An engineering response to the needs of Burmese refugees in Bangladesh

by Martin Gambrill

The engineering response to the flood of refugees from Burma in 1992 solved the short-term water supply problems, but recruiting local engineers and handing over the technical work made the situation workable for the long term.

BY APRIL OF 1992 approximately 260 000 Rohingya refugees had fled the Arakan province of Myanmar (formerly Burma) across the estuarine Naaf river to one of the thirteen refugee camps spread throughout the Teknaf peninsula in south-eastern Bangladesh. These Muslim Rohingya people were fleeing persecution and attacks on their community by the army in Myanmar. The daily rate of arrival peaked at some 5000 to 6000, and the influx became recognized internationally as a major crisis. The refugee camps were established along the main road which links the towns of Coxs Bazar and Teknaf, the latter being located at the most southerly point of the peninsula. The refugees' main entry point into Bangladesh was by way of small fishing boats across the estuary to Teknaf.

The Bangladesh Government's Department of Public Health Engineering (DPHE) had implemented an extensive programme of tube-and-ring well construction in the refugee camps by the end of March 1992. But in the two most southerly camps, Dumdumia and Noyapara, and in the spontaneous unofficial settlements along the roadside between Dumdumia and Teknaf, the DPHE's attempts to provide water proved unsuccessful because there were insufficient yields of groundwater. The refugees in these camps got their water by waiting for up to 8 or 10 hours for tankered water, by walking for 3 or 4km to springs, or by drinking from polluted surface sources.

The scale of the problem was daunting: Dumdumia camps I and II were each designed to accommodate 10 000 refugees, but by April 1992 there were some 70 000 people settled in the camps and in the impromptu shacks located along the road to Teknaf.

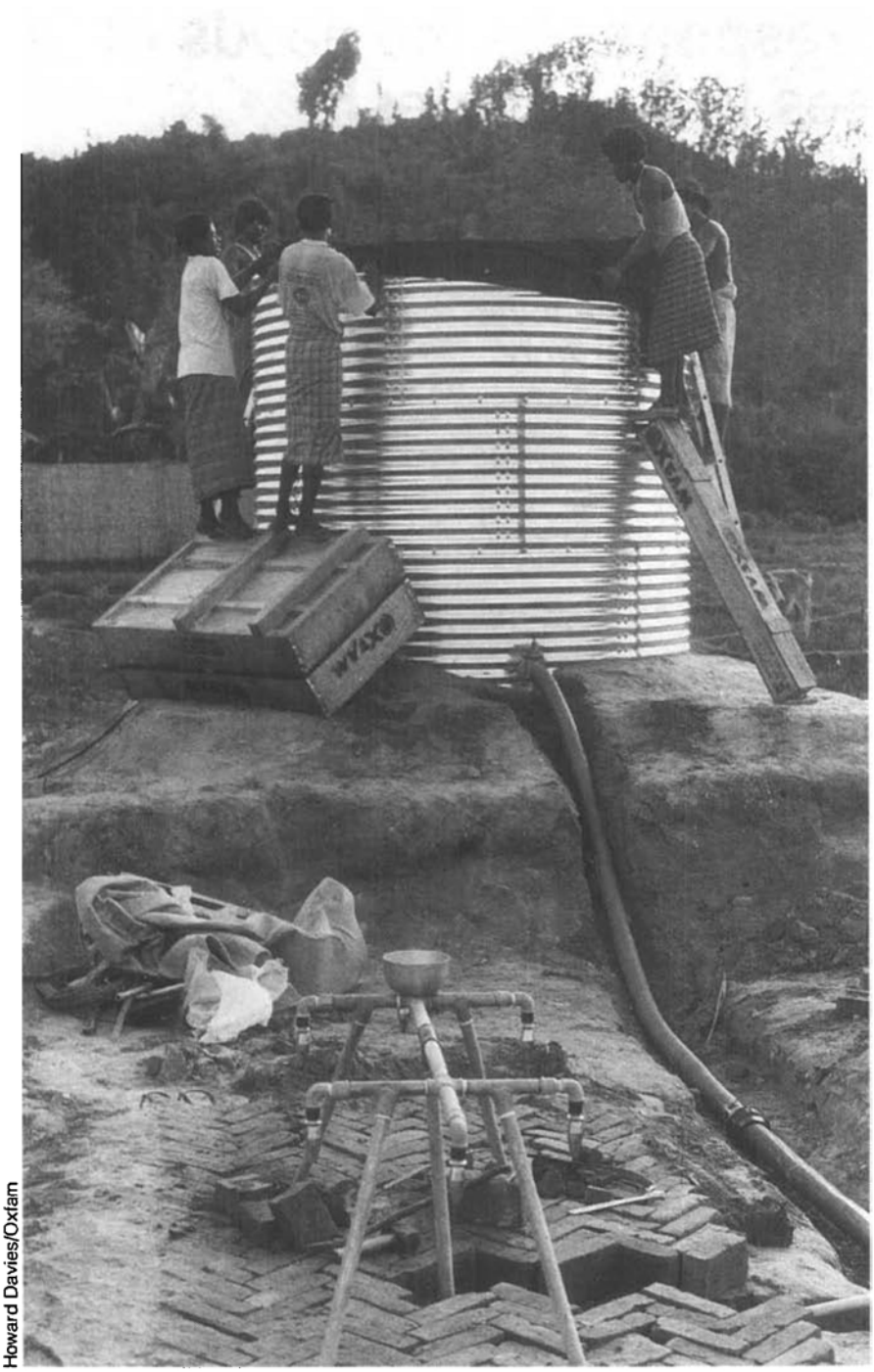
The severity of the situation in Dumdumia and Noyapara was recognized by Oxfam in-country staff, who prepared a proposal for the improvement of the camps' water supplies. A needs-assessment engineer from the UK (Alan Hayes of RedR) visited the camps in order to assess the technical requirements of the project. Oxfam subsequently entered into an agreement with the United Nations High Commission for Refugees (UNHCR), who were co-ordinating the refugee relief programme from Coxs Bazar, to provide the staff and equipment needed to supply more water of a higher quality to the two camps.

Preparing the tank foundations at Noyapara.

Skimming the 'slime layer' off a slow sand filter at Dumdumia.

A pit-latrine building programme had already been undertaken by other parties in Dumdumia, and one was planned for Noyapara before more refugees were moved into the camp from their roadside shelters. Although sanitation was far from ideal in both camps, it was not considered an initial priority by Oxfam.

To implement the water improvement programme two engineers were recruited in the UK, and a third expatriate engineer and other Bangladeshi staff were recruited locally.



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A team of Rohingyas were trained to erect the water tanks and install the fittings with minimal supervision.

Within a week a consignment of 30 tonnes of emergency equipment was assembled and air-freighted to Bangladesh. The Oxfam Water Team was based in Teknaf, three hours by road from Coxs Bazar. There was no telecommunications equipment to enable the team to keep in contact with the UNHCR or other organizations in Coxs Bazar, and communication with the Oxfam office in Dhaka was even more precarious.

The assessment exercise had identified the need to treat the grossly polluted water in the stream running through the camps as the principal means of providing even minimum quantities of potable water for the refugees. The springs in the adjacent hills had too low a seasonal flow and were too distant to merit immediate attention. The water team's primary objective was thus the installation of an Oxfam water filtration kit at each camp. The kits had been installed by Oxfam before in emergency situations in Africa, but it was the first time they were to be used in Asia.

The hardware

An Oxfam water filtration kit comprises five pre-fabricated galvanized steel tanks (in sections) complete with butyl rubber linings, interconnecting pipework and other fittings, diesel pumps, distribution pipework, tapstands, and tool kits. The fully assembled kits can treat polluted water to a potable standard by sedimentation and slow sand filtration. Complementary $10m^3$ water storage tanks, uPVC and MDPE pipework, and diesel pumps were included in the Teknaf consignment. Additional pipework and fittings, not always of good quality, were procured in the commercial district of Coxs Bazar as and when was necessary. Other materials, such as alum and bleaching powder, were available locally from the market and the DPHE.

The water filtration kits each contain two $95m^3$ raw water tanks (RWTs) into which river water is pumped. The raw water undergoes a period of quiescent settlement in the RWTs during which settleable solids accumulate as a sludge. The liquid off the top (supernatant) of one of the tanks is then fed to the slow sand filters. While one RWT is feeding the filters, the other is being filled and its contents settled. Once the first RWT has discharged its liquid, the second tank is set to feed the filters, and the first is refilled.

Two $70m^3$ tanks form the slow sand filtration units, which provide physical and microbiological purification of the water. This supernatant from the RWTs is discharged into the top of the sand filters. This water percolates through the biological slime layer, which is responsible for most of the water-quality improvement, through the sand layer, and into the underlying gravel where it is collected in underdrains. Both sand filters are fed simultaneously from a single RWT. The filtrate from both filters is then fed to a $45m^3$ tank where it is stored and, if necessary, chlorinated, before distribution. The levels of the tanks are set so that the water flows between them by gravity.

The pace of construction was very fast: one of the two sand filters at the Dumdumia plant was on-line and delivering water in just over two weeks from the beginning of the earthworks. The period to commissioning was accelerated at Noyapara, since there were less earthworks and the team's experience was much increased. At both plants, however, interim water treatment was achieved within 7 to 10 days of starting work on site, by alum dosing to clarify the raw water in the $95m^3$ RWTs and, subsequently, chlorinating the supernatant in the $45m^3$ storage tank before distribution. This interim treatment was maintained for the period during which the sand for the filters was being washed and placed. The sand was imported by lorry from the northern district of Sylhet since no suitable material was available locally. Sylhet sand is widely used throughout the country in sand-filter installations.

An Oxfam filtration system is designed to produce approximately 150m^3 of water per day, equivalent to 5 litres per person per day for some 30 000 refugees: just about the bare minimum for survival, and well below the desired amount of 20 litres, which is considered the minimum for drinking and hygiene. It was intended from the outset, however, that the refugees would only use the treated water for drinking and cooking, and that other water sources would have to be investigated for bathing and for washing clothes and cooking utensils.

The river water being treated was grossly polluted, especially at Dumdumia, where people washed themselves and their clothes and defecated in areas adjacent to the river upstream of the plant intake. In addition to the faecal contamination, the river water was naturally very turbid: levels in excess of 100 NTU were common. As a result of this high turbidity the slow sand filters had to be skimmed approximately once a month. A special filter fabric, which came as part of the kit, covered the sand surfaces and aided the cleaning process by minimizing the amount of sand that had to be removed when the filter became blocked, and thus extended the period before the filters had to be re-sanded.

In an attempt to reduce the suspended solids concentration of the raw water an infiltration gallery was constructed and filled with broken bricks; the river water was pumped through this before feeding the treatment plant. Despite the nature of the influent water, the filtration plant consistently produced potable water with no detectable faecal coliforms and with a very acceptable turbidity level of less than 2NTU.

Valuable lessons

The second filtration plant was erected more quickly and efficiently than the first. The water team had learned valuable lessons in the initial exercises, and a team of eight Rohingya refugees had been trained to erect tanks and install fittings with minimal supervision. Other Rohingyas were employed to carry out earthworks, break bricks for the aggregate, dig trenchs, lay pipes, mix and pour concrete, install pumps, and operate and maintain the water treatment plants and associated equipment. The refugees were paid for their work until this practice was prohibited by the Bangladeshi Government, who eventually prohibited the use or employment of the refugees at all. A few Rohingya and locally recruited operatives were retained for the operation and maintenance of the treatment plants, however, on the understanding that they were highly trained and could not be replaced easily.

The Rohingya workforce had a competent and dedicated foreman, who was soon identified by the water team, and who ensured that work was carried out with speed and diligence. When substantial earthworks were being carried out, up to 100 refugees were employed on a daily basis. Women were employed on a piece-work basis to break bricks for aggregate and to crush alum crystals for water dosing.

A number of local engineering supervisors were recruited by Oxfam in Dhaka. They proved invaluable, especially when work was progressing simultaneously at a number of sites. Their ability to act as interpreters between the refugees and those members of the water team who did not speak Bengali greatly aided the progress of the work.

All the objectives of the relief programme, with modifications where necessary, were completed within three months. Additional water projects were also undertaken that were beyond the original scope of works.

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Queuing for water at a tapstand in Dumdumia camp.

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Additional projects were carried out to extend and improve the camp's water supply.

In order to ensure an uninterrupted and reliable supply of intake water to the treatment plants at Dumdumia and Noyapara, substantial earthwork programmes were undertaken. These were intended to guarantee that the earth dams, which were constructed by local people in the rivers for agricultural purposes and adopted as intake reservoirs for the treatment plants, were not washed away by the seasonal monsoon floods. In order to safeguard the intake reservoir a 6m-high, 15m-wide earth dam was built at Noyapara along with a long, deep storm diversion channel further upstream. A second intake was also built as a contingency, should the strengthened earth dam fail.

Additional projects undertaken that were beyond the team's remit included:

- the upgrading of a UNICEF slow-sand filter;
- the erection of 10m^3 satellite water distribution tanks fed by pumps from the treatment plants and used to ensure a better distribution of water throughout the camps;
- the construction of bathing ponds to provide alternative water sources for washing clothes and cooking utensils;
- the co-ordination and rationalization of the UNHCR tankering programme;
- the implementation of a rainwater harvesting programme;
- spring capping;
- the provision of standpipes for feeding centres, hospitals, and cholera centres; and
- the installation of water collection, treatment, and distribution systems at three other refugee camps.

The majority of the Bangladeshi locals were as poor and underprivileged as their refugee neighbours. The former did not, however, receive weekly food rations or other benefits that were afforded to the refugees. Resentment occasionally manifested itself in confrontations between the two groups, often concerning disputed water sources. In one camp a water-sharing policy between the refugees and the locals was introduced. The employment of locals as watchmen and plant operatives also helped to smooth relations.

As the water situation improved, Oxfam, in association with two Bangladeshi NGOs, turned their attention to sanitation and health education. A pit latrine building programme was implemented and health workers were deployed in the camps.

Much importance was attached to the training of refugees and local people in the operation and maintenance of the treatment plants and associated facilities. A supervisory engineer from Dhaka took charge of the water programme and expanded it where necessary when the expatriates left. The majority of the refugees remained in Bangladesh for far longer than the six months initially envisaged, and Oxfam's original emergency relief programme gradually developed into a rational long-term project encompassing water, sanitation, and educational elements.

A field report 18 months after I left confirmed that the treatment plants and other equipment were still functioning and producing clean water for the refugees. In May of this year a cyclone travelling up the Bay of Bengal struck the Rohingya refugee camps with its full force. Dumdumia was particularly badly affected, with all of the refugees' shelters being destroyed. The water treatment plants at both camps, however, survived the cyclone intact and, following a short period off-line during which they were recommissioned, are now fully operational again. The refugee camps are currently being rebuilt as the Rohingyas continue to wait for the day that they can safely return to their homeland. ●

References

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