NEED ANALYSIS APPLICATION ON THE FEASIBILITY STUDY OF THE HYDROELECTRIC POWER SELECTION (CASE IN SOLOK, PESISIR SELATAN, AND SIJUNJUNG REGENCY)

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ABSTRACT: This study aims to determine the criteria of data and information needed to be related to the selection of the ideal location of the potential of hydroelectric power from several rivers namely; Batang Lembang Solok, Batang Bayang Pesel, Batang Sukam and Batang Kuantan in Sijunjung Regency, Designing technical works such as Mechanical, Electrical and Civil Works of a Minihydro Power Plant at the selected potential point. While the benefits of this research are to obtain complete information and valid data in the selection of locations and design of hydroelectric power plants for several investors and local governments concerned. Stages of this research are to arrange systematic framework of thinking using needs analysis. The systematics of the framework contains the work sequence that guides the preparation of the feasibility of the Hydro Power plant in 3 planning locations in Sijunjung, Solok and Pesel regency. Followed by field survey, identification of data collection of water debit and height fall (head). Design and installation studies, Turbine and Generator types as well as civil works covering water retrieval doors, ducts, tranquilizers, garbage screens, generator houses to drainage channels.The results of this study selected location data input is in Solok district as follows; discharge design is 5,431 m3 / s, high difference available is 29 m. The length of the measuring channel is approximately 1150 m until it reaches the tranquilizer and power that can be raised at 1.1 MW or 1250 kVA and type of turbine type Francis.

Keywords: Need Analysis, Hydroelectric Power, Feasibility Studies, Mini HydroPower

1. INTRODUCTION

Need Analysis is a way to facilitate people in conducting analysis and review a problem. One method of need analysis is often used in the field of science is Concept Mapping.

According to Ryan Watkin etc in the book A Guide to Assessing Needs, Concept mapping is a way of visualizing hierarchy and the relationship between propositions, ideas, and information. There are three main phases of the concept mapping technique is planning, gathering information, analyzing and interpreting

Related to the selection of power plant sites located in three districts in West Sumatera, by applying Concept Mapping to get one of the best-selected locations based on various criteria of valuation of important aspects as well as related supporting factors in feasibility studies such as technical, mechanical electrical, social, legal, economic.

Technically the region of West Sumatra is famous belief rough consisting of mountains (hills) and the valley. This valley is generally a watershed (DAS) that can be used for electricity generation, to replace the alternative energy that has been a deficit in the last few years due to the growing demand for electrical energy.

There are several watersheds that have been utilized by the community just for the needs of lighting by using simple technology. In addition, several PLTMH (micro hydro power plants) have also been built, however, about 80% of existing MHP is no longer operational because of the entry of PLN network and technology simply. Electricity generating capacity up to 2028 is estimated at 9,757,507,038 KVA consisting of domestic needs of 7,392,050,786 KVA and for general infrastructure 2.36 MW. (Source Esdm Sumbar, 2014)

The objectives and targets of this study using the method of need analysis in the selection of generating sites in the study of the preparation of Feasibility Study Investments of Hydro Power Plant (Mini Hydro) is to provide accurate data and information to potential investors regarding the condition of supporting facilities and infrastructure for the development of PLTMH in selected areas later on.

BASIC THEORY

In support of the preparation work process of FS Hydro Power Plant (Mini Hydro), need to compile systematics framework. The systematics of the framework contains the work sequence that guides the preparation of FS Power Hydro (Mini Hydro) in 3 planning locations in Sijunjung, Solok and Pesisir Selatan districts. More details about the framework for the work of FS Hydro Power Generation (Mini Hydro) Development can be seen in Figure 1. following.

- Preparation Step
- Implementation of the Survey
    - o Secunder Survey
    - o Primary Survey
- Identification, Compilation and Basic Analysis

Site selection the criteria on the potential feasibility of the MHP must meet: a). The length of the distribution point network location of the plant to the receiver power (load) radius of 5 km for medium voltage 20 kV and 2 km radius for low voltage.b). The presence of potential customers who are around the plant.c). Potential power generated sufficient power according to micro-hydro standard with power 1 MV d). Availability of river flow throughout the year.e). The access road to the location can be reached or can be reached with inexpensive technology.f). The site of the plant does not damage the environment and/or be in a nature reserve or culture in accordance with the applicable provisions

In the execution of work, the basic approach pattern used for this work is the conceptual approach. The pattern of conceptual approach is the mindset of approach concerning policy, strategy, philosophy framework or basic concept that will be used in formulating, selecting and setting strategy and recommendation in the formulation of investment feasibility for development of Hydro Power in District.

1. Approach to Literature and Development Policy: This approach is aimed to find out the various study literature studies and studies that have been done related to the feasibility study of investment on the development of hydroelectric power.

2. Resource Approach (Resources Base Approach); The Resources Base Approach is an approach that relies on the availability of resources or local potential that can be used or needs to be supported by its development through the implementation of a plan or program.

3. Participation Approach (In Participation Approach) In many cases during this time the community is like a spectator who witnessed the implementation of development in the region. This happens because the nature and format of its development are "Top Down". The point is from planning, implementation to operation without the community or local government involved. Even if they look just as workers. This, in turn, makes the further distance between the development itself and society. Approach with the involvement of stakeholders (Participant Approach) area determines the successful implementation of development programs.

According to Suad Hasan and Suwarsono (1994: 7) in the feasibility study it is necessary to know the characteristics of the project (scope of activities, means of activity, evaluation of the aspects that determine the success of the required facilities, the results of the activities and the costs to be paid for obtaining the results.

- **The Importance of Feasibility Study**

According to Prof.Dr.Niswardi Jalinus MPd on lecture Need Assessment (2016), Before a new business starts or developed in advance should be held research on whether the business will be pioneered or developed will be profitable or not. If profitable, whether the benefits are adequate and can be obtained for a long time. Technically it may be feasible, but economic and social are of little use.

According Suryana (2000: 139), explains that "Business feasibility study or business analysis is also called business is a study on whether or not a business is carried out by continuous profitable".

Further Suryana (2000: 145) states that parties who need and concerned with business feasibility studies, among them are:

a. Entrepreneur party (Company Owner).

Starting a business or developing a business that necessitate a considerable sacrifice and faced with uncertainty. In entrepreneurship, a business feasibility study is essential so that its business activities will not fail and experience profits over time. Similarly, for funders who require certain requirements such as bankers, investors, and the government.

b. Investors and funders

For investors and funders, a business feasibility study is essential to select the most profitable type of investment and as a guarantee of capital invested or lent it. Whether the investment does provide a guarantee of an adequate investment return or not. By investor, a feasibility study is often used as consideration whether or not a feasible investor.

c. The community and the government

Parties to the feasibility study community are necessary especially as a matter of study whether the business established or developed beneficial to the surrounding community or otherwise even harmful forever. How are positive and negative environmental impacts? Likewise, for the government, it is very important to consider the business license or the provision of other facilities.

METHODOLOGY

The methodology required in site selection activities in the preparation of Feasibility Study of Hydro Power Plant (Mini Hydro) is based on:

1. Identification of Spatial Use Utilization

This stage is done by analyzing the carrying capacity and space capacity of the utilization plan. In

addition, specifically to identify the development of space and activities, then analyzed the contents of space planning which then overlaid with the existing condition of the area. The results of the analysis of the feasibility of space/land area planning.

2. Identification of Typology of "Profile" of the Watershed

In this stage, secondary surveys and primary surveys are conducted. A secondary survey was conducted to identify the functions and characteristics of the Watershed (DAS) of the planning area.

3. Identification of Existing Condition of Planning Area

Steps in this stage are to mapping the physical and environmental hue directly. The tools used include the GPS, Theodolite and the camera as a tool for field documentation. The results of the observations will be analyzed to identify the planning area (Batang Bayang watershed (South Pesisir), Batang Lembang in Solok and Batang Kuantan districts in Sijunjung District).

A.Preparation Stages

The preparation stage is the initial stage of this work. The method used is to prepare all the needs related to the work Feasibility Study Investment of Hydro Power Plant (Mini Hydro), among others:

a). Administration preparation.,b). Provision and Mobilization of experts.,c). Preparation introduction to the initial condition of material and location of planning review,d). Preparation of survey needs (design survey, cameras, questionnaires, interview sheets) and Preparation of literature and legislation

B.Data Generating Stages

The data were collected using two methods namely secondary data collection method and primary data collection method. This stage is a follow-up of the commencement of the Feasibility Study Work Process of Hydro Power Plant (Mini Hydro), which at this stage will be done two forms of activities namely:

C.Secondary Data Collection

The technique of collecting secondary data was done by conducting literature study from the publication of statistical data of West Sumatera BPS, BPS of Sijunjung District, Solok District, Watershed Data from PSDA of West Sumatera Province and PSDA of Sijunjung Regency and Pesisir Selatan Regency.

The types of secondary data collected include a). Data Sumatera Barat In Figures (time series),b). Sijunjung District Data In Figures (time series),c). South Pesisir Regency Data In Figures (time series),d) Data Number of electricity customers of West Sumatra, electricity customers Pesisir Selatan District and Sijunjung District,e). Rainfall Data, Average Rainfall, Water Discharge of Batang Bayang Watershed, Batang Sukam and Batang Kuantan,f). Data Land use area around the watershed Batang Bayang, Batang Sukam and Batang Kuantan,g).Population and economic data of West Sumatera Province, Pesisir Selatan Regency, Sijunjung Regency, Solok Regency and planning area covering such as: {Population level,Level of community heterogeneity,Accessibility of location from the center of village, sub-district, city / district activities, road conditions and availability of modes of transportation,Availability of energy services and patterns of use,Level of electricity consumption, Availability of public infrastructure.}, next h). Data of Water Resources of Batang Bayang In Pesisir Selatan Regency, Batang Lembang and Batang Kuantan in Sijunjung Regency, and Batang Lembang, i).Data of Batang Bayang River Basin, Batang Sukam and Batang Kuantan,j).Topographic and Geological Map of Batang Bayang Watershed Area, Batang Lembang, and Batang Kuantan. These maps are on a mapping scale of 1: 50,000, k).. Hydrogeology Map of Batang Bayang Watershed Area, Batang Lembang and Batang Kuantan,l). Map of Electrical Service Area of West Sumatra, Kab. Pesisir Selatan and Kab. Sijunjung,m. Related studies/studies that have been done.

Primary data collection is done through observation, observation and measurement of location/planning area (Batang Bayang in South Coastal District, Batang Lembang in Solok and Batang Kuantan Regencies in Sijunjung Regency). The primary survey data comes with documentation. In this primary data collection will be done Measurement of the planning area. Measurements made using modern equipment such as GPS, Theodolite and other perceived tools will help the field survey process.

1) Preliminary Survey

The preliminary survey was conducted to determine the initial location as a prospective location for the construction of the MHP. The target data sought in the form: a). Data and Maps of Study Areas, b). Location Planning Position Data, c). Accessibility,d). Characteristics of the River such as River straightness, River Materials, River Sedimentation, Watershed, and River normalization.

2) Selected Site Survey

The selected location survey is a follow-up survey of the PLTM development plan, the survey of

the selected locations is conducted on the location chosen for the implementation and in-depth assessment of the MHP. The survey conducted in the form, as: a).Measurement of river conditions, like as Potential water and its quantity (water discharge), Height of rainfall, Climate change, High waterfall and can be used (head) and Speed, b). Land use around river area, c). Geological conditions like as; Land movement due to rain, Movement of the earth due to the earthquake, Soil types and rocks, d). Land status, e). Availability of power grid, f). Social impact like as; Technical Operations and Environment, and g). Community Response.

3. Stages of Identification, Compilation and Data Analysis

To know the condition of the planning watershed area (Batang Bayang, Batang Lembang, and Batang Kuantan), we must first know the general description of the area in general (macro) ie Sijunjung, Solok and Pesisir Selatan. Analytical methods used are quantitative analysis and qualitative analysis. Qualitative analysis was conducted on feasibility analysis of hydroelectric development in Sijunjung, Solok and Pesisir Selatan districts.

4. Stages of the Feasibility Plan Formulation

The phase of the feasibility plan for the Hydro Power Plant (Mini Hydro) refers to the results of previous analyzes. In this stage, a feasibility plan for hydro power plant (Mini Hydro) development will be formulated at the Selected Location, which will function as one of the suppliers of electricity needs for West Sumatera Province.

LOCATION SELECTION ANALYSIS

a.Alternative Candidate Location of PLTM

In the preparation of Investment Feasibility Study of Hydro Power Plant (Mini Hydro) has been limited to 3 candidates in 3 regencies: Batang Bayang River is located in Pesisir Selatan Regency, b) Batang Kuantan River in Sijunjung Regency, c) Batang River Sumani Hulu in Solok District.

b.Election Of PLTM Location

Mini Hydro Power Plant works by altering the kinetic energy of the water when it flows down to rotate the coupled turbine with the generator as a Power Plant. In order to obtain sufficient water level at a short flow distance, a Dam is created. Water is directed to a rapid pipe that leads to the turbine to turn the turbine, rotate the electric generator, to generate electricity. Some important aspects of the development of Mini Hydro Power Plant (PLTM) related to Water Resources are Climate and Rainfall, Watershed, Evapotranspiration, Available water debit and Head.In addition to aspects related to water resources itself, there are also non-technical aspects that are not less important, namely:

1. The principle of location usage principle (in some location of prospective PLTM, permit principle of location usage already owned by another developer).
2. The proximity of location of prospective PLTM with the nearest power grid
3. Utilization of the river for other activities.

Based on the above aspects, it can be prepared the criteria needed to select one location from three candidates for the location of the development of the MHP. For the determination of the selected location, we use the scoring method (weighting), the weight of 1 (one) for the lowest criteria up to 4 (four) weights for the best criteria. Here are the criteria and scores for each of the criteria:

Tabel.1 Site Selection Criteria

No.	Criteria	Scoring			
		1	2	3	4
1	Whether the location status (principle permit) is already owned	80% - 100% of locations already have a principle license	60% - 80% have a principle license	40% - 60% have a principle license	0% - 40% have a principle license
2	Location distance from the nearest power grid	>5 KM	3-5 KM	1-3 KM	<1 KM
3	as the river been utilized for other activities	mine	PLTM (H) & Irrigation is simple	Permanent irrigation	untapped
4	Accessibility to location	Far and difficult to achieve	Close but the terrain is difficult	Far away but easy access	Close and easy access
5	Water discharge	Very small	small	medium	Very large
6	Climate and rainfall	Very small	low	medium	large
7	Watershed	Damaged	broken	good	Very well
8	Head	Very low	low	medium	Very large

Based on the criteria and the results of the site survey, the findings in the field in three candidates are as follows (see table 2 below):

Tabel 2.Scoring of location assessments

No.	Criteria	Sungai Batang Bayang (Painan)	Sungai Batang Kuantan (Sijunjung)	Sungai Batang Sumanik (Solok)
1	Whether the location status has been owned by another party	2	4	4
2	Distance location from the nearest electrical network	3	3	4
3	Has the river been utilized for other activities	2	1	3
4	Accessibility to location	2	2	4
5	Water discharge is available	4	2	3
6	Climate and rainfall	4	4	4
7	Watershed	2	1	3
8	Head	3	1	4
	Total weight	***22***	***18***	***29***

The result of weighting above Sumani river has the highest score of 29 points, followed by the river shadow stem with a score of 22 points and the lowest rivers of Kuantan with 18 points score. From the results of scoring analysis above can be concluded that the ideal location for development is Batang Sumani Hulu River with a score of 29 points. So that the follow up of this location selection is done further study on Sumatera upstream rods in the form of field measurement using theodolite, instantaneous debit measurement using the current meter and manual discharge data and feasibility study on Sumani rivers. Meanwhile, the results of field surveys conducted on the stem rivers Sumani in Solok District showed the following results:

1. Location of Batang Sumanik river still not developed professionally for PLTM (H). This location is still pure and can be used as the location of PLTM.
2. Distance location with power grid is close enough, estimated less than 1KM.
3. Sumanik Batang River has been utilized for permanent irrigation. Approximately 1.2 KM from the location of the planned PLTM (in the upper river) has been built permanent irrigation, and the construction of this MHP does not interfere with the irrigation, because the PLTM is downstream.
4. The location point of the PLTM is located in the city development area, close to public facilities, access to the location is quite easy. About 0.5 km from the public road to the location.
5. While the available medium water discharge. Compared to Batang Bayang River, this river has a smaller discharge, but the water discharge is sufficient for the development of micro power plants with a capacity of 100KW - 1MW.

Calculation of turbine generated power based on a calculation of empires from the head and debit technical data as in table 3 below.

Table 3. Turbine Generated Power

Technical data			
Head			
	Available head	29	m
	Head Loss	1.3	m
	Head Net	27.7	m
Turbin			
	Design Flow	5.41	M^3/s
	Head Net	27.73	m
	Power output	1176	kW
	Turbin Type	francis	
	Turbin Speed	500	rpm
	Specific Flow	93	rpm
	Runner diameter	0.4	m

Turbine power calculation results in the above table are 1176 kW then the generator output power can be completed as follows:

$$P_{outgenerator} = P_t.\pi_{transmisi}.\pi_{geneator}$$

It is planned that the efficiency of transmission and efficiency of generator 95% and 90% so that the generator output power is as follows;

$$P_{out\ generator} = 1176\ kW.0{,}95.0{,}90 = 1\ MW$$

Assume power factor = 0.8, then kVA generator can be determined as follows namely

$$kVA_{(generator)} = \frac{1000\ kW}{0.8} = 1250\ kVA$$

3. CONCLUSION

From the results of the discussion that the location used as the location of Hydro Power Plant (Mini Hydro) is located in Kanagarian Koto Gaek Solok District, precisely located on the River Batang Sumani Hulu. In conducting an analysis of the feasibility of investments to the Hydro Power Plant which is the indicator of its feasibility consists of technical feasibility (site selection for civil building facilities, availability of water debit, civil facility planning, mechanical electrical facilities planning), economic and financial feasibility, feasibility towards social culture, and environmental feasibility. From the results of field, calculations obtained that the location of Upper Batang Sumani River obtained the actual head of 29 meters.While the parameters

which are also the main consideration is the discharge of the instantaneous discharge at upstream rivers Sumani rivers carried out the data of debit obtained measurable discharge 15.44 m3/s.

From the result of physical analysis to civil building that it got :

1. The location for the intake channel is at coordinates 00.56,40.6 LS and 100.36.25.3 BT where the irrigation dam is located which was established during the Dutch colonial period with the width of the weir 50 m with the height of the weir of approximately 1.2 m from the bottom of the river.
2. The length of the conductor channel after field carrying along 1150 to the tranquilizer with the cross section is planned to be a trapezium-shaped open channel with a slope of 1: 0,5 using stone pairs.
3. A tranquilizer is a planned building to reduce turbine flow before the flow into the penstock, the tranquilizer also serves as the final filter before the water enters the pipe and eventually enters the turbine.
4. Pipe rapid (penstock) is a pipe that serves to drain the water from the sedative pond to the turbine, the size of the pipe is planned to have a diameter of 2 m, with a length of 182 m.
5. Water power generated turbine 1176 kW and generator power 1 MW or kVA generator 1250 Kva

4. REFERENCES

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