

## Brief results

### *The Yarsha Khola Watershed*

The 218 households interviewed in the Yarsha Khola were more or less evenly spread throughout the watershed (with a small gap at Kathrigau village) (Figure 4). More than three quarters of the houses were in the elevation band between 1200 and 2000m. This is the most densely populated area in the watershed. The areas below 1200m are mainly used for irrigated agriculture and the area above 2000m is mainly bush and forest.

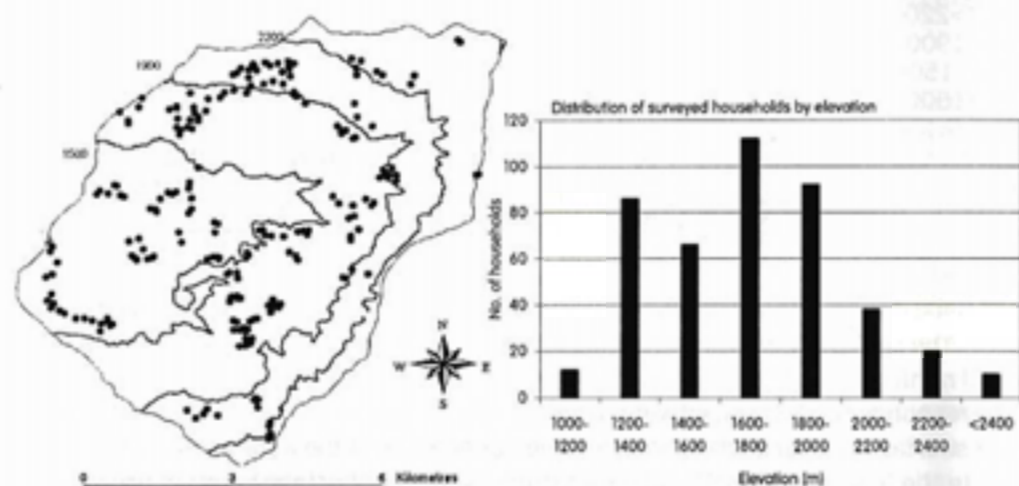


Figure 4: Interviewed households in the Yarsha Khola watershed:  
(a) spatial distribution; (b) distribution according to elevation

The importance of water is underlined by the words that local people used to describe it: just over half (223 people) chose 'life' as the one word to describe water; others said 'soul', 'important', 'creation', and 'essential thing'. People also considered that there were major problems with water. One half of the respondents considered the watershed to be dry, and 45% considered it wet (Table 1). People generally saw the south-facing slope, the middle part of the watershed, and the lowest part of the north-facing slope as being dry, and the upland areas of the north-facing slope as wet. Table 1 shows the actual rainfall in the different blocks in comparison with the perception of the residents.

In terms of the annual average, there is plenty of rainfall and the watershed can be classified as humid sub-tropical to cool temperate. However, the residents even perceived areas with a total annual rainfall of 1800 mm and more as dry. Thuloban, at 2640 masl, received 3316 mm of rainfall in 1998, but 16 people out of 20 still considered this area to be dry. The same was true of Bagar and Namdu. Overall 50% of the residents thought that the watershed was dry or very dry, particularly those from the south facing slope. It seems that total annual rainfall is not a good indicator of people's perception of the relative wetness/dryness of a location.

**Table 1: Water-related constraints according to altitude and aspect in the Yarsha Khola watershed**

| Block (altitude)   | Perception (No of farmers) |     | Yes answers to the question: Do you face problems with water quantity for: |              |              |            | Annual rainfall      |                           |
|--------------------|----------------------------|-----|--|--------------|--------------|------------|----------------------|---------------------------|
|                    | Dry                        | Wet | Irrigation No.   | Irrigation % | Drinking No. | Drinking % | Amount (mm)          | Station (Altitude, m)     |
| South (>2200)      | 16                         | 4   | 15   | 75           | 14           | 70         | 3316                 | Thuloban (2640)           |
| South (1900-2200)  | 38                         | 40  | 50   | 63           | 43           | 54         | 2554                 | Jyamire (1950)            |
| South (1500-1900)  | 33                         | 6   | 24   | 60           | 19           | 48         | 2049                 | Bagar (1690)              |
| South (<1500)      | 39                         | 1   | 33   | 83           | 18           | 45         | 1760                 | Namdu (1400)              |
| North (>2200)      | 4                          | 12  | 14   | 88           | 14           | 88         | Installed in July 98 | Pokhari (2260)            |
| North (1900-2200)  | 5                          | 29  | 21   | 53           | 21           | 53         | .                    | .                         |
| Middle (1500-1900) | 35                         | 16  | 35   | 58           | 23           | 38         | Installed in June 98 | Mrige (1610)              |
| North (1500-2200)  | 0                          | 60  | 31   | 52           | 47           | 78         | 1847                 | Gairimudi (1530)          |
| Middle (<1500)     | 22                         | 17  | 32   | 80           | 36           | 90         | .                    | .                         |
| North (<1500)      | 26                         | 9   | 32   | 78           | 25           | 63         | 1678                 | Main Hydro Station (1005) |
| Total              | 218                        | 194 | 287  |              | 260          |            |                      |                           |

Most of the rainfall (more than 80% on average; Merz et al. 2000) falls during the monsoon period, the remaining months are relatively dry. This partly explains why despite heavy annual rainfall 81% of those interviewed said that they faced water problems. Two-thirds of the respondents (287) faced water shortages for irrigation and 60% (260) for drinking. Water shortage is a particular concern in the upper areas of the watershed, on the central ridge in the lower part (90% indicated drinking water shortage), and in areas below 1500m. Drinking water quality also seems to be a major issue in the most densely populated areas, which include the settlements of Mainapokhari and Gairimudi: 65 people (15%), all from densely populated areas, mentioned water quality as a problem. Minor problems included slumping (7 respondents) and surface erosion (2).

Water shortage for both agricultural and household supply was mainly felt to be a problem during the pre-monsoon period. Shortage of irrigation water is already apparent in early winter and peaks in the month of Falgun (mid January to mid February), household water shortage problems arise in late winter to early pre-monsoon, the peak felt to be in Chaitra (mid-February to mid-March). No water shortages were expected in Shrawan to Ashwin (mid-June to mid-October), that is the monsoon and post-monsoon periods.

#### Household Water Supply

Only women were asked about household water supply. Household water shortage was found to be a major concern – more than half the respondents (57%) mentioned water scarcity, with the biggest problems in the upper parts of the watershed. All the eight respondents in the north-facing block above 2200m mentioned water scarcity, and eight out of ten of those on the south-facing slope. Overall the situation was thought to have improved somewhat over the last five years: 137 women (64%) thought that household water availability had increased, 30 (14%) that it had decreased, and 45 (21%) that there had been no change. This increase seems to have resulted from the installation of

an extensive tap system; 84% of the interviewed households obtained their water from tapped sources, which mainly belong to the communities.

However, the problems with water sources mentioned by a number of respondents indicate that many taps are improperly installed: 52 people mentioned sediment contamination as a problem, mostly in the middle and upper parts of the watershed, and there were complaints of bad taste, bad quality ("people often sick") and animal droppings in the water, indicating improper filtering and poor intake construction. Water quality is mainly an issue in the densely populated areas of the bigger villages in the watershed, Gairimudi and Mainapokhari. Water shortage at the source was indicated by answers like "often dry" (27 people). 'Other problems' with taps included that they were too far away, there was only one tap, and pipe breakages.

The average round trip time for fetching water from different water sources was 22 minutes (248 responses; i.e. one household may get water from different sources); the maximum was more than 60 minutes. The average time per day per household spent fetching water was 109 minutes. Water was mainly collected by the female head of household (138 cases) or by female household members generally (265 cases); 174 respondents said that a male member of the household fetched water and 67 that any member of the family fetched water. However, these answers were not supported by personal observations in the field; very few men were seen queuing at the public water taps.

The average household used 107.5 l water per day (calculated as a simple average, total water used for all households divided by the number of households); the average person used 20.6 l water per day (the amount per head calculated for each household separately and then averaged). This is very low: drinking water schemes in Nepal are designed on the basis of an average use of 45 l per person per day which is considered the minimum to ensure sufficient intake and personal hygiene (RWSSSP 1994). However, the survey didn't take into account direct use of water at the source or elsewhere, only that brought to the house. The total amount used will be higher as in many cases bathing, washing clothes, washing vegetables, and even cleaning dishes may be done at the tap or in rivers or streams.

In addition, each household brought an average of 65.5 l per day to the house for animal supply (drinking as well as washing). The average household had 6.5 animals (1 buffalo, 1 cow, 1 to 2 oxen, and 3 goats), with a range from no animals (two households) to as many as 31 (one household with 7 cows, 2 oxen and 22 goats). Two households owned chauri, a cross-breed of yak and cattle. The survey indicated that most households (167 or 77%) bring water for the animals to the house rather than taking the animals to the water source.

In general, it seems that the domestic water supply situation in the Yarsha Khola watershed is better than in many other Nepali middle mountain watersheds. The situation could be improved through work on the tap systems and on source protection, but innovative strategies and techniques will be required to overcome the water shortage periods.

### Water Supply for Agriculture

Just over half of the watershed area (51%, Shrestha 2000) is under agriculture, both irrigated and rainfed, thus demand for agricultural water is high. However, lack of water for irrigation is a major concern (Table 1): 181 of 218 men (83%) said that they faced irrigation water shortages. The problem was most acute on the south facing slopes where 93% of the respondents mentioned irrigation water shortage and only 3% said explicitly that they did not face any shortage; 75% of those on the north-facing slopes and 83% on the middle ridge also faced shortages.

Most farmers had not observed any change in the availability of irrigation water over the last five and 25 years; although 17% had experienced a decrease over the last five years and 29% over the last 25 years, and 2% an increase over the last five years and 4.5% in the last 25 years. Historic land use information indicates that there was no major change in the amount of land under irrigation between 1981 and 1996: 15% in 1981 and 14% in 1996 (Shrestha 2000).

The shortage of water for irrigation peaks in the month of Falgun (mid-January to mid-February) when the wheat and potato crops require water. The potato and wheat crops are grown from October/November to March/April, which is the leanest period of the year in terms of water availability. If the winter rains fail, very little water is available and farmers can face a serious problem.

The rice crop faces few if any water shortages during the monsoon season, but there can be problems in the nursery and planting stages, especially if the monsoon is late. Comparison of the irrigation calendar for 1998 (Figure 5) with the climatological water balance derived for Bagar (the main meteorological station of the watershed, which lies in the upper parts of the irrigated area, Figure 6) shows that there were no problems for the rice crop in that year as the monsoon arrived on time (around June 15<sup>th</sup>).

### Summary for the Yarsha Khola

The key points learned from the survey in the Yarsha Khola can be summarised as follows.

- Quantity of water for irrigation is perceived to be the key water issue, followed by drinking water quantity and drinking water quality. Water is considered to play only a limited role in land degradation.
- Drinking water quantity is a particular problem along the divide and on spurs.
- Drinking water quality is an issue in the major villages.
- Access to irrigation water is felt to have been stagnant to decreasing in the last 5 to 25 years.
- Access to drinking water has increased over the last 5 to 25 years for the majority of respondents; this is attributed to improved conveyance of water from the different sources through polythene pipes.
- Sediment is reported to be a major problem in the drinking water supply.
- Water shortages for both irrigation and drinking are felt most during the dry season (winter and pre-monsoon).
- The Yarsha Khola has limited road access, which means limited market access; the result is that agriculture is mainly for subsistence and is low intensity.

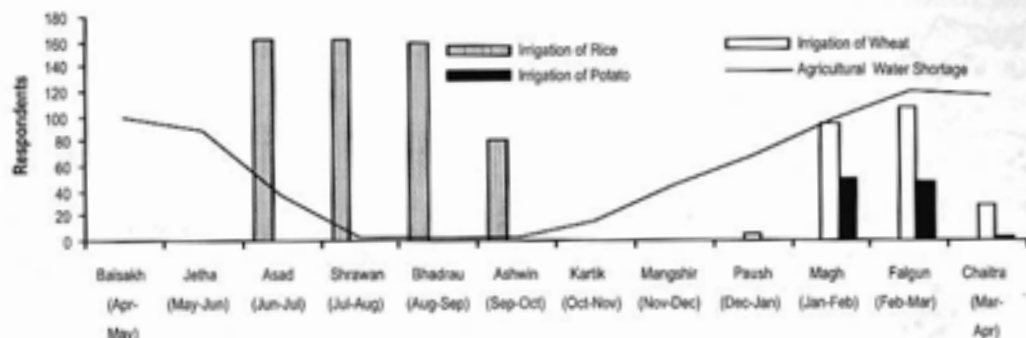


Figure 5: Irrigation calendar and perceived water shortage in the Yarsha Khola watershed

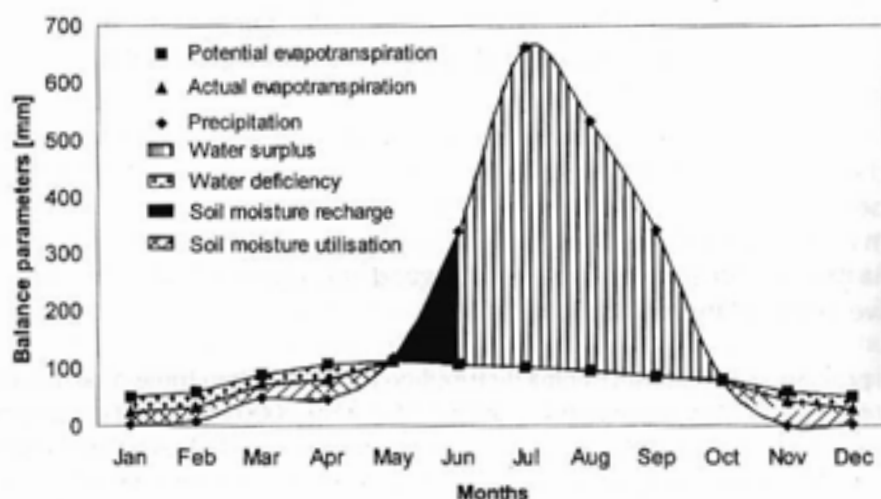


Figure 6: Climatological water balance for Bagar for the period 1998 - 2000

### ***The Jhikhu Khola Watershed***

A total of 178 households were interviewed in the Jhikhu Khola watershed. The largest number of interviews was conducted in the biggest VDCs: Panchkhal and Baluwa (Figure 7) and the least in Banepa Municipality, which has the smallest area within the watershed.

The importance of water was again underlined by the words that people used to describe it: 65% of the 159 who answered described water in one word as "life", other words used included "base of life", "biggest", "important", and "precious". There are some problems associated with water in this area, however: 59% of the respondents described the watershed to be dry to very dry and barely 10% mentioned that their areas were wet, mainly those residing near upper sites along the north-facing slopes in Dhulikhel, Kabhre, and Patlekhet. Generally residents along the water divides, on south-facing slopes, and along the foothills considered their areas to be dry.

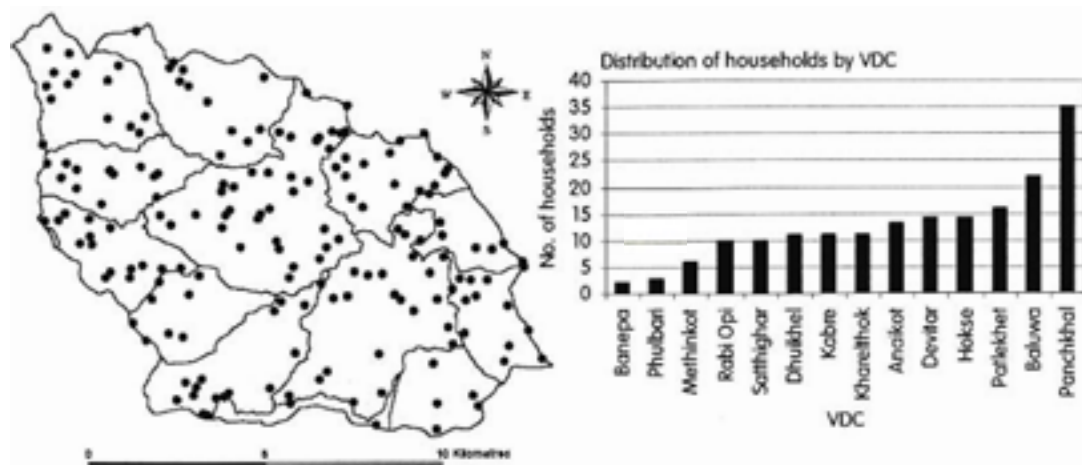


Figure 7: Interviewed households in the Jhikhu Khola watershed:  
 (a) spatial distribution; (b) distribution according to VDCs

In terms of the annual average, there is plenty of rainfall and the watershed can be classified as humid sub-tropical to cool temperate. However, the residents perceived areas to be dry that had a total annual rainfall of 1500 mm and more. Rabi Opi recorded 1790 mm rainfall in 1999, yet 7 out of 10 respondents considered the area dry. As in the Yarsha Khola, total annual rainfall is not a good indicator of people's perception of the relative wetness/dryness of a location.

The main problem is the uneven rainfall distribution with more than three-quarters of the annual total on average falling during the monsoon (Merz et al. 2000). Most of the respondents (90%) indicated that they were facing water problems: 68% (243) faced shortages for irrigation and 59% for drinking (209 people); 34% (122 people) mentioned the poor quality of drinking water; other problems included slumping along agricultural fields (16%), quality of water for irrigation (14%), surface erosion (8%) and flooding (2%).

The number of people facing water shortage for both irrigation and domestic purposes peaks during the pre-monsoon period (April/May). Irrigation water supply is perceived to be a problem from shortly after the end of the monsoon in November; the problem gradually increases to a peak in April/May and extends up to early June. The problem becomes less acute as pre-monsoon showers occur. The problems with household water supply start late in winter and rise sharply during the pre-monsoon period (March to May). If there is notable pre-monsoon rainfall, then local water sources are recharged and relieve the shortage. There is no shortage of water for any purpose during the monsoon, but problems related to excess water such as slumping and surface erosion then become evident.

#### Household Water Supply

Generally it is the responsibility of women to ensure the supply of water for domestic purposes, which includes both human and animal water needs. The great majority of

women interviewees (151 or 84%) mentioned shortage of water as a problem, with particular problems for those living on the water divides, and the upper and south-facing slopes. The slope aspect played an important role in the water shortage: 69% of the respondents faced with water shortages on the north-facing slopes were from elevations above 1100m, whereas those on south-facing slopes experienced water shortage at elevations just above 900m. Overall the water supply has worsened slightly in the last five years: although 33% of the women (58) felt that more water was available, 40% (70) thought that there was less, and 27% (49) that it hadn't changed. The improvement observed by some respondents is related to increased distribution through tap networks, 44% of the interviewees collected water from taps, which are generally maintained by the communities themselves.

There are problems with the water that is distributed as the sources are not well protected and become polluted during the rainy season. More than 40% of women (76) mentioned sediment, which reduces water quality and gives it a bad taste, as the main problem pollutant. Animal droppings near the source, poor maintenance and lack of protection of the source, and improper intake construction are major factors contributing to contamination; 14 women reported sickness from drinking water. In general, people do not filter or boil water prior to consumption.

The major other problem mentioned was the distance to the source. Women in the watershed spent 26 minutes per trip on average fetching water. The maximum time of two hours per trip was reported by a few households in Devitar, Panchkhal, and Dhulikhel Municipality. The average household used 161 l water per day with a range of 30 to 700 (calculated as a simple average, total for all households divided by the number of households); the average person used 25 l water per day, with a maximum of 73 l per person in one household (the amount per head calculated for each household separately and then averaged). Family members make between 2 and 30 trips per day to collect water for household consumption, and more time again to collect water for their animals; a person typically carries one gagri (15 l) per trip, although some people take two or three at a time to reduce travel frequency. Water was mainly collected by women (including the wife, daughter, daughter-in-law, and mother-in-law of the male head of house), although in 61 households men and boys were said to help and in four households collecting was by any family member.

Animals are an important component in agricultural farming and the need for water for animals is likely to rise sharply as the number of livestock increases. On average each household has one buffalo, one cow, one ox, and three goats drinking an average 98 l water per day. Only about one tenth of those surveyed (19 households) took their animals to the water source, spending on average 46 min. This work was mainly divided between the wife (27%), the husband (22%), the son (22%), and the daughter (16%) with daughters-in-law and mothers-in-law participating least.

Overall the domestic water supply in the Jhikhu Khola is satisfactory, but there are pocket areas that face a chronic shortage. The supply could be improved to some extent by better management of distribution systems and protecting the sources, but innovative

strategies and techniques and greater involvement of local beneficiaries will be essential to solve the chronic and increasing water shortage during the dry season.

### Agricultural Water Supply

Just over half of the watershed area (55%) is occupied by agriculture (Shrestha and Brown 1995), of which one third is irrigated and the remainder rainfed. Timely supply of water is essential for successful agricultural production. In the survey, however, the great majority of farmers had insufficient water for irrigation (87% or 154 out of 178), including 76 of 97 farmers on the south-facing slopes and 78 out of 81 farmers on the north-facing slopes.

Just over half of the men (52%) thought that the amount of water available for irrigation had decreased over the last five (and 25) years, 32% said there had been no change, and 9% thought there had been an increase – probably the result of a reduction in seepage losses through using polythene pipes to divert stream water and of collecting water in open ponds for irrigation. Shortage of irrigation water is felt immediately after the monsoon in mid November when planting of potato commences. The shortage gradually rises to a peak around April/May when some farmers transplant early rice in paddy fields, and maize in upland areas. If the onset of the monsoon is delayed, water shortages can affect transplantation of the major rice crop. In general, there is no problem for the rice crop during the monsoon (Figure 8). Winter rain is unreliable, so farmers growing potato and wheat can face water shortages from January to March.

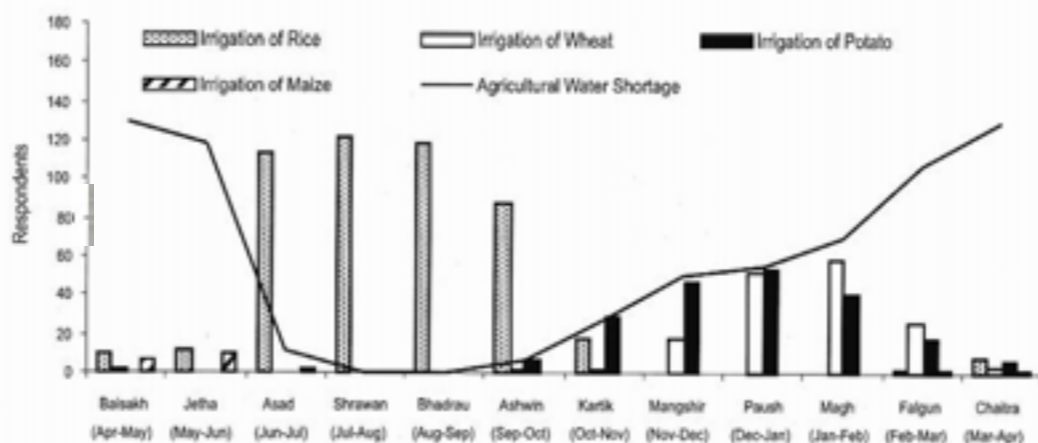


Figure 8: Irrigation calendar and perceived water shortage in the Jhikhu Khola watershed

### Summary for the Jhikhu Khola

The key points learned from the survey in the Jhikhu Khola can be summarised as follows.

- The number one problem for farmers is shortage of water for irrigation, followed by domestic water supply and, increasingly, poor water quality.
- The supply of irrigation water is felt to have decreased over the last 5 to 25 years.



- The supply of drinking water is also thought to have decreased over the last 5 to 25 years but not as dramatically as in the case of irrigation water.
- Water shortage is confined to the dry season from October to May.
- Water induced land degradation is viewed as a minor problem.
- Agricultural production is highly intensive with high fertiliser and pesticide inputs resulting in higher yields than on average in the Nepal middle mountains.
- Farmers increasingly plant vegetable cash crops throughout the watershed for the market in Kathmandu.