sounding. A preliminary assessment of the results indicated that there is a link between boreholes with high levels of iron, and conductive layers of below 40 Ωm, below 30 m depth. This was interpreted in the geological context of an association with clay.

Table 1:

Borehole name	Iron filter	Fe (mg/ℓ)
Mafuliwanjamba RHC	Inlet	6.910
Mafuliwanjamba RHC	Outlet	0.212
Chilemba BS1	Inlet	10.600
Chilemba BS1	Outlet	0.235
Kivuku	Inlet	4.410
Kivuku	Outlet	0.013

This reliable handpump, situated next to a healthcare centre in North Western Zambia, was hardly used despite its good yield due to the large concentrations of iron in the water.

The project has now moved to full scale. The boreholes with high iron content are dealt with as follows. If the iron levels are above 1 mg/ℓ a second borehole is drilled. If iron levels are also high in the second borehole, the borehole with the lowest iron concentration is selected and an iron filter installed.

The filtration system is being modified so that it can be incorporated into the civil works that will be constructed next to each new borehole. The crucial issue, however, is the sustainability of the filter. Based on monitoring data and the fact that the communities themselves were put in charge of the maintenance of the handpumps it is believed that this problem can be solved.

About 350 boreholes will be drilled in North West Zambia, and it is anticipated that about 10% of these boreholes will have levels of iron above acceptable limits. It is anticipated that the installation of the filtration system will go a long way in overcoming this challenge.

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