Feasibility Study on Proposed Micro Hydro Electrical Power Plant @ Kappadi (Byndoor), Karnataka, India

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Abstract

Electricity is a very important energy in the modern civilization. It helps us to be productive and improves the quality of living. Kappadi region of Udupi district in Karnataka India, faces many difficult to get access the electric energy. Therefore, it is very important to find new solutions for electric generation in the rural areas (at load centers) which are cost effective and sustainable. This project aims to make use of renewable resources such as hydro energy and convert it into useful electric energy by installing a micro hydro power plant at kappadi. As per the research and based on the calculations there is a probability of generation up to 20kw power from a head of 1.5 to 3.34 meters using bulb turbine. This paper comprises all the data which will help to analyze how power can be generated with less head, also it reveals all methods which were carried out well enough to ensure that this proposal is eximious.

Keywords

MHPP - Micro hydroelectric power plant, Bulb Turbine, Survey.

1. Introduction

Electricity is accepted as one of the driving forces of economic development of all nations. The challenge of continuously generating electricity and meeting growing demands exerts tremendous pressure on energy infrastructure for both developed and developing nations [1].

India being a developing country fosters in enhancing the livelihood of its population. Though the focus of government is narrowed towards the urban sector, there are appreciable steps taken by the government for rural empowerment, but these are not effectively reaching the destitute (indigent). In such cases, rural areas have to look for alternatives to make lives better.

Due to the exploitation of non-renewable resources such as coal, gas, petroleum etc. (which accounts for 71% of Indian power generation source), If this trend continuous, electricity will be unaffordable. Being dense area, with high vegetative cover, large multipurpose projects are insane and inconvenient. Therefore, installation of micro power plant

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vicinal to the load center will be of great assistance (relief). This will also reduce the electric demand for the duration of few months for the government. Also for the villagers, it will provide free access to electricity. This serves as a most appropriate substitute for such areas where load shedding caused due to the falling of trees on cables is a major problem. The electricity saved during the interval of five months can be utilized in a better manner and no need of power supply from the government to that zone for the mean time.

Hydro power is based on the principle that flowing and falling water has a certain amount of kinetic energy potential associated with it [2]. MHPP consists of a turbine and a generator to convert Kinetic energy of water into electricity. MHPP usually generates power in the range of 5 to 100kW of electricity output.

Power generation mainly depends on

- Amount of water flow
- Head.

Water flow is measured in m^3/s and head in m.

Water flow from certain heights at sufficient quantity is necessary to drive the turbine. This certain head is calculated and the appropriate spot of installation is chosen. It is possible to install without being affected by the flood, during the rainy seasons. These areas have a variation of rainfall ranging up to 20 cm, which was found using rain-gauge estimation. The sufficient head for the turbine to run is made possible by stretching a penstock.

The micro hydropower potential of state has been assessed and viable sites have been identified in Karavali zone and one of the site is chosen (Kappadi) which have the potential to generate 10 to 20 kw electricity by theoretical calculations. At the proposed site (Kappadi), there is a dam which was already constructed by the government for the purpose of irrigation. This area receives heavy rainfall for a continuous period of five months per year during which the water level rises pointing the possibility of micro hydro power generation.

This dam at present has a height of 3.6m at bridge level. Water can be stored up to a height of 1.5m. Using proper penstock and by reducing its diameter in the midway, the velocity of water can be increased and it stands good enough to produce a total power of 14Kw to 20kW theoretically.

The proposed site can be made more resourceful by the installation of a micro-hydro power plant with bulb turbine. Also, if the present head of water can be increasable from 1.5m to 2m, the capacity can be further increased (20 kW).

2.Literature survey.

Capacities up to 100 kW or less are referred to as micro/pico hydro plants [3]. The Idea of micro-hydro power plant is though new in the state of Karnataka, it is a very successful and efficient method of power generation in various parts of Indonesia. In India, the first micro hydropower plant was established in West Bengal in the year of 1897 with a capacity of 130 kW. Most of the micro-hydro power plants in India are installed in the hilly areas [4]. Jakhna micro hydro power is a remotely hilly area Bhilangana block of Tehri Garwhal district of Uttarakhand (India) [5].

In Indonesia, the micro-hydro power plant is very successful and efficient method of power generation in various parts of the country especially in a rural community who can get clean and reliable power. The most commonly used turbine is the cross-flow turbine which operates well with a moderate head of 15m and flows requirements of 150 m^3/sec. The hilly rural areas provide more electricity generation at the site.

In China too, where there is abundant of hydropower resources, micro hydro power plants are large in number because they are always proved as economical and sustainable. Almost 652 primary rural electrification setups had been established by the year of 2002 which had the power capacity of 28,489 megawatts (MW). This number of micro-hydro power plants had increased enormously resulting in the generation of 2,000 MW annually. Also, 15 provinces of china have been installed with small hydropower generation [SHP] which accounts for 91.6% of total installed capacity in China [4]. The idea of MHPP is also widened to countries such as Turkey, Thailand, japan etc.

3.Objective

- Conduct the survey to find out the required parameters (distance, head, discharge, and topography) necessary for the installation of the turbine for power generation of a capacity of 10 to 20kW.
- Cost estimation for the installation of MHPP.

4.Methodology

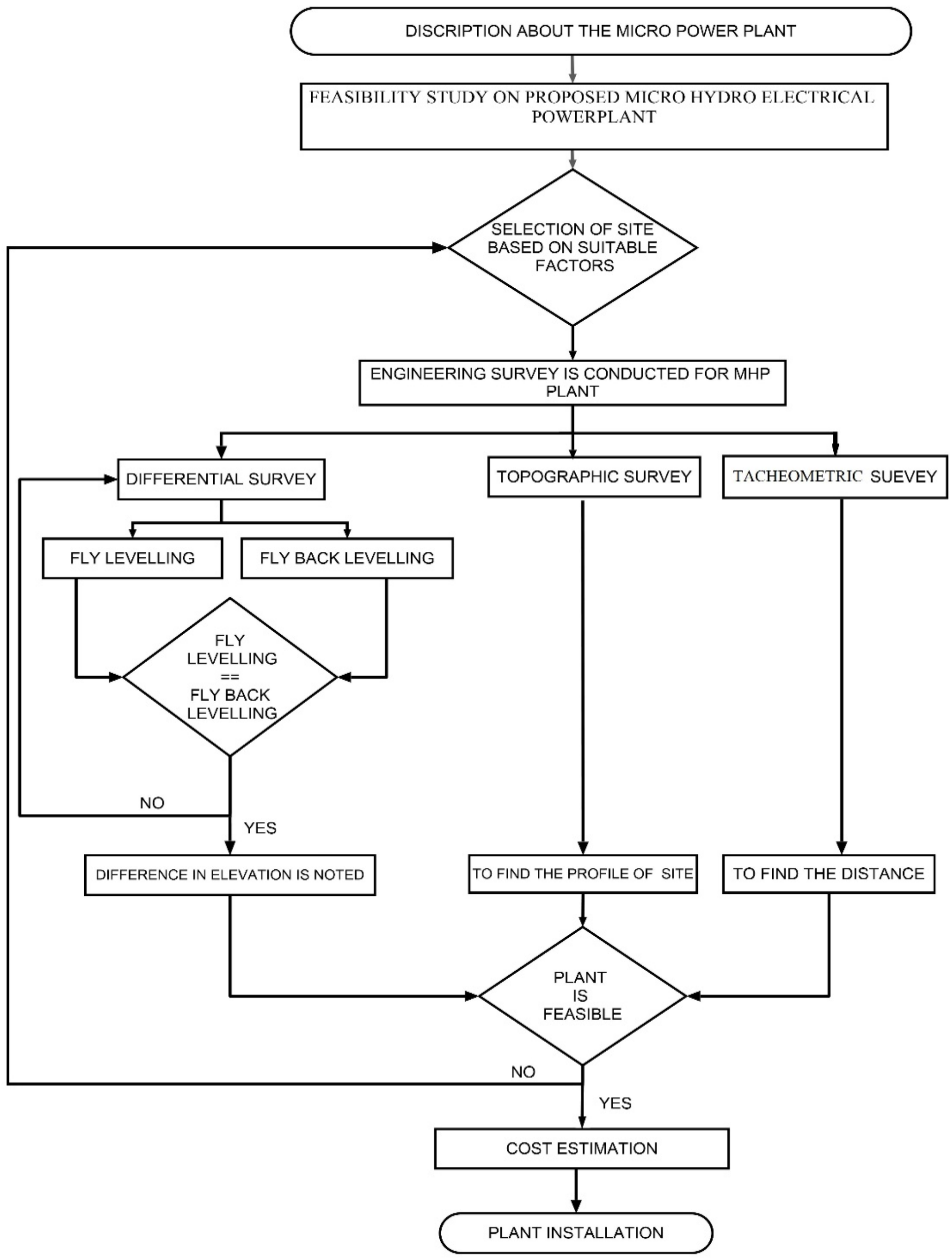

Fig 1: Flow chart to carryout feasibility study.

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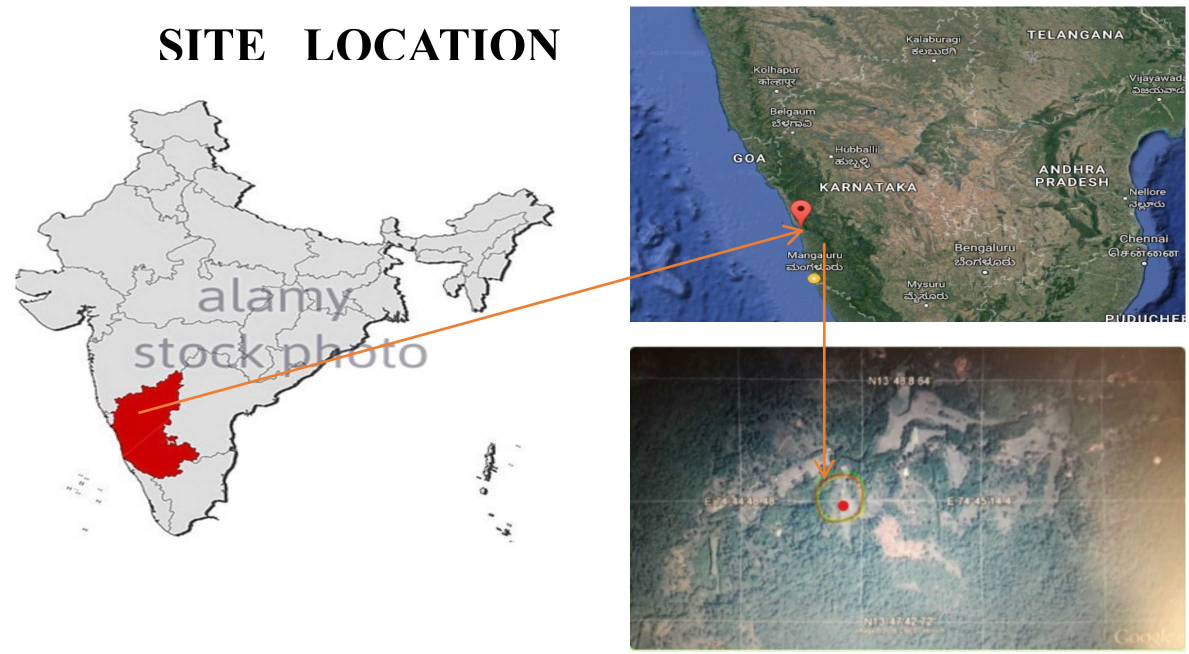

Fig.2. Satellite view of site from Google map showing latitudes.

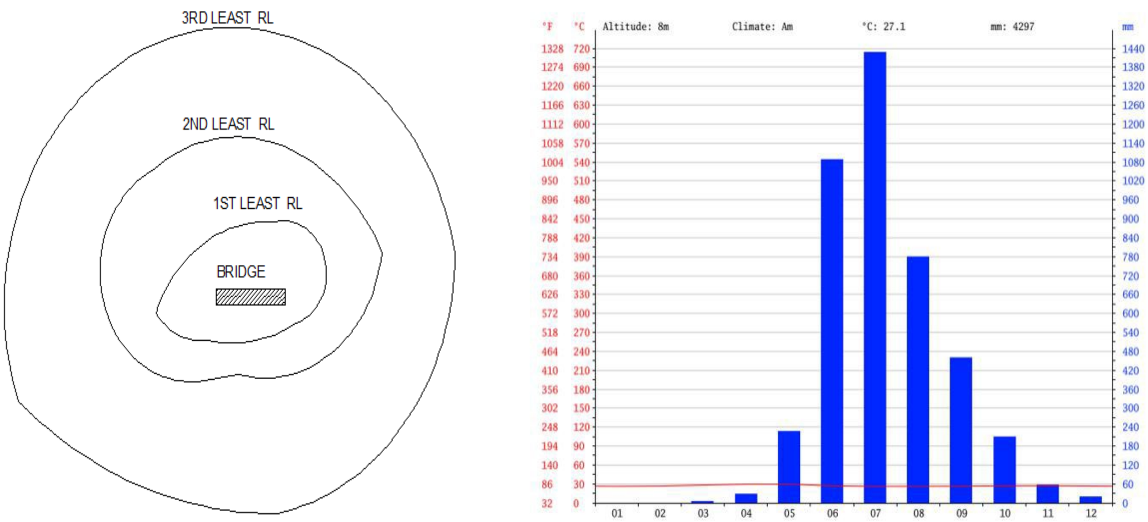

Fig:3: Contour map and Graph showing intensity of rainfall at Kundapura.

The complete overview of the feasibility study conducted is shown in fig. 1. Topographical survey is used to identify and map the contours of the ground and existing features on the surface of the earth [6]. It is important to do a topographical survey which will give us a clear idea of the entire area and therefore enable us to take appropriate decision on discharge calculation and capacity of the catchment area. In the topographical survey, we mainly focused on the bridge point with respect to two hill points on either side of the bridge. By knowing the distances and elevations of two hills with respect to the bridge point we can get an idea of the catchment area. The hills will become a source of water for our dam when the rain water from the hill becomes runoff and reaches the dam. The observations and tabulations are listed below in Table 1 and 2 respectively. The contour plot is plotted according to the elevation available at the site and site satellite view as well as the hydrograph which specifies the average rainfall of current year is shown in fig. 2 &3.

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It is important to do a topographical survey which will give us a clear idea of the entire area and therefore enable us to take appropriate decision on discharge calculation and capacity of the catchment area. 1^{st} RL =101.5 ,2^{nd} RL =102.3 ,3^{rd} RL =104.8. In the topographical survey, focus is given on the bridge point with respect to two hill points on either side of the bridge. By knowing the distances and elevations of two hills with respect to the bridge point we can get an idea of the catchment area.

Table 1. The difference in elevation between bridge point and right hill.

POINTS	BACK SIGHT(BS)	FORE SIGHT (FS)	HEIGHT OF INSTRUMENT (HI)	RL OF BM
1	1.900		101.900	100.000
2	2.755	0.910	103.745	100.990
3	3.845	1.380	106.210	102.365
4	2.945	1.210	107.945	105.000
5	5.410	0.420	112.935	107.525
6		0.140		112.795

Difference in elevation between bridge point 1 and right hill (point 6) = 12.795m

Table 2. The difference in elevation between bridge point and left hill.

POINTS	BS	FS	HI	RL OF BM
1	1.73		101.73	100.00
7	1.95	0.36	103.32	101.37
8	2.29	1.00	104.61	102.32
9		1.27		103.34

Difference in elevation between bridge point 1 and left hill (point 9) = 3.34m

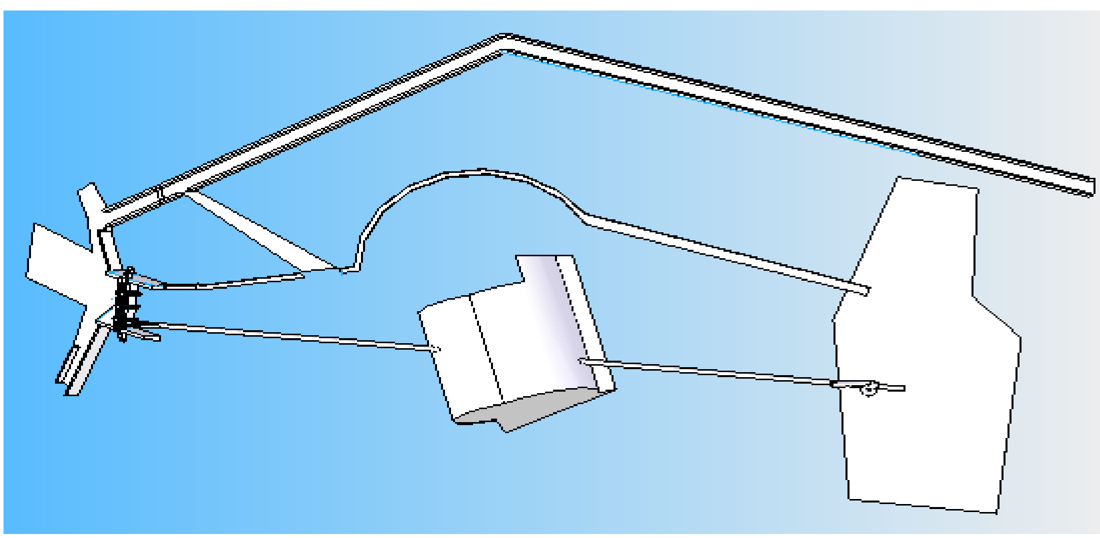

Fig. 4 MHPP Model created in Solid edge software.

5.Cost estimation

Table 3. Cost Estimation for MHPP.

Sl. No	Part Name		Quantity	Price (lakhs)
1	Bulb turbine with alternator		1	2.5-3
2	Penstock	Galvanized Iron (GI)	100-120 meters	1.8-2
		Mild Steel		1.5-1.8
		PVC		1.2-1.5
		Fiber Resin Epoxy		2-2.5
3	Pressure Regulator	Butterfly valve	1	0.5-0.7
		Duplex Ball Valve		0.3-0.4
		Gate Valve		0.2-0.3
4	Track rash	Mild Steel(Coarse and Fine)	2	0.4-0.5
5	Miscellaneous charges	JCB work, Transportation, Etc.	Hour and distance basis	0.9-1
			Total	7.7

In table 3 the complete cost of MHPP is mentioned with its components according to the availability of components with miscellaneous charges the total estimated cost is 7.7 lakhs rupees in Indian currency.

6.Conclusion

Micro hydro power plant [MHPP] proves to be the best alternative for power generation in remote areas especially in regions with dense vegetation and low economy. The selected site has the intensity to produce 10 to 20 KW which is very near to kappadi village. 17 houses situated near to this site, in rainy season, it's difficult to supply power to this dense forest zone. Due to availability of source MHPP will serve 5 months without any problem. Payback period of this plant is 4 years and main advantage is already check dam is constructed for this stream.

Since the head of water at bridge point was less we thought of providing a penstock to draw water for bridge point to place where we got the head as 3.18m (turbine point). To know the length of penstock that needs to be provided we carried out tachometric survey. The length of the penstock was found **89.23m**.

To install MHPP at site one of the necessary details required is topographical map. The topographical survey was carried to know the contour view of the site. Discharge is one of the parameter which is directly proportional to power generation. It was calculated by knowing the average stream flow velocity and average stream depth. Average stream velocity was found to be **0.212m/s** and average stream depth was found to be **0.41m**. By that the discharge was found to be **0.39m^3/s**. Power calculation is done based on the parameters of head and discharge. It was found that with our head and discharge available we can produce up to **13.79KW** of energy which was found to be more than our requirement.

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