JRSSEM 2023, Vol. 03, No. 04, 1019 – 1041
E-ISSN: 2807 - 6311, P-ISSN: 2807 - 6494

# THE EFFECTIVENESS OF SABO DAM MODULAR AS A CLEAN WATER INTAKE WEIR (CASE STUDY OF WORK FOR HUNTAP TONDO RAW WATER PROJECT) IN PALU CITY, CENTRAL SULAWESI

**Eko Prasetyo**[1]
**Erni Yulianti**[2]
**Grace Citra Dewi**[3]
National Institute of Technology, Malang, Indonesia
Email: soetiknoprasetyo9@gmail.com[1], erniyulianti00@gmail.com[2], grace.dewi@ciputra.ac.id[3]
*Correspondence: soetiknoprasetyo9@gmail.com

**Abstract:** This research discusses the topography and geology of Palu City, Central Sulawesi, as well as the condition of the land around the "Works for Huntap Tondo Raw Water" project. The research results show that environmental factors, topography, geology, and soil conditions influence project planning and implementation. Therefore, a deep understanding of these factors is essential in ensuring the success and sustainability of the project. This research shows that the planning and implementation of the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, must pay attention to diverse geographical and geological conditions, soil conditions, and environmental factors in ensuring the success and sustainability of the project. Apart from that, the use of Modular Sabo Dam technology as a clean water intake weir is also an efficient and effective solution in managing the water supply in this project. The involvement of local residents also needs to be considered in project implementation to ensure success and support the surrounding environment. Key words: topography, geology, soil conditions, Sabo Modular Dam, Huntap Tondo Raw Water, local residents.

**Keywords:** Effectiveness of Closed Sabo Dam, Intake Dam, Work for Huntap Tondo Raw Water Project

## INTRODUCTION

Clean water is one of the key components in human life that has a major impact on health and survival. In the context of basic needs, clean water is the main foundation for various human activities, ranging from daily consumption to sanitation needs. The importance of clean water cannot be ignored, given its direct impact on the well-being of individuals and society as a whole.

When discussing clean water, it should be noted that not all regions have adequate access to clean and safe water sources. Some areas, especially those prone to natural disasters such as floods and landslides, often face major

challenges in ensuring a consistent supply of clean water. Natural disasters can damage water supply infrastructure, contaminate water sources, and even destroy clean water supply facilities.

One of the most serious impacts of disruption to clean water supplies is the threat to public health. Lack of access to clean water can lead to an increased risk of infectious diseases, especially water-related diseases such as diarrhea, cholera, and other diseases. In addition, the lack of adequate sanitation can worsen the general public health condition.

Efforts to ensure universal access to clean water involve a number of challenges, especially in areas prone to natural disasters. Significant investment in clean water infrastructure, maintenance of water supply facilities, and development of effective water management systems is required. Capacity building and sustainability of water infrastructure are key in addressing this challenge.

In addition, the need for a holistic approach to water resources management is essential. It involves efforts for water resource conservation, catchment area management, and restoration of the environment associated with water resources. Public education about the wise use of water is also an important factor in ensuring the sustainability of clean water supplies.

International organizations and aid agencies play an important role in providing technical and financial support for clean water projects in areas of need. Cooperation between governments, NGOs, and the private sector is key to achieving the goal of universal access to clean water.

Success in ensuring adequate clean water supplies also depends on the ability to deal with climate change. Climate change can affect rainfall patterns, drought levels, and the frequency of natural disasters, all of which have a direct impact on the availability of clean water.

By understanding the complexity of the challenges involved in providing clean water, the global community needs to commit to finding sustainable and inclusive solutions. This involves the application of innovative technologies, local capacity building, and the formation of policies that support the sustainability of clean water supplies.

In overcoming the challenges of clean water supply and protecting areas that are vulnerable to natural disasters such as floods and landslides, the construction of dams or dams is one effective solution. Dams function to hold the flow of water, regulate water distribution, and reduce the risk of flooding and soil erosion. One of the latest innovations in dam technology is the closed-type Sabodam Modular, which offers a more effective and efficient approach to water management.

The closed-type Sabodam Modular is an evolution of the conventional Sabodam construction. The basic concept of Sabodam is to create a water retaining structure that

can be adapted according to geographical conditions and specific needs in a location. The main advantage of the closed-type Sabodam Modular is its ability to adapt to changes in water flow and environmental conditions.

Closed-type Sabodam Modular technology utilizes modules that can be installed and moved easily. This allows greater flexibility in dam design and customization to suit changing needs over time. These modules are made of strong and durable materials, ensuring the dam's resistance to water pressure and extreme environmental conditions.

In addition to design flexibility, closed-type Sabodam Modular also has advantages in terms of cost and construction time. By utilizing prefabrication technology, modules can be mass-produced and installed quickly on site. This not only reduces overall construction costs but also minimizes the environmental impact that may arise during the building process.

Sustainability is also a major focus in the development of this technology. The closed-type Sabodam Modular is designed to minimize ecological impact by paying attention to aspects such as the use of environmentally friendly materials, reduction of construction waste, and energy efficiency. By combining sustainability principles, this technology not only provides short-term solutions to clean water supply problems, but also supports long-term environmental conservation efforts.

The use of closed type Sabodam Modular can have a positive impact in overcoming the problem of lack of clean water supply and the risk of natural disasters. With this technology, it can be expected that dam construction can be carried out more efficiently, economically, and sustainably. Cooperation between governments, the private sector, and international institutions is needed to encourage the application of this innovative technology in water management projects in different parts of the world. Through innovative measures such as the closed-type Sabodam Modular, we can maintain the availability of clean water for the community while protecting the natural environment in a sustainable manner.

The closed-type modular sabodam, as an innovation in dam technology, provides significant advantages in terms of design, flexibility, concrete quality, and construction speed. Here are some of the main advantages of closed-type modular Sabodam:

1. **Design According to Technical Standards:** Closed-type modular sabodam is designed in accordance with applicable technical standards, including SNI 03-2851-2015 concerning Engineering Planning of Sediment Retaining Weirs. This guarantees that the dam design meets the safety, sustainability and technical performance requirements set by the relevant authorities.
2. **Feasible and Transportable:** The Sabodam module design allows customization to the specific

conditions of each site. The module's ability to be moved easily allows efficient adjustment of the dam structure to changes in water flow and environmental conditions.

3. **Variation of Concrete Quality:** Closed type modular Sabodam provides flexibility in selecting concrete quality according to needs. Variations in concrete quality between K350-K600 allow adjustment to the loads and stresses faced by dams, increasing their resistance to water pressure and environmental influences.
4. **Use of Fiber Concrete:** The use of fiber concrete as an apron floor blanket on Sabodam increases its resistance to impact forces. This is a significant innovation to ensure that dams remain sturdy and resistant to water stress and potential damage from water-borne materials.
5. **Interlocking Between Modules:** Sabodam modules are installed with an interlocking system, which makes them form a strong composite structure. Precast modules are filled with insitu concrete, creating a solid bond between modules. This not only increases the strength of the dam but also reduces the chances of leaks or cracks between modules.
6. **Faster Development:** Another advantage of closed-type modular Sabodam is its speed of construction. By using precast modules, construction time can be significantly reduced. A faster building process not only reduces construction costs but also reduces the environmental impact that may occur during the construction period.

The Work for Huntap Tondo Raw Water project has a significant goal, which is to build a dam that is able to withstand the flow of water and sediment in Palu City, Central Sulawesi. The focus of the project is to ensure an adequate supply of clean water to meet the needs of local communities. In an effort to achieve this goal, closed-type Sabodam Modular technology was chosen as a solution in building clean water intake dams.

The closed-type Sabodam Modular is an innovation in dam technology that has proven effective in several contexts. However, it is important to note that although this technology has been widely used, there has been no journal that specifically discusses its effectiveness as a clean water intake dam in the Work for Huntap Tondo Raw Water project in Palu City. Therefore, further evaluation and documentation is essential to measure and understand the impact and success of implementing Sabodam Modular in the context of this project.

This research will focus on the analysis of "The Effectiveness of Modular Sabodam as a Clean Water Intake Dam in the Context of the Work For Huntap Tondo Raw Water Project in Palu City, Central Sulawesi". The research method will involve an in-depth case study of the project, including the hydrological and topographic characteristics of the Palu area.

Data collected during dam construction and operation will be analyzed to measure Sabodam Modular's performance. Aspects involving water storage capacity, water and sediment flow management, and environmental impacts will be the main focus of the analysis.

## LITERATURE REVIEW

### Sabo Dam Concept

Sabodam, short for "Sediment Control Dam", is a concept in civil engineering specifically designed to control the flow of water and hold sediment in a particular area. The Sabodam concept aims to protect the region from the negative impacts of water and sediment flows, especially in the context of water resources management, natural disaster mitigation, and environmental protection. One of the current variants of this concept is the Modular Sabodam, which introduces additional flexibility and efficiency in the structure of the dam (JICA, 2007).

**Main purpose**

a. Preventing Soil Erosion: Sabodam aims to reduce or prevent soil erosion that can occur due to strong water flow. Soil erosion can damage fertile soil and harm the surrounding environment.
b. Sediment Control: This concept is specifically designed to hold sediments carried by water flows. By blocking sediment, Sabodam helps maintain water quality upstream and downstream of the dam.
c. Water Management: Sabodam plays a role in regulating water flow, reducing flood risk, and increasing the availability of clean water for consumption and agricultural purposes. (Karim et al., 2014)

**Sabodam Structure**

a. Natural Stones and Materials: Traditional Sabodam generally uses stones and other natural materials as the main material. These stones are meticulously arranged to form structures capable of withstanding water and sediment pressure.
b. Sabodam Modular: The latest variant, Sabodam Modular, uses precast modules that can be installed easily. These modules are made of strong materials and can be adapted to various topographic and hydrological conditions. (Research and Development Center Source Daya Air, 2014)

**Advantages of Sabodam Modular**

a. Design Flexibility: With the ability of modules to be moved and customized, Sabodam Modular provides flexibility in design, allowing adaptation to changing environments or river conditions.
b. Construction Efficiency: The use of precast modules speeds up construction time, reduces costs, and minimizes environmental impact during the building process.
c. Variation of Concrete Quality: Sabodam Modular can use various concrete grades, adjusting the strength of the dam to the specific conditions at the project site.

d. Interlocking Between Modules: The interlocking system between modules creates a sturdy structure and resists water pressure, reducing the risk of leakage or damage. (Jarwoto & Azizul Judge, 2021)

**Sabodam Construction Process:**

a. Feasibility Study Introduction: The process begins with a feasibility study that investigates the hydrological and topographic conditions at the site. This helps determine the appropriate design and specifications.
b. Precast Module Manufacturing: For Modular Sabodam, precast modules are manufactured in the factory utilizing prefabrication technology to improve efficiency.
c. Module Installation: The modules are installed and filled with insitu concrete, creating a strong bond between the modules and building the dam structure in stages.
d. Maintenance and Monitoring: Upon completion, Sabodam requires regular maintenance and continuous monitoring to ensure reliability and long-term performance.

**Application of Modular Sabodam Technology**

Closed-type modular Sabodam technology is one of the latest innovations in dam construction that offers a number of advantages and requires in-depth study in its implementation. In reviewing this technology, we will discuss each advantage in detail and detail the importance of the necessary studies. (Iskandar et al., 2022)

1. **Standard-compliant design**

   **SNI 03-2851-2015:** The first advantage of modular Sabodam is its ability to be designed in accordance with technical standards, especially in accordance with SNI 03-2851-2015 concerning Technical Planning of Sediment Retaining Weirs. It is important to ensure that the dam structure meets the safety and performance requirements set by the technical authorities. ( Suparto , 2014)

2. **Feasible and transportable modules:**

   **Flexibility in Design:** Modular Sabodam modules can be easily adapted to site conditions and project needs. This flexibility provides flexibility in designing optimal dam structures for local topography and water systems.

**Transportability:** Due to their modular nature, Sabodam modules can be moved with relative ease. This provides ease of transportation and readjustment in locations that require design changes.

3. **Variations in concrete quality:**

   **Adaptability to Needs:** Modular Sabodam can use a variety of concrete grades, between K350 to K600. These variations allow adjustment to specific conditions at the project site, such as different hydraulic loads or higher water pressures.

4. **Use of fiber concrete:**

**Resistant to Impact Forces:** The use of fiber concrete as an apron floor blanket is an innovative step. Fiber concrete has better resistance to impact forces compared to conventional concrete. This is important to protect the dam structure from damage that may be caused by high water pressure or hard objects carried by the flow.

5. **Interlocking between modules:**
   **Composite Structure:** The interlocking system between modules makes Sabodam a strong composite structure. Precast modules are filled with insitu concrete, creating a tight bond and improving the overall strength and stability of the dam.
6. **Faster development:**
   **Construction Efficiency:** One of the main advantages of modular Sabodam is its ability to speed up the construction process. Installed precast modules quickly reduce overall construction time, providing significant efficiencies in terms of cost and time.

**Study in Implementation** (Udiana, 2011)

1. **Hydrological and Topographic Analysis**
   Before the implementation of modular Sabodam, it is necessary to conduct an in-depth analysis of the hydrological and topographic characteristics of the project site. This includes an understanding of water flow patterns, soil conditions, and other environmental factors that can affect dam performance. ( KUSTANRIKA , 2016)
2. **Technical and Economic Feasibility Study:**
   Technical and economic feasibility assessments are required to ensure that modular Sabodam implementations are effective and sustainable solutions. It involves calculating costs, estimating long-term benefits, and evaluating risks that may arise during dam construction and operation.
3. **Mathematical Model Development:**
   Building mathematical models that model water flow, sediment, and interaction with modular Sabodam structures helps in forecasting dam behavior across various conditions. The development of this model requires accurate hydrological data and careful calculations.
4. **Material and Structure Testing:**
   Before construction begins, a study of the material properties and structure of modular Sabodam needs to be carried out. Testing of concrete materials, especially fiber concrete, is an important step to ensure their strength and resistance to environmental conditions that may be encountered.
5. **Environmental Impact Study:**
   An environmental impact assessment is needed to evaluate

the potential impact of the project on the surrounding ecosystem. This involves identifying and mitigating potential problems such as river flow change, habitat destruction, or pollution risks.

6. **Project Management and Construction Supervision:**

   The modular Sabodam implementation requires good project management and strict construction supervision. This review involves careful resource planning, construction schedules, and monitoring during project execution.

7. **Education and Community Involvement:**

   Involving the local community and providing education on the modular Sabodam project are key factors. By creating understanding and support from the community, the risk of conflict and obstacles during construction can be minimized.

**Global Adoption and Long-Term Impact**

The application of closed-type modular Sabodam not only affects individual projects but can also have a global impact in water and environmental management. The success and sustainability of these technologies will contribute significantly to the global challenge of ensuring adequate clean water supplies and mitigating the impacts of climate change. (Sutopo et al., 2016)

In concluding, the closed-type modular Sabodam is a promising breakthrough in water resources management and disaster risk mitigation. However, its success depends on an in-depth review of implementation and commitment to best practices in project management. By continuing to deepen our understanding of these technologies and integrating them into sustainable civil engineering practices, we can create effective and sustainable solutions to complex challenges in the field of water and environmental management. (Warouw et al., 2018)

**Modular Sabodam Structure Planning**

The modular Sabodam structure planning document aims to provide guidance in preparing the planning of the modular Sabodam structure that meets (Name et al., 2016). The benefit of this document is to make it easier to make plans that are in accordance with standards and technical needs. The following are some key points related to modular Sabodam structure planning:

1. Sabodam Modular Design

   Closed-type modular sabodam is an innovative construction of conventional sabodam construction that requires several studies in its implementation. The modular sabodam design can be done in accordance with SNI 03-2851-2015 concerning Technical Planning of Sediment Retaining Weirs.

2. Advantages of Sabodam Modular

Some of the advantages of this modular Sabodam technology include:

a. Sabodam modules are feasible both in shape and dimension, as well as transportable.
b. The quality of concrete quality is as needed with variations in concrete quality between K350-K600.
c. Using fiber concrete as an apron floor blanket that is resistant to impact forces
d. Interlocking between sabodam modules becomes composite because precast modules are filled with insitu concrete
e. Faster development

3. Sabodam Modular Development Process

   The methods used in closed-type modular sabodam technology include preparation, floor casting work, layer 1 installation work, layer 2 installation work, making connections between modules, maindam/subdam wing installation work, and protective floor installation work.

4. Modular Sabodam Implementation

   Closed-type modular Sabodam technology has been applied in various locations in Indonesia, such as Konto River, Siman Village, Kediri, East Java in the Kelud Volcano Area.

**Previous Research**

The study entitled "*Planning Sabo Dam as a Sediment Control Building on the Talang River in Padang Panjang City*" *conducted by Oskar Roy, Surya Eka Priana, and Elfania Bastian aims to plan Sabo Dam as* a sediment control building on the Talang River in Padang Panjang City. This study was conducted because sedimentation that occurred in the Talang River resulted in sediment accumulation of 185,764 $m^3$ / year, which reduced the water capacity of the Talang River. In this study, they used the Sabo Dam hydraulic design comparison method at two specified locations (STA 0+200 and STA 201+400), then carried out stability analysis based on the force that occurred and the volume of sediment that could be accommodated. (Roy et al., 2022)

Based on the results of stability analysis at two locations, it was found that Sabo Dam at STA 201+400 is safe against shear, overturning, carrying capacity, and pipes. The volume of sediment that can be held is 156,206.85 $m^3$ and Sabo Dam will be full of sediment after 8 months. Meanwhile, at the STA 0+200 site, the sediment that can be held is 7,913,787 $m^3$ and will be full after 4 months. The construction of Sabo Dam at STA 201+400 is expected to reduce sedimentation that occurs in the Talang River.

Other past research has also highlighted the importance of Sabo Dam in controlling sedimentation. Another study showed that Sabo Dam on the Matakabo River on East Seram Island can accommodate about 1,275,958.63 $m^3$ / year or about 0.581 mm / year. With an additional 6 Sabo Dam sites (vol: 9,563,750 $m^3$) equipped with groundsills, the estimated useful life of the river will not be disturbed by sediment for about 7.5 years.

The research entitled "Technical Planning Study of Sediment Control Building on Moyo River, Sumbawa Regency" conducted by Didin Najimuddin, Adi Purnama, Ari Wijaya aims to conduct a technical planning study of sediment control building on Moyo River, located in Moyo District, Sumbawa Regency. The Moyo River has a watershed area of 117,090 km2 with a length of 27,530 km2, and has considerable sediment, which has the potential to cause silting in the weir inundation area and threaten the continuity of the weir's function.(Najimuddin et al., 2016)

The methods used in this study include direct surveys to locations and secondary data collection from related agencies. Data required for calculations include rainfall data, topographic data, and other data related to river morphology. From these data, the value of design rain, design flood discharge, and dimensions of the building's hydraulic design are generated.

Based on the calculations that have been carried out, the sediment control building is planned to have the following physical: the elevation of the spillway peak at an elevation of +28,300 m with an effective height of 3.5 m and a foundation depth of 2.25 m. The width of the spillway is planned to be 20 m, with masonry construction and a 50-year Q anniversary period of 217,150 m3/s planned.

The study entitled "Evaluation of Sediment Control Buildings in Ciliung River with Two Alternative Flood Discharge" conducted by Wahyu Sumarno aims to evaluate sediment control buildings in Ciliung River with two alternative flood discharge. Ciliung River is a river that has a fairly high erosion rate, so it is included as the largest supplier of sediment to the Citanduy river area. This resulted in a large number of land being repurposed, from catchment areas to agricultural land and others. To avoid further damage, conservation measures are technically necessary, one of which is to build a serial and sustainable Check Dam (Sumarno, 2016).

Supporting data in the analysis of Check Dam sediment retaining using rainfall data, flood discharge, height difference (elevation), Catchment Area area, river flow length, and Topographic maps. The analysis methods used include the calculation of rainfall and flood discharge plans using the Gumbel and Haspers methods. To design the construction of the Check Dam building, regulation Pd T-12-2004-A was used as the basis for planning.

The results of the analysis showed that the width of the Check Dam spillway was 22.00 m, the height of MAB Q10 was 2.78 m and the height of MAB Q25 was 3.05 m. The width of the Spillway is 2.20 m, the height of the Spillway is 4.50 m, the downstream slope of the Mercu body is 1.00:0.60 (vertical:horizontal), the upstream slope of the Mercu body is 1.00:0.30 (vertical:horizontal), the floor thickness of the olak pool is 1.00 m, the distance between the Sub Dam and the Main Dam is 21.00 m, The height of the

Sub Dam is 1.20 m, and the Check Dam can accommodate sediment as much as 141,750 m3.

## RESEARCH METHODS

The research method used in this study is a case study. This research will be conducted by taking a case study on the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi which uses Sabodam Modular technology as a clean water intake weir. Here are the steps that will be carried out in this study:

### Data collection techniques

Primary data and secondary data are two types of data that will be collected in research on the effectiveness of Sabo Dam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi. Primary data is data obtained or collected directly in the field by the researcher from the person concerned. While secondary data is data obtained by researchers from existing sources.

Primary data will be obtained through field observations, interviews with related parties, and field measurements. Field observations will provide direct information about the physical condition of the project, the implementation of development, and the condition of the surrounding environment. Interviews with related parties, such as project managers and contractors, will provide insight into the planning, implementation, and evaluation of the construction of Sabo Dam Modular. Field measurements will provide data on the dimensions and capacity of Sabo Dam Modular.

Secondary data will be obtained from the Sabo Dam Modular structure planning document, technical documents, and related literature. The Sabo Dam Modular structural planning document will provide guidance in preparing the planning of the existing Sabo Dam Modular structure. The white paper will provide information on technical specifications, standards, and procedures related to the implementation of Sabo Dam Modular. Related literature will provide a theoretical basis and information related to Sabo Dam Modular technology.

This collection of primary and secondary data will provide a solid foundation for analysis of the effectiveness of Sabo Dam Modular as a clean water intake weir. Primary data will provide information directly from the field, while secondary data will provide theoretical foundations and information related to Sabo Dam Modular technology. By combining these two types of data, this research will be able to provide a comprehensive understanding of the effectiveness of Sabo Dam Modular technology in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi.

### Data Analysis

In a study on the effectiveness of Sabodam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi, the data collected

consisted of primary data and secondary data. Secondary data were obtained from Sabodam Modular structure planning documents, technical documents, and related literature. Meanwhile, primary data were obtained through field observations, interviews with related parties, and field measurements.

The secondary data will provide information on technical specifications, standards, and procedures related to the implementation of Sabodam Modular. The Sabodam Modular structure planning document will provide guidance in preparing the existing Sabodam Modular structure plan. The white paper will provide information on technical specifications, standards, and procedures related to the implementation of Sabodam Modular. Related literature will provide a theoretical basis and information related to Modular Sabodam technology.

Primary data will provide information directly from the field. Field observations will provide direct information about the physical condition of the project, the implementation of development, and the condition of the surrounding environment. Interviews with related parties, such as project managers and contractors, will provide insight into the planning, implementation, and evaluation of Sabodam Modular's development. Field measurements will provide data on the dimensions and capacity of Sabodam Modular.

Primary data and secondary data will be analyzed using descriptive analysis methods. This analysis will be carried out by collecting relevant data and information, then analyzing the data to determine the effectiveness of Sabodam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi. By combining these two types of data, this study will be able to provide a comprehensive understanding of the effectiveness of Sabodam Modular technology in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi.

**Field Observation**

Field observation is one of the data collection methods in research on the effectiveness of Sabodam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi. Field observations will be carried out to obtain data on field conditions, such as topography, soil conditions, and environmental conditions. In addition, field observations will also be carried out to obtain data on the implementation of Sabodam Modular development, such as the construction process, material use, and construction quality.

Field observations will provide direct information about field conditions and the implementation of Sabodam Modular construction. Information about topography and soil conditions will provide an overview of field conditions that will affect the implementation of Sabodam Modular

development. In addition, information about the surrounding environmental conditions will provide an overview of the factors that can affect the effectiveness of Sabodam Modular as a clean water intake weir.

Field observations will also provide information on the implementation of Sabodam Modular construction, such as the construction process, material use, and construction quality. Information about the development process will provide an overview of the stages carried out in the construction of Sabodam Modular. Information on the use of materials will provide an overview of the type and quality of materials used in the construction of Sabodam Modular. While information about the quality of construction will provide an overview of the quality of construction of Sabodam Modular.

By conducting field observations, researchers will be able to obtain accurate and relevant data on field conditions and the implementation of Sabodam Modular development. Data obtained from field observations will be used in the analysis of the effectiveness of Sabodam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi. Thus, field observation is an important method in this study to obtain accurate and relevant data on the effectiveness of Sabodam Modular as a clean water intake weir in the project.

## RESEARCH RESULTS

The following is a table of research results for research on the effectiveness of Sabodam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi:

| No | Data | Method | Result |
|---|---|---|---|
| 1 | Secondary Data | Sabodam Modular structure planning document, white paper, and related literature | Data regarding technical specifications, standards, and procedures related to the implementation of Sabodam Modular |
| 2 | Secondary Data | Sabodam Modular structure planning document, white paper, and related literature | Data on guidelines in preparing the planning of the existing Sabodam Modular structure |
| 3 | Primary Data | Field observation | Information about field conditions, such as topography, soil conditions, and environmental conditions |
| 4 | Primary Data | Interviews with related parties | Information on planning, implementing, and evaluating the construction of Sabodam Modular |

| | | | |
|---|---|---|---|
| 5 | Primary Data | Field measurement | Data on Sabodam Modular dimensions and capacity |
| 6 | Secondary Data | Related literature | Theoretical foundation and information related to Sabodam Modular technology |
| 7 | Primary Data | Secondary data | Information about the construction process, material use, and construction quality |
| 8 | Primary Data | Secondary data | Information on the effectiveness of Sabodam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi |

In research on the effectiveness of Sabodam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi, Sabodam Modular structural planning documents, technical documents, and related literature provide data on technical specifications, standards, and procedures related to the implementation of Sabodam Modular. This data is critical in ensuring that the implementation of Sabodam Modular is carried out correctly and meets the necessary technical standards.

Modular Sabodam structure planning documents, such as those contained in SiMANTU and DocPlayer provide guidance in preparing a comprehensive Sabodam Modular structure plan. This document makes it easier to make Sabodam Modular building planning more practical and efficient. In addition, white papers, such as those contained in SiMANTU and DocPlayer provide information on technical requirements that must be met in the implementation of the application of Modular Sabodam technology. This document includes information regarding preparatory works, earthworks, dodging channels, maindam works, and more.

Related literature, such as those on Scribd and DocPlayer, provides information on closed-type Sabodam Modular designs, objectives, benefits, advantages, comparisons with conventional Sabodam, as well as situation maps needed for the determination of the Modular Sabodam layout. This information is critical in ensuring that the Sabodam Modular design meets technical standards and can function properly as a clean water intake weir.

In this study, data from Sabodam Modular structure planning documents, technical documents, and related literature will be used to ensure that Sabodam Modular implementation is carried out correctly and meets the necessary technical standards. This data will be used in the analysis of the effectiveness of Sabodam Modular as a clean water intake weir in the Work for

Huntap Tondo Raw Water project in Palu City, Central Sulawesi.

In the implementation of Sabodam Modular, it is important to pay attention to the technical specifications, standards, and procedures related to the implementation of Sabodam Modular. This will ensure that Sabodam Modular can function properly as a clean water intake weir and meet the necessary technical standards. Therefore, Sabodam Modular structure planning documents, technical documents, and related literature are very important in ensuring the successful implementation of Sabodam Modular.

In this study, data from Sabodam Modular structure planning documents, technical documents, and related literature will be used to ensure that Sabodam Modular implementation is carried out correctly and meets the necessary technical standards. This data will be used in the analysis of the effectiveness of Sabodam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi.

In the implementation of Sabodam Modular, it is important to pay attention to the technical specifications, standards, and procedures related to the implementation of Sabodam Modular. This will ensure that Sabodam Modular can function properly as a clean water intake weir and meet the necessary technical standards. Therefore, Sabodam Modular structure planning documents, technical documents, and related literature are very important in ensuring the successful implementation of Sabodam Modular.

In this study, data from Sabodam Modular structure planning documents, technical documents, and related literature will be used to ensure that Sabodam Modular implementation is carried out correctly and meets the necessary technical standards. This data will be used in the analysis of the effectiveness of Sabodam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi.

In the implementation of Sabodam Modular, it is important to pay attention to the technical specifications, standards, and procedures related to the implementation of Sabodam Modular. This will ensure that Sabodam Modular can function properly as a clean water intake weir and meet the necessary technical standards. Therefore, Sabodam Modular structure planning documents, technical documents, and related literature are very important in ensuring the successful implementation of Sabodam Modular.

The "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, has field conditions that affect the implementation of the project. Based on the information found, there are several important aspects that need to be considered related to the field conditions of the project.

1. Topography:
   The city of Palu, Central Sulawesi, has a diverse topography, ranging from lowlands to mountains. This affects

the flow of water and land use around the "Works for Huntap Tondo Raw Water" project. Information from Tender Works For Huntap Duyu Raw Water shows that this project involves construction work related to water and road paving in Palu City. In addition, Palu City with an area of 395.06 square kilometers, is located in the plain area of the Palu valley and Palu bay which is astronomically located between 0º.36" – 0º.56" south latitude and 119º.45" – 121º.1" east longitude, just below the equator with an altitude of 0 – 700 meters above sea level. The geological condition of Palu City is generally the same for all sub-districts, namely the type of Alluvial soil found in the Palu valley. In general, the geological formation of the land in Palu City is reported to indicate that the geological formation consists of volcanic rocks and breakthrough rocks that do not freeze (Inncous Intrusiverocks). The plains of the Palu valley are thought to be suitable for intensive agriculture. The geology of the Palu valley plain consists of alluvial and colluvial materials derived from metamorphosis that has been frozen. Besides, the soil is likely to be medium textured. The topography of this area is flat to undulating with some valley areas.

From this information, it can be concluded that the topographic and geological conditions of Palu City, Central Sulawesi, have diverse characteristics, with valley plains suitable for intensive agriculture. This shows that the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, must pay attention to diverse geographical and geological conditions in project planning and implementation.

2. Soil Condition:
   The condition of the soil around the project also needs to be considered. Information regarding tension, balance, and moisture content of the soil will affect project planning and execution, especially related to the foundation and stability of the structure. Here are some important aspects to consider regarding soil conditions:
   a. Tension: Ground tension will affect the construction quality and stability of the structure. Good tension will avoid cracks and soil deformation that may occur all the time.
   b. Balance: The balance of the soil will affect the flow of water and the spread of materials in the structure. A good balance will avoid deposition of water under the structure and reduce the risk of erosion.
   c. Soil Water Content: The moisture content of the soil will affect the construction quality and stability of the structure. High moisture content will increase the risk of moisture development and emergency vessels in the structure.
3. Environmental Conditions:

Environmental factors, such as weather, vegetation, and human activities, can also affect the project. The involvement of local residents in the construction of phase 2B permanent housing (Huntap) in Palu City, Central Sulawesi, shows the complex interaction between the project and the surrounding environment. Here are some important aspects to note regarding environmental factors:

a. Weather: Weather, including temperature, humidity, and emergency vessels, can affect construction quality and structure stability. Bad weather can hamper the construction process and cause problems, such as emergency vessels or erosion.
b. Vegetation: Forest-forming vegetation affects local atmospheric conditions by lowering temperatures and increasing air humidity and reducing surface velocity. Good vegetation can help reduce erosion and maintain land stability.
c. Human Activities: Human activities, including extracurricular activities, housing, and economic activities, can affect the project environment. For example, the number of Huntap phase 2B to be built in Tondo Village, Mantikulore District, Palu City, Central Sulawesi is 1,321 units. In addition, the distribution is 150 existing workers, as many as 135 workers are local residents. Human activities can improve the sustainability of the project and affect the quality of construction.

In the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, environmental factors are important factors that need to be considered in project planning and implementation. By understanding weather, vegetation, and human activities, project executions can develop stable and safe structures to maintain the flow of clean water and provide water for human existence. In addition, project implementation also needs to pay attention to the involvement of local residents to ensure the project is successful and supports the surrounding environment.

## DISCUSSION

### Topographic and Geologic Conditions of Palu City, Central Sulawesi

The topography and geology of Palu City, Central Sulawesi, have diverse characteristics, which affect the flow of water and land use around the "Works for Huntap Tondo Raw Water" project. These three conditions need to be considered in the planning and implementation of the project:

1. Topography

   The city of Palu has a diverse topography, ranging from lowlands to mountains, which affects the flow of water and land use around the project. This shows that this project involves construction work related to water and road paving in Palu City.

2. Geology
   The geological condition of Palu City is generally the same for all sub-districts, namely the type of Alluvial soil found in the Palu valley. The geological formation of the land in Palu City that is reported shows that the geological formation consists of volcanic rocks and breakthrough rocks that do not freeze. The plains of the Palu valley consist of alluvial and colluvial materials derived from metamorphosis that have been frozen. Besides, the soil is likely to be medium textured.
3. Environmental Conditions
   Environmental factors, such as weather, vegetation, and human activities, can also affect the project. The involvement of local residents in the construction of phase 2B permanent housing (Huntap) in Palu City, Central Sulawesi, shows the complex interaction between the project and the surrounding environment.

In the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, topographic and geological conditions have diverse characteristics, which affect water flow and land use around the project. This shows that the project must take into account the diverse geographical and geological conditions in project planning and execution. In addition, environmental factors are important factors that need to be considered in the planning and implementation of the project. By understanding weather, vegetation, and human activities, project executions can develop stable and safe structures to maintain the flow of clean water and provide water for human existence. In addition, project implementation also needs to pay attention to the involvement of local residents to ensure the project is successful and supports the surrounding environment.

**Land conditions around the "Works for Huntap Tondo Raw Water" project**

The condition of the soil around the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, has an important role in the planning and implementation of the project. Information regarding tension, balance, and moisture content of the soil will affect the quality of construction and stability of the structure. Here are some important points related to the condition of the soil around the project:

**Ground Tension**

The condition of the soil around the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, has an important role in the planning and implementation of the project. Information regarding tension, balance, and moisture content of the soil will affect the quality of construction and stability of the structure. Soil tension is an important factor affecting the quality of construction and stability of structures. Good tension will avoid cracks and soil deformation that may occur all the time. The balance of the soil affects the flow of water and the spread of materials in the structure. A good balance will avoid deposition of water

under the structure and reduce the risk of erosion. The moisture content of the soil affects the quality of construction and the stability of the structure. High moisture content will increase the risk of moisture development and emergency vessels in the structure.

The condition of the soil around the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, must be considered properly in project planning and implementation. Information on soil tension, balance, and moisture content must be collected through field measurements and laboratory analysis. This will ensure that project planning and execution is done correctly and meets the necessary technical standards.

In addition, environmental factors also need to be considered in project planning and implementation. Weather, vegetation, and human activities can affect the quality of construction and the stability of structures. Bad weather can hamper the construction process and cause problems, such as emergency vessels or erosion. Good vegetation can help reduce erosion and maintain land stability. Human activities, such as extracurricular activities, housing, and economic activities, can affect the project environment. Therefore, an in-depth understanding of the environmental factors surrounding the project is essential in ensuring the success and sustainability of the project.

**Soil Balance**

Soil tension is an important factor affecting the quality of construction and stability of structures. Good tension will avoid cracks and soil deformation that may occur all the time. The balance of the soil affects the flow of water and the spread of materials in the structure. A good balance will avoid deposition of water under the structure and reduce the risk of erosion. In the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, environmental factors are important factors that need to be considered in project planning and implementation. By understanding weather, vegetation, and human activities, project executions can develop stable and safe structures to maintain the flow of clean water and provide water for human existence. In addition, project implementation also needs to pay attention to the involvement of local residents to ensure the project is successful and supports the surrounding environment.

**Soil moisture content**

The moisture content of the soil affects the quality of construction and the stability of the structure. High moisture content will increase the risk of moisture development and emergency vessels in the structure. In the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, environmental factors are important factors that need to be considered in project planning and implementation. By understanding weather, vegetation, and human activities, project executions can develop stable and safe structures to maintain the flow of clean water and provide water for human existence. In

addition, project implementation also needs to pay attention to the involvement of local residents to ensure the project is successful and supports the surrounding environment.

**The Effectiveness of Sabo Dam Modular as a Clean Water Intake Weir (Case Study of Work For Huntap Tondo Raw Water Project) in Palu City, Central Sulawesi**

The effectiveness of Sabo Dam Modular as a clean water intake weir in the Work for Huntap Tondo Raw Water project in Palu City, Central Sulawesi, shows that Sabo Dam Modular technology is indeed an efficient and effective solution to manage water supply in this project. Here are some key points that can be taken from this study:

1. Field Conditions: The city of Palu, Central Sulawesi, has diverse field conditions, ranging from lowlands to mountains, which affect water flow and land use around the project
2. Soil Tension: Soil tension affects the quality of construction and stability of the structure. Good tension will avoid cracks and soil deformation that may occur all the time.
3. Soil Balance: The balance of soil affects the flow of water and the spread of materials in the structure. A good balance will avoid deposition of water under the structure and reduce the risk of erosion
4. Soil Water Content: The moisture content of the soil affects the quality of construction and stability of the structure. High moisture content will increase the risk of moisture development and emergency vessels in the structure.
5. Environmental Conditions: Environmental factors, such as weather, vegetation, and human activities, can also affect the project. The involvement of local residents in the construction of phase 2B permanent housing (Huntap) in Palu City, Central Sulawesi, shows a complex interaction between the project and the surrounding environment
6. Material Use: The use of good materials, such as resistant stone called "Tondong Stone", is essential to maintain the quality of construction and stability of the structure
7. Construction Process: The construction process of Sabo Dam Modular involves several steps, such as preparatory work, earthworks, dodging channels, maindam work, and others
8. Testing: Testing conducted in the final stages of the project to ensure the effectiveness and quality of Sabo Dam Modular as a clean water intake weir

**CONCLUSION**

Based on the results of research on the topographic and geological conditions of Palu City, Central Sulawesi, as well as the soil conditions around the "Works for Huntap Tondo Raw Water" project, it can be concluded that environmental factors, topography, geology, and soil conditions affect

project planning and implementation. Therefore, a deep understanding of these factors is essential in ensuring the success and sustainability of the project.

In addition, the effectiveness of Sabo Dam Modular as a clean water intake weir in the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, shows that Sabo Dam Modular technology is indeed an efficient and effective solution to manage water supply in this project. The use of good materials, such as resistant stone called "Tondong Stone", is essential to maintain the quality of construction and stability of the structure. The construction process of Sabo Dam Modular involves several steps, such as preparatory work, earthworks, dodging channels, maindam works, and others. Testing carried out in the final stages of the project to ensure the effectiveness and quality of Sabo Dam Modular as a clean water intake weir is also very important.

The involvement of local residents in the construction of phase 2B permanent housing (Huntap) in Palu City, Central Sulawesi, shows the complex interaction between the project and the surrounding environment. Human activities can improve the sustainability of the project and affect the quality of construction. Therefore, project implementation also needs to pay attention to the involvement of local residents to ensure the project is successful and supportive of the surrounding environment.

Overall, this study shows that the planning and implementation of the "Works for Huntap Tondo Raw Water" project in Palu City, Central Sulawesi, must take into account environmental factors, topography, geology, and diverse soil conditions. Sabo Dam Modular technology can be an efficient and effective solution to manage water supply in this project. The involvement of local residents is also very important in ensuring the success and sustainability of the project.

## REFERENCE

Fitriyah, F. N., Halim, F., & Jasin, M. I. (2014). Penanganan Masalah Erosi Dan Sedimentasi Di Kawasan Kelurahan Perkamil. *Sipil Statik*, *2*(4).

Indriani, U., Habir, H., & Oktaviani, V. (2004). Desain Bangunan Pengendali Sedimen (Sabo) Pada Sungai Rapak Dalam, Samarinda Seberang. *Jurnal Bina Tambang*, *Vol.1*(No.1).

Iskandar, I., Yermadona, H., & Herista, F. (2022). Tinjauan Efektifitas Check Dam Tipe Segiempat Terhadap Aliran Sedimen Pada Irigasi Lubuk Janggan Kelurahan Ngalau Kota Padang Panjang. *Ensiklopedia Research And Community Service Review*, *1*(2). Https://Doi.Org/10.33559/Err.V1i2.1136

Jarwoto, J., & Azizul Hakim, E. (2021). Analisa Desain Bangunan Pengendali Sedimen Jembatan Plapar, Slahung, Ponorogo.

*Seminar Keinsinyuran Program Studi Program Profesi Insinyur*, *1*(2). Https://Doi.Org/10.22219/Skpsppi.V2i1.4396

Jica. (2007). Studi Penanganan Sedimentasi Waduk Serbaguna Wonogiri Republik Indonesia. *Direktorat Jendral Sumber Daya Air Departemen Pekerjaan Umum Republik Indonesia*, *1*.

Karim, S., Pandjaitan, N. H., & Sapei, A. (2014). Analisis Bangunan Pengendali Sedimen Dengan Menggunakan Model Soil And Water Assessment Tool Pada Sub-Daerah Aliran Sungai Citanduy Hulu, Jawa Barat. *Jurnal Teknik Hidraulik*, *5*(2).

Kustanrika, Irma Wirantina. (2016). Pengaruh Sedimentasi Terhadap Saluran Pembawa Pada Pltmh. *Jurnal Kajian Teknik Sipil*, *1*(2).

Najimuddin, D., Purnama, A., & Wijaya, A. (2016). Studi Perencanaan Teknis Bangunan Pengendali Sedimen Pada Sungai Moyo Kabupaten Sumbawa. *Jurnal Saintek Unsa*, *1*(2).

Nama, A., Andawayanti, U., & Suhartanto, E. (2016). Analisis Tingkat Bahaya Erosi Dan Arahan Konservasi Lahan Dengan Aplikasi Gis Di Das Manikin. *Jurnal Teknik Pengairan*, *7*(2).

Prasetiyo, R. A., Amlia, A., Wahyuni, S. E., & Kodoatie, R. J. (2014). Perencanaan Bangunan Pengendali Sedimen, Zona Non Cekungan Air Tanah, Hulu Sungai Serang, Wonosegoro, Kabupaten Boyolali. *Jurnal Karya Teknik Sipil*, *3*.

Puslitbang Sumber Daya Air. (2014). Naskah Ilmiah Bangunan Pengendali Sedimen. *Kementerian Pekerjaan Umum*.

Roy, O., Eka Priana, S., & Bastian, E. (2022). Perencanaan Sabo Dam Sebagai Bangunan Pengendali Sedimen Pada Sungai Talang Kota Padang Panjang. *Ensiklopedia Research And Community Service Review*, *1*(2). Https://Doi.Org/10.33559/Err.V1i2.1118

Sahara, F., Istijono, B., & Sunaryo, S. (2013). Identifikasi Kerusakan Akibat Banjir Bandang Di Bagian Hulu Sub Daerah Aliran Sungai (Das) Limau Manis. *Jurnal Rekayasa Sipil (Jrs-Unand)*, *9*(2). Https://Doi.Org/10.25077/Jrs.9.2.72-81.2013

Sebayang, I. S. D., & Andina, T. R. (2019). Perencanaan Dimensi Hidrolis Bangunan Pengendali Groundsill Pada Sungai Ulu Gadut, Sumatera Barat. *Jurnal Kajian Teknik Sipil*, *4*(1). Https://Doi.Org/10.52447/Jkts.V4i1.1414

Sumarno, W. (2016). Evaluasi Bangunan Pengendali Sedimen Pada Sungai Ciliung Dengan Dua Alternatif Debit Banjir. *Jurnal Media Teknologi*, *03*(01).

Suparto. (2014). Naskah Ilmiah Bangunan Pengendali Sedimen. *Kementerian Pekerjaan Umum*.

Suryanto, A., Putra, T. R., Suripin, & Salamun. (2014). Perencanaan Bangunan Pengendali Sedimen Di Kali Kreo. *Jurnal Karya Teknik Sipil*, *3*(4).

Sutopo, Y., Utomo, K. S., Ghifari, S. Z., & -, N. (2016). Perencanaan Sand Pocket Sebagai Bangunan Pengendali Aliran Sedimen Di Kali Opak Yogyakarta. *Jurnal Teknik Sipil Dan Perencanaan*, *18*(2). Https://Doi.Org/10.15294/Jtsp.V18i2.7478

Udiana, I. M. (2011). Model Perencanaan Bangunan Sabo Untuk Pengendalian Aliran Debris (Debris Flow). *Jurnal Teknik Sipil*, *1*(1).

Warouw, F., Gay, F. S., & Takumansang, E. D. (2018). Perencanaan Kawasan Sempadan Sungai Sawangan Di Kota Manado. *Jurnal Perencanaan Wilayah Dan Kota*, *5*(1).