Small Reservoir Development for Poor Alleviation in Arid Area : Case Study in Blora, Central Java, Indonesia

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Abstract

Consist of marginal land, large plantation, small rice field area and small villages with medium density population is a typical land use of arid and underdeveloped area in Indonesia. Low education and skill enforced its people to become a farmer. Limited surface water and capital investment availability is the main reason why rice harvesting should only be done during the rainy season. Catling during the dry season is a limited substitute work as it also requires surface water for harvesting a good grass. The lack of this surface water, making both works as a low income generating work. Therefore, provided water become a promising effort for this area for improving the prosperities of its people in the short term and increasing the development acceleration of this area in the long term. This paper present the benefit comparison of small reservoir development as multy purpose water resources for poor alleviation in arid area of Indonesia compared to ground water and large reservoir. Field observations were done to get social economic data, engineering data (hydrology, climatology, topography etc) and environmental data which were required to conduct the comparison study. Based on its social benefit, engineering performance and environmental concern, it is found that small reservoir is the most advantageous multy purpose water resources for poor alleviation in arid area of Blora, Central Java, Indonesia. The study result will be implemented by the stakeholder who consists of local government, NGO, private institution and local people. It is also suggested that the same further study would be useful for other arid and poor area in Indonesia.

Keywords: Small Reservoir, Poor Alleviation, Arid Area, Java Island.

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1. Introduction

Although dominated by tropical monsoon, local climate of Indonesian's island may significantly be varied due to the influence of its mountain range. Indonesian arid area is generated when its mountain range block the wet monsoon line into that area. Water scarcity is the main issue for developing agriculture in this arid area as surface water is very limited and ground water table is too deep. As most of Indonesian people in villages work as farmer, villages located in this arid are is frequently related to under developed and poor area, in which the annual income of its people below $ 1000 USD (Ministry of National Development Agency of Indonesia, 2009). Based on its development policy, Indonesian Government provide that poor area with poverty subside of fuel and rice in the short time, and infrastructur development (for agroindustry, transportation and energy) in the longterm. The main problem of the Indonesian Government in implementing this policy is to develop program that match the needs of poor people for developing their own capacity in fighting their poverty. The development of large reservoir have insignicant impact in reducing poverty in arid area as in the last decade, most of them have been drought during the dry season when the poor farmer require water for their rice field and livestock. Meanwhile, development of small reservoir (or situ in Indonesian Language) has shown a better impact to this arid area compared to large reservoir (M. Syahril B.K., 2007). A case study in Randu Blatung's village, Blora regency as one of the arid and poor area in Central Java Province in Indonesia is used to enrich the discussion. The study

conducted based on both secondary and primary data which cover engineering, policy, social economy and envinronment aspect. Government and NGO were used as the main sources of secondary data. Field observation, interview and questionnaire were also used to get data.

Figure 1. Blora Regency, Central Java Island, Indonesia

2. Identified Poverty Issue

Population of Randublatung subdistrict was 72.635 people or 461 people/km2 in 2006. This poupulation consist of 20.577 household with 3,5 people/household from which 44,34% is categorized as poor people whose maximum daily income < 2 $ USD. Most of this poor people is also illiterate. Having less education/skill enforced the local people to become a farmer therefore other employment that required higher skill such as miner, trader or banker are taken by the incoming people from more developed area.

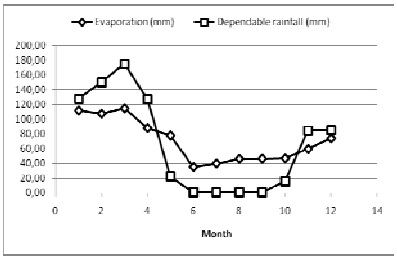

Figure 2 Randu Blatung Water balance

The study area has average elevation range of 44-75 m above sea level and ground slopes of 0–25 %. This area has monthly rainfall of 84–175 mm/month during rainy season, monthly rainfall of 0–22 mm/month during dry season, daily evapotranspiration of 4,51– 6,23 mm/day (see figure2). Most of its soil surface is categorized as sandy clay to limestone where teakwood growing best and become the main agro industry activity that cover 65.69 % of its area. Meanwhile agriculture (rice field and corps) and grass for livestock cover consecutively 26,2 % and 3,11 % ot its area. The rest of the area are developed as mining (rock and petrolium) and villages.

Teak wood has 15-40 years harvesting time so that it require large area and capital investment to comply economic feasibility. This is why teakwood plantation is developed and conducted under state own company which could provide less employment with less paid than the local people needs. High profit teakwood home industry which produce valuable house structure, furnitures and handy craft require high capital investment and high skill people. Therefore charcoal become a pragmative alternative home industry for poor and unskill people who produce it not only from the waste of the above teakwood home industry but also from teakwood roots which is actualy more valuable as handycraft.

Meanwhile, the main product of agriculture are rice (22.900 ton/year) and corn (13.600 ton/year) which are even far from the local people requirement. The main constraint for increasing its productivity is limited water availibility that could only support one yield/year for the existing ricefield and corn owned by poor household.

3. Poverty Reduction Program

Several previous study (BAPPENAS, 2008, Syamsul Maarif, 2006, UNDA 2006 and UNDP 2005) have concluded that poverty reduction program in Indonesia will be succed when it consist of activity which could continously support the effort of poor people in improving their capacity for increasing their income.

The following discussion concern about the poverty reduction program implemented in one of the village of Randublatung subdistrict where its population is 300 people. Identification survey in the study area had shown that the local people has free (unemployed) time 4-6 hour/day after farming in either their ricefield or teakwood plantation. Only some of them who could use this free time to get very limited additional income by doing cattling, teakwood handy craft, teakwood charcoal and masonry in

housing contruction (Oemar et al, 2009). Other type of additional work are needed to provide more work to them. Improving the skill of poor people to transform charcoal industry into handycraft industry is an immediate effort that could be done. Furthermore, there are several other potential economic activities such as bio industry (eg fertilizer, biogas etc) and tourism (eg fishing ground, camping ground, play ground, eco tourism, etc) that have been identified during the field investigation.

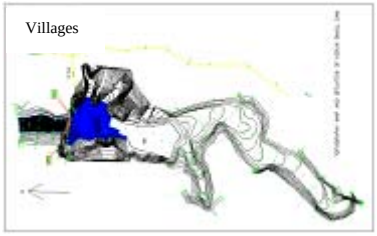

Figure 4 Mass curve of the reservoir

As it is reported by the local people, the fist stage of poverty reduction program was conducted through the development of a small multy purpose reservoir (situ) by government and supported by international donor institution in 2005. This program could provide surface water for 3 ha paddy field, fishing and maintening ground water during the dry season. But the whole dam of this situ was brokedown due to the heavy rain in June 2006. The situ reconstruction was done by local NGO, local people and local government from 2006 to 2007 with approximately the same dimension. This existing situ is found has + 2 m maximum depth, 2,81 ha inundated area and 13.461,3 m3 storage water. The small dam constructed from earth fill with 2 m high, 123 m lenght, 3 m top width and 8 m bottom width. Small spillway is provided from lined masonry with 8 m lenght and 1.5 m height which is estimated not adequate to spill the peak disharge of 5 years period of flood hydrograph. This existing situ serve 3-5 ha paddy field that yield 4-5 ton rice/ha during the dry season which is far from the local people need to reduce the poverty as planned. Therefore further improvement of water supply capacity is required to sustain the effort of poor alleviation in the area. The question is what size of situ which appropriate to support that effort? This effort should be supported by at least with 20 ha of rice field during dry season which require 20 l/s water supply. Meanwhile the developed situ has 170,34 ha catchment area, 65,981 m3/s flood discharge and 300.000 m3/year of 95 % dependable surface water. Regarding the above condition and criteria, the following second stage of poverty reduction program are proposed and implemented.

a) Multy purpose reservoir development.
   The reservoir is developed to provide additional surface water for ricefield and catling. Fishing ground, ground water prereservation during the dry season and ecotourism are additional purpose of this reservoir.
b) Improving local people capacity
   This program is planned not only to increase the local people skill in teakwood handycraf, farming and catling but also to develop their skill for expanding their income generating activity in several potential derivative agriculture such as biogas, fertilizer, biomas and ecotourism.
c) Improving stakeholder contribution.
   This program is conducted for reshaping the role of any member of stakeholder based on its capacity to ensure the sustainability of its contribution as it is committed.

Figure 3. Keruk Situ before collapsed

Muka Air Eksisting

Elevation	Area (m^2)	Volume (m^3)
0,0	28150,0	13461,3
0,5	65584,0	29940,9
1,0	78588,0	65755,2
1,5	88545,0	107422,1
2,0	109798,0	157007,9
2,5	126014,2	215961,0
3,0	145991,9	283962,5

Figure 5 Mass curve of the reservoir

Based on geotechnical survey, Oemar et al (2009) concluded that the vertical geotechnical profile at the dam cross section consist of soft soil (0-3 m), hard clay (3-7,5 m), sandy silt (7,5-10 m) and hard rock (below 10 m). This geotechnical condition allow us to increase the dam height of the existing reservoir so that its future storage capacity would reach 300 000 m3 and could provide water for 50 ha of paddy field during dry season, 10 ha of camping ground, 10 ha of fishing ground and 100 ha of cattling ground.

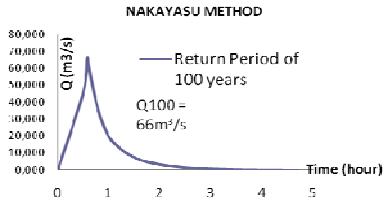

Figure 6 Flood Hydrograph

Figure 7. Keruk Situ after collapsed.

Figure 8. Kedung Ombo (large) reservoir in Blora arid area (Antara, dry season 2009).

As it is presented in figure 2, the water balance of the studied area is deficit more than 6 month. During this dry period, the draw down of ground water table could reach 10 m depeer so that soil surface becoming drought and loose. In the last two decade, the maximum rainfall intensity during the rainy season and evaporation rate during the dry season are significantly increased so that it generate both potential flood hazard and drought hazard to its surrounding area (see also figure 3 to 8). This phenomenon is believed as the influence of climate change to the studied area (*Lenny Bernstein et al, 2007 and* M. Syahril B.K, 2007).

4. Results and discussion

It is seen from the above condition that the poor in the studied area are heavily dependent on agricultures and other related works so that provided surface water and eco-systems for maintaining sustainable livelihoods and strengthened environmental management is imperative for poverty reduction. In this case situ could fulfill both function. The existence of situ could improve the prosperity of the local people as it is shown in figure 9 and figure 10. The willingness of local people to improve the level education of their children and the ability of local people in immediate self reconstructing the failure situ are a good performance indicator that have shown the suceed of the poverty reduction program in Randu Blatung. Meanwhile, several large reservoir in neighbour arid area that have been drought and damaged by sudden drawdown during the dr y season are still insecured as both government and local people could not afford its immediate reconstruction. In this case, provided surface water from situ has the following advantages compared to the large reservoir.

Figure 9. Village library to fight Illiterate

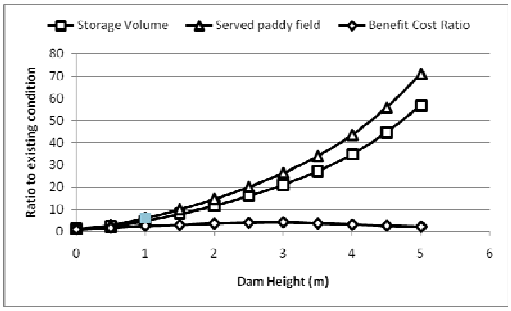

Figure 10 Performance indicator ratio of each scenario of dam height.

- Poverty area spreaded out in a vast area so that the cost for water distribution of large reservoir is higher and more complex than that of situ.
- Arid area has low annual rainfall and high evaporation so that water availibility of situ is les sensible to evaporation.
- Topographical condition of most arid are has low storage capacity.
- Both construction and maintenance of situ is more affordable for local people and government.
- Low capacity of poor people in contributing the reservor development and maintenance.
- *In this case, the development of situ is moreappropriate to the capacity of the local people as the main actor and physical condition of arid area.*

5. Conclusion

Discussion of situ performance in supporting poor alleviation program in small village of Blora Regency is conducted. Based on its social benefit, engineering performance and environmental concern, it is found that small reservoir (situ) is most advantageous multy purpose water resources for poor alleviation in arid area of Blora, Central Java, Indonesia. While the function developed large reservoir to support poor alleviation program in its neighbour arid area is apted due to the extrem drought. The study result will be implemented by the stakeholder who consists of local government, NGO, private institution and local people. It is also suggested that the same further study would be useful for other arid and poor area in Indonesia.

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