4 WATER QUALITY

Background

Deterioration of water quality is an increasing concern in many parts of the world. Pollution of water sources in rural areas due to human waste and use of chemical fertilisers and pesticides is a problem in large areas of the middle mountains in the Himalayan region. During the rainy season, faeces and other pollutants are washed into river systems and water sources, adding to the health risk. The Jhikhu Khola watershed is no exception to these issues. In the Water Demand and Supply Survey, 17% of respondents in Jhikhu Khola and 9% in Yarsha Khola mentioned the problem of drinking water quality (Merz et al. 2002).

The question that PARDYP sought to answer was *'What is the status of water quality and how can drinking water quality be improved'?* Water quality was monitored and different options tested.

Water Quality Monitoring

PARDYP conducted a survey of water sources and monitored the water quality of a large number of public sources such as springs, streams, dug wells, and rainwater harvesting jars (Figure 31). Monitoring was carried out during four seasons over a number of years: pre-monsoon (March-May), monsoon (June-September), post-monsoon (October-November), and winter (December-February). The data were analysed and compared with the 1997 World Health Organization guidelines to quantify the water quality status.
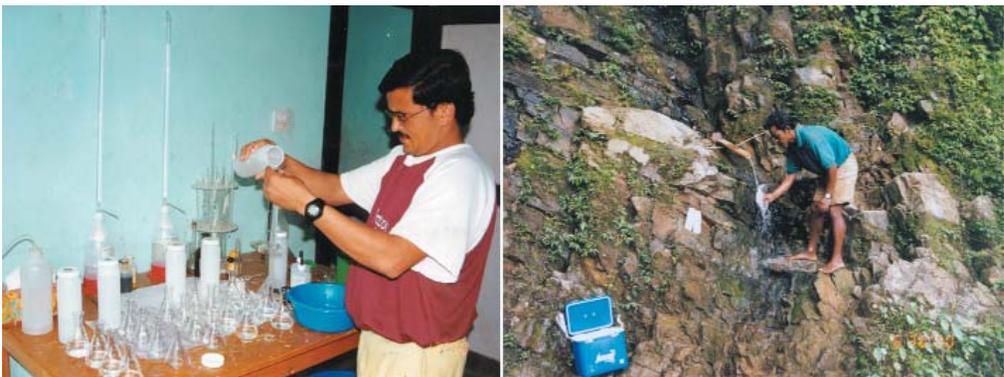
Figure 31: Collection and investigation of samples from drinking water sources

Springs

Basic physical and chemical parameters were investigated in a total of 319 springs in the Jhikhu Khola and 215 springs in the Yarsha Khola watersheds (Annex 14, Table 1). The majority of the springs in both watersheds had a turbidity of less than one nephelometric turbidity unit (NTU). In terms of pH and electrical conductivity (EC), water quality was better in the Jhikhu Khola than in the Yarsha Khola springs (Annex 14, Table 3). All other water quality studies were carried out in the Jhikhu Khola watershed only.

Microbiological and other contamination

Total and faecal coliform contamination was very high in **stream water** at all sites tested. Phosphate was above the European Commission (EC) recommended limit of 0.4 mg/l at about 60% of the stream sites. Turbidity was high (> 25 NTU) in most seasons but particularly so in pre-monsoon and monsoon (Annex 14, Tables 4 and 5).

Total and faecal coliform/E. coli contamination was very high in all **spring sources**. Phosphate exceeded the EC limit in more than 50% of the spring sources; however, the springs in the Kubinde area and the Barabot spring in the Dhotra area had phosphate levels within the limit (Annex 14, Tables 6 to 10).

Total coliform and faecal coliform/E. coli contamination was very high in all the **shallow dug wells** investigated. Phosphate exceeded the EC recommendations in most cases. High turbidity was observed especially in the pre-monsoon and monsoon seasons. Ammonia was also a problem in a number of wells, especially in the monsoon season. The pre-monsoon and monsoon seasons were more problematic generally than other seasons (Annex 14, Tables 11 and 12).

Total coliform and E. coli contamination was found in the majority of **rainwater harvesting jars** investigated, particularly in the pre-monsoon and monsoon seasons. Phosphate was above the EC limit in a number of jars; the pH was mostly above 8 (Annex 14, Table 12).

Water Quality Improvement Options

PARDYP tested various options for addressing drinking water quality issues, including organising dissemination and awareness building workshops, solar water disinfection (SODIS), low cost water filters, and a case study on spring source protection with community participation.

Awareness building

PARDYP organised a number of workshops for local residents, authorities, science teachers, school children, and health volunteers to discuss and present the water quality status and potential treatment measures. People were made aware of water quality problems, health, and sanitation improvement systems. Pamphlets on low-cost water filters and SODIS were disseminated and the methods promoted. People were trained to tackle the microbiological problems of drinking water by using methods such as boiling, chlorination, SODIS, and low-cost water filters.

SODIS (solar water disinfection)

SODIS is a simple, cheap, and environmentally friendly technology which consists of putting clear water into PET bottles and exposing it to sunlight for about eight hours. Ultraviolet rays in the sunlight kill any microorganisms in the water. This is a laboratory tested and proven technology. PARDYP tested the technology in the Jhikhu Khola watershed and found it very effective for disinfecting microbiological contamination in drinking water. About 50 local residents from different parts of the Jhikhu Khola watershed were given training and orientation on the SODIS technology. It was also disseminated to the people in the Baluwa area in the Jhikhu Khola watershed through Rani Pani Gram Sewa Kendra, a local non-government organisation (NGO). People were also provided with pamphlets explaining how to use the method properly. They found it very easy and useful. The main problem was that it was difficult to find PET bottles in rural areas. SODIS was mainly useful for household consumption; it was not practical to carry large quantities of water to farmers working in the fields. People also felt that the water in the plastic bottles became warm and lost its natural taste. For these reasons and the lack of health consciousness, SODIS has not been scaled up and was not popular. Very few people practise it.

Low cost water filter (SAFA filter)

A low cost water filter (SAFA filter) developed by International Development Enterprise was applied locally with two plastic transparent buckets containing a silver-coated ceramic candle and outflow tap. This candle filters about 2 l/h of water, which was quite efficient compared to other water filters available in the market. PARDYP tested this technology in the Jhikhu Khola watershed and found the silver coated candle used in the SAFA filter to be highly effective in removing turbidity and coliform contamination from the water. As the buckets were transparent, it was easy to see the clean filtered water in the lower bucket. About 20 sets of this filter were tested and disseminated to the local residents who found it a very appropriate option for improving drinking water quality. However, due to poverty, lack of health consciousness, and lack of availability of the SAFA filter in the rural market, the method did not become popular and was not scaled up and replicated. There were also some quality problems with fitting of filters. Without proper handling, cleaning, and maintenance, the SAFA filter will not give pure and clean water.

Case study: Water quality management – Barabot Spring, Dhotra

A case study was conducted on Barabot spring at Dhotra in the Jhikhu Khola watershed to test and disseminate promising water management options for more efficient use and equitable access. Management of drinking water quality was a part of the study. Barabot spring was a natural spring without any structure and the source was in very poor condition. The water was turbid and microbiologically contaminated. The community had no alternative source nearby. The case study included monitoring water quality seasonally, community mobilisation, motivating user groups, structural improvement of the source with a closed spring box (Figure 32), source and catchment protection, and creating user awareness of water quality problems and health issues. After the new

measures were introduced, the water became clear and microbiological contamination was reduced. The users became aware of water quality problems, water conservation methods, and proper sanitation. They were also given household-level treatment options like chlorination, solar water disinfection (SODIS), and low-cost water filters. Of these, users preferred the low-cost water filter as it is simple and easy. The case study showed that participatory and integrated management can effectively address water problems.
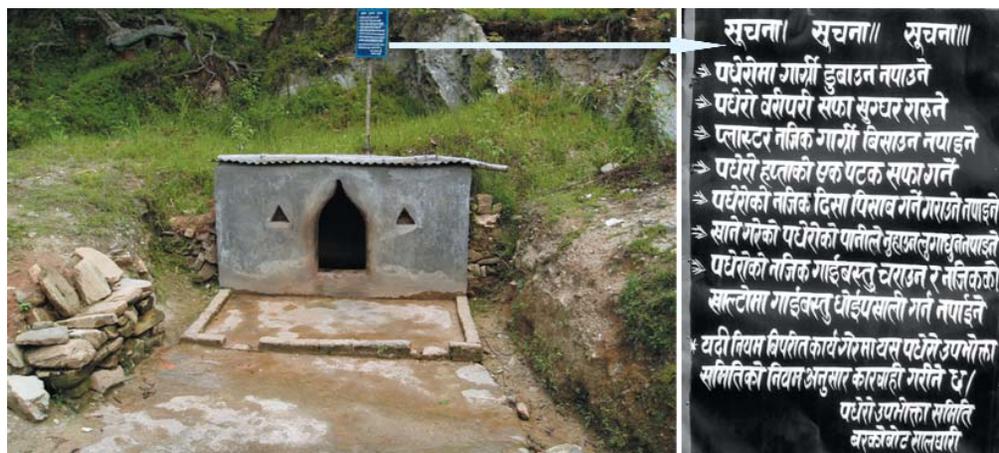

Figure 32: Protected spring at Barabot Dhotra, showing the user rules

Lessons Learned and Recommendations

- Microbiological contamination was the main problem in all types of drinking water sources.
- All sources were unsafe for drinking without treatment irrespective of the season, although during winter the quality of drinking water was better.
- Contamination is due to poor sanitation systems and seepage, the poor structure of water sources, and the poor handling of water.
- Phosphate was a problem in many of the sources, indicating agricultural pollution. Nitrate was within the World Health Organization guideline value.
- Seasonal water quality analysis did not show any distinctive pattern of the water quality parameters, but did show that water during the pre-monsoon and monsoon was more polluted.
- It is recommended that water from any source should be treated by boiling, addition of bleaching powder or chlorination, solar disinfection (SODIS), or low-cost water filter as short term solutions.
- Long-term measures to protect sources and their catchments are urgently required.