6-2 Results of observation of meteorology and rate of streamflow

The fossil valley where the subsurface dam was built is probably buried along the Kolongo River. A close relationship is thus suggested between the recharge of groundwater stored by the subsurface dam and the rainfall within the Kolongo River basin. In addition, as this area is located in an semi-arid region, much of the water provided by rainfall is probably lost through evapotranspiration.

For a quantitative evaluation of the effectiveness of water storage by the subsurface dam, it is thus necessary to know not only the groundwater level, but also the rainfall within the Kolongo River basin, the amount of evapotranspiration and the rate of streamflow of the Kolongo River. However, almost no such observation has been carried out by the present local authorities. Therefore, observation of these parameters was carried out as a part of this project.

(1) Observation of daily rainfall

The observation of daily rainfall started in 1997 in the Koulikare Quarter, in which the subsurface dam was built, in Nare Village, and in the Kossonkore Quarter of the same village. In 1998, the observation of daily rainfall also started in Ouanobian Village and Noka Village located in the upstream area of the Kolongo River. Table 6.2 shows the results of the observation carried out in Koulikare in Nare Village.

Table 6.2: Rainfall in the Koulikare Quarter in Nare Village from 1997 to 2002

Year of obser-vation	Monthly rainfall (mm)									Annual rainfall (mm)	Cereal harvest
	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	N-F**		
1997*	0.5	19.9	31.9	73.9	123.9	81.0	102.0	35.0	0	468.1	Poor
1998*	0	1.3	55.2	90.8	139.5	157.4	138.9	28.6	0	611.7	Good
1999	0	0.7	13.1	26.8	166.0	189.4	178.2	0	0	574.2	Average
2000	0	8.3	0.9	56.1	112.6	43.5	74.8	20.7	0	316.9	Very poor
2001	0	0.1	20.3	52.0	113.1	169.6	43.5	6.7	0	405.3	Average
2002	0	3.0	75.6	80.2	131.0	166.1	77.8	67.8	0	601.5	Good

* Although the data for 1997 and 1998 were those of the Kossonkore Quarter in Nare Village, they can be considered as almost the same as those of the Koulikare Quarter.

** "N-F" in the last column of "Monthly rainfall" represents the total rainfall from November to February of the following year.

Year 2000 was "a year of extraordinary drought" according to the inhabitants. That year's rainfall was only 316.9 mm as shown in Table 6.2. From just after the dry season of 2000 until just before the rainy season of 2001, the groundwater level in the reservoir area of the subsurface dam dropped markedly. This extraordinary drop in groundwater level was considered due to the exceptional drought of 2000.

The annual rainfall in the Kolongo River basin is shown in Table 6.3. This shows the tendency that the further upstream (to the west-south-west), the greater the annual rainfall.

Table 6.3: Annual rainfall in the Kolongo River basin and its surrounding area

(mm)

	Annual rainfall in the Kolongo River basin (*1)			Outside the River basin (*2)
	Koulikare	Ouanobian	Noka	Kaya
Distance from subsurface dam	At the subsurface dam site	About 15 km upstream	About 35 km upstream	About 50 km upstream
1998	611.7	601.2	616.8	709.6
1999	574.2	718.2	696.1	900.8
2000	316.9	－(*3)	642.1	639.4
2001	405.3	460.4	570.1	504.3
2002	601.5	488.8	791.5	－(*4)
Average	501.9	567.2	663.3	688.5

*1 Observation by this project
*2 Observation by the Meteorological Service of Burkina Faso
*3 This cell is not filled due to numerous missing data.
*4 Data are not available.

(2) Observation of evaporation

In the Koulikare Quarter, in which the subsurface dam was built, in Nare Village, potential evaporation was observed from August 2000 by measuring water loss from an evaporation plate.

Table 6.4 shows the results of the observation between August 2000 and December 2002. These values were corrected considering water loss from the plate due to strong wind.

Annual potential evaporation amounted to 3,700 mm, with the maximum in April and the minimum in August.

Table 6.4: Potential evaporation in the Koulikare Quarter in Nare Village

Average values from August 2000 to December 2002

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly evaporation (mm)	306	327	424	476	413	310	281	183	197	259	246	255	3,703
Average daily evaporation (mm)	9.9	11.7	13.7	15.9	13.3	10.3	9.0	5.9	6.6	8.4	8.2	8.3	10.1

(3) Observation of rate of streamflow

To estimate the rate of streamflow of the Kolongo River that probably recharges the groundwater stored by the subsurface dam, the rate of streamflow and the level of the river water were observed at the points where the geometry of the cross-section of the river could be measured easily. The observations were conducted at two points: where the old main road crosses the Kolongo River, and where the current main road crosses the river.

The observation was carried out for 5 years from 1998 to 2002, but reliable results were obtained only in 2000 and 2001. The rate of streamflow where the old main road crosses the river, calculated from the results of the observation, was as follows:

in 2000 (exceptional drought year): about 6,000,000 m^3/year
in 2001: about 11,000,000 m^3/year

6-3 Fluctuation in the groundwater level in the reservoir area

(1) Assessment of the effectiveness of the subsurface dam for water storage

Figure 6.3 shows the water storage state by the subsurface dam at two periods after the construction of the dam, i.e., on 2 October 1998 (at the beginning of the dry season) and from 19 to 24 February 1999 (in the middle of the dry season).

In these two periods, the reserved water level was higher by 4.5 to 6.5 m compared with the groundwater level downstream of the dam. It was also higher by 2.5 to 5 m compared with the groundwater level in the corresponding seasons before the construction of the dam. All these results proved the effectiveness of the subsurface dam for water storage.

(2) Seasonal fluctuation in the reserved water level

However, the reserved water level fell in the dry season, as the comparison of the results of the observation in the two periods in Fig. 6.3 shows. Indeed, some of the reserved water was pumped out, but the amount of such water was tiny compared with the whole reserved water (the amount of pumped out water was 3,000 m^3/year (see Section 7.(1)), whereas the estimated reserved water volume was about 400,000 m^3 at the end of the dry season of 2002 (see Section 6-5)), and could not have caused the fall in the reserved water level.

Such "seasonal fluctuation" in the reserved water level occurred every year. As a proof of this, Fig. 6.4 shows the results of the continuous observation of the groundwater level from June 1998 to February 2003 at the well P-4 (a “well of the all-strainer type”) located about 200 m upstream of the subsurface dam. This figure also shows the groundwater level observed from November 1996 to November 1997 in the well B-2-4 located at the dam site, for comparison with the groundwater level before the construction of the dam.

(3) Interannual fluctuation in the reserved water level

The results of the observation of the reserved water level shown in Fig. 6.4 show the following characteristics of interannual fluctuation in the reserved water level.

1) Every year, the reserved water level rose in the rainy season and fell by 2.5 to 4.5m by May and June, i.e., between the end of the dry season and the beginning of the rainy season.

2) The lowest level in a year, which was recorded between the end of the dry season and the beginning of the rainy season, rose year by year except in 2001.