

# SOCIAL CAPITAL ON WATER RESOURCE MANAGEMENT

(Case Study: Community Involvement on Rural Wellspring Handling in Sumberawan  
Hamlet of Malang Regency, Indonesia)

[Ismu Rini Dwi Ari, Septiana Hariyani, Dwi Maulidatuz Zakiyah, Rindang Alfiah]

**Abstract**— The good economic growth of Indonesia has not yet been accompanied by a parallel development of infrastructure and institutional capacity on water resource management. A large number of the population still lacks access to safe water and most of the population in villages and remote areas still rely on potentially contaminated water sources. Out of 72.944 villages, only 7.474 villages have been intervened and supported to establish community based organization to manage local water supply services. Water resource management is the activity of planning, developing, distributing and managing the optimum use of water resources. Much efforts in water resource management is directed at optimizing the use of water and in minimizing the environmental impact on the natural environment. Sumberawan is one of plateau villages in Malang regency which has a water management based on community participation. From this research, we investigate the extent to which different forms of community participation explain in HIPPAM sustainability using data collected from 100 rural communities in Sumberawan. Data sources include household surveys and interviews with water committees and village leaders. HIPPAM is an abbreviation for a residents' association of drinking water users, a voluntary association of villagers which creates and manages a piped water supply system within the scope of the local community. There are various tools and methods which can be used to identify the depth of community members' participation on rural water system. Social Network Analysis (SNA) used here to investigate social structures through the use of network and graph theories. The result shows the depth of community members' involvement in water handling is positively associated with HIPPAM sustainability. It is enhanced by household members' participation in management-related decisions. The existence of power relations is inadequate to drive community members to reach a common goal, but they have moderately strong social ties within the community, with a lack of bridging social capital. **Keywords**—*water resource; sustainability; community involvement*

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## I. Introduction

In line with the new Development Agenda 2030 on SDGs, sustainable water management in Indonesia requires an emerging paradigm change through integrated approaches and dynamic interactions to stimulate an interaction between hydrology, environment, and social factors. To support SDG's programs, Indonesia has a policy and strategy in national medium term development plan 2015-2019 about water and sanitation universal access. The strategies of them are optimization of domestic water balance; provision of productive infrastructure; water and sanitation synergy; and improving the efficacy and efficiency development financing.

It means that water management needed to manage the optimum use of water resources. Ideally, water resource management planning has regard to all the competing demands for water and seeks to allocate water on an equitable basis to satisfy all uses and demands. As with other resource management, this is rarely possible in practice, but we found this possibility in an HIPPAM system in Sumberawan Hamlet.

HIPPAM (*Himpunan Penduduk Pemakai Air Minum*) is a voluntary association of villagers to manage the system of water supply distribution within the scope of the local community. Sumberawan Hamlet in Malang Regency not only became water secure but also managed to provide a welfare solution through community participation. Based on the social network analysis of this research, social capital has a huge influences to the rural water management system in Sumberawan. Social capital of the villagers focus on social relations that have productive benefits of the domestic water balance.

Social capital can be defined as non-formalized networks that are used by the networks' nodes/actors to distribute norms, values, preferences and other social attributes and characteristics [1]. Social capital is defined by its function. It is not only a single entity, but a variety of different entities having two characteristics in common: They all consist of some aspect of social structure, and they facilitate certain actions of individuals who are within the structure [2].

HIPPAM's Sumberawan system is one of the best practice in water resource management system in Indonesia which has the high value in social capital to create the sustainable water security system in rural areas. This system can be adopted to increase water management in other villages of Indonesia towards SDG's targets in availability, sustainability and affordability of water and sanitation for all.

## II. Study Area

Malang is a one of regencies in East Java. It had a population of 2,544.315 at the 2015 Census, excluding the areas and populations of the two autonomous cities of Malang and Batu which geographically lie within the regency but are administratively independent of it. Malang Regency is the second largest regency in East Java after Banyuwangi Regency. It has a total area of 3,534.86 km<sup>2</sup> and a population of 2,544.315 inhabitants (2015 Census). This regency is also known as a region rich in potential including from agriculture, plantation and medical plants and is also known for tourism.

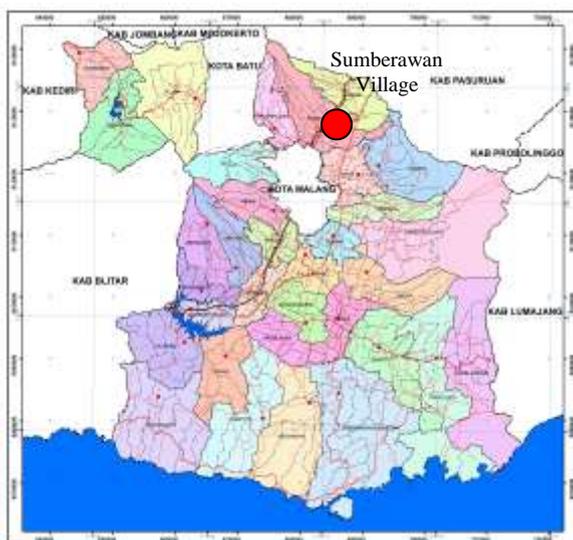


Figure 1 Administrative of Malang Regency, 2015

Sumberawan is one of hamlets in Malang Regency which is nearby to three mountains, (Gunung Kembar, Gunung Budukusu and Gunung Jugrug). Sumberawan is located in Latitude 7°48'52.2" (7.8145°) south; Longitude 112°37'32.9" (112.6258°) east with the average elevation are 1.160 meters (3.806 feet).

## III. DATA SETS

Survey research is a commonly used method of collecting information about a population of interest. In this research, we used questionnaires and interviews method to collect information from individual (residents of Sumberawan Hamlet) about their opinion of HIPPAM's performance in controlling the Sumberawan wellspring system.

## IV. RESULT AND DISCUSSION

### A. Water Supply System Development in Sumberawan Hamlet

Water pipeline of Sumberawan Hamlet was developed by KOSTRAD (Army Strategic Reserve Command) in 1961 to utilize Sumberawan wellspring for supplying their water requirement in Ardumulyo village. Second, in the period of 1962-1963, BLKI (Industrial Education Training Center) Singosari developed another water pipeline there to supply their building in Ardumulyo village. Third, gradually from

1962 to the 1980s other water pipelines were constructed by two divisions of Indonesian Army and Indonesian Air Force in Singosari district.



Figure 2 Timeline of Development Water Resource System

Between 1991 and 1992, a group of ABRI conducted their social responsibility program on water management. One of their activities was constructing a water transmission pipeline network from Sumberawan wellspring to Ngujung hamlet, whereby the pipeline network followed the earlier pipeline of PDAM (local government-owned water utilities). Pipeline from the wellspring was developed along the river in the southwest of Sumbrawan hamlet and transmitted water to a main reservoir in Ngujung hamlet. Then, this public hydrant motivated residents in Ngujung hamlet to develop piped clean water connections to houses and to establish their first and only HIPPAM group in the hamlet.



Figure 3 Dam of Sumberawan Wellspring

Around 1994, villagers of Sumberawan hamlet started to construct their own piped clean water supply system with connections to houses, as well as to develop some public hydrants. They interested in getting a good access of water supply too likes their neighbor in Ngujung Hamlet. The residents of Sumberawan tried to organize and control the water distribution system by their selves. Then, over the time, as the number of users increased, in 1996 the community leaders initiated a grouping of the users into 4 HIPPAM groups, namely Gotong Royong I-IV. Around 1996, there were also initiated the establishment of another HIPPAM group called HIPPAM Sumber Banyon. The growth of the community-managed water supply system in Sumberawan hamlet seems to be an effect of the flow of information among residents, driven by the leader of the hamlet, enabling members to achieve their common goal of having piped access to water.



Figure 4 Reservoir and Pipeline Network of Sumberawan Wellspring

The development of rural water system in Sumberawan hamlet explain the important of public participation with the good cooperation between villagers and also because of the good leadership of them.

### B. Social Network Analysis

Study about Third World migrants from rural areas to cities in early 1970s, inception notion of social network using network concepts began. The migrants would become rootless members of urban mass society because they were no longer members of solidary village communities (Kornhauser, 1968) [3]. Network analysis study about deep structure social system which is often complex. Network analyst try to describe these pattern and use their descriptions to learn how network structures shows about social behavior and social change in the network. All ties are studied by network analyst, not just the residual node that crossed group and category boundaries.

Social network is defined by the relationship between units or nodes in the network. By assuming a social network represents communication, centrality classified into three classes which is degree, closeness and betweenness by Freeman (1978) [4]. Wasserman and Faust (1994) [5] defined a social network as a sets of node connected by a link between each nodes. There are four parts of social network analysis namely:

1. Action by the actors in network system
2. relational between ties shown in linkage
3. Individuals view in the network structure that shows by Network models
4. Relations between actors/node shown by network models

The steps and results of SNA are:

#### 1) Affiliation Network

In this study, the units in a network are actors that affiliated in fulfilling the needs of clean water in the Sumberawan hamlet. Relationships between actors can be seen from the participation of the institutions in Sumberawan Hamlet. Slovin formula used to calculate number of respondents in this study that produces 100 households drawn randomly in Sumberawan Hamlet. Table 1 illustrates an example of respondents' membership in community groups in a shape of incidence matrix. In this data, we put "1" for respondents who join in community group and "0" for respondent who not join to community group.

TABLE 1. AFFILIATION NETWORK OF RESPONDENT BY COMMUNITY GROUPS MATRIX

RESPONDENT	PKK	Religious	HIPPAM	Local Group	Other
Ahmad Sayuti	0	1	1	0	0
Sumiati	1	1	1	0	0
Wariyatin	1	1	1	0	0
Alfiah	0	0	1	0	0

RESPONDENT	PKK	Religious	HIPPAM	Local Group	Other
Hj. Siti	0	1	1	0	0
Siti Alfiah	1	1	1	0	0
Kasiati	1	1	1	0	0
Dito Harmadi	0	0	1	0	0
Sunarni	1	1	1	0	0
Sugiyarti	1	1	1	0	0
Widyanti	0	0	1	0	0
Suprpto	0	1	1	0	0
Solikhah	1	1	1	0	0
Tasrih	0	0	1	0	0

From that matrix, we can continue to see ties between members in community groups in Table 2 which illustrates the relation between respondent due to their participation in one similar community group in a share of adjacency matrix. In this table, we can see that there are a relation in each actor. The diagonal cell are set to zero due to ties a respondent to him/herself.

TABLE 2. RELATION EACH ACTOR MATRIX

RESPONDENT	AS	S	W	A	SS	SA	K	DH	S	S
Ahmad Sayuti	0	1	1	1	1	1	1	1	1	1
Sumiati	1	0	1	1	1	1	1	1	1	1
Wariyatin	1	1	0	1	1	1	1	1	1	1
Alfiah	1	1	1	0	1	1	1	1	1	1
Hj. Siti S	1	1	1	1	0	1	1	1	1	1
Siti Alfiah	1	1	1	1	1	0	1	1	1	1
Kasiati	1	1	1	1	1	1	0	1	1	1
Dito Harmadi	1	1	1	1	1	1	1	0	1	1
Sunarni	1	1	1	1	1	1	1	1	0	1
Sugiyarti	1	1	1	1	1	1	1	1	1	0

#### 2) Centrality

Centrality analysis is used to determine the strength and influence of the most responsible individual or node in Sumberawan Hamlet. Centrality gives an indication about the size of the actor who have a power in community refers to their interconnected in a network. In this study, measurement of centrality is indicated by three indices – degree centrality, closeness centrality, and betweenness centrality, referring to formula that is developed by Wasserman & Faust (2009). Thus, it will be easier to determine the power of community in Sumberawan Hamlet. For degree and betweenness centrality calculations, all respondent is used without considering isolated respondent. Meanwhile, to calculate closeness centrality, used respondents included in the network. That is, respondents who are isolated or do not follow at all institutions included in the calculation.

TABLE 3. CENTRALITY OF RESPONDENT IN SUMBERAWAN HAMLET

	Member of HIPPAM, g = 100		
	C <sub>D</sub>	C <sub>C</sub>	C <sub>B</sub>
Centrality			
Mean	0,91	0,92	0,088
Min	0,63	0,73	0
Max	1	1	0,16
Std Dev	0,11	0,08	0,08
Variance	1,33	0,76	0,007
Level of Centrality			
0 – 0,333	0	0	100
0,334 – 0,666	12	0	0
0,667 - 1	88	100	0

By the calculation, shown the value of degree centrality, closeness centrality and betweenness centrality, we can see that all of respondents in Sumberawan Hamlet are interconnected without any isolated respondent. The high value of closeness followed by a very small value of

betweenness. It indicates that there is no respondents dominate as the main actor with the highest value in the calculation of centrality. All respondents have the same role in the development of HIPPAM community.

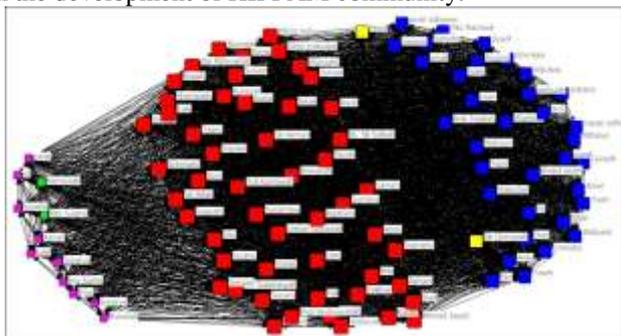


Figure 1 Degree Centrality netdraw of respondent in Sumberawan Hamlet

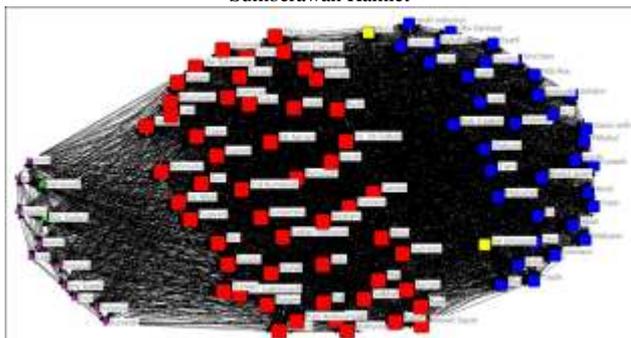


Figure 2 Closeness Centrality netdraw of respondent in Sumberawan Hamlet

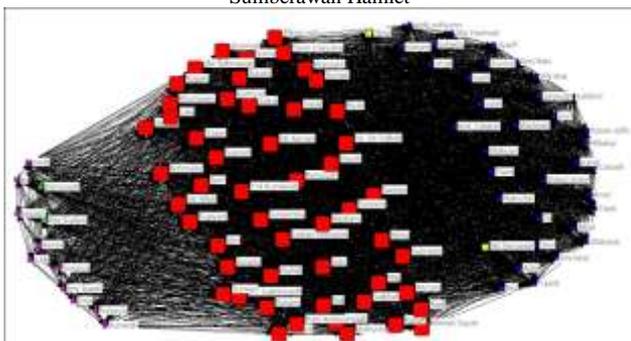


Figure 2 Betweenness Centrality netdraw of respondent in Sumberawan Hamlet

### 3) Density

Density analysis is used to scrutinize the large of density in a network. Density shows how each node connected and how large their connections. The density ranges between 0-1, with the following formula

$$\Delta(N) = \frac{\sum_{i=1}^g \sum_{j=1}^g x_{ij}^N}{g(g-1)} = \frac{2L}{g(g-1)}; i \neq j \quad (1)$$

$\Delta(N)$  = The density / density relationship

$g$  = node / respondents with an affiliate network with other respondents

$(g-1)$  = Node / respondents isolated

$x_{ij}^N$  = Primary matrix of respondents  $i$  to  $j$

$L$  = the number of lines connecting the respondents

The Calculation of density analysis in Sumberawan hamlet shows a result as 0,914. The value is close to 1 means that all of respondent in Sumberawan hamlet is connected each other with good participation not only in

HIPPAM community, but also in other community around them.

### 4) Rate of Participation Analysis

The level of participation seen from people who joint community group in Sumberawan Hamlet. The level of public participation is calculated using formula (2):

$$\bar{a}_{i+} = \frac{\sum_{i=1}^g \sum_{j=1}^h a_{ij}}{g} = \frac{a_{++}}{g} = \frac{\sum_{i=1}^g x_{ij}^N}{g} \quad (2)$$

$g$  = code / respondent

$n$  = number of institutional

$x_{ij}^N$  = primary matrix of respondents  $i$  to  $j$

There can also be obtained from the calculation by total of Diagonal Matrix divided by Number of Respondents. Category level of participation be divided into three categories, such as:

TABLE 4 LEVEL OF PARTICIPATION CATEGORY

Category	Level of participation
Low	0-1,66
Medium	1,67 – 3,33
High	3,34-5

**Rate of Participation = Sum of Diagonal Matrix / Numb of Respondents = 173/100 = 1,73 ≈ 2**

Table 4 shows that rate of public participation is on 1.73 or we can say 2 in a medium category. It means, each respondent joined 2 communities. The participation rate defines the average number of community membership in the existing institutions. There are four institutions in the Sumberawan hamlet. The calculation can be seen that the public follows two same institutions including HIPPAM. Therefore, the level of public participation classified as medium.

## V. CONCLUSION

Based on the result of social network analysis which is centrality, density and rate of participation, we may know that there are a good social capital in Sumberawan Hamlet. All people is connected by community which help them to increase their independence on rural water management. They are three types of social capital (Putnam, 2000) [6]: bonding, bridging and linking. In addition to the bonding social capital in the form of helping those close to them, in this case is bonding between members of HIPPAM community. All benefit of joining HIPPAM community obtained only by member. Different with bonding social capital, bridging and linking social capital exchanges information in which people provided and shared information with other community. In this study, there is only shows the bridging social capital which exchange information between HIPPAM to other community in same level. But, they not represented linking social capital yet. Because they can't exchange information to different level of community. There is no good link to the government that can help them to increase the quality of HIPPAM community.

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