



DISCHARGE MEASUREMENT REPORT

(Lagan Khola and Nyamya Masal Khola)

Project:

Brahmayani Hydroelectric Project

&

Upper Brahmayeni Hydroelectric Project

Date: 29/08/2078

Developer:

Brahmayani Hydropower Company Pvt. Ltd.

Kathmandu, Nepal

&

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1. Introduction

Discharge measurements in natural watercourses are performed in order to determine the value of the surface outflow of a basin, its temporal variability, and the outflow characteristics. The methods conventionally used for these measurements utilize an immersed current meter in different points of a river section, which acquires the mean flow velocity. Using this measurement, the discharge can be calculated.

In principle, a current meter is used to measure the water velocity at various vertical locations within a transverse section of a watercourse and the area to which each measurement refers is determined the flow velocity is multiplied by each corresponding area, and the sum of these products gives the average watercourse discharge in the selected section.

2. Instrument used

The current meter used is cup type current meter which can measure velocity range from 0.3m/s to 3.5 m/s with additional fish weight of 10kg mount at the bottom. The picture of current meter used is shown below.



Figure 1: Current Meter (Cup type)

The discharge is measured using Wading rod, Tape and Current Meter at site of Brahmayani Hydropower Project.

3. Measurement Location

This report covers the discharge measurement at the intake of Brahmayani (Lagan Khola) and intake of Upper Brahmayani (Nyamya Masal Khola) for the Bramyani Hydroelectric Project, the Nyamya masal khola will be delivered to Brahmayani intake from the Upper Brahmayani Powerhouse. The coordinates of the discharge measurement Locations are: $28^{\circ} 4' 28.28''N$, $85^{\circ} 44' 56.51''E$ at Lagan khola and $28^{\circ} 5' 51.946''N$ $85^{\circ} 47' 27.2''E$ at Nyamya Masal Khola . The google earth image of measured location is as below.

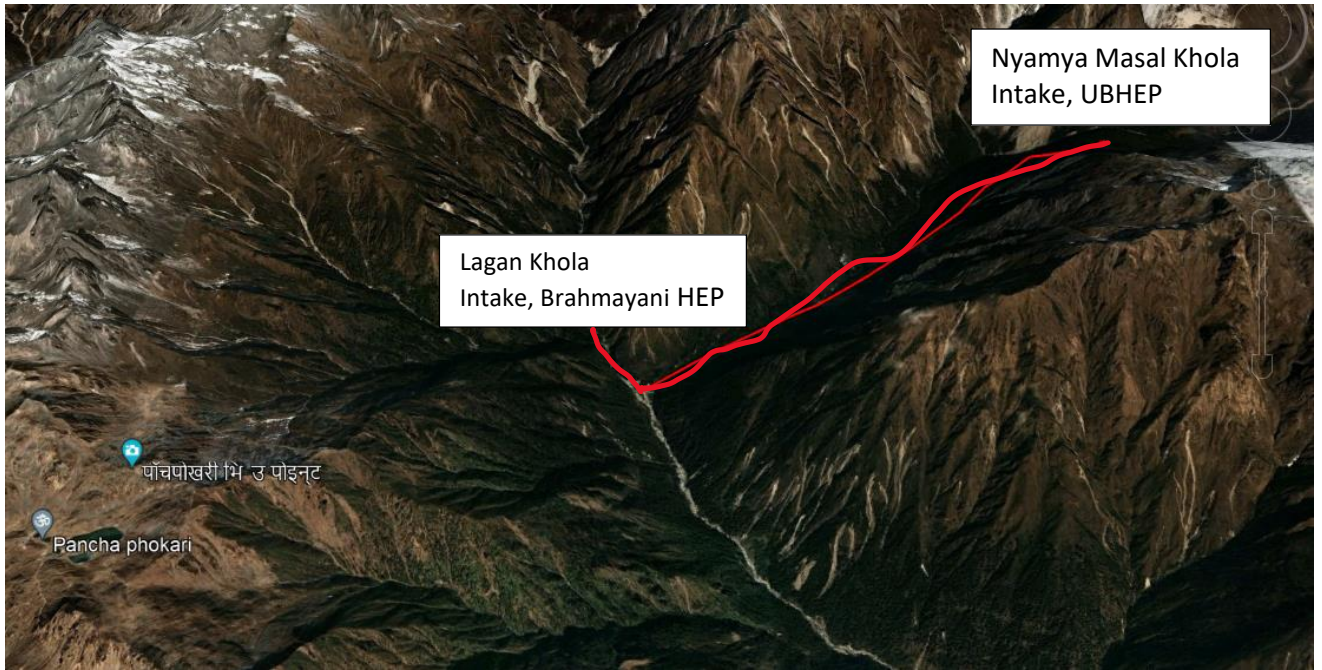


Figure 2: Google Map for the project location

4. Objective and Scopes of work

The major activity of this assignment is to:

- Discharge measurement

To fulfill the above objective, following activities has been performed by the consultant:

- Arranged necessary manpower and materials as outlined in the contract document.
- Performed discharge measurement.
- Prepare and submit discharge measurement report with clear data and chart.

5. Field Mobilization Team

Table 1: Site Visit Team

S N	Name	Designation	Date	Remarks
1	Mr. Bhupesh Sirmal	Reader	26/07/2078	
2	Mr. Ganesh Khadka	Reader	26/07/2078	
3	Mr. Renzi Sherpa	Helper	26/07/2078	
4	Mr. Pasang Tamang	Helper	26/07/2078	

6. Discharge Measurement

For discharge measurement following equipment has been used:

- Gurley Cup-type Current Meter;
- Wading Equipment;
- Communication cable;
- Measuring tape;
- Water proof wears, etc.

6.1 Measurement Procedure

A standard procedure of taking measurement as specified in USGS guideline is being followed. The following procedures are followed in discharge measurement:

6.1.1 Measurement of Width

The distance to the verticals and the width of the stream are measured from a fixed reference point (initial point) on the bank of the stream. The distances are usually determined by use of a measuring tape or tag line stretched across the stream.

6.1.2 Spacing of the Measuring Verticals

The accuracy of a current-meter measurement depends largely on the number of verticals at which the observations of depth and velocities are made. The verticals should be so spaced as to disclose the real shape of the stream bed and the true mean velocity of the flowing water. Only where the velocity appears to be well-distributed and where the profile of the cross section is reasonably regular and smooth, is it desirable to space the verticals at equal intervals throughout the measuring cross-section. At two adjacent verticals, neither the depth nor the velocity should differ excessively. The interval between any two verticals should not be more than $\frac{1}{2}$ of the total width, and the discharge between any two verticals should not be more than 10 per cent of the total discharge. Generally, the number of verticals required is between 20 and 30. For very small streams, the number can be reduced if the distance between the verticals becomes less than 30 cm.

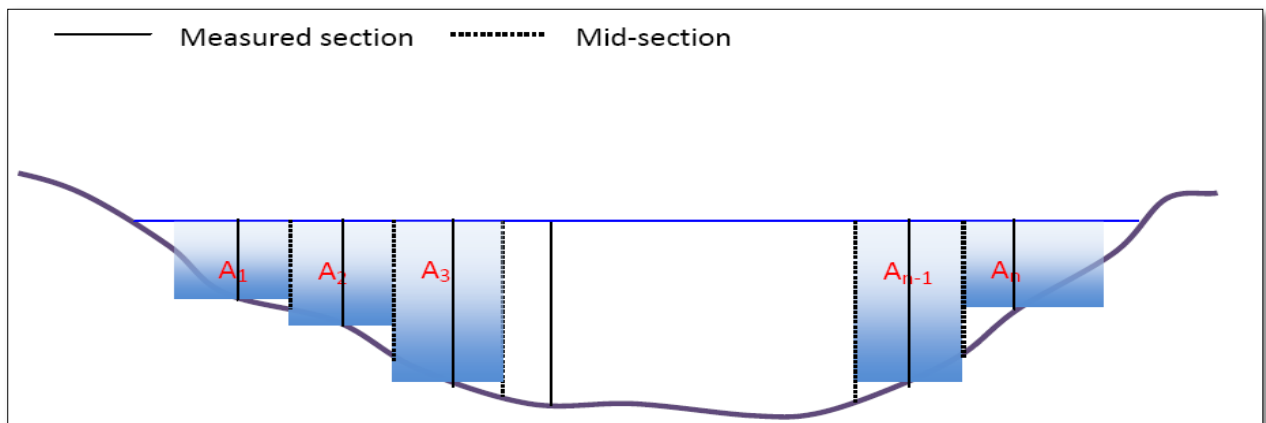


Figure 3: Ideal River Profile with verticals for discharge measurement

6.1.3 Measurement of Depth

The depth of the vertical and the position of the current meter in the vertical are measured by a graduated rod on which the current meter slides.

6.1.4 Measurement of Velocity

The discharge of a River is the product of a River cross-section and the flow velocity normal to that section. Hence, measuring velocity at predefined verticals is another task involved. The measuring cross-section is placed normal to the general direction of flow. The velocity is measured at one or more points in the vertical by observing the number of revolutions of the current-meter rotor during a period of 60 seconds. Where the vertical-velocity distribution is approximately parabolic and the depth is greater than about 100 cm, velocity observations are made at 0.2 and 0.8 of the depth below the surface. The average of these two observations is taken as the mean velocity in the vertical. For depths between 20 cm and 100 cm, an observation of velocity made at 0.6 of the depth below surface is taken as the mean velocity in the vertical. Should the vertical velocity distribution be very irregular,

then velocity observations are made just below the water surface, just above the stream bed and at 0.2, 0.5 and 0.8 of the depth. The current meter is supported at the desired point in the measuring vertical on a wading rod in the case of a shallow stream that can be waded.

The constants of current meter are: -

$$v = a N + b$$

Whereas,

v = Velocity of water (m/s)

N = Revolutions of Cup wheel per second

a, b = Constants having value ($a = 0.6644, b = 0.0334$)

7. Measurement and Calculations

The discharge calculations sheet for Lagan Khola and Nyamya Masal Khola are given below. The velocity has been measured at 0.4H from the bottom of River for all measurement works.

River Name: Lagan Khola

Width of water way: 13.50 m

Date: 20/06/2078

Weather: Rainy

Location: Intake, Lagan Khola

Guage Height: None Time:10:00 PM

Table 2: Discharge calculation Sheet Aswin 078, Lagan Khola

Serial No.	Dist. to initial point	Width	Current meter Constant (K)	Ration test constant (Y)	Time	Revolution	Meas. depth	0.4xH	Mean vel.	Area	Discharge Segmental	
	m	m			s	nos	m	m	m/s	m ²	m ³ /s	
1	2	3	4	5	6	7	8	9	10	11	12	
1	0.00	0.00	0.2725	0.0529	60	<u>0</u>	<u>0.00</u>	0.00		0.00		
2	1.35	1.35	0.2725	0.0529	60	<u>115</u>	<u>0.80</u>	0.32	0.575	0.54	0.311	
3	2.70	1.35	0.2725	0.0529	60	<u>128</u>	<u>1.01</u>	0.40	0.634	1.22	0.775	
4	4.05	1.35	0.2725	0.0529	60	<u>137</u>	<u>1.18</u>	0.47	0.675	1.48	0.998	
5	5.40	1.35	0.2725	0.0529	60	<u>140</u>	<u>1.43</u>	0.57	0.689	1.76	1.213	
6	6.75	1.35	0.2725	0.0529	60	<u>180</u>	<u>1.50</u>	0.60	0.870	1.98	1.721	
7	8.10	1.35	0.2725	0.0529	60	<u>184</u>	<u>1.09</u>	0.44	0.889	1.75	1.553	
8	9.45	1.35	0.2725	0.0529	60	<u>148</u>	<u>1.05</u>	0.42	0.725	1.44	1.047	
9	10.80	1.35	0.2725	0.0529	60	<u>145</u>	<u>0.53</u>	0.21	0.711	1.07	0.759	
10	12.15	1.35	0.2725	0.0529	60	<u>122</u>	<u>0.41</u>	0.16	0.607	0.63	0.385	
11	Total									0.708	11.87	8.763

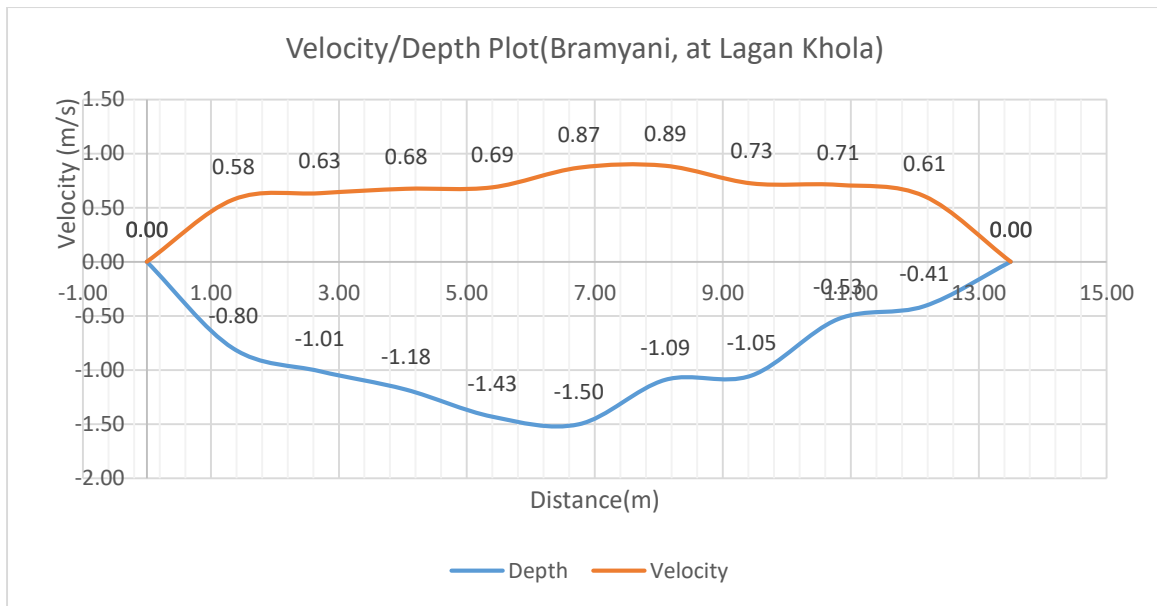


Figure 4: Velocity / Depth Plot Aswin, 2078, Lagan Khola

River Name: Lagan Khola

Width of water way: 12 m

Date: 26/07/2078

Weather: Cloudy

Location: Intake, Lagan Khola

Guage Height: None Time:10:00 PM

Table 3: Discharge calculation Sheet kartik 078, Lagan Khola

Serial No.	Dist. to initial point	Width	Current meter Constant (K)	Ration test constant (Y)	Time	Revolution	Meas. depth	0.4xH	Mean vel.	Area	Discharge Segmental
	m	m			s	nos	m	m	m/s	m ²	m ³ /s
1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.6644	0.0334	60	0	0.00	0.00		0.00	
2	0.60	0.60	0.6644	0.0334	60	52	0.13	0.10	0.609	0.04	0.023
3	1.20	0.60	0.6644	0.0334	60	53	0.25	0.16	0.620	0.11	0.070
4	1.80	0.60	0.6644	0.0334	60	88	0.33	0.21	1.008	0.17	0.174
5	2.40	0.60	0.6644	0.0334	60	83	0.40	0.19	0.953	0.22	0.207
6	3.00	0.60	0.6644	0.0334	60	94	0.46	0.24	1.074	0.26	0.277
7	3.60	0.60	0.6644	0.0334	60	108	0.52	0.26	1.229	0.29	0.361
8	4.20	0.60	0.6644	0.0334	60	125	0.50	0.21	1.418	0.30	0.432
9	4.80	0.60	0.6644	0.0334	60	121	0.47	0.17	1.373	0.29	0.398
10	5.40	0.60	0.6644	0.0334	60	131	0.54	0.12	1.484	0.30	0.450
11	6.00	0.60	0.6644	0.0334	60	136	0.61	0.06	1.539	0.35	0.531
12	6.60	0.60	0.6644	0.0334	60	127	0.63	0.00	1.440	0.37	0.536

Serial No.	Dist. to initial point	Width	Current meter Constant (K)	Ration test constant (Y)	Time	Revolution	Meas. depth	0.4xH	Mean vel.	Area	Discharge Segmental
13	7.20	0.60	0.6644	0.0334	60	90	0.65	0.00	1.030	0.38	0.396
14	7.80	0.60	0.6644	0.0334	60	105	0.59	0.00	1.196	0.37	0.445
15	8.40	0.60	0.6644	0.0334	60	61	0.53	0.00	0.709	0.34	0.238
16	9.00	0.60	0.6644	0.0334	60	98	0.48	0.00	1.119	0.30	0.337
17	9.60	0.60	0.6644	0.0334	60	58	0.42	0.00	0.676	0.27	0.181
18	10.20	0.60	0.6644	0.0334	60	78	0.37	0.00	0.897	0.24	0.211
19	10.80	0.60	0.6644	0.0334	60	42	0.31	0.00	0.499	0.20	0.101
20	11.40	0.60	0.6644	0.0334	60	37	0.16	0.00	0.443	0.14	0.062
Total									1.085	1.99	5.429

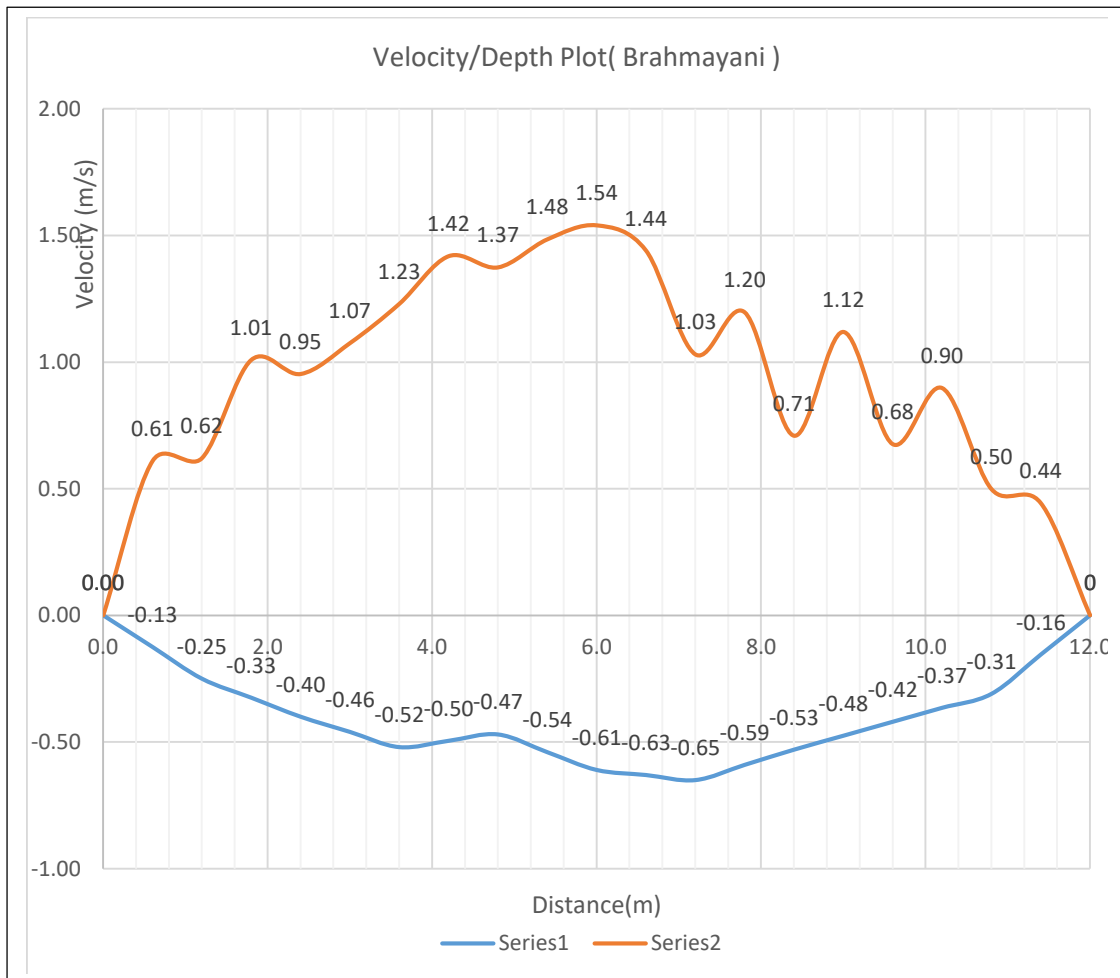


Figure 5: Velocity / Depth Plot Kartik, 2078, Lagan Khola

River Name: Lagan Khola

Width of water way: 10 m

Date: 29/08/2078

Weather: Rainy

Location: Intake, Lagan Khola

Guage Height: None

Time:1:00 PM

Table 4: Discharge calculation Sheet Mansir 078, Lagan Khola

Serial No.	Dist. to initial point	Width	Current meter Constant (K)	Ration test constant (Y)	Time	Revolution	Meas. depth	0.4xH	Mean vel.	Area	Discharge Segmental
	m	m			s	nos	m	m	m/s	m2	m3/s
1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.6644	0.0334	60	0	0.00	0.00		0.00	
2	0.50	0.50	0.6644	0.0334	60	14	0.08	0.06	0.188	0.02	0.004
3	1.00	0.50	0.6644	0.0334	60	28	0.15	0.12	0.343	0.06	0.019
4	1.50	0.50	0.6644	0.0334	60	44	0.23	0.14	0.515	0.09	0.048
5	2.00	0.50	0.6644	0.0334	60	59	0.30	0.20	0.687	0.13	0.090
6	2.50	0.50	0.6644	0.0334	60	68	0.33	0.24	0.781	0.16	0.122
7	3.00	0.50	0.6644	0.0334	60	76	0.35	0.24	0.875	0.17	0.148
8	3.50	0.50	0.6644	0.0334	60	80	0.43	0.20	0.919	0.19	0.178
9	4.00	0.50	0.6644	0.0334	60	84	0.50	0.18	0.964	0.23	0.223
10	4.50	0.50	0.6644	0.0334	60	88	0.55	0.10	1.002	0.26	0.262
11	5.00	0.50	0.6644	0.0334	60	91	0.59	0.05	1.041	0.28	0.295
12	5.50	0.50	0.6644	0.0334	60	85	0.60	0.00	0.975	0.30	0.290
13	6.00	0.50	0.6644	0.0334	60	79	0.61	0.00	0.908	0.30	0.275
14	6.50	0.50	0.6644	0.0334	60	74	0.56	0.00	0.847	0.29	0.247
15	7.00	0.50	0.6644	0.0334	60	68	0.50	0.00	0.786	0.26	0.207
16	7.50	0.50	0.6644	0.0334	60	56	0.48	0.00	0.648	0.24	0.158
17	8.00	0.50	0.6644	0.0334	60	43	0.45	0.00	0.510	0.23	0.118
18	8.50	0.50	0.6644	0.0334	60	36	0.35	0.00	0.427	0.20	0.085
19	9.00	0.50	0.6644	0.0334	60	28	0.25	0.00	0.343	0.15	0.052
20	9.50	0.50	0.6644	0.0334	60	14	0.13	0.00	0.188	0.09	0.018
11	Total								0.697	1.31	2.838

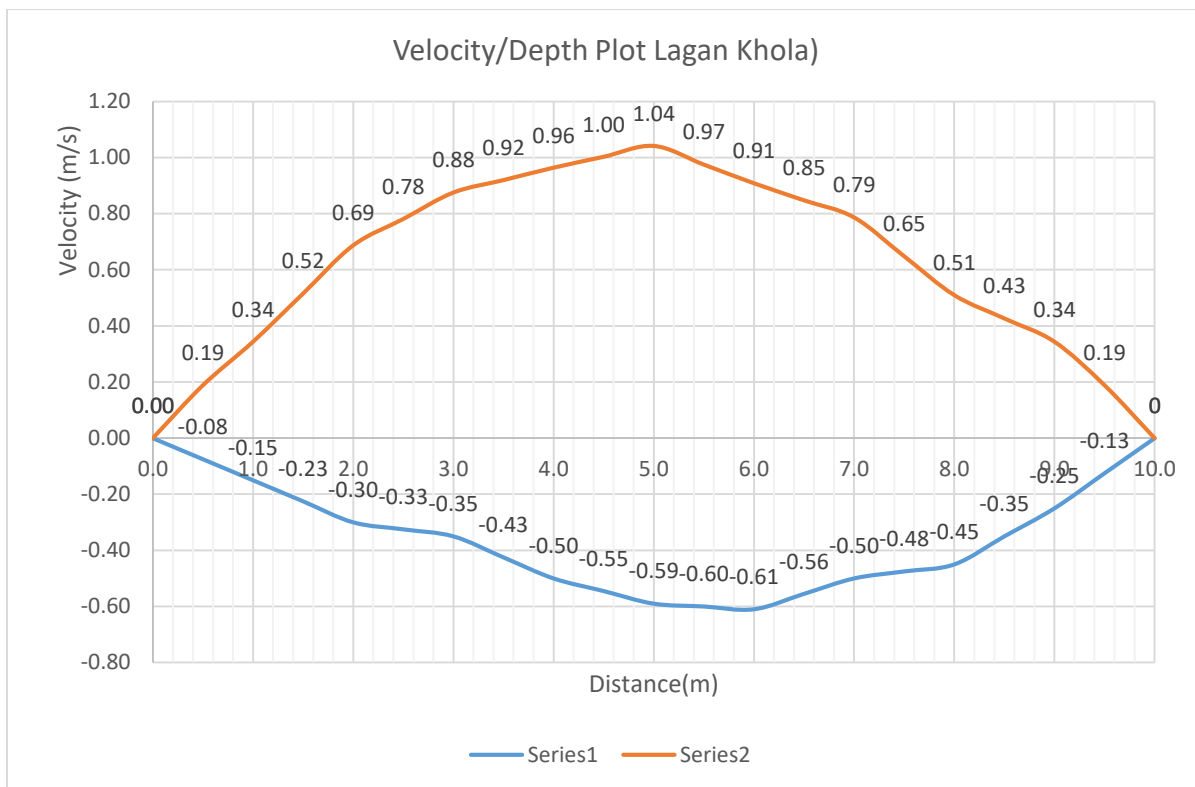


Figure 6: Velocity / Depth Plot Mangsir, 2078, Lagan Khola

River Name: Nyamaya Masal Khola

Width of water way: 14 m

Date: 20/06/2078

Weather: Rainy

Location: Intake, Upper Brahmayeni HEP

Guage Height: None

Table 5: Discharge Calculation for Aswin, 2078

Serial No.	Dist. to initial point	Width	Current meter Constant (K)	Ration test constant (Y)	Time	Revolution	Meas. depth	0.4xH	Mean vel.	Area	Discharge Segmental
	m	m			s	nos	m	m	m/s	m ²	m ³ /s
1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.2725	0.0529	60	<u>0</u>	<u>0.00</u>	0.00		0.00	
2	1.50	1.50	0.2725	0.0529	60	<u>123</u>	<u>0.80</u>	0.32	0.612	0.60	0.367
3	3.00	1.50	0.2725	0.0529	60	<u>128</u>	<u>1.25</u>	0.50	0.634	1.54	0.975
4	4.50	1.50	0.2725	0.0529	60	<u>135</u>	<u>1.30</u>	0.52	0.666	1.91	1.274
5	6.00	1.50	0.2725	0.0529	60	<u>140</u>	<u>1.60</u>	0.64	0.689	2.18	1.498
6	7.50	1.50	0.2725	0.0529	60	<u>215</u>	<u>1.50</u>	0.60	1.029	2.33	2.393
7	9.00	1.50	0.2725	0.0529	60	<u>184</u>	<u>1.20</u>	0.48	0.889	2.03	1.799
8	10.50	1.50	0.2725	0.0529	60	<u>162</u>	<u>1.05</u>	0.42	0.789	1.69	1.331
9	12.00	1.50	0.2725	0.0529	60	<u>145</u>	<u>0.70</u>	0.28	0.711	1.31	0.934
10	13.50	1.50	0.2725	0.0529	60	<u>122</u>	<u>0.50</u>	0.20	0.607	0.90	0.546
Total									0.736	14.48	11.117

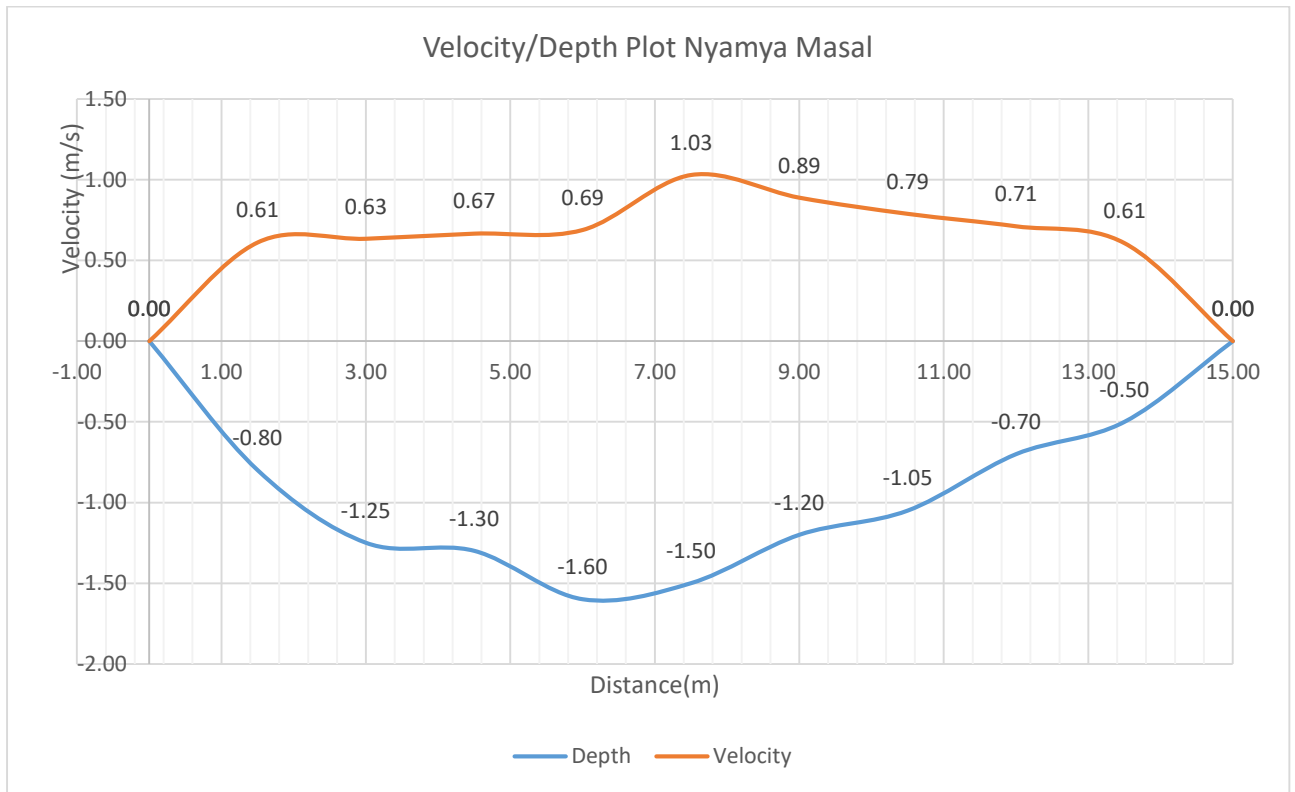


Figure 7: Velocity / Depth Plot for the month of Aswin 2078, Nyamya Masal Khola

River Name: Nyamaya Masal Khola

Width of water way: 14 m

Date: 26/07/2078

Weather: Cloudy

Location: Intake, Upper Brahmayeni HEP

Guage Height: None

Table 6: Discharge Calculation for Kartik, 2078

Serial No.	Dist. to initial point, m	Width, m	Current meter Constant (K)	Ration test constant (Y)	Time s	Revolution nos	Meas. depth m	0.4xH m	Mean vel. m/s	Area m ²	Discharge Segmental m ³ /s
1	0.00	0.00	0.6644	0.0334	60	0	0.00	0.00		0.00	
2	0.70	0.70	0.6644	0.0334	60	39	0.22	0.17	0.465	0.08	0.035
3	1.40	0.70	0.6644	0.0334	60	53	0.43	0.24	0.620	0.23	0.140
4	2.10	0.70	0.6644	0.0334	60	73	0.52	0.39	0.842	0.33	0.278
5	2.80	0.70	0.6644	0.0334	60	83	0.60	0.42	0.953	0.39	0.372
6	3.50	0.70	0.6644	0.0334	60	96	0.79	0.45	1.091	0.49	0.531
7	4.20	0.70	0.6644	0.0334	60	108	0.98	0.47	1.229	0.62	0.762
8	4.90	0.70	0.6644	0.0334	60	115	1.02	0.39	1.301	0.70	0.909
9	5.60	0.70	0.6644	0.0334	60	121	1.05	0.24	1.373	0.72	0.993

Serial No.	Dist. to initial point,	Width, m	Current meter Constant (K)	Ration test constant (Y)	Time	Revolution	Meas. depth	0.4xH	Mean vel.	Area	Discharge Segmental
10	6.30	0.70	0.6644	0.0334	60	<u>129</u>	<u>1.09</u>	0.22	1.456	0.75	1.088
11	7.00	0.70	0.6644	0.0334	60	<u>136</u>	<u>1.12</u>	0.11	1.539	0.77	1.188
12	7.70	0.70	0.6644	0.0334	60	<u>113</u>	<u>1.15</u>	0.00	1.285	0.79	1.021
13	8.40	0.70	0.6644	0.0334	60	<u>90</u>	<u>1.18</u>	0.00	1.030	0.82	0.840
14	9.10	0.70	0.6644	0.0334	60	<u>76</u>	<u>1.08</u>	0.00	0.869	0.79	0.688
15	9.80	0.70	0.6644	0.0334	60	<u>61</u>	<u>0.98</u>	0.00	0.709	0.72	0.511
16	10.50	0.70	0.6644	0.0334	60	<u>65</u>	<u>0.79</u>	0.00	0.748	0.62	0.463
17	11.20	0.70	0.6644	0.0334	60	<u>58</u>	<u>0.60</u>	0.00	0.676	0.49	0.329
18	11.90	0.70	0.6644	0.0334	60	<u>51</u>	<u>0.58</u>	0.00	0.598	0.41	0.246
19	12.60	0.70	0.6644	0.0334	60	<u>42</u>	<u>0.55</u>	0.00	0.499	0.39	0.196
20	13.30	0.70	0.6644	0.0334	60	<u>37</u>	<u>0.28</u>	0.00	0.443	0.29	0.128
Total									1.037	4.30	10.717

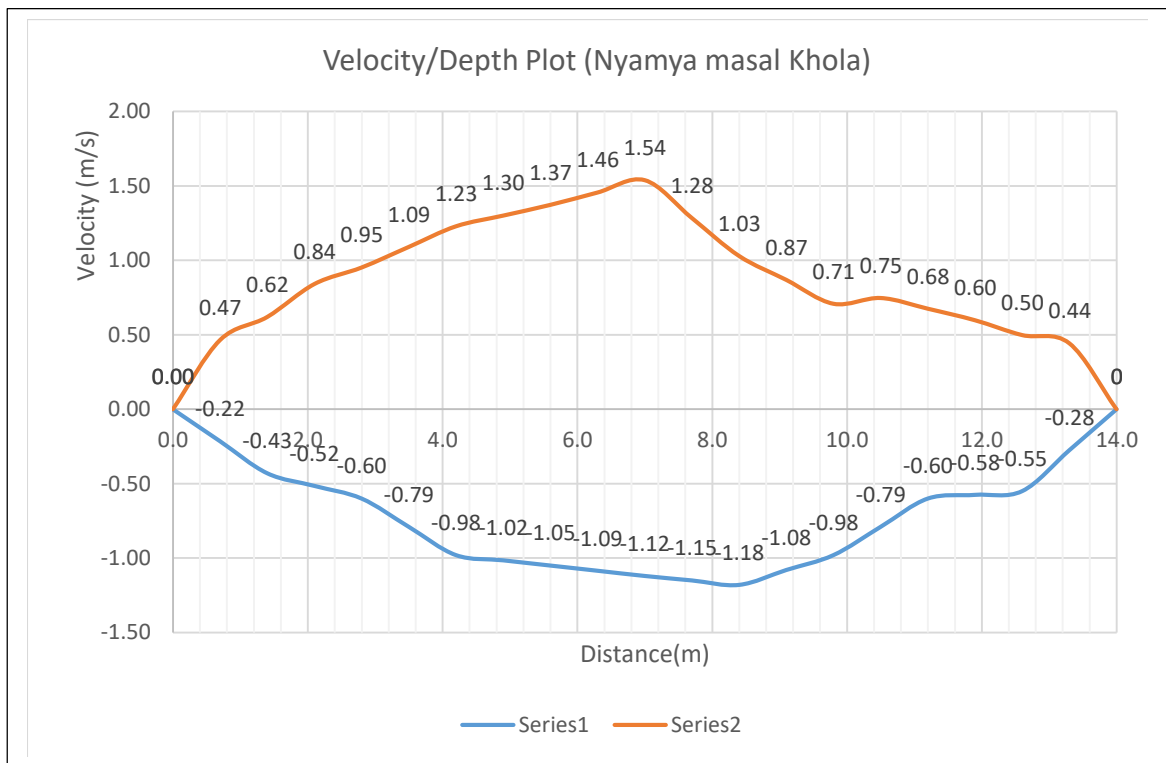


Figure 9: Velocity/ Depth plot for the month of Kartik, 2078, Nyamya Masal Khola

River Name: Nyamya Masal Khola

Width of water way: 11 m

Date: 29/08/2078

Weather: Rainy

Location: Intake, Upper Brahmayeni HEP

Guage Height: None Time:3:10 PM

Table 7: Discharge Calculation Sheet Mansir 078, Nyamya Masal Khola

S.N	Dist. to initial point	Width	Current meter Constant (K)	Ration test constant (Y)	Time	Revolution	Meas. depth	0.4xH	Mean vel.	Area	Discharge Segmental
	m	m			s	nos	m	m	m/s	m2	m3/s
1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.6644	0.0334	60	<u>0</u>	<u>0.00</u>	0.00		0.00	
2	0.55	0.55	0.6644	0.0334	60	<u>31</u>	<u>0.16</u>	0.12	0.377	0.04	0.016
3	1.10	0.55	0.6644	0.0334	60	<u>42</u>	<u>0.31</u>	0.16	0.499	0.13	0.064
4	1.65	0.55	0.6644	0.0334	60	<u>69</u>	<u>0.36</u>	0.17	0.792	0.18	0.145
5	2.20	0.55	0.6644	0.0334	60	<u>95</u>	<u>0.40</u>	0.22	1.085	0.21	0.225
6	2.75	0.55	0.6644	0.0334	60	<u>100</u>	<u>0.41</u>	0.26	1.141	0.22	0.254
7	3.30	0.55	0.6644	0.0334	60	<u>105</u>	<u>0.42</u>	0.23	1.196	0.23	0.273
8	3.85	0.55	0.6644	0.0334	60	<u>126</u>	<u>0.49</u>	0.17	1.423	0.25	0.354
9	4.40	0.55	0.6644	0.0334	60	<u>146</u>	<u>0.55</u>	0.14	1.650	0.28	0.470
10	4.95	0.55	0.6644	0.0334	60	<u>150</u>	<u>0.60</u>	0.08	1.694	0.32	0.536
11	5.50	0.55	0.6644	0.0334	60	<u>154</u>	<u>0.65</u>	0.04	1.739	0.34	0.598
12	6.05	0.55	0.6644	0.0334	60	<u>126</u>	<u>0.61</u>	0.00	1.429	0.35	0.495
13	6.60	0.55	0.6644	0.0334	60	<u>98</u>	<u>0.57</u>	0.00	1.119	0.32	0.363
14	7.15	0.55	0.6644	0.0334	60	<u>88</u>	<u>0.50</u>	0.00	1.008	0.29	0.295
15	7.70	0.55	0.6644	0.0334	60	<u>78</u>	<u>0.42</u>	0.00	0.897	0.25	0.226
16	8.25	0.55	0.6644	0.0334	60	<u>90</u>	<u>0.39</u>	0.00	1.025	0.22	0.227
17	8.80	0.55	0.6644	0.0334	60	<u>101</u>	<u>0.35</u>	0.00	1.152	0.20	0.233
18	9.35	0.55	0.6644	0.0334	60	<u>104</u>	<u>0.28</u>	0.00	1.185	0.17	0.205
19	9.90	0.55	0.6644	0.0334	60	<u>107</u>	<u>0.21</u>	0.00	1.218	0.13	0.164
20	10.45	0.55	0.6644	0.0334	60	<u>64</u>	<u>0.11</u>	0.00	0.737	0.09	0.064
11	Total								1.095	1.86	5.206

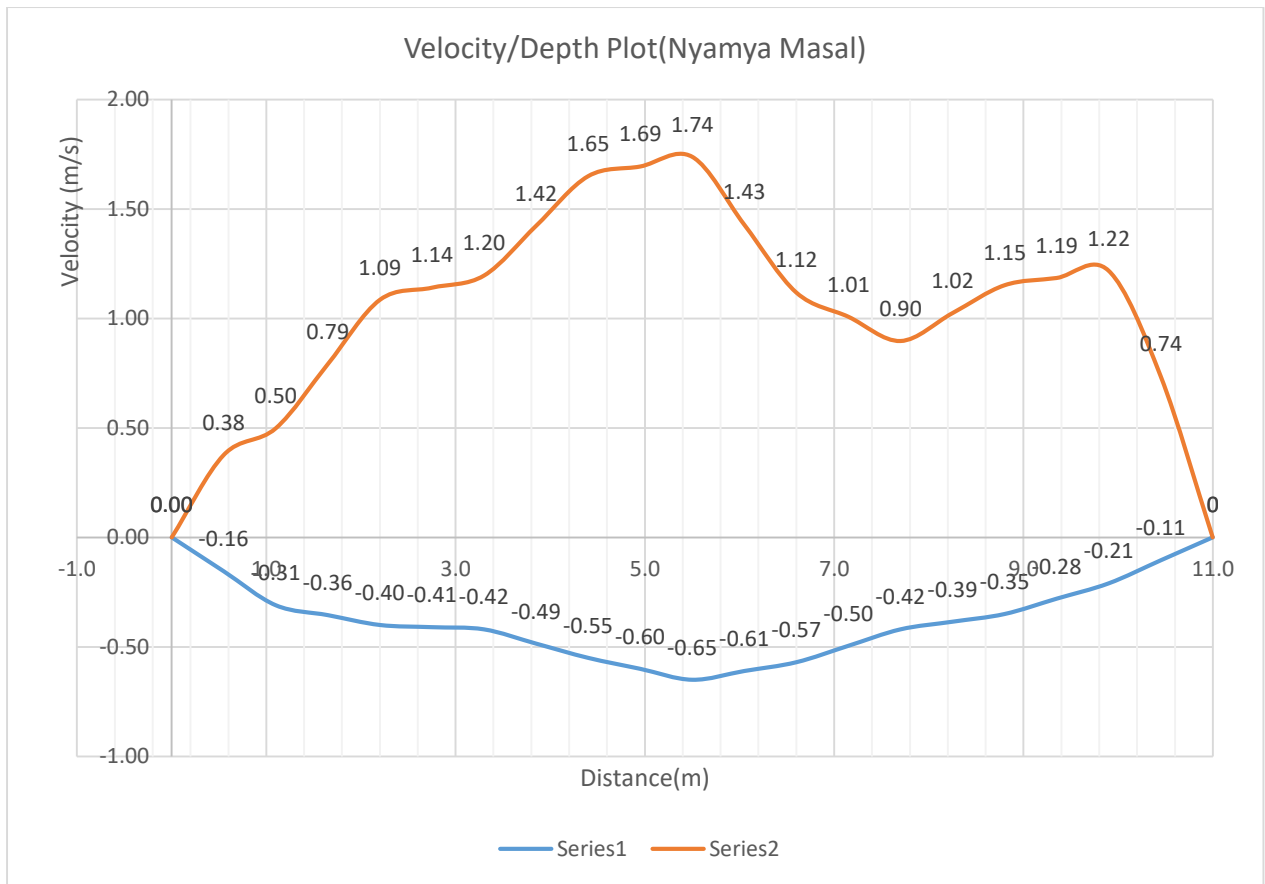


Figure 10: Velocity / Depth Plot Mangsir, 2078, Nyamyasa Masal Khola

8. Results

The total discharge to be measured is calculated for the month of Aswin, Kartik and Mangsir 2078. The discharge is measure in head works of Lagan Khola and Nyamyasa Masal Khola. The summary of the results for both Khola is shown in **Table 8**.

Table 8: Summary of Results

Date	Co-Ordinates of Nyamyasa masal Khola	Discharge -1 Nyamyasa Masal Khola	Co-Ordinates of Lagan khola	Discharge -2 Lagan khola	Total Discharge	Remarks
20/06/078	28° 5' 51.946''N 85° 47' 27.2''E	11.117 m ³ /s	28° 4' 28.28''N 85° 44' 56.51''E	8.763m ³ /s	19.88 m ³ /s	
26/07/078	28° 5' 51.946''N 85° 47' 27.2''E	10.717 m ³ /s	28° 4' 28.28''N 85° 44' 56.51''E	5.429 m ³ /s	16.146 m ³ /s	
29/08/078	28° 5' 51.946''N 85° 47' 27.2''E	5.206 m ³ /s	28° 4' 28.28''N 85° 44' 56.51''E	2.838m ³ /s	8.044 m ³ /s	

9. Photographs



Figure 11: Photographs, Brahmayani, Lagan Khola

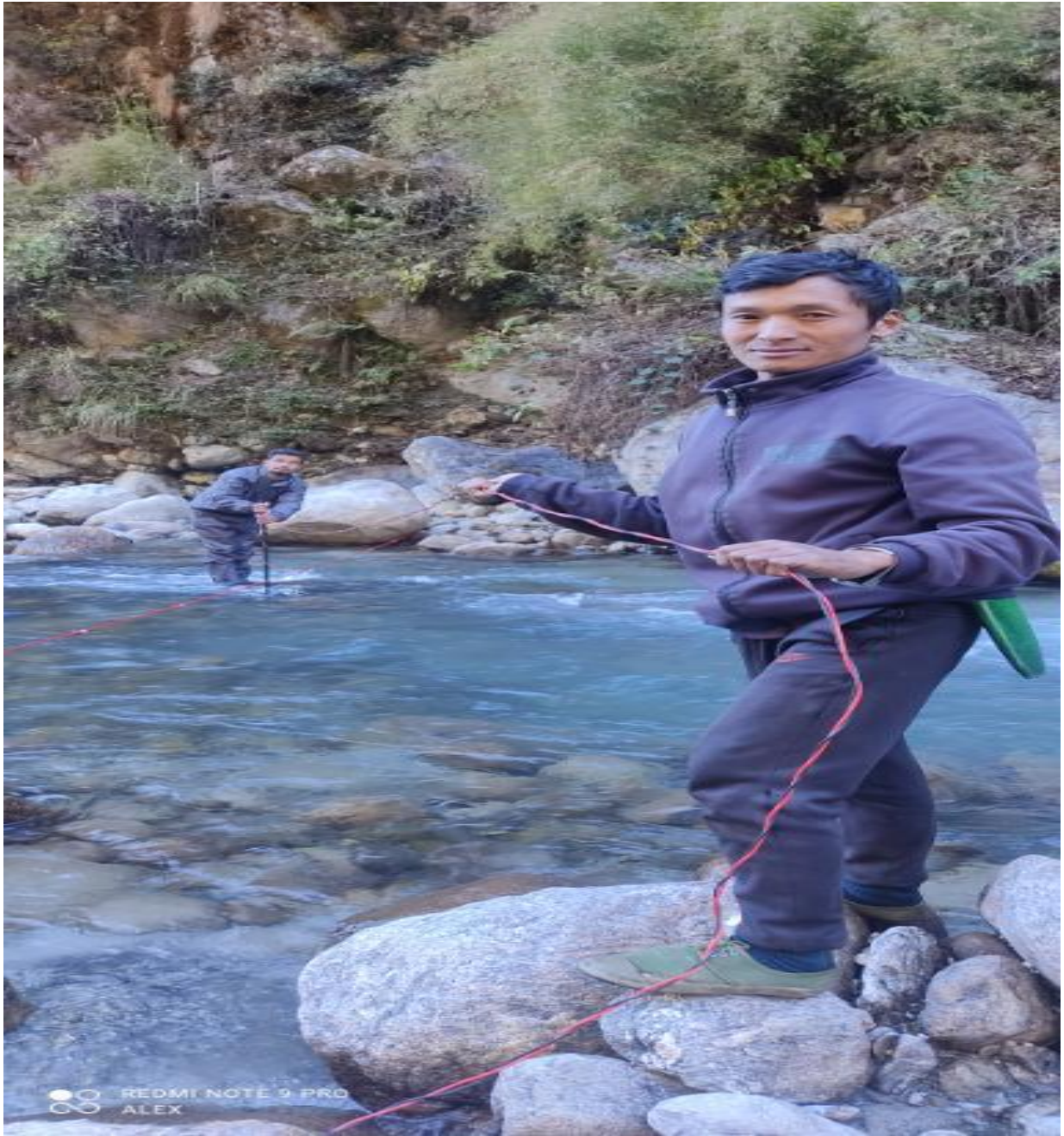


Figure 12: Photographs (Upper Brahmayeni, Nyamya Masal Khola)