Identification of development of feasibility assessment for community based water power plant

Suryadimal[1*],Ganefri[2], Ambiyar[3], Nizwardi Jalinus[4],Fahmi Rizal[5],Yeasy Darmayanti[6]

[1]Department of Mechanical Engineering, Faculty of Industrial Technology, Universitas Bung Hatta Padang, Indonesia
[1]Phd Engineering Student, Faculty Engineering, Universitas Negeri Padang, Indonesia
[2]Department of Electrical Engineering, Faculty Engineering, Universitas Negeri Padang, Indonesia
[3,4]Department of Mechanical Engineering, Faculty Engineering, Universitas Negeri Padang, Indonesia
[5]Department of Civil Engineering, Faculty Engineering, Universitas Negeri Padang, Indonesia
[6]Department of Accountancy, Faculty Bisnis and Economic, Universitas Bung Hatta Padang, Indonesia

*suryadimal@bunghatta.ac.id

Abstract. This study aims to identify technical and non-technical aspects in developing the feasibility assessment of community-based hydropower.The technical aspects consist of the aspects of Hydrology, Civil and Mechanical Electrical and non-technical aspects influenced by economic, socio-cultural and environmental aspects. In identifying the two aspects above exploration of Borg and Gall theory, and related studies in the feasibility assessment commonly used by a team of experts and technical consultants and government standards.The feasibility assessment is strongly influenced by 43.24% of technical and non-technical aspects, the relationship between hydraulics and economic aspects ranges 32.43%, and the influence of social and environmental aspects by 24.32%

1. Introduction

Electricity consumption has increased directly proportional to the level of economic progress of the national community. Based on the Indonesia Energy Outlook & Statistics 2004 (RUKN 2004-2013) the electrification ratio in Indonesia in 2003 reached 54.8% and in 2013 to 75%. At present the achievement of electrification has increased to 94.83% while the growth of energy which refers to the average electricity demand accumulation 172 GW RUKN periodization in 2010-2030.According to Adhitya Himawan and the Government through the Ministry of Energy said that now there are many power plants that ineffective. According to the Expert Staff of the Minister of Energy and Mineral

Resources Tri Mumpuni ineffectiveness is not due to the contractor or infrastructure that does not exist, but because the people who have not been prepared to run the technology.

Internationally agreed upon the distribution of capacity of Small Scale Hydropower (SSH), however most production varies from 2.5 MW to 25 MW. According to the European Commission the production of SSH is less than 10 MW. Mini Hydropower refers to production under 2 MW, Micro Hydro refers to the production of power below 500 kW and Pico Hydro refers to the production of power below 10 kW [1]. According to Williams and Simpson [2] Pico-Hydro scheme is a cost-effective option for off-grid areas [3]. Small Scale Hydropower (SSH) hydroelectric energy scale is an option especially in small and remote areas. The development of small-scale hydropower is a topic of interest throughout the world [4].

Hydroelectric power is one of the most commonly used renewable energy sources as an energy source. Small Scale Hydropower (SSH) is the choice for hydroelectric power plants, especially in small and remote areas. Compared to other renewable energy sources the advantages of hydroelectric power plants are more reliable, economical, efficient, low maintenance costs and large energy generation capacity. Scale Hydropower is an issue of effective renewable energy sources in rural India because it takes into account environmental impacts that are sustainable, green, friendly and long-term [5].

The level of economic growth that has a large impact on the increase in energy demand. More and more private companies invest in hydroelectric power, the energy market will be privatized from the investment in the previous year. [6] Turkey is a country whose supply and demand for electricity is very high. power plant 5.7% per year. Crucial issues that develop that the investment decision for a new power plant depends on the scale, type of power plant and who has ownership. To get the best power plant is based on aspects of power plant efficiency on economic value [7].

Hydro power plants that are built or developed with the primary purpose of measuring the economic value of a nation. However, from the context of relevance to policies can reduce negative externalities such as the environmental impact of hydropower facilities. In fact, the public's willingness to pay for externality compensation is very low [8].The assessment of power plant locations under construction is carried out with high accuracy such as analysis of project costs, level of experience and expertise. Other main emphasis such as the scale of generating resources, Then how to identify potential locations and evaluate energy output and environmental studies before continuing the feasibility study [9]. However, for the feasibility assessment requires a field survey, needs analysis and pre FS [10] so that developers can make decisions for the confidence of the project implementation.

Stable economic growth amid the global crisis shows Indonesia is prospective to be more advanced, but the main obstacle is the lack of power output of the plant which is characterized by low electrification rates, low consumption, and high transmission and distribution inefficiencies.Hydro Power Plants are affected by discharge and profile rivers and the lack of river discharge data and information have become obstacles in the development of hydropower energy sources [11].

2. Literatur Review

Feasibility study is a procedure for predicting the results of investigative investigations or assessing the Feasibility Study scheme allowing proper investigation and evaluation of each production or important requirements for starting a project.The feasibility study is important for evaluating each proposed project as feasible or not. Factor factors considered in the development stage eligibility is considered as an important step for investors or organizations to ensure that the project is formally feasible, profitable for the organization and beneficial for the community [12].Because the population is very large and there is growing economic activity, electricity demand is increasing too, so hydro power plants such as waterfalls are the first renewable source used to produce electricity. Almost 21.7% of electricity production worldwide is contributed by renewable energy [13].

One important aspect in a plant feasibility analysis is the hydrological analysis needed to estimate the duration of fluid flow.The main output is the flow duration curve where the FDC is a tool used for the initial study of hydroelectric power capacity.The flow duration curve includes data which consists of; rainfall, evapotranspiration, and runoff mechanism.Before the Feasibility process is carried out, the initial stage is carried out pre FS assessment so that potential can be predicted such as flow capacity [14].

A comprehensive evaluation framework that is very important to ensure the level of sustainability in assessing various aspects such as water supply, demand management, economic aspects, social risks, environment collectively presents a set of information to support it.Various institutional and political challenges must be faced during the appraisal of a power plant project.Renewable energy must be developed and become attractive to public or private sector investors.Conduct reliable preliminary evaluations of SHP installations so that they can use well-received financial indexes and enter into SHP installation calculations [15] [16] [17].

South Korea is one of the main energy producing countries in the world that has promoted national development strategies for green and sustainable economic growth.While there is a lot of potential energy for the use of waste heat as an energy supply.A number of countries have reassessed their generating capacity based on spastial water information, water catchment areas, the development of tools for automatic hydro identification. and energy output and environmental conditions [18] [19].

The assessment of the environmental impacts associated with hydroelectric power between 1990-2016 can be divided into four main attributes namely; flora, fauna, landscape and the rest of Flora's history. Each hydroelectric power plant has specific characteristics so the need to consider impacts is also different [20].Estimates of the accuracy of the availability of resources such as water discharge are important components for generating capacity and environmental protection To estimate the feasibility of generating energy, the costs and budget allocations needed are technically unfeasible, but are potentially commercially viable, and can bring benefits to the community and other benefits [21].

Nigeria faces the biggest electricity supply shortages.While around two thirds of Nigeria's territory is located in a watershed namely; Niger River, Benue River and its tributaries.Rural communities in Nigeria are near river currents. Nigeria's hydro potential is high but underutilized.Many obstacles have limited the development of small hydro and the absence of a comprehensive national inventory of the location of hydroelectric power plants [22].

In 2005 in Brazil 83.4% of the electricity generated 76.06% of the installed power came from hydroelectric power plants.The potential of large hydroelectric power plants is due to the presence of hills and mountains with varying heights between 200 and 1000m.While the level of utilization electricity is only 27.24%.In North Brazil, due to small population, low industrialization rates and the cost of installing large transmission and distribution systems due to the long distance between hydroelectric power plants and customers, the potential utilization rate of hydroelectric power plants is small compared to Brazil's territory other.Relief Brazil is composed by small mountains and plateaus, so that it contributes to the formation of rivers with a high amount of waterfalls. Dams must be formed to focus water while anticipating environmental and social impacts [23].

Water resources are very important in generating economic planning.Implement river hydrodynamic modeling to estimate the speed, depth of the river, estimate the hydrokinetic potential of the location and contribute to understanding the potential impact of the power generation method. largest for power plants [24].

Based on the US Department of Energy, a comprehensive assessment to obtain potential sources using the US Gelogical Survey (USGS) and Geographic Information System (GIS) according to. Energy feasibility study by GHD Pty Ltd in Sarawak with selected location candidates is conducted before the feasibility is pre-installed. the first feasibility is obtained the potential of the location identified based on mapping, aerial photographs and earth maps. Secondly economic evaluation of locations with water source level, hydrological aspects and sedimentation such as catchment areas. Then Geological aspects are carried out to see the safety of dams or dams [25].

Various problems arise in the evaluation of small-scale power plant projects.It starts with simple physical measurement problems, calculation of hydraulic losses, regarding pipe material and water velocity. There are two main approaches which are based on the flow duration curve (fdc) and the streamflow simulation method (ssf).The SSF approach uses recorded discharge data which is then synthesized by time series analysis using weather and topographic data. Instead the FDC method uses catchment area characteristics such as rainfall areas [26].Before deciding on the choice of any energy project, a strong assessment must be made of the impacts social and environmental economics [27].

Hydroelectric production produces several environmental impacts. Environmental impacts also depend very much on specific characteristics. Fauna and flora conditions experience the most frequent impacts due to plant construction including coastal erosion induced by dams.Assessment based on Multi-Criteria Decision-Making Analysis in terms of low investment costs, small greenhouse gas emissions, and High output efficiency for power plant performance is a key factor in evaluating energy parameters [28] [29].

A hydroelectric power plant development assessment must be appropriate and refer to sustainable engineering, design and implementation planning according to the International Hydropower Association's (IHA).According to the EIA (Environmental Impact Assessment) it is necessary to review the EIA ensuring that hydroelectric projects do not damage the environment.Professionals must involved and use their experience in combining good techniques with environmental understanding. The sustainability of the plant is influenced by several factors, namely risk factors and political approvals, additional economic benefits, planned operational efficiency and reliability, site selection and design optimization, community and stakeholder consultation and support , Cultural heritage, Environmental Impact Analysis and management systems, Land management and rehabilitation and Environmental flow and reservoir management [30].

Microhydro energy generators are more efficient than renewable energy sources such as wind or sun. Solar cells are only able to convert 10-20% of electrical energy while micro hydro has 60% to 90% efficiency.Economic analysis varies depending on the position and capacity of energy generation. The total operational costs per microhydro kwh range around 670 $ / kWh.Investment returns 1-6 years for micro hydro, 8-13 years wind turbines, 18-21 years for solar power [31].

CDM is an interesting mechanism to direct the development of HR.Internationally CDM is financed and projects in developed countries have specific guidelines (legislation) especially for the planning stage, they proceed through an intense process with several public consultations.CDM must continue several steps in the future, so that sustainable project development is guaranteed [32].

Hydrologically, it is very important to estimate information from water capacity data using tools or hydrological modeling that together utilize sensors and geospatial technologies such as systematic geographic information (GIS) and Soil and Water Assessment Tool (SWAT).Assess the potential of plants in the smallest areas, the location is located in the mountains, and complex hydrological phenomena that become obstacles to the development of smal hydropower [33].

The approach methods used to assess the feasibility plan of the Renewable Energy generating system are several such as triangular fuzzy numbers (TFNs), analytic hierarchy process (AHP), data envelopment analysis (DEA), and Models (Rham) that use Geographic Information Systems with computational models for connects geographical location.AHP is a simple and flexible decision-making method for handling qualitative and quantitative assessments from aspects of technical analysis, environmental, and socio-economic impact.This method integrates all decisions with structured links. A techno economic feasibility analysis model is needed for the best assessment local conditions, needs and resources in evaluating the optimal size of the economy (turbine), nominal power generated from small hydroelectric power plants.This model estimates the design of the main hydro and civil components [34] [35] [36] [37].

3. Research Methodology

The research step is based online in gathering information on the aspects involved and identifying the publication of feasibility assessments of community-based hydropower from 1998 to 2018 using the Borg and Gall method stages.Population in this study are all written documents regarding feasibility assessment research hydroelectric power.The research sample was taken using purposive sampling technique.The results of identification from the research literature are based on preliminary studies from e-databases of 105 articles and then filter the titles and abstracts with study variables that focus on the Feasibility Study Assessment and Community-Based Hydro Power Plant Feasibility Assessment.Found 37 articles that discuss the issue of Feasibility Assessment implications in the field of community-based hydropower.

4. Results and Discussion

Research on the feasibility study and the appraisal of the hydro power plant have obtained 105 related articles, but found only 37 articles that are very relevant based on the purpose of the study.The researches were obtained from various sources, namely: research results and research reports.Analysis based on the research objectives that have been obtained from the appraisal of plant feasibility based on technical and non-technical factors can be seen from the following table 1:

Table 1.Feasibility assessment based on technical and non-technical aspects

Aspects	Frequency	Percentage
Impact of technical and non-technical aspects	16	43,24
Relationship between hydraulics and economical aspects	12	32,43
Influence of social and environmental aspects	9	24,32

- From the review of the results of the study in general, it was obtained that some data in the assessment of the feasibility of technical and non-technical aspects of 43.24% was to ascertain whether technically, certain technological choices or in the business plan could be implemented properly meeting the elements of feasibility both during project construction and operational relations.
- The main aspects of hydraulics and economics are around 32.43% because the most important thing to plan well is the availability of the amount of water in a certain period whether the flow capacity and the source are sufficient to turn the turbine wheel so that the continuity of the energy produced can produce benefits in the long run long.
- If technically feasible for investment in a power plant but in certain areas it is necessary to ensure social and environmental feasibility because the investment in a power plant requires large funds. The influence of social and environmental aspects ranges from 24.32%.
- Some developed countries in the feasibility assessment of a hydropower plant conduct a very rigorous analysis such as first carrying out potential sources by utilizing digital technology using satellites considering potential areas are within forest areas so that the available flow capacity, differences in height from sea level are directly measured and then just proceed with a field survey of primary data that has been obtained previously and other technical data that are measured or processed based on secondary data that already exists at the relevant agencies.

5. Conclusion

Based on the results of this research and discussion, it can be concluded that the feasibility assessment on the community-based hydropower system is influenced by the consideration of several aspects including technical aspects consisting of hydrological aspects, flow capacity, height difference, civil. Then the non-technical aspects such as economic, environmental and social aspects. Both aspects play a major role in making sound or inappropriate decisions about community-based investments. The results of the study illustrate that the feasibility assessment is influenced by 43.24% of the technical

and non-technical aspects, the relationship between the main aspects of hydraulics and economics is around 32.43% and the influence of social and environmental aspects is 24.32%.

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