Analysis of Embung Abimanyu Utilization in Temanggung, Central Java, Indonesia

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Abstract: A retention basin, named Embung Abimanyu, has been built as an effort to fulfill water requirement for the local community, especially for horticulture crops in Temanggung area, Central Java of Indonesia. It covers an area of approximately 90 x 70-meter square with a depth of 3.5 meters. This paper presents the results of performance analysis of the basin by using the following approaches; physical aspects, utilization aspects, and operational and maintenance aspects. We use the descriptive method with quantitative approach by collecting some technical data. In addition to technical aspects, non-technical ones are also included, which are attitude, opinion, and perception regarding the utilization of the basin.

1 INTRODUCTION

Embung is a small reservoir that serves to collect water during periods of excess water during the wet season, and is used in times of water shortage in the dry season, for various purposes, such as drinking water, irrigation, tourism, flood control, etc. (Kasiro,).

According to Law no. 11 year 1974 on Watering, it stated that the community should participate in the implementation of operation and maintenance water resources, including the building of embung. Operation of embungs/reservoirs is the effort to utilize the water that is accommodated in the optimal containment effectively. While the maintenance of embung is a business effort to keep the existing infrastructure facilities so that it can always function well, during the period of embung building and the planned service period (Suripin, 2004).

Embung Abimanyu is located in Ngabeyan Village, Ngropoh Village, Kranggran Subdistrict, Temanggung Regency, Central Java. Embung Ngropoh is one of several artificial lakes built by Temanggung District Government in 2013 by the Environment Department of Temanggung Regency, which built on the land owned by the local village. This embankment has an area of about 90 x 70 meters with 3.5 meters depth.

The embung water capacity is planned to reach 13,000 m^3 and can flow water up to 25 hectares of land around the embung area. Embung Abimanyu, in addition to functioning to accommodate water during excessive water in the rainy season, is also being used in times of lack of water in the dry season as well as for activities of tourism objects of interest. Ngropoh village is famous for its durian commodity which is quite famous in Temanggung and surrounding areas because it has a sweet taste and in the location of the embung from year to year is becoming the location of the Durian Festival held an interesting events and attract lots of crowds.

The purpose of this research is to uncover the benefit of development of Embung Abimayu in Ngropoh village for people in Ngropoh village and its surroundings in terms of Physical aspect, Utilization aspect, Operation aspect and Purchasing aspect, and to increase the number of tourism, particularly during the durian season.

2 LITERATURE REVIEW

2.1 Embung Components

The embung building has several components (Kasiro,), including: rainfed area, storage area, embankment, spillway, distribution network/reticulation system (distribution pipe, transmission pipe), (water tubs, cattle tubs, garden water tubs), safety fences (fences surrounding embankments and

puddles, gates) and complementary buildings such as measuring rails, bench marks and embung name plates.

2.2 Operation and Maintenance of Embung

In general, the operation and maintenance activities of embung consists of three parts, namely:

1. Implementation of the operation of embung
   Due to the limited volume of water present in the reservoir, prior to operation, an operation plan should be made. This activity begins with the allocation of water distribution for the population, based on the calculation of water requirements.

2. Implementation of monitoring and inspection
   Regular monitoring is necessary to obtain good and accurate data. This is for early drilling and inspection of the characteristics and safety of the embungs. The data to be taken include: (a) rainfall data on the embung area, (b) discharge data on the spillway, (c) raw water supply data on the valve hause, (d) stream embankment, and (e) seepage discharge data on the down stream of the embankment. In addition to these data, it is necessary to inspect the overall condition of the embung building.

3. Maintenance and repair
   In order to maintain the continuity of the function of the embung building, the components and completeness of the embung building need to be maintained on a regular basis. Routine maintenance activities, including:

   (a) Embankment maintenance
       Grasses grown on embankments need watering during the dry season and mowing to see if damage is likely to occur on the embankment. The types of damage can be cracks, landslides, leaks, and so on.

   (b) Storage maintenance
       The flow of water that enters the container column often carries garbage including tree trunks, therefore cleaning needs to be done.

   (c) Spillway maintenance
       Trash and tree trunks carried by runoff water need to be cleaned and prevent hardwoods from growing along the channel or the edge of the canal.

   (d) Maintenance of distribution networks and complementary buildings
       This maintenance is important to prevent damage or leakage that will result in waste of water and also uneven distribution.

2.3 Aspects Reviewed

There are 3 (three) aspects that are very important in relations to embung mangement, namely the physical aspects, aspects of utilization, and aspects of Operation and Maintenance (O & M). Each aspect consists of several variables (Umum, 2018).

1. Physical Aspects

   (a) Embankment, consisting of: Wet area due to seepage through body of embung or foundation causing local landslide due to saturated soil, Wet area extends in body of embung and creates seepage, Cracks across the body of embungs, Cracks extends in the body of the embung at the top (can be straight/curve), shrinkage, cracks are usually short, shallow, narrow, numerous, and irregularly directed, Erosion of grooves in the body of embungs, and plants high in the body of the embung.

   (b) Variables in the overflow consist of: Collapsed in overflow ducts, Erosion grooves in overflow ducts, Local scours in spills, and High plants in the body of the embungs.

   (c) Variables in the storage pool, consisting of: Deposition of mud, Dirt/twigs of deciduous trees on the column, Fence around the pool, Board guess, buoys, and Water availability.

   (d) in the distribution network pipeline, consisting of: Transmission pipes, and Pipe distribution.

   (e) Variables on the tubs, consisting of: Tubs of human need, Tubs of purposes of livestock, and Tubs of purposes garden.

2. Aspect Utilization, consisting of: Water distribution, Feel comfortable with the quality of water embung, and Improvement of quality of life/health.

3. Aspects of Operation and Maintenance, consisting of: Obedience to implement O & P, Availability of facilities and funds O & M, Subsidies, and Activities training and maintenance operation of embung.

3 METHOD

3.1 Research Sites

This research was conducted at Embung Abimanyu location in Ngabeyan hamlet, Ngropoh Village, Kranggan Sub-district, Temanggung Regency, Central Java Province, Indonesia as presented in Figure 1 and Figure 2.

Figure 1: Research sites

Figure 2: Aerial looks over Embung Abimanyu

3.2 Aerial Looks over Embung Abimanyu

The population in this study consists of related SKPD and the community of water users of Ngropoh who are educated elementary school until graduate. Sample in this study was taken randomly with the propotionate stratified random sampling. The technique used when the population have different levels of education. The reason for the use of the above mentioned sample technique is that Embung Abimanyu users have different levels of education ranging from elementary to graduate with a population of 150 people. The total population of each level of education are: elementary school = 55 people, junior high school = 47 people, high school = 40 people, Diploma = 5 people, and Undergraduate = 3 people.

The total number of sample members is determined by Taro Yaname and Slovin formula. This refers to the opinion of (Reduwan, 2007) that the sampling technique uses the formula of Taro Yaname and Slovin when the population is known and more than 100 people. The formula is as follows:

$$n = \frac{N}{N.d^2 + 1} \qquad (1)$$

where n is the number of sample members, N is the population number, and d^2 is precision. Precision set 10%, then:

$$n = \frac{150}{150.(0.1)^2 + 1 = 60} respondent \qquad (2)$$

The number of sample members uses the proportional allocation formula:

$$ni = \frac{Ni}{N}n \qquad (3)$$

where ni is the number of sample members by stratum, n is the total number of sample members, Ni is the number of population members by stratum, and N is the total population number. Thus, the number of sample members based on education level is as follows:

$$Elementary school = \frac{55}{150}.60 = 22,$$
$$junior high school = \frac{47.60}{150} = 18,8 \approx 19,$$
$$senior high school = \frac{40}{150}.60 = 16,$$
$$diploma = \frac{5}{150}.60 = 2,$$
$$and undergraduate = \frac{3}{150}.60$$
$$= 1,2 \approx 1 \qquad (4)$$

3.3 Data Collection

Data collection techniques used field observation techniques and questionnaires. The research used descriptive method with quantitative approach and data collection technique. Quantitative research is a study that takes samples from a population and uses questionnaires as a basic data collection tool (Singarimbun and Effendi, 1989).

Observation Technique is a field research technique in order to collect data where the researcher as a participant in the cultural environment of the object studied (Mantju, 1994). Questionnaire technique is a technique of data collection done by giving a set of questions or questions written to the respondent to be answered (Sugiyono, 2011). The questionnaire used in this study is a questionnaire with Likert scale as it was exposed in (Sugiyono, 2011). Likert scale is used to measure attitudes, opinions, and perceptions of a person or group of people about social phenomena. In the Likert scale the variables to be measured are translated into variable indicators. Then the indicator is used as a starting point to arrange the items of the instrument that can be a statement or question. Theanswer of each instrument item using Likert scale has gradation from very positive to negative.

3.4 Data Analysis

The data of the research results were analyzed by assigning specific values to each variable using the Likert scale method. Likert scale is used to measure attitudes, opinions, and perceptions of a person or group of people against a particular fonomena. The phenomenon in question is research variables that have been specified by the researcher. The values on the Likert scale are as follows:

a Strongly Agree/Always/Very Important/Always,rated 5

b Agree/Important/Frequently, rated 4

c Doubt/Quite Important/Almost Never, rated 3

d Less Agree/Less Important/Almost Never, rated 2

e Disagree/Not Important/Never, rated 1

The above values are used to measure the performance of each aspect reviewed. The steps in the data analysis are assessments for each aspect of the same value, in which all variables of each component are considered to have an equal contribution to the management of the Embung Abimanyu. Assessment of the embung performance for each aspect can be seen in Figure 3 below:

Aspects	Score				
	Very good	Good	Moderate	Bad	Very bad
Physical	4.01–5.00	3.51–4.00	2.51–3.50	1.51-2.50	1.00–1.50
Utilization	4.01–5.00	3.51–4.00	2.51–3.50	1.51-2.50	1.00–1.50
Operations and maintenance	4.01–5.00	3.51–4.00	2.51–3.50	1.51-2.50	1.00–1.50

Figure 3: Interpretation Scoring Criteriafor Embung Performance(Source : (Sugiyono, 2011)).

The questionnaire consisted of two types of questions/statements that use positive sentences and negative sentences, aiming for respondents to answer each question more seriously and not mechanistic. Questions/statements that use positive sentences have the following assessment answers:

a Strongly Agree/Very Important/Always 5

b Agree/Important/Often 4

c Doubt/Quite Important/Sometimes 3

d Less Quality/Less Important/Never 2

e Disagree/Not Important/Never 1

Questions/statements that use negative sentences have the following assessment answers:

a Strongly agree/Very Important/Always 1

b Agree/Important/Often 2

c Doubt/Quite Important/Sometimes 3

d Less Quality/Less Important/Never 4

e Disagree/Not Important/Never 5

Each variable consists of several questions/statements that use positive and negative sentences so that for the assessors then the number of answers from positive sentences and negative sentences summed and then distributed with the number of questions from these variables. After getting the value of each variable then the sum of variables to get the average value of each variable. The average value is obtained by using the formula:

$$X = \frac{x_1 + x_2 + ... + x_n}{n} \tag{5}$$

where X is mean, $x_1 x_2 + ... + x_n$ is variable – n according to Likert scale, and n is variable number.

$$X = \frac{\Sigma f_i x_i}{\Sigma f_i} \tag{6}$$

where X is mean, f_1 is variable number, and xi is variable value of – n according to Likert scale. Furthermore, to obtain a conclusion that the performance of the management of embung is optimal in accordance with the plan or vice versa not optimal obtained from the average value of the 3 aspects ie physical aspect, utilization aspect, and aspects of O & M (Operational and Maintenance). So the final value of the 3 aspects that have been averaged is the final answer to the problem in this research. The final value is obtained by using the formula:

$$N_{FINAL} = \frac{N_{AF} + N_{AP} + N_{AOP}}{3} \tag{7}$$

where N_{FINAL} is the final mean score N_{AF} is mean of physical aspect, N_{AP} is mean of utilization, and N_{AOP} is mean of O and P.

4 RESULT AND DISCUSSION

4.1 Respondents Profile

Total respondents: 60
Sex: male = 24 and female = 6
Age: 25 – 30 years old = 1, 31 – 35 years old = 6,
36 – 40 years old = 6, 41 – 45 years old = 8,
46 – 50 years old = 10, 51 – 55 years old = 20,
and 56 – 60 years old = 9
Education: elementary =22, junior high = 19, senior high = 16, Diploma = 2, and under graduate = 1

4.2 Physical Aspect

No	Variable	Score	% Respondents
1	Dike	4.42	19
2	Spillway	4.00	19
3	Pool/pond retention	4.00	19
4	Pipe distribution network	5.00	24
5	Tub/service pond	4.00	19
	Total Score	21.42	100
	Mean	4.28	

Figure 4: Interpretation Scoring Criteriafor Embung Performance.

The Figure 4 above shows that the respondents observation of the embankment is in excellent condition, the spillway is in good condition, the pool is in good condition, the distribution network pipe is in excellent condition, and the tub is in good condition.

The majority of respondents answered very well on the physical aspect and it can be concluded that the 5 (five) physical aspects such as embankment, spillway, catch pond, distribution network pipeline, and tub service on embung Abimanyu belong to very good condition so that the benefits of embung Abhimanyu functioned very well good.

4.3 Utilization Aspect

No	Variable	Score	% Respondents
1	Water distribution	4.15	19
2	Comfortable feeling with water guarantee	4.05	19
3	Improved quality of life of tourist attraction	4.42	19
	Total Score	12.62	12.62
	Mean	4.21	

Figure 5: Value of variable condition in Utilization aspect.

Based on the above table it can be seen that the majority of respondents answered very well on the value of the condition of each variable on the utilization aspect. Respondents stated that the distribution of water in excellent condition did not occur conflict in the seizure of water distribution in Abimanyu embung, respondents feel comfortable with the guarantee of water during the long dry season because the water embung never happened drought, and the existence of quality improvement of life with the existence of tourist attraction during the durian harvest season so as to improve the welfare for Ngropoh and surrounding villagers.

4.4 Operations and Maintenance Aspect

No	Variable	Score	% Respondents
1	Compliance with Operation and Maintenance	3.94	19
2	The availability of Operation and Maintenance funds	4.07	19
3	Subsidy	3.96	19
4	Operation and Maintenance training activities	4.31	24
	Total Score	16.28	100
	Mean	4.07	

Figure 6: Values of variable conditions in the aspects of Operation and Maintenance.

Based on the Figure 6 it can be seen that the majority of respondents answered very well on aspects of operation and maintenance. This indicates that the respondents rated the operational and maintenance training activities very well, the availability of facilities and operational fund maintenance is very good, the subsidy is considered good, and the obedience of operational and maintenance is also considered good

4.5 Utilization Analysis

Based on the results of the analysis and discussion on the physical aspects, aspects of utilization, and aspects of operation and maintenance, the overall analysis of the benefits of Abimanyu embungs are: $N_{AF} = 4.28$, $N_{AP} = 4.21$, and $N_{AOP} = 4.07$.

Abimanyu Utilization Analysis

$$= \frac{N_{AF} + N_{AP} + N_{AOP}}{3} = \frac{4.28 + 4.21 + 4.07}{3} = 4.19$$
(8)

Based on the results of the analysis, overall Abhimanyu embank on very good condition. This value condition is strongly influenced by physical aspect, utilization aspect, and aspect of Operation and Maintenance.

The achievements of each variable can be seen in the graph of the radar diagram below.
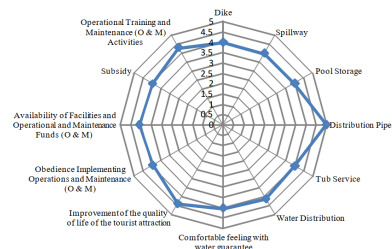

Figure 7: Graph of Radar Diagrams of Research Variables

5 CONCLUSIONS

5.1 Conclusion

Based on the results of the analysis on Embung Abimanyu, it can be concluded as follows:

1 Viewed from the physical aspect of 4.28 means the overall meaning of the embung parts such as embankment, spillway, pond storage, pipeline network, tub service is in very good condition.

2 From the aspect of utilization, yield value of 4.21 means that from the aspect of embung utilization, it has been utilized very well by society.

3 From the aspect of operation and maintenance yields of 4.07 value,operation and maintenance of the embung are in excellent condition.

Based on the aforementioned results, the overall analysis of the benefits of Embung Abimanyu are on very good condition. This means that the Abimanyu Embung can provide excellent benefits to the surrounding community either in terms of physical aspects, aspects of utilization, as well as from aspects of operation and maintenance

5.2 Suggestions

Based on the conclusions as described above, the following suggestions can be given:

1 There is a need to increase the observance of operational and maintenance (O & M) of Embung Abimanyu.

2 There is a need to add operational standard (SOP) in implementing O & P Embung Abimanyu so that local community will have better understanding about operation and maintenance system and also actions that need to be taken in overcoming problem at Embung Abimanyu.

3 There is a need for a rules on village regulations governing the distribution of water ponds.

4 There is a need for an independent maintenance costs from villages that do not rely on the government for the maintenance costs of the embungs.

5 There is a need for care of the physical aspects of parts such as embankments, spillways, storage ponds, pipelines, and service tanks to function better.

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