

A Study of Probable Submerged Area in the Catchment With The Change in Elevation of Sundarijal Hydropower Dam in Nepal

Raghu N. Prajapati¹, Anish Shrestha², Aayukta Raman Aryal³, Arun Khanal⁴, Abdul Hai Miya⁵, Ayush Singh⁶, Brabin Sapkota⁷

Department of Civil Engineering

Nepal Engineering College, Changunarayan, Bhaktapur, Nepal

Corresponding Author's E-mail:- raghunp@nec.edu.np

Abstract

Sundarijal Watershed in Shivapuri National Park, Nepal has been providing services to Kathmandu Valley population in terms of Hydropower Generation and Drinking Water Supply. In this study, the probable submerged area in the catchment with the change in elevation of Sundarijal Hydropower Dam is calculated with the help of GIS-based tools and land use maps. In addition, assessment of the impacts on the vicinity due to the impounding reservoir is prepared. We hope that this study will be useful in designing of dam of an optimum elevation with minimum effects on the environment and maximum efficiency for sustainable period.

Keywords: *Hydropower, Power Generation, Sundarijal Watershed, Dam*

INTRODUCTION

The importance of water resources has increased with industrialization and growth of population, as these are needed for sustaining crop productivity, meeting the ever increasing needs of the domestic, industrial and power sector. Dams are therefore being constructed for harnessing water resources.

Dams are a region of the economic development model of virtually all nations of the globe. At some stage of their development, most countries with water resources which will be economically exploited have designed dams for energy, irrigation, and drinkable. Hydropower provides a non-polluting supply of energy which will be generated in increasing

amounts for the growing wants of growing populations. [6]

Dams but, aren't designed while not a big value. Additionally to substantial adverse impacts on the physical atmosphere, they will disrupt the lives and lifestyles of individuals living within the reservoir space and of these obsessed on this space. Even once thorough surveys of individuals adversely laid low with dam area unit conducted, that isn't continually the case; it's challenging to acknowledge all the adverse impacts of dam construction on the affected folks. Impacts that aren't totally known area unit tough to totally mitigate. Poorly planned and enforced dams will devastate native socioeconomic systems while not exchange them with comparable and acceptable various systems.

The Himalayan terrain provides cost-effective conditions for dam construction – deep gorges with wide valleys on the upstream; but the inherent fragility and proneness of the terrain to seismic tremors is the bone of contention between environmentalists and policy implementers.[4] Whatever the concerns, water resources need to be tapped because, despite being endowed with vast water resources, Nepal faces severe scarcity of water in relation to agriculture, municipal

and industrial needs, and also for power generation[2].

A team of Nepal Engineering College studied Probable Submerged Area in the Catchment with the Change in Elevation of Sundarijal Hydropower Dam in Nepal

LIMITATION OF THE PROJECT

There was no more detailed study and records on Sundarijal Hydropower Plant. The present study is basically based on detailed field investigation to the dam site, field survey, and interview with concerned officers, staff and local people, topographic map and DEM of Nepal.

DESCRIPTION TO SUNDARIJAL HYDROPOWER

Sundarijal Hydropower Station, located at Sundarijal, 15 km northeast of Kathmandu with installed capacity of 640 kW and annual design generation of 4.77 GWh was commissioned in 1934 AD in a grant from British government. Both the Pelton units, each with 320 kW, are in normal operation and have the capacity to operate in full load when required. [5] The penstock and station flows are part of the water supply system to Kathmandu Valley looked after by Kathmandu Upatayaka Khanepai Limited (KUKL).The co-ordinate of the hydropower plant is 27°43'46.20"N

The cumulative generation of the station has reached 99.95 GWh till 2011/12 from its first run. The station has generated 4.12



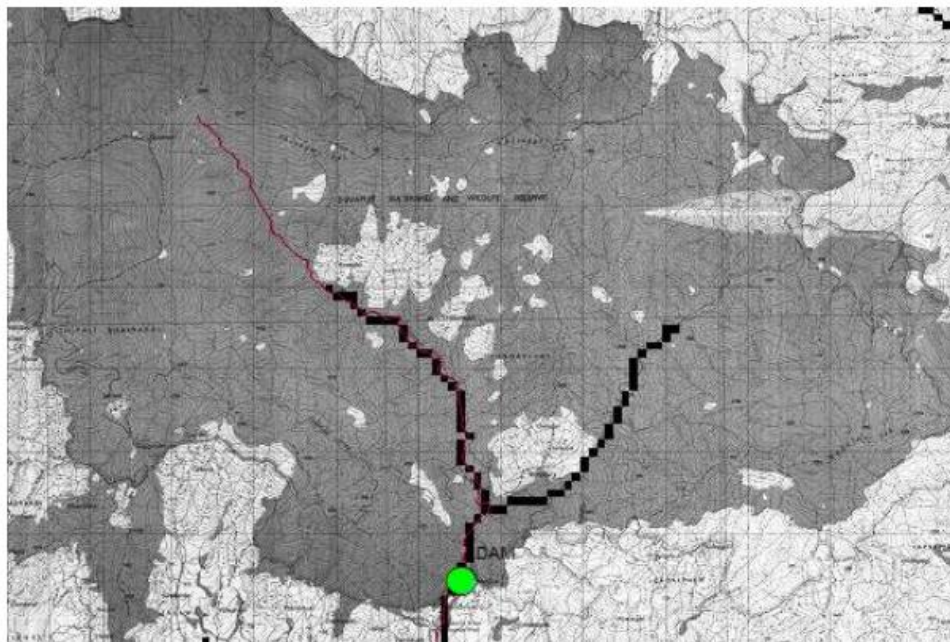


Fig.3: Tributaries of Sundarijal Hydropower Catchment Area

OBJECTIVES OF STUDY

The adverse impacts of dam construction are compounded when the affected people belong to indigenous groups with a close or special relationship to the lands on which they live. The land likely to be submerged behind a dam could be supporting a distinct culture, with a language, and customs and traditions that are unique to the location. [7] Resettlement of people from such locations is a much more difficult process, and can be successful only if the affected people themselves determine that acceptable alternatives exist, and those alternatives are actually offered to them.

Thus, if the Sundarijal Hydropower Dam is to be upgraded to increase the water supply capacity and the hydropower potential to

meet the increasing demands of the ever increasing population, the water level will rise. Therefore, it is important to study the land-cover changes in the area due to the impounding reservoir and its overall impact upon the life-support system of the masses. By this study, effective assessment of the impacts on the features in the area can be prepared.

DATA COLLECTION AND ANALYSIS

The detailed of different points and features around the DAM site is taken by using the GPS Device. The data taken at these different points are as follows:

Table-1: Location of different points around the dam site

sn	Easting(X)	Northing (Y)	Reduced level (RL)	Remarks
1	640369	3072200	1366	
2	640336	3071531	1344	
3	640543	3071706	1370	
4	640660	3072449	1429	
5	640718	3072423	1450	Ticket counter
6	640713	3071415	1576	
7	640721	3073379	1599	Dam
8	640728	3073369	1605	House
9	640727	3073390	1606	Opposite of Dam
10	640743	3073443	1610	
11	640717	3073514	1614	
12	640728	3073545	1608	
13	640740	3073526	1602	
14	640753	3073565	1603	
15	640761	3073596	1606	
16	640731	3073620	1607	Bagmati river basin Sundarijal
17	640738	3073520	1607	
18	640772	3073501	1609	

The delineated catchment area of the present dam height is determined by using DEM with GIS tool.

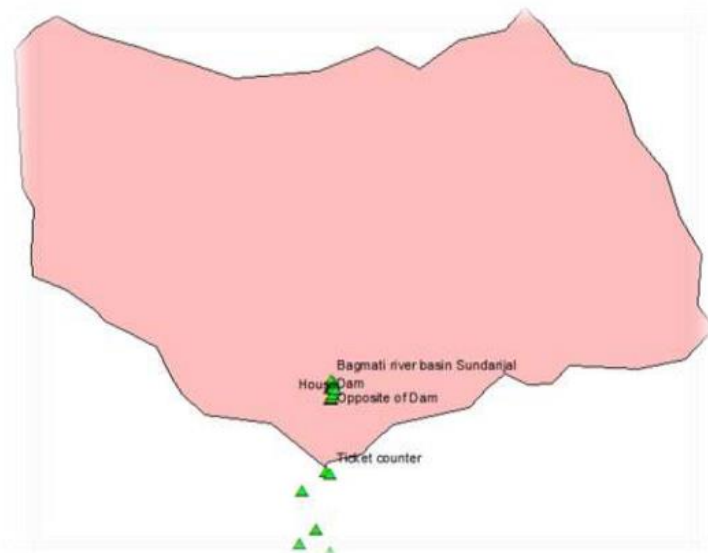


Fig. 4: Delineated present catchment area of Sundarijal Hydropower Dam

FINDINGS AND DISCUSSION

The Sundarijal Hydropower Dam was designed to 1600.0 m high. Digital elevation model (DEM) of the area together with the land-use map prepared with the

help of GPS data have been utilized for studying the likely land-use changes in the area. Under the GIS environment, a dam with 1600.0 m height was simulated to assess the storage capacity of the reservoir

as also the extent of the area that is likely to be impounded. **(See figure:5)**

This study shows that the Sundarijal Reservoir covers an area of 144531.40 square meters. The introduction of a huge reservoir would be disturbing the delicate

balance between soil, water and plants through rise in groundwater table (water logging), and disturbing the distribution in the soil, and the agricultural fields around the reservoir would be rendered unfit for cultivation. **(See Table: 2)**

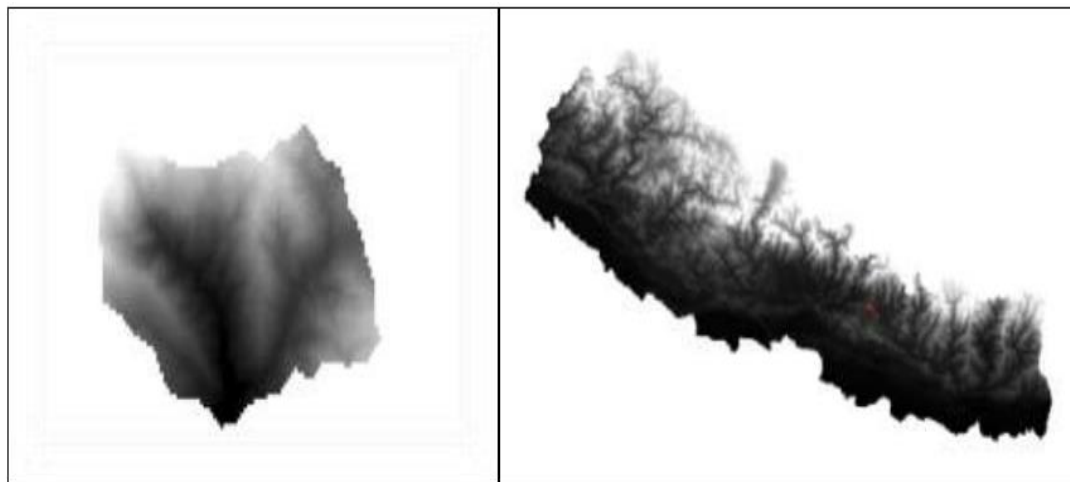


Fig.5: Extracted DEM (left) and the Whole Nepal DEM (right)

Table 2: Coverage of the Area by the Change in Elevation of the Dam

SN	Elevation of the Dam (m)	Area covered by the Dam(Sq.m)
1.	1600	144531.40
2.	2000	12138876.85
3.	2500	32767614.11
4.	3000	33393979.15

The change in the submerged area of the catchment of the Sundarijal Dam according to variation in Elevation of the Dam is graphically illustrated below:

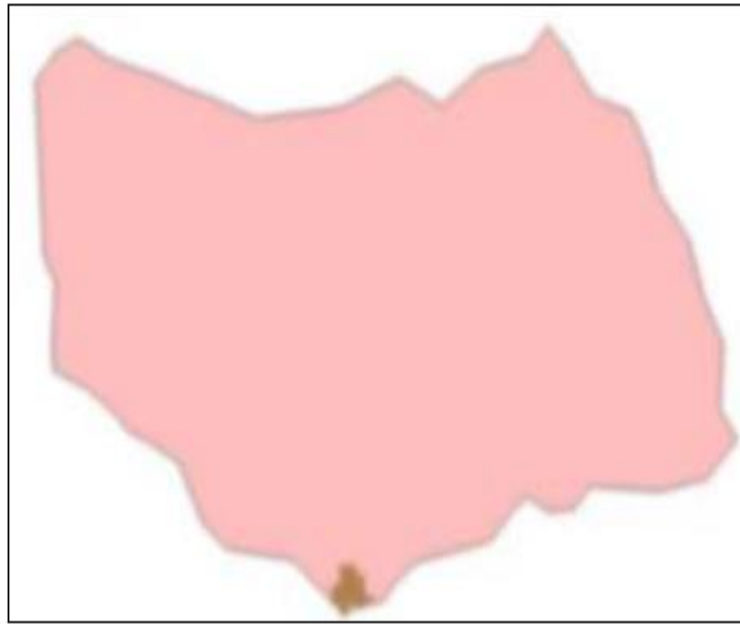


Fig.6: Height of Dam at 1600m from the sea level and its coverage over the Catchment
Area is 144531.40 m²

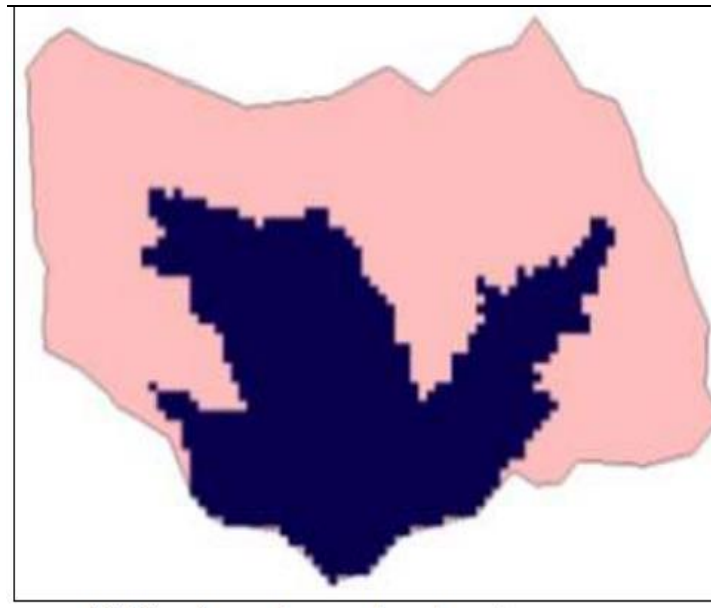


Fig. 7: Height of Dam at 2000m from the sea level and its coverage over Catchment Area is
12138876.85 m²

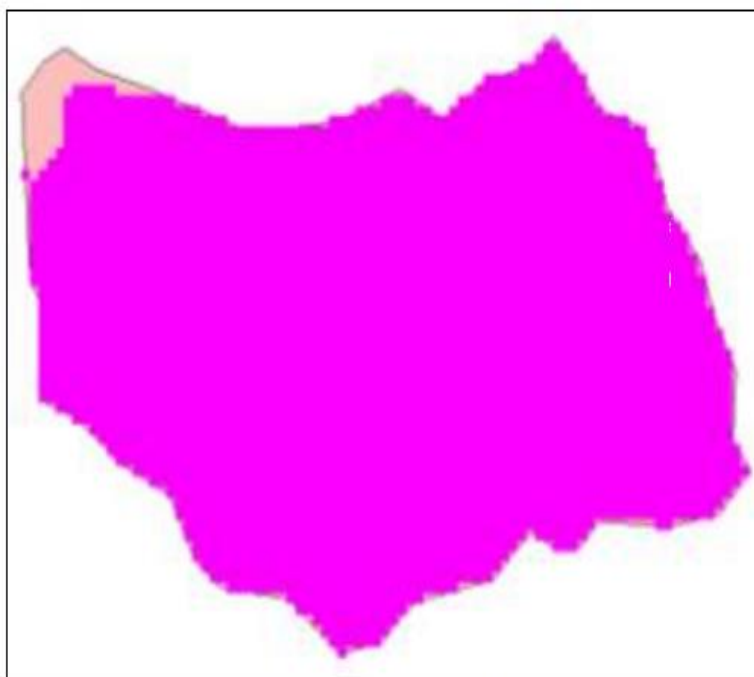


Fig.8: Height of Dam at 2500m from the sea level and its coverage over the Catchment
Area is 32767614.11 m²

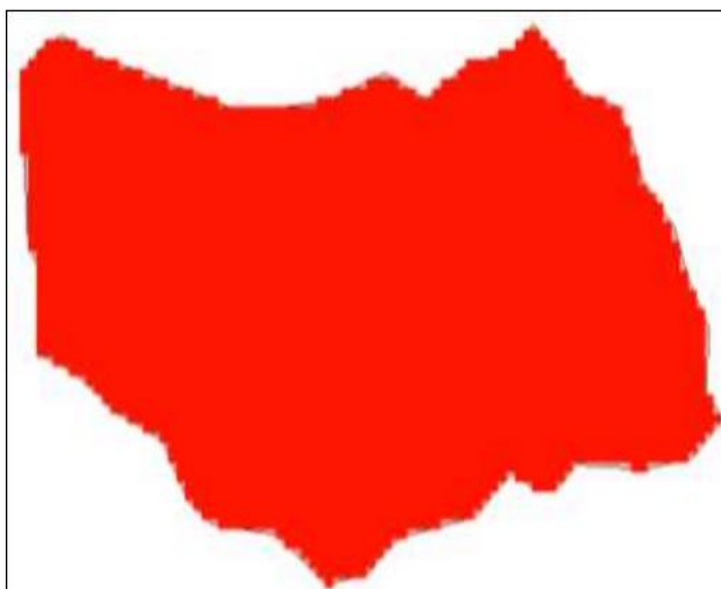


Fig.9: Height of Dam at 3000m from the sea level and its coverage over the Catchment
Area is 33393979.153 m²

Hence, it can be clearly seen that as the elevation of the dam increases, more catchment area is submerged. If the

elevation of the dam is between 2500 and 3000m, entire area of the catchment is submerged.

As the area falls under the shivapuri national park so, we may also say that the habitat of the animals and birds would be affected.

CONCLUSION

After the case study made on the Sundarijal dam, it was observed that the dam was at the height of 1600 m from the mean sea level. If the impounded water height is increased to 2000 m, the coverage of the catchment increases. This implies that if the impounded water height is increased then it covers almost 40% of the total catchment area. If the impounded water height was increased to 2500 m then it would cover about 98% of the total catchment area. The forest and the houses around the dam would get flooded.

We found that at the height of 2000 of the reservoir, it is safe as the resident around the dam is not affected. But in case to maximize the capacity of the reservoir and increasing the height of the dam we need to resettle the house around the reservoir.

REFERENCES

- I. H.M. Shrestha, Cadastre of Hydropower Resources, PhD Thesis, Moscow Power Institute, Moscow, 1966
- II. H.M. Shrestha, Facts and Figures about Hydropower Development in Nepal, Hydro-Nepal, Issue 20, January 2017
- III. L.K. Verdin, Estimation of average annual Stream flows and power Potentials for Alaska and Hawaii, Idaho National Engineering and Environment Laboratory, 2004
- IV. R.B. Khadka, Integrative Micro development in Sundarijal, Nepal Study Center. University of New Mexico, 2005
- V. Nepal Electricity Authority Generation, Operation and Maintenance Business, Nepal Electricity Authority, 2013
- VI. R. N. Prajapati and S. Manandhar, Hydropower Engineering, First Edition, Heritage Publication, Kathmandu Nepal, 2013
- VII. <http://www.tripmondo.com/nepal/nepal-general/sundarijal/>
- VIII. <http://www.everestuncensored.org/sundarijal-hike/>