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Efficiency And Effectiveness Performances Of Hydro-Powered Water Pump (Path) Technology Application

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ABSTRACT

This research aims to analyze the effectiveness and efficiency performance of the implementation of Hydro Water Pump technology in Wonokerso Village, Temanggung Regency. This research uses a qualitative method with a case study approach. Primary data was obtained through Focus Group Discussions and interviews with stakeholders, while secondary data was obtained from related documents. Effectiveness performance analysis was conducted using the Social Return on Investment method to measure the social, economic, and environmental impacts of PATH technology implementation, while efficiency performance was measured by comparing the outputs produced with the inputs used. The results showed that the effectiveness performance of PATH technology implementation in Wonokerso Village improved farmers' welfare by increasing the planting period from twice to three times a year, increasing the spirit of mutual cooperation and harmony among farmers and maintaining air cleanliness because it was able to provide irrigation water with non-oil fueled water pump technology. Thus, this program can be said to be effective so that it can be implemented further. Therefore, this study concludes that the application of PATH technology in Wonokerso Village is efficient and effective, so it can be implemented further.

INTRODUCTION

Performance measurement in the public sector is crucial for ensuring accountability and transparency in the use of public funds. This measurement can be conducted by examining two main aspects: effectiveness and efficiency. Efficiency refers to doing things in the right way and considering the available resources. Effectiveness, on the other hand, refers to the success of achieving the predetermined outputs (Sundqvist et al., 2014). Efficiency measures the extent to which outputs are produced with a given level of input, while effectiveness focuses on achieving predetermined goals (Ferreira & Marques, 2021).

Effectiveness and efficiency are indeed crucial elements of Value for Money (VfM (Aulia & Nugraheni, 2022). VfM is a tool used to assess the costs and benefits of investments in public sector projects (Kiiza & Ngaka, 2023). Effectiveness and efficiency performance measurement uses input, output and outcome indicators. Inputs refer to the resources used in the production process or in the implementation of a project or activity. Outputs are the direct results of using inputs in the production process or activity. Outcome refers to the impact or change that occurs as a result of the output.

Comparing the inputs or resources used with the outputs or results achieved is a way to measure efficiency. Efficiency involves using resources to achieve a specific outcome. The use of

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resources in public sector organizations includes time, labor, and capital economically to produce a good or service. Measuring the efficiency of project implementation is done by comparing the budget realization with the budget ceiling (Welde & Volden, 2022). An activity is said to be efficient if it uses the least amount of resources possible to achieve its goals (Rumagit et al., 2022).

Performance efficiency measurement in the public sector is closely related to New Public Management (NPM) Theory. NPM Theory emphasizes improving the quality and reducing the cost of public sector service delivery. NPM Theory introduces a performance-based budgeting scheme that links the amount of resources allocated to an agency with performance indicators (Agasisti et al., 2022). Allocated resources are inputs, while performance indicators are outputs.

Effectiveness performance measurement is the relationship between outcomes and outputs (Manimbaga et al., 2021). Outputs are the direct results of activities or processes carried out by the organization, while outcomes refer to the changes or benefits that occur as a result of the outputs. This measurement allows the organization to assess its success in achieving its goals and strategic objectives, as well as the extent to which resources are used. An organization can be said to be effective if the output makes a greater contribution to the achievement of the organization's goals and strategic objectives.

In effectiveness performance measurement, Social Return on Investment (SROI) analysis is a commonly used tool. SROI is a method for measuring the social impact of a project or program in the public sector by identifying, measuring, and evaluating the results of social change and linking them to financial value. Analyzing the social, environmental, and economic impacts and converting them into financial value can help organizations understand and manage the social, environmental, and economic benefits of a program or activity more comprehensively (Lawlor et al., 2008).

SROI has a logical framework called the Theory of Change (TOC), which transforms inputs and outputs into outcomes and impacts for stakeholders (Lawlor et al., 2008). The use of the Theory of Change in this research does not only measure effectiveness at the outcome level but also at the impact level. Impact is the long-term and significant change resulting from a series of activities or interventions of a program or activity.

A previous study conducted by Veronica (2020) employed SROI analysis to measure the effectiveness performance of the CSR Micro Hydro Power Plant program at PT. PJB UP Paiton in Andungbiru Village, Probolinggo Regency, using Social Return on Investment (SROI) analysis. The findings revealed that the program has successfully provided benefits and empowered the community both economically and socially, while also preserving the environment.

Khadlirin et al. (2021) conducted a study aimed at analyzing the level of effectiveness and efficiency of Village Fund management in Tegalarum Village, Mranggen District, Demak Regency. The results of the study showed that the average level of efficiency of Village Fund management in Tegalarum Village, Mranggen District, Demak Regency met the efficiency criteria, and the average level of effectiveness fell into the effective category.

Hermansyah (2023) conducted research on the Sekar Arum Domestic Wastewater Management System (SPALD) in Malang City using SROI analysis. The results showed that the SPALD Sekar Arum effectively had a positive impact on the community, both from social, economic, and environmental aspects.

Previous research has indicated that performance measurement of the effectiveness and efficiency of public sector infrastructure development is still lacking. Performance measurement is often limited to the use of input, output, and outcome indicators. SROI (Social Return on Investment) offers a more comprehensive approach to measuring effectiveness by incorporating impact indicators into the evaluation process. However, SROI is typically used solely to assess effectiveness, while efficiency measurement is not explicitly addressed in SROI studies. Therefore, this research aims to not only measure effectiveness using SROI analysis but also to evaluate efficiency using input and output indicators.

This research was conducted at the Ministry of Public Works and Housing (PUPR), a public sector organization. One of the main tasks of the PUPR Ministry is to develop infrastructure in Indonesia by utilizing various technologies (Sudja'i & Mardikaningsih, 2021). Infrastructure development requires performance measurement to assess the effectiveness and efficiency of the constructed infrastructure. Performance measurement is crucial to evaluate the success of the public sector organization in achieving its mission of providing public goods and services (Putri et al., 2020).

The implementation of Hydropower Pump (PATH) technology is an innovation developed by the Ministry of PUPR for water resource management. This technology aims to raise water to locations higher than the water source by utilizing water energy (Praja et al., 2019). PATH allows the kinetic energy of river water or other water flows to be used to drive water pumps, which can then be used for various purposes such as agricultural irrigation, drinking water supply, and household needs in industries. This technology has the potential to increase water and energy efficiency, reduce environmental impacts, and improve community access to quality water. So far, there has been limited research and application of SROI as a research methodology (Anam et al., 2022), therefore this research is very important to fill the gap in knowledge and understanding of the social impact of implementing this technology.

Water pumps powered by diesel or fossil fuels are expensive, wasteful, and inefficien (Atthoriq et al., 2022). Therefore, it is crucial to optimize technological innovations to reduce these high costs. PATH utilizes hydropower (water) as its primary energy source, eliminating the need for fossil fuels or diesel to drive the turbines.

SROI analysis provides a deeper understanding of the social benefits generated by the PATH project, enabling stakeholders, governments, and financial institutions to make more informed decisions in planning, implementing, and developing similar projects in the future. SROI analysis is considered a valuable tool for evaluating the economic value of innovative social projects. It can be used both to estimate the value of implemented social projects and to forecast the return on investment in future social innovations (Moroń & Klimowicz, 2021). By applying SROI to the implementation of PATH, this research will provide deeper insights into the project's success in achieving its social, economic, and environmental goals.

The Ministry of PUPR has implemented PATH technology in several regions, including Temanggung, Magelang, Pacitan, Banten, Lampung, and Humbang Hasundutan. The research location was chosen in Wonokerso Village, Temanggung Regency, as it is the site of the pilot project for PATH technology implementation within the Ministry of PUPR. Serving as a pilot project, Wonokerso Village can serve as a benchmark for the successful implementation of similar technologies in other locations

The implementation of PATH technology, which provides raw water for irrigation in Wonokerso Village, Temanggung Regency, is crucial. Assessing the social value impact of government infrastructure projects funded by the State Budget (APBN) is essential to fulfill the government's responsibility to its citizens. It demonstrates that the constructed projects hold social value and contribute to the well-being of the broader community. The novelty in this research compared to similar studies is that in addition to measuring the development performance of an infrastructure project in terms of effectiveness through the SROI analysis method with Theory of Change, it also measures efficiency using New Public Management theory.

Drawing on the context presented earlier, this research establishes two key objectives. The first objective involves analyzing the efficiency of implementing this technology. Here, the focus will be on how effectively resources are used to achieve the desired outcomes with the Hydropower Water Pump. The second technologyobjective is to analyze the effectiveness of implementing Hydro-powered Water Pump technology. This analysis will delve into how well the technology achieves its intended results.

The results of this study can provide an explanation of the performance of efficiency and effectiveness of PATH technology implementation in terms of social, economic and environmental aspects. This is expected to support the Theory of Change (ToC) and the theory of New Public Management (NPM). In addition, this study contributes as a reference material for further research relevant to this study. The practical implication of this research is that it provides benefits to government agencies as an evaluation material for the government regarding social, economic and environmental values in water resources infrastructure development, especially the application of Hydro-Powered Water Pump (PATH) technology.

MATERIALS AND METHODS

This research employs a qualitative research method with a case study approach. The case study is specifically focused on the implementation of PATH technology in Wonokerso Village, Temanggung Regency, utilizing SROI analysis. The technology was handed over to the local government in 2015 and consists of permanent structures with a lifespan of 20 years. The SROI analysis is projected for 2024 to 2034 or 11 (eleven) years. This is because to find out the projected social value from this year until the useful life of the PATH building ends.

The central focus of this research is to analyze the effectiveness of Hydropower Water Pump technology implementation using SROI (Social Return on Investment) methodology, which encompasses social, economic, and environmental impact assessments. The implementation of PATH technology not only addresses water scarcity during the dry season but also generates broader societal benefits, including increased farmer income due to improved crop yields. This research will delve deeper into these broader impacts. Additionally, the study will measure efficiency by comparing outputs and inputs.

Data in qualitative research encompasses non-numerical information that portrays phenomena in the form of text narratives, images, or other objects that cannot be directly quantified. The data in this research comprises interview transcripts, observation notes, documents, field notes, and photographs or videos related to the implementation of PATH technology in Wonokerso Village.

The data used in this research are primary data and secondary data. Primary data was obtained from Focus Group Discussions with stakeholders consisting of Wonokerso Village Government, Gemahripah Farmer Group 1, Gemahripah Farmer Group 2, and PATH Sicandi Operator. In addition, interviews with stakeholders such as informants from the River Engineering Center, Temanggung Regency PUPR Office and other informants who are considered relevant and know information related to this research. In addition, observation in the field was also carried out in collecting primary data. The interview protocol consists of several important components regarding basic information about the interview, introduction, interview content questions with probes, and closing instructions. The interview protocol was developed and used to ask questions and record answers during the qualitative interviews.

Secondary data was obtained from documentation studies such as: (1) Final Report on the Utilization of River Water with the Application of Hydro-Powered Pump Technology of River Hall FY 2014; (2) PATH Operation and Maintenance Report which includes PATH Operation, PATH Periodic Inspection, and PATH Post-Flood Inspection; (3) other documents released through official websites such as the Ministry of PUPR, Central Bureau of Statistics, as well as data from other literature that supports this research.

The data collection techniques used in this study are based on those proposed by Creswell & Creswell (2018:257) for case study research. These techniques typically encompass a wider range of methods, including observation, interviews, document analysis, and audiovisual materials. Interviews themselves can be further classified into one-on-one interviews or Focus Group Discussions (FGDs).

FGD involves a group of participants who are invited to discuss related research with a moderator. FGD participants in this study were the Wonokerso Village Government, Gemahripah Farmer Group 1, Gemahripah Farmer Group 2, and PATH Sicandi Operator. The Wonokerso Village Government as the recipient of the program who attended the FGD was the Hamlet Head. The Farmer Groups selected as FGD participants were only the Gemah Ripah I and II Farmer Groups who were the beneficiaries or Farmer Groups affected by the PATH development in Wonokerso Village. PATH Sicandi operators as program implementers can consist of chairman, secretary, treasurer, and members according to the organizational structure of PATH Sicandi operators.

Researchers may participate in focus group interviews with six to eight respondents from each group (Creswell & Creswell, 2018). The FGD was conducted on May 18, 2024 with a total of 8 (eight) participants consisting of village officials, Gemah Ripah 1 farmer group, Gemah Ripah II farmer group, and PATH operators. The determination of FGD participants used a convenience sampling method in which participants were appointed by the local Village Head or Hamlet Head who was more familiar with the surrounding environment. This was done because the number of beneficiaries was too large to conduct FGDs, so FGD participants were appointed by the Wonokerso Village Government with the criteria that the participants were people who were considered to know the Wonokerso PATH development from the beginning to the present.

The document study was carried out by means of researchers interpreting written documents or other recordings related to the focus of the research. The documents analyzed in this study include: (1) Final Report on the Utilization of River Water with the Application of Hydro Power Pump Technology of River Hall FY 2014; (2) PATH Operation and Maintenance Report which includes PATH Operation, PATH Periodic Inspection, and PATH Post-Flood Inspection; (3) other documents released through official websites such as the Ministry of PUPR, Central Bureau of Statistics, as well as data from other literature that supports this research.

Creswell and Creswell, 2018 said that in ensuring internal validity, there are several strategies used, as follows: (1) riangulation of data sources; Data will be collected through various sources, including interviews, observations, and document analyses. Researchers tested the validity of the data by checking the results of interviews with informants against the results of FGDs conducted with stakeholders. Secondary data obtained is also further reviewed to ensure the validity of the data that has been obtained and (2) Member checking; Informants will serve as checkers during the analysis process. An ongoing dialogue regarding the researcher's interpretation of reality and informants' meanings to ensure the veracity of the data. The researcher conducted an ongoing dialogue with the informants either through face-to-face meetings or communicating through phone lines or WhatsApp. The data validity test used in this research is data source triangulation and member checking. Triangulation of data sources, examines the consistency of different data sources in the same method. While member checking can involve conducting follow-up interviews with participants in the study and providing an opportunity to comment on the findings (Creswell & Creswell, 2018).

In analyzing the data, the author uses the steps mentioned by Miles & Huberman (1992) which mentioning there are three steps that must be taken in analyzing qualitative data, among others: (1) Data reduction; (2) Data presentation (data display); and (3) Conclusion drawing. Analysis of efficiency performance is carried out by calculating the efficiency ratio by connecting the theory of New Public Management. According to Mahmudi (2013) efficiency is the relationship between the output produced and the resources to produce that output. The calculation of the efficiency ratio is formulated as follows:

$$Efficiency\ Ratio = \frac{Output\ generated}{Inputs\ used} x100\%$$

To calculate the social value generated by an intervention, an impact map is created during the SROI analysis. This involves six stages (Hopkins et al., 2023): (1) Establishing scope and identifying stakeholders; (2) Mapping outcomes; (3) Evidencing outcomes and giving them a value; (4) Establishing impact; (5) Calculating SROI; and (6) Reporting, using, and embedding. The result of the drop off value calculation is 20%. The results of these calculations will be used to fill in column 17 'Impact' on the Impact Map. The actual time period of this study is 9 (nine) years. The formula for calculating the impact is:

$$Impact\ Year\ 1 = (quantity\ x\ financial\ proxy\ value) - deadweight - displacement - attribution$$

The SROI calculation ratio can be seen in the following formulation:

$$[SROI\ ratio] = \frac{[Value\ of\ Benefits]}{[Value\ of\ Inputs]}$$

Before calculating the SROI ratio is to calculate the Present Value and then calculate the Net Present Value (NPV). How to calculate the present value using the following formula where "r" represents the discount rate:

$$Present\ Value_t = \frac{Value\ of\ Impact_t}{(1+r)^n}$$

The payback period can illustrate how long it takes for an investment to pay off. The calculation formula is as follows assuming the impact of each year is the same:

$$Payback\ period\ in\ months = \frac{Invesment}{(Annual\ Impact/12)}$$

RESULTS AND DISCUSSION

Efficiency Performance of PATH Technology Implementation

After conducting the SROI analysis to assess the effectiveness of the Hydro-Powered Water Pump, efficiency ratio calculations were also performed. The efficiency ratio calculation is formulated as follows:

$$Efficiency\ Ratio = \frac{Output\ generated}{Inputs\ used} x100\%$$

The output generated represents the budget realization from the implementation of PATH Wonokerso technology. From the analysis of the final activity report, it is known that the achievement of the PATH implementation activities amounted to Rp.1,168,623,940. Meanwhile, the input used was Rp.1,168,656,000. Therefore, the efficiency ratio calculation is as follows:

$$Efficiency\ Ratio = \frac{1.168.623.940}{1.168.656.000} x100\% = 99{,}99\%$$

The above calculation shows an efficiency performance ratio of 99.99% (ninety-nine point nine nine percent). This indicates that the efficiency value of PATH technology implementation is indicative of efficiency.

Effectiveness Performance of Path Technology Implementation

The effectiveness performance of implementing Hydro-Powered Water Pump Technology (PATH) is analyzed using the Social Return on Investment (SROI) analysis. There are six stages in the SROI analysis (Nicholls et al., 2012) as follows: (1) Establishing scope and identifying stakeholders; (2) Mapping outcomes; (3) Evidencing outcomes and giving them a value; (4) Establishing impact; (5) Calculating SROI; and (6) Reporting, using, and embedding.

Establishing scope and identifying stakeholders

The first stage in conducting SROI analysis is establishing scope and identifying stakeholders, which consists of three steps. These steps are: (1) defining the scope; (2) identifying stakeholders; and (3) deciding how to involve stakeholders.

The first step in establishing scope and identifying stakeholders is defining the scope. The scope for the SROI analysis in this study focuses on the implementation of Hydro-Powered Water Pump Technology (PATH) in Wonokerso Village, Tembarak Subdistrict, Temanggung Regency. PATH functions to help address the shortage of raw water during the dry season for irrigation purposes for the residents of Wonokerso Village.

The second step, after clearly defining the scope of the analysis, is identifying stakeholders. In identifying stakeholders, the researcher will list all parties who may influence or be influenced by the implementation of PATH technology. The stakeholder identification process aligns with the Theory of Change, which considers changes in individuals or organizations in a positive or negative direction, whether intended or unintended.

In identifying stakeholders involved in the implementation of PATH technology in Wonokerso Village, the researcher collected data through interviews with employees of the River Engineering Office who were involved in the implementation of PATH technology in Wonokerso Village in 2014. The primary stakeholders identified are as follows:

1) The River Engineering Office as the program contributor.
2) The Government of Wonokerso Village as the provider of the location and coordinator of residents in preparing the site for PATH construction.
3) The PATH Sicandi operator, responsible for managing and maintaining PATH in case of damage.
4) The Gemah Ripah 1 and 2 Farmer Groups, which are the farmer groups affected by the construction of PATH in Wonokerso.

The third step in establishing scope and identifying stakeholders is deciding how to involve stakeholders. It is important to engage primary stakeholders such as the River Engineering Office, the Government of Wonokerso Village, the PATH operator, and the Gemah Ripah 1 and 2 Farmer Groups to understand both the positive and negative impacts of the implemented PATH. The researcher will then detail how to involve the primary stakeholders in the SROI analysis, as outlined in the table below:

Table 1
Key Stakeholder Engagement

No	Stakeholders	Engagement Methods	Information that will be obtained
1	River Technical Center	Interview	Information on inputs, processes, outputs and outcomes. Providing secondary data in the form of reports that support the research. Liaising between researchers and other stakeholders. Provide input and evaluation of the research analysis.
2	Wonokerso Village Government	Interview, FGD	Information on inputs, processes, outputs and outcomes. Provide data and information support related to the implementation of Wonokerso PATH development. Participate in the consultation process and validation of SROI analysis results. Help identify improvement opportunities and recommendations to increase the effectiveness of the impact of Wonokerso PATH technology implementation. Facilitate coordination with other stakeholders for FGD implementation.
3	Sicandi PATH Operator	FGD	Provide information about the roles and responsibilities of PATH Sicandi Operators. Provided information on the operational implementation of Wonokerso PATH. Participate in the consultation process and validation of SROI analysis results. Assisted in identifying improvement opportunities and recommendations to increase the effectiveness of the impact of Wonokerso PATH technology implementation.
4	Gemah Ripah Farmers Group 1 and 2	FGD	Provide information on the impacts and benefits felt as beneficiaries after the construction of Wonokerso PATH. Provide information on the resources expended in the operation and maintenance of Wonokerso PATH. Participate in the consultation and validation process of the SROI analysis results. Help identify improvement opportunities and recommendations to increase the effectiveness of the impact of Wonokerso PATH technology implementation.

No	Stakeholders	Engagement Methods	Information that will be obtained
			Provide input on the sustainability of Wonokerso PATH.

Source: processed data (2024)

Mapping Outcames

The second stage in SROI analysis is mapping outcomes. Creating an impact map is done to detail how the implementation of PATH technology in Wonokerso is analyzed using SROI by connecting inputs, outputs, and outcomes (Nicholls, 2012). The creation of the impact map includes five steps: (1) starting the impact map; (2) identifying inputs; (3) assessing inputs; (4) clarifying outputs; and (5) describing outcomes.

The first step in mapping outcomes is to start with the impact map. This stage begins with completing the top section of the impact map, which provides information about the organization and the scope of the research analysis. The next step is to fill in the first two columns of the impact map, which contain the stakeholders and the desired or undesired changes based on the stakeholder analysis conducted in the previous stage.

The second step in developing the impact map is identifying inputs. Input identification is carried out to determine the stakeholders' contributions to the implementation of PATH construction. These contributions will be recorded as input information in the third column of the impact map.

The third step in this stage is assessing inputs. Input assessment includes financial investments and non-financial contributions, such as voluntary time and in-kind contributions that are not monetized. The results of this input assessment will be documented in the fourth column (Input: Value) of the impact map. Based on information obtained from interviews and document studies, it was found that the financial investment value used in the implementation of PATH technology was Rp. 1,168,659,000.00.

The fourth step in developing the impact map is clarifying outputs. The researcher clarifies the outputs obtained during data collection and records them in the fifth column of the impact map, which is labeled "outputs." Based on statements from informants, it was found that agricultural productivity increased due to the construction of PATH, with the number of harvests per year rising from two to three. The area of affected farmland remained the same at 36 hectares.

The fifth and final step in mapping outcomes is describing the outcomes. When describing outcomes, it is necessary to consider the chain of events resulting from the outputs to illustrate the Theory of Change. The results of this outcome description are recorded in the sixth column (Outcomes) of the SROI Impact Map.

The first output was meeting the need for raw water for irrigation during the dry season, resulting in the outcome of improved farmer welfare. The second output was the increased spirit of cooperation and harmony among farmers. The third output was the reduction in air pollution due to lower carbon emissions, resulting in cleaner air, as PATH uses water energy to drive the turbine and saves on fuel costs.

Evidencing Outcomes and Giving Them a Value

The stage following the mapping of impacts and describing outcomes for stakeholders, which constitutes the third stage in the SROI analysis, is to evidence outcomes and assign them a value. This stage involves four steps: (1) developing outcome indicators; (2) collecting outcome data; (3) determining the duration of the outcomes; and (4) assigning a value to the outcomes.

The first step in evidencing outcomes and assigning them value is to develop outcome indicators. Developing indicators is a way to identify changes that occur as a result of program activities. In SROI analysis, indicators are applied to outcomes and used to measure the changes that occur. Subsequently, the implementation of indicator development is outlined in the Impact Map in column 7, labeled 'Indicators.'

The first outcome following the construction of the PATH Wonokerso is the improvement in farmers' welfare. The indicator of increased farmers' welfare is the rise in farmers' income from the harvests of rice, tobacco, and other vegetable crops. The second outcome is the enhancement of the spirit of mutual cooperation and harmony among farmers. The indicator of this outcome is that since the construction of the PATH, residents no longer need to rent water pumps to plow their fields. The third outcome is the maintenance of air cleanliness. The indicator of this third outcome is the reduction in carbon emissions due to the use of fuel-powered water pumps. Carbon emissions have the potential to cause global warming due to the increasing greenhouse gases (Lestari et al., 2021).

The second step is to collect outcome data. Outcome data can be gathered from existing sources (both internal and external) or by collecting new data. In this study, several indicators were the result of new data collection from focus group discussions (FGDs) with stakeholders. Researchers also conducted benchmarking using external data sources from the Central Statistics Agency, the

Department of Agriculture and Food Security of Temanggung Regency, and other relevant sources. The collected outcome data is then used to continue filling in the Impact Map in column 8, labeled 'Information Source,' and column 9, labeled 'Quantity.' The quantity for each indicator is one (1).

The third step is to determine how long the outcomes will last. Information on the duration of outcomes is obtained through interviews and FGDs with stakeholders. The duration of outcomes will be recorded in the Impact Map in column 10, labeled 'Duration.' In determining the duration of outcomes, one can refer to the Minister of Finance Regulation of the Republic of Indonesia Number 72 of 2023 concerning the Depreciation of Tangible Assets and/or Amortization of Intangible Assets. The PATH Wonokerso buildings and machinery are categorized as permanent buildings and not as group 4 buildings, which have a useful life of 20 (twenty) years (Kementerian Keuangan, 2023).

The fourth step in the third stage of SROI analysis is to assign a value to the outcomes. This process, commonly referred to as monetization, involves assigning a monetary value to outcomes that do not have a market price. If the outcomes cannot be valued financially, assumptions and proxies must be used, based on clear decisions and supported by evidence explaining why those proxies were chosen (Inah et al., 2023). The valuation results for the outcomes are then presented in the Impact Map in column 11, labeled 'Financial Proxies,' column 12, labeled 'Value,' and column 13, labeled 'Source.'

Based on the two tables above, it is evident that there has been an increase in the area of productive rice fields over one year from 72 hectares to 108 hectares. The area planted with rice increased from 64 hectares to 87 hectares. Meanwhile, the area for tobacco cultivation increased from 8 hectares to 10 hectares, and there was an increase in the area of fields for other crops, specifically maize (6 hectares), chili (3 hectares), and tomatoes (2 hectares). Before the program, these other crops were not planted in the fields.

Stakeholders reported during the FGD that the agricultural production of unhusked rice was 4 tons per hectare. The harvest of unhusked rice is partially stored for self-consumption and partially sold in the form of unhusked rice. Stakeholders also reported that the selling price of unhusked rice is approximately Rp.7,400.00 (seven thousand four hundred rupiah) per kilogram.

The second indicator of the first outcome is the increase in farmers' income from tobacco harvests. Tobacco productivity has shown an increase in yields following the construction of PATH Wonokerso. The increase in tobacco harvest yields is 250 kilograms per *kesuk* (shows the measure of time, i.e. from morning) or equivalent to 2.5 tons per hectare. Prior to the program, the harvest yield was 1 ton per kesuk or 10 tons per hectare, which increased to 1.25 tons per kesuk or 12.5 tons per hectare. Additionally, the productive land area planted with tobacco increased by 2 hectares post-construction of PATH. All tobacco production is sold by the farmers. Farmers sell the tobacco harvest as wet leaves freshly picked without prior processing. Researchers used financial proxies to monetize the tobacco harvest yields. Financial proxies were obtained from the Market Information System (SIP) of the Department of Agriculture and Plantation (Distanbun) of Central Java Province. As of December 2023, the highest price for wet tobacco was Rp.6,000.00 (six thousand rupiah) (Distanbun Prov. Jateng, 2024).

The third indicator of the first outcome is the increase in farmers' income from the harvest of secondary crops and other vegetables. Before the construction of PATH, secondary crops and other vegetables were not agricultural commodities in the Sicandi Irrigation Area due to water shortages for irrigation during the dry season. Some additional agricultural commodities include maize, red chili peppers, and tomatoes. The financial proxies used to monetize Outcome 1 Indicator 2 are the same as those for Outcome 1 Indicator 1, obtained from the Market Information System (SIP) of the Department of Agriculture and Plantation (Distanbun) of Central Java Province. The average prices as of December 31, 2023, for these commodities are Rp.5,900.00 (five thousand nine hundred rupiah) for maize, Rp.58,800.00 (fifty-eight thousand eight hundred rupiah) for red chili peppers, and Rp.6,507.00 (six thousand five hundred seven rupiah) for tomatoes (Distanbun Prov. Jateng, 2024).

The second outcome is the increased spirit of mutual cooperation and harmony among farmers as a result of sufficient water availability for irrigation. Before PATH was established, farmers queued to rent water pumps to irrigate their fields during the dry season and prepare their land at the beginning of the rainy season. Thus, within a year and during two harvest seasons, farmers incurred expenses for renting water pumps and purchasing fuel, specifically diesel. The calculation for renting a water pump is Rp.50,000.00 (fifty thousand rupiah) per kesuk or Rp.500,000.00 (five hundred thousand rupiah) per hectare.

The third outcome is the preserved air cleanliness, with its indicator being the reduction in carbon emissions due to the use of fuel-powered water pumps. The combustion process of fuel oil can emit carbon, primarily carbon dioxide (Lestari et al., 2021). PATH has the potential to reduce carbon emissions by replacing diesel-powered water pumps with water-powered pumps. The financial proxy used to monetize the savings in diesel fuel is from the My Pertamina website, where the subsidized price of biodiesel as of January 1, 2024, in Central Java Province is Rp.6,800.00 (six thousand eight hundred rupiah) (My Pertamina, 2024). This price is used to calculate the savings in fuel consumption, with an average usage of 6 (six) liters per kesuk to operate the water pump.

Establishing Impact

The fourth stage in SROI analysis involves constructing impact aimed at reducing the risk of overclaiming. This stage consists of four components: (1) deadweight, which represents changes that occur without intervention, and displacement, where intervention benefits replace existing interventions; (2) attribution, which quantifies changes caused by activities outside the intervention; (3) drop-off, calculating changes sustained beyond 12 months; and (4) calculating impact.

The first part of building impact is determining deadweight and displacement. The results of calculating deadweight and displacement are percentages entered into the Impact Map to adjust previously calculated outcomes. A deadweight of 0% indicates that without PATH Wonokerso, outcomes such as increased farmer welfare, enhanced spirit of mutual cooperation and harmony among residents, and preserved air cleanliness would not be achieved. Similarly, a displacement of 0% shows that the outcomes generated after the construction of PATH Wonokerso do not affect outcomes produced by other programs. This is because the primary livelihood of residents around the Sicandi Irrigation Area is farming, and the main issue is the availability of raw water for irrigation.

The second part of building impact is determining attribution. The calculation approach for attribution is similar to deadweight and displacement, involving reducing outcomes and using percentages to fill the Impact Map. In this study, the attribution is 0%, indicating that no interventions from other programs contribute to achieving outcomes such as increased farmer welfare, enhanced spirit of mutual cooperation and harmony among residents, and preserved air cleanliness. Researchers engaged stakeholders to gather information on other programs that could potentially attribute PATH's program in achieving the established outcomes.

The third part of the impact building stage is to set the drop-off. The drop-off column on the impact map represents the percentage of impacts that persist for more than one year by considering the useful life. The useful life of Wonokerso PATH is categorized as a permanent building and not a group 4 (four) building that has a useful life of 20 (twenty) years (Kementerian Keuangan, 2023). The result of the drop off value calculation is 20%.

The last part of building the impact is to calculate the impact. The results of these calculations will be used to fill in column 17 'Impact' on the Impact Map. The actual time period of this study is 9 (nine) years. The formula for calculating the impact is:

$$Impact\ Year\ 1 = (quantity\ x\ financial\ proxy\ value) - deadweight - displacement - attribution$$

Calculating SROI

The fifth stage in SROI analysis is calculating the SROI. There are five steps in calculating SROI, namely: (1) projecting into the future; (2) calculating present value; (3) computing the ratio; (4) sensitivity analysis; and (5) payback period.

The first step in calculating SROI is projecting into the future. The equation used to project into the future is the impact value minus drop-off. The time period used in this study is nine years, while the lifespan of the PATH Wonokerso building is twenty years. Therefore, the projection calculation starts from year 10 to year 20. Hence, the projection calculation into the future begins from 2024 to 2034.

The second step in calculating SROI is computing the Present Value. The Present Value calculation in this study is conducted over 11 years following the perceived actual lifespan of PATH Wonokerso by the beneficiaries. The actual lifespan is nine years or the year 2023 after PATH was completed. The Present Value calculation in this study uses the following formula:

$$Present\ Value_t = \frac{Value\ of\ Impact_t}{(1+r)^n}$$

The determination of the discount rate is based on the determination of the interest rate set by Bank Indonesia. Based on the publication of Bank Indonesia's official website, it is known that as of December 2023 the social discount rate is 6% (Bank Indonesia, 2024).

The third step of the fifth stage in calculating SROI is calculating the ratio. There are differences in the calculation formula in calculating SROI between actual impact and projected impact. To calculate the actual impact, the calculation formula is:

$$[SROI\ ratio] = \frac{[Value\ of\ Benefits]}{[Value\ of\ Inputs]} = \frac{4.185.049.182}{1.168.659.000} = 3,58$$

SROI ratio comparison of 1:3.58 for actual impact in 2023, which means that every Rp.1,- (one rupiah) invested yields Rp.3.58,- (three point fifty-eight rupiahs).

The fourth step in the fifth stage of SROI analysis is sensitivity analysis. Sensitivity analysis is conducted by changing the estimated outcome gains to produce a social return ratio of 1:1 (Nicholls et al., 2012). Changes in outcomes can occur due to decreases in outcomes resulting from several factors. In the implementation of PATH Wonokerso technology, changes in outcomes can occur due to increased operational costs, crop failure due to bad weather or pest attacks, or major damage to PATH. Therefore, researchers conducted sensitivity analysis with an estimated 80% decrease in outcomes, resulting in the finding that assuming an 80% decrease in outcomes yields an SROI value of 1.4. A value greater than 1 indicates that despite the decrease in outcomes, PATH Wonokerso still provides a positive social return on investment.

The fifth step in the fifth stage of SROI analysis is calculating the payback period. The payback period calculation is performed to determine how long the investment value spent benefits the beneficiaries. The investment is the program input, amounting to Rp.1,168,659,000. The annual impact is the total benefit in the 9th year divided by 9, which is Rp.5,116,842,490 ÷ 9 = Rp.568,538,054. Therefore, the calculation is as follows:

$$Payback\ period\ in\ months = \frac{Invesment}{(Annual\ Impact/12)} = \frac{1.168.659.000}{(568.538.054/12)} = 25$$

From the payback period calculation above, it is determined that the duration of the social return on investment in the implementation of PATH Wonokerso technology is 25 months or 2 years and 1 month. This means that within 2 years and 1 month, the investment spent has already returned in the form of social returns.

Reporting, Using, and Embedding

In the sixth stage of SROI analysis, researchers report their research findings to stakeholders, especially program contributors, regarding the social return value of PATH Wonokerso. The construction of PATH Wonokerso, a pilot project for PATH technology implementation in Indonesia, has evidently provided positive impacts for the affected communities as program beneficiaries. These positive findings can assist organizations in formulating policies or similar programs in the future. The evaluative SROI analysis calculation also aids organizations in determining the direction of sustainable policies.

CONCLUSIONS AND SUGGESTIONS

This study aims to analyze the effectiveness and efficiency performance of the Hydropower Water Pump (PATH) in Wonokerso Village, Tembarak District, Temanggung Regency, Central Java. Effectiveness performance is analyzed using the SROI method to determine the economic, social, and environmental impacts. The results of the study show that the implementation of PATH Wonokerso technology has proven to not only provide social benefits limited to technical aspects in the form of providing infrastructure in the form of fulfilling raw water for irrigation in the dry season covering an area of 36 Ha. However, with the existence of PATH Wonokerso, it has created broader social values, namely improving the quality of life of the community involved or affected by the program.

The calculation of the efficiency ratio shows a figure of 99.99%. According to the efficiency ratio indicator, this indicates that the performance of PATH Wonokerso is efficient. However, in public sector organizations, the size of the budget absorption is also considered in the performance indicator measurement. This is what makes the performance of public sector organizations efficient.

The calculation of the actual SROI ratio shows that every Rp 1 (one rupiah) invested generates Rp 3.58 (three point fifty-eight rupiah) of social value. While the projected SROI ratio shows that every Rp 1 (one rupiah) invested generates Rp 3.88 (three point eighty-eight rupiah) of social value. The positive SROI ratio, both actual and projected, shows that the program is effective and can be further implemented. The benefits generated by the program from an economic perspective are increased farmer welfare, from a social perspective are increased mutual cooperation and harmony among farmers, and from an environmental perspective are maintained air cleanliness as a result of not using fossil fuel-powered water pumps.

The research has three implications, namely from the perspectives of theory, practice, and policy. The theoretical implications of this research are that it can provide an explanation of the changes that occur with the implementation of PATH Wonokerso technology from an economic, social, and environmental perspective based on the theory of change (TOC). This research also contributes to the development of literature, which can be used as a reference for further research related to performance measurement, especially in the public sector.

The practical implications of the results of this research are that they can be used as evaluation material for the Ministry of PUPR as a program contributor. This research can provide a perspective on the greater social value of the construction or improvement of infrastructure functions, especially in the field of water resources, in order to improve the quality of life of the community involved or affected by the program. Thus, it can be a basis for decision-making for organizations, that the program has been effective in accordance with the planned objectives, and provides broader benefits for the community, so that the implementation of the program is worth continuing.

The policy implications of this research are that it can be used as a consideration by the government in perfecting the guidelines for empowering farmer groups related to technical aspects of irrigation management, as well as technical aspects of farming businesses that are directed towards increasing knowledge and skills in the field of farming businesses and food security.

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