Water Discharge of Rikha Samba Khola in Hidden Valley, Mukut Himal*

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Abstract

The water level of Rikha Samba Khola in Hidden Valley, Mukut Himal was measured from July 16 to September 7, 1974. The discharge was estimated on the basis of a stage-discharge curve, giving a gradual decrease during the observational period. The amount of the suspended materials in the river was measured after sampling the river water at the same place during the monsoon season of 1974. The amount also decreased gradually during this period. The daily variation of discharge and the amount of suspended materials shows a maximum around 1400 NST (Nepal Standard Time).

1. Introduction

The water supply to a river from a glacier is important when considering the relation of the river to the ablation of the glacier. But observations of river discharge are few in the Nepal Himalayas. The present work was carried out with the object of determining the general tendency of the water discharge of a river from glaciers in Hidden Valley, which is considered to be less affected by precipitation during the monsoon season than the river in eastern Nepal such as the Khumbu region. This paper also deals with the variation of the amount of suspended materials in the river water.

2. Observation of discharge

The observation of the discharge was carried out during the period from July 16 to September 7, 1974 at a point along Rikha Samba Khola, Hidden Valley which is indicated by M (5055 m above sea level) in Fig. 1. The drainage basin higher than the gaging station, M is shown in Fig. 1. There are several glaciers in the drainage basin and the total area of the glaciers is about one half of the total area of the basin, that is, about 25 km². The mean width and depth of the river are about 10 m and 0.5 m respectively at the observation point M.

Fig. 1. Drainage basin of Rikha Samba Khola.

3. Estimation of discharge

The surface flow velocity, \( V_s (\text{m/sec}) \), was estimated several times by measuring the speed of a float between two points which were set 50 m apart: the relative water level, \( H (\text{cm}) \), was measured at the same time. The relation between these two values was obtained as shown in...
The mean flow velocity, $V_m$ (m/sec), was estimated by the equation:

$$V_m = \frac{21.75}{45.8 - H} \quad (1)$$

The cross-sectional area at the measuring point, $S$ (m$^2$), was also measured as a function of $H$. Then the discharge, $Q$ (m$^3$/sec), could be obtained from the following equation which is a function of $H$ only:

$$Q = V_m \times S = 0.9 \times \frac{21.75}{45.8 - H} \quad (2)$$

The hydraulic radius, $R$, of the river was about 0.35 and the surface inclination, $I$, was about 0.0156. When these data and the observed mean velocity, 1.55 m/sec, were substituted into Manning's formula,

$$V_m = \frac{1}{n} \times R^{2/3} \times I^{1/2} \quad (4)$$

the roughness parameter, $n$, was obtained as 0.04. This value of the roughness parameter is reasonable for a rough river with a gravel base like Rikha Samba Khola.

4. Seasonal variation of discharge

The relative water level was observed for the purpose of estimating the discharge from Eq. (3). Observations were carried out almost every
day at 1800 NST during the period from July 16 to September 7 and every 3 hours from 0600 NST to 1800 NST in the later observational period. With the aim of obtaining the daily total runoff, the water level was measured every hour from 0600 NST to 2100 NST every 10 days, and the discharge at night time was interpolated between the observational results at 2100 NST and at 0600 NST the next morning. The daily total runoff derived from the data taken every 3 hours, which were observed in the later season, was approximately the same as that from the data taken every 1 hour.

A linear relation was found between the daily total discharge and the discharge at 1800 NST, as shown in Fig. 3. From this relation, the daily total of the discharge during the earlier observational period can be estimated from the measurement of discharge at 1800 NST.

The discharge hydrograph during the observational period is shown in Fig. 4. The results obtained from hourly observations and 3-hourly observations are shown with solid circles and open circles in this figure respectively. The dotted line indicates the discharge which was estimated from the data at 1800 NST using the relation mentioned above. As seen in this figure, the discharge of Rikha Samba Khola decreased gradually from the middle to the end of the monsoon season.

5. Relation between discharge and solar radiation

Many observations of the heat balance at the snow or ice surface of a glacier have shown that the predominant factor controlling the melting of snow or ice was solar radiation in cold locations such as polar or high mountains areas. In the Nepal Himalaya also, Inoue and Yasunari (1976) reported that most of the heat to melt snow or ice was supplied by radiation.

![Fig. 5. Relation between discharge and radiation.](image)

**Figure 5** shows the relation between the daily runoff and the daily total of solar radiation on the same day, computed only from the latitude and the solar declination. The deviation from the linear relation (correlation coefficient: 0.85) is considered to be caused by second or third factors causing snow or ice to melt such as air temperature and cloud amount.

The dashed line in Fig. 4 shows the variation of the solar radiation through the observational period, which corresponds to the discharge obtained from the relation in Fig. 5. It can be

![Fig. 6. Seasonal variation of amount of suspended materials.](image)
said that this line is nearly in agreement with the gradual decreasing of the discharge, except the last week of the observational period when the discharge was larger than the values estimated from solar radiation. The deviation can be considered as due to lower cloud cover during this period than during the other periods. The daily mean cloud cover was around 9 and around 3 before and after August 29, respectively.

6. Variation of amount of suspended materials
The water sample (about 150 ml) was collected from the river at 1800 NST about every 5 days for the purpose of estimating the amount of suspended materials in the river water. The suspended materials are sampled by filtering the water through filter paper of 8 μm pore size. After the filter paper with the materials was dried up, its weight was measured. The seasonal variation of the amount of the suspended materials in the river water taken at 1800 NST is shown in Fig. 6. It can be seen that the amount of the suspended materials also decreases during the period from the middle of July to the beginning of September as the discharge decreased.

The daily variations of discharge and the amount of the suspended materials are shown in Fig. 7. The former is shown by open circle and the latter is shown by solid circle. The solid line and broken line show their variations on July 30 and August 20 respectively. Both the discharge and the amount of suspended materials are very small in the early morning and increase gradually until a maximum is reached around 1400 NST, then decrease toward evening.

It is reasonable to consider that the river water becomes turbid when the discharge increases. Such a relation can be seen in Fig. 7, but the relation between the turbidity and discharge is not so clear.

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