Participatory Approach to Community Based Water Supply System

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by

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Abstract
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Having access to safe drinking water is one of the most indispensable human necessities. WHO (2010) stated that six out of the seven people without access to an improved water source live in rural areas, moreover, regarding UNICEF (2004) the number of urban residents without adequate water services is increasing rapidly. Consequently, estimates of access to safe drinking water are a cornerstone of most international assessments of progress toward solving global and regional water problems, particularly to reach target 10 of the Millennium Development Goals (MDGs) that reduces by half the proportion of people without sustainable access to safe drinking water by 2015.

There is a mechanism that inhabitants who live near the water resource cannot develop the water resource with their value. In line with the report of Asian Water Development Outlook (AWDO) that the future water crisis in Asian countries, it will not be because of physical scarcity of water, but because of inadequate or inappropriate water governance, including management practices, institutional arrangements, and socio-political conditions, which leave much to be desired (The 1st Asia Pacific Water Summit in 2007).

Under collaboration activities for water supply system by community members who live close to the water resource has examined in many countries. Collective action may be defined as action on the part of one or more people striving to achieve objective or satisfy common interest of the group, implies devising frameworks that limit the pursuit of individual self interest and sustain the benefit shared by the group. In this sense, we may assume that community based water supply system is one of strong alternatives to existing water supply system by the public sector. Thus, this dissertation focuses on participatory approach as an effective and sustainable water management system based on the view points of human security and well-being, and demonstrates the role of participatory approach in promoting water availability and accessibility.

Main objective of this dissertation is to investigate participatory approach to community based water supply system through social network analysis and spatial autoregressive probit model with respect to empirical research on community based water supply system in Indonesian rural area. Next, we assume that community based water supply system is one of strong alternatives to existing water supply system by the public sector. Then, we formulate a hypothesis that households with better community tie have ability to organize "community based" water supply system. Last, in this research we might argue that we able to provide a significant hint to answer the ‘incomplete’ knowledge between the linkage of collective action theories and the social capital approach that is searched by social capital researchers up to now as mentioned by Ostrom and Ahn (2003).

The whole dissertation consists of 7 chapters in which the following paragraph explain each chapter in to more detail.

Chapter 1 describes basic idea of the research about participatory approach to community water supply system, rationale and objective of the research, as well as methodology and contribution of the research to the body of knowledge. Inception of this research is driven by the

belief that community based water supply system is one strong alternatives to existing water services by the public sector with respect to Indonesian rural case study. This research attempts to develop theory as well as analytical model of household's social interaction as an essence in participatory approach. Thus, the research presented in this dissertation may enrich research theory and model in vary disciplines covering engineering and social science, as well as empirical research whereby the result will bring possibility for development better policy in water governance, particularly in case of developing countries.

Chapter 2 investigates literature review about social capital in collaborative action and voluntary association as the basic driven of the research. In this sense, it assumes that participatory approach is an effective and sustainable water management system in the view points of human security and well-being, and it demonstrates the role of participatory approach in promoting water availability and accessibility.

Chapter 3 portrays chronological and institution of community water supply system with respect to research area. In the inception development of water supply system, there was a mechanism that inhabitants who live near the water resource could not develop the water resource with their value and even more for several decades they were excluded from the piped clean water system that is constructed exclusively for certain community in a particular territory. Next, initiation of establishment of HIPPAM group is driven by internal notion of the community itself whereby they mimic their neighbor's behavior in Ngujung hamlet on establishment community based water supply system called HIPPAM Air Minum Bersaudara. Construction of public hydrant in Ngujung hamlet by Indonesian Army as part of the Social Responsibility Program gave stimulation to the residents to develop their community based water system that able to serve piped clean water connection to house. Last, scrutinize more detail about the development process of HIPPAM in Sumberawan hamlet wherein formal and informal leaders drive the residents to joint participate in HIPPAM groups. This case is quite different from Ngujung and RW 6 hamlet whereby decision to join HIPPAM more or less reflects an action of individual households.

Chapter 4 displays result of household questionnaire survey covering eight demographic characters of the households, issue of water supply system, and community network. There are five types' water resources in the research area. The first and the second are households who acquire clean water through piped clean water services with direct connection to house provided by (i) HIPPAM and (ii) PDAM. Whereas, the other three types could be categorized as non piping clean water system consist of individual wells, public hydrant – communal wells and public tap provided by some HIPPAM groups, and river. Multiple memberships in community groups, trust on lending and borrowing, concern to community welfare as well as opinion to living environment may illustrate the presence of social capital among households through their direct and indirect linkages. Moreover, relate to opinion about six closest people for the respondents it is illustrated that instead of all kin consist of father, mother, son, daughter, brother, and sister, generally neighbor is the closest people for respondents, particularly when they live in the same community or within hamlet. In this sense, we may reveal that closeness relationship has negative relation to social capital in which their closeness relationships are lessened sharply through further distance of residential place. Hence, we may conclude that position of the neighbors who live in the same community may give strong ties towards respondents in the research area through their direct face to face contact in the daily activity.

Chapter 5 investigates social network in the community level focus upon pairs of respondents' memberships in community groups employing social network analysis. There are three types community in the research area. The first community is best described as a community with combination between (i) an existence of power relation driven by a formal and informal leader and (ii) a strong social tie within the community which enables them to establish and maintain their community based water management. The second is a community where (i) existence of power relation is less enough to drive the community member to reach a common

goal, but (ii) they have moderate strong social tie within the community, also lack of bridging social capital. This situation may bring their current collective action on managing water supply system may difficult to sustain in the long term. The last community could be describing as the area which has characteristic between the two communities. In this community, there is a power relation but it is not as strong as the first community since the central is just occupying role position as informal leader. Moreover, in general there is moderate high social tie within the community that might enable the community reach their common goal driven by their demographic characteristic such as education background and a quite wide contact with other actor outside the community. Another important thing, in this community they able to 'formalize' their community based water supply system. In this sense, their social tie might bring them to have ability to maintain their community based water supply system in different way than the first community. Thus, in this chapter we may provide evidence about the linkage of collective action theory and social capital approach that bring access to community 'piped' clean water supply system in the community level.

Chapter 6 investigates the choice of individuals to piped clean water supply system that is determined by the influential others' interaction effect as well as the individual's intrinsic effect by employing spatial autoregressive (SAR) probit model. There are three types of weight matrices which are estimated covering (i) geographic distance, (ii) memberships in multiple community groups and (iii) attributes demographic. The entire three type weight matrices W – nearness of physical, emotional and attribute, the estimated parameters ρ show positive and significant result which might us to conclude that households' choice to community based water supply system is interdependent – display social interaction effects of significant respondents on individual households. Next, the entire estimated parameter working place is statistically negative and significant, whereas estimated parameter education is positive and significant for the six weight matrices W – geographic distance and community group, except the attribute weight matrix W which is statistically positive but insignificant. In this sense, we may argue that households' behavior is also determined by their own local effect with respect to the six weight matrices W – geographic distance and community membership. Thus, through spatial autoregressive (SAR) probit model we might provide evident that individual households' behavior is determined by social interaction effect of the significant others on individual households as well as by their own local effect of the individual households that is represented by nearness of physical and emotional.

Chapter 7 there are two topics for future research as follows. First, it is necessity to investigate the institution identity of community based water supply system as a part of proposing appropriate water governance in order to establish a more sustained collective action. Second, it is necessity to scrutinize into more detail the relation between social capital and power relation which we may assume that there is a significant influence from the prominence actor on choice to access community based water supply system. This remains a subject matter for the future research.

Dedicated to my beloved father Hari Subagijo and my dearest mother Irahwati, all my lovely Sisters and Brothers, and all my great Niece and Nephew

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Acknowledgments

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Chapter 1
Introduction

1.1 Participatory Approach of Community Based Water Supply System

Having access to safe drinking water is one of the most indispensable human necessities. WHO (2010) stated that six out of the seven people without access to an improved water source live in rural areas. Moreover, regarding UNICEF (2004) the number of urban residents without adequate water services is increasing rapidly. Consequently, estimates of access to safe drinking water are a cornerstone of most international assessments of progress toward solving global and regional water problems, particularly to reach target 10 of the Millennium Development Goals (MDGs) that reduces by half the proportion of people without sustainable access to safe drinking water by 2015.

There is a mechanism that inhabitants who live near the water resource cannot develop the water resource with their value. In line with the report of Asian Water Development Outlook (AWDO) that the future water crisis in Asian countries, it will not be because of physical scarcity of water, but because of inadequate or inappropriate water governance, including management practices, institutional arrangements, and socio-political conditions, which leave much to be desired (Bird et.al, 2008).

Under collaboration activities for water supply system by community members who live close to the water resource has examined in many countries. Collective action may be defined as action on the part of one or more people striving to achieve objective or satisfy common interest of the group, implies devising frameworks that limit the pursuit of individual self interest and sustain the benefit shared by the group. In case of Indonesia, among total 231.6 million inhabitants only around 49.7% of the citizen has access to water which its 10% is obtained through community based water management (Statistic Centre Board, 2005). In this sense, we may assume that community based water supply system is one of strong alternatives to existing water supply system by the public sector.

In order to support and sustain the participatory approach to community based water supply system, it is necessary to clarify the mechanism and to invent institutional system for support the collaboration activities. However, there are not enough investigations on the participatory approach to community based water supply system. Necessitate of better understanding about local community structure and network is urgent toward encouraging suitable water policy and institutional restructuring.

Therefore some questions arise - Why people are involved in establishing the community

based water supply system in order to access water?, Whether their choices to join the community based water supply system are cooperated or not?, Why people do or do not engage in a kind of collective action? It is important to investigate the mechanism of the voluntary collaboration to access water. Here, we formulate a hypothesis that households with better community tie have ability to organize "community based" water supply system.

Moreover, we raise further questions as follows: (i) How do the access to clean water in the research area? (ii) Why only a few residents get access to piped clean water system? (ii) Who are they – the people who have option to piped clean water system and the people beyond the piped clean water system? (iii) What are their opinions towards current water supply system? It is important to scrutinize the situation of the resident with access to piped clean water system in order to understand their choice to the clean water system. And, it is necessary to have proper understanding from the real context in order to be able to propose appropriate water governance whereby the ultimate goal is to give discordant thoughts to open more possibility access to clean water for all as targeted in the Millennium Development Goals (MDGs).

1.2 Rationale of the Research

Participatory approach has been underlined in recent development projects which toward value-oriented development, capability-oriented development, and human right-oriented development. Participatory approach takes a form of coordinated action for providing public service based on mutual decision making, operation, and management; and stimulates better matched services corresponding diverse needs than those provided by government and private company, and secures fair and adequate price of the service for the engaged civic members.

This dissertation focuses on participatory approach as an effective and sustainable water management system based on the view points of human security and well-being, and it demonstrates the role of participatory approach in promoting water availability and accessibility.

Under the water scarcity, there are many examples of self-help interaction and voluntary action to provide water service. However, the collective action is hard to ensure. Rational choice theory and classic agency theory demonstrate collective action with self-interest based motivation. Their basic idea is that people will join in collective action only when he/she can expect rewards from his/her participation, e.g., not only pecuniary benefit but also non-pecuniary benefits such as reputation, honor, prestige, authority, power, and position. That is, it depends on outcome of collective action. The failure of collective action has modeled as prisoner's dilemma and free-rider (or moral hazard) problem (Olson, 1965; Hardin, 1968, 1978). The point of prisoner's dilemma could be demonstrated as a situation where communication

failure and tit-for-tat strategy – e.g., **'**I will help you if you help me**'** - occur partner's treachery. The point of free-rider problem could be demonstrated as a situation where cost and benefit sharing arrangement failure occurs partner's moral hazard and no obligation. The failure of collective action might be caused by the failure of coordination.

As the resolution of the failure of collective action, Hardin (1968, 1978) argued that the commons could be privatized or kept as public property to which rights to entry and use could be allocated. He argued that if we do not act in one of these two ways - private enterprise (controlled by market) and socialism (controlled by regulation), we acquiesce in the destruction of the commons. The collective action models based on rational choice theory and classic agency theory depict the society without humanity – such as social capital (e.g., trust and norm), communicative action (e.g., consensus on plan or rule), and responsibility. Fracois and Vlassopoulos (2008) reviewed a lot of papers about pro-social motivation of provision of public good and argue that pro-social motivation has effects on the provision of public good. Collective actions not only depend on cost-benefit sharing, but also mobilizing people to trust, share knowledge, and collaborate on solution itself. Social capital and communicative action could facilitate collective action, using exist mutual understanding and coordination based on mutual adjustment of members. Community based water provision actions are the example to provide water for supporting each other through mutual understanding, mutual philia (i.e., friendship), mutual aid in the day-to-day collaboration. In addition, Hardin's two solutions could not consider moral right to life and simplification problem. Lohmann (1992) said that the nonprofit, voluntary, or philanthropic behavior based on mutuality and fairness is a partial resolution.

1.3 Objective of the Research

Main objective of this dissertation is to investigate participatory approach to community based water supply system through social network analysis and spatial autoregressive probit model with respect to empirical research on community based water supply system in Indonesian rural area. Next, we assume that community based water supply system is one of strong alternatives to existing water supply system by the public sector. Then, we formulate a hypothesis that households with better community tie have ability to organize "community based" water supply system. Last, in this research we attempt to provide appropriate answer of the 'incomplete' knowledge between the linkage of collective action theories and the social capital approach that is searched by social capital researchers up to now as mentioned by Ostrom and Ahn (2003).

In addition, household questionnaire survey was distributed to 500 selected respondents consist of the husband, the wife or the head of family that are chosen so as they represent

households. Therefore, in this dissertation we will use expressions of 'respondent' and 'household' interchangeably.

Furthermore, in this dissertation our analysis focuses upon access to 'clean' water with two main purposes. First purpose is for the fulfillment of basic needs of drinking water whereby it requires cooking process to become drinkable. Secondly is for the fulfillment of other domestic purposes such as cleaning and bathing. Thus, we may use terms of 'clean water' in the same meaning with 'drinking water'.

1.4 Research Methods

There are two main research methods in this research with respect to empirical case on participatory approach to community based water supply system in Indonesian rural areas. First method is implementing social network analysis through measure of centrality, and rate of participation and size of events in multiple memberships in community groups. The purpose is to capture important theoretical insights about the position of central respondents and their social ties in memberships of community associations which describes structure of social network that is developed in the community. The second method is spatial autoregressive (SAR) probit model to define the effect of social interaction upon respondent choices in water supply system. Moreover, Markov Chain Monte Carlo (MCMC) is adopt to estimate parameter covering three types weight matrices - geographic distance, memberships in community groups and demographic attributes to show the existence of social interaction between households.

1.5 Contribution of the Research

This research attempts to develop theory as well as spatial choice model of household's social interaction as an essence in participatory approach. Hence the finding in the research will give important notion of developing appropriate water governance which may open wider possibility access to clean water for all. Thus, the research presented in this dissertation may enrich research theory and model in vary disciplines covering engineering and social science, as well as empirical research whereby the result will bring possibility for development better policy in water governance, particularly case in developing countries.

1.6 Structure of the Dissertation

The following Figure 1.1 describes structure of dissertation consists of 7 chapters in which the following paragraph explain each chapter in to more detail.

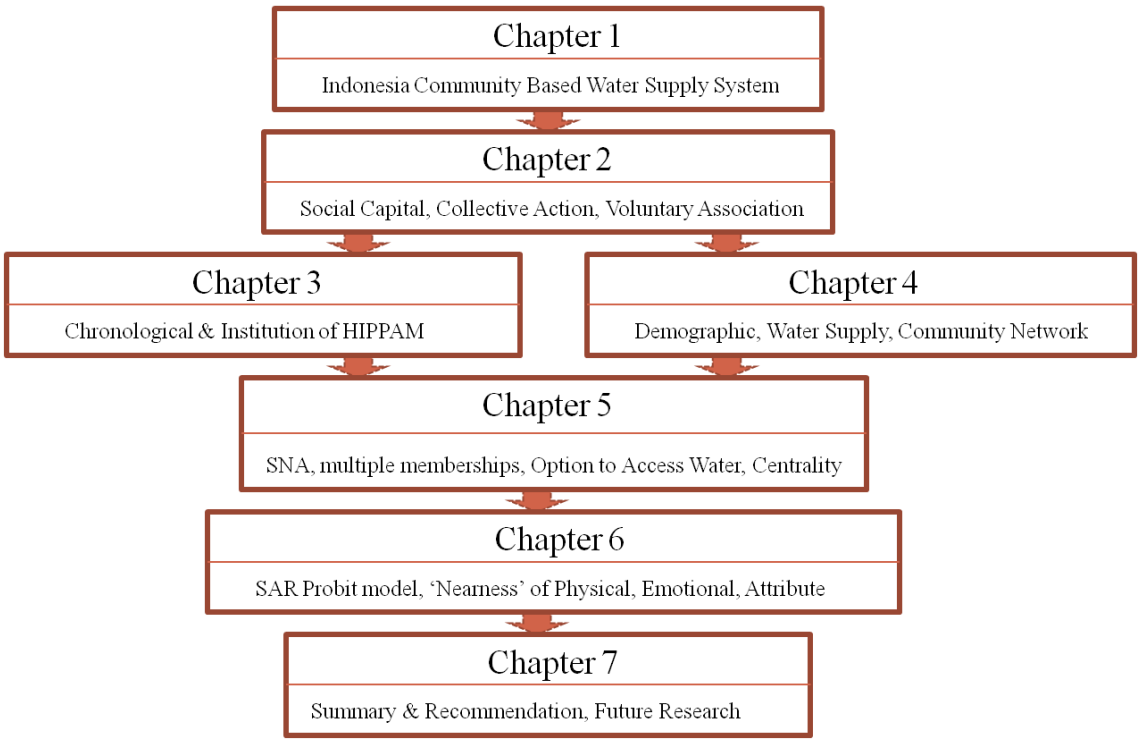

Figure 1.1 Structure of Dissertation

Chapter 1 describes basic idea of the research about participatory approach to community water supply system, rationale and objective of the research, as well as methodology and contribution of the research to the body of knowledge. Inception of this research is driven by the belief that community based water supply system is one strong alternatives to existing water services by the public sector with respect to Indonesian rural case study. This research attempts to develop theory as well as analytical model of household's social interaction as an essence in participatory approach. Thus, the research presented in this dissertation may enrich research theory and model in vary disciplines covering engineering and social science, as well as empirical research whereby the result will bring possibility for development better policy in water governance, particularly in case of developing countries.

Chapter 2 investigates literature review about social capital in collaborative action and voluntary association serve as a grand knowledge of the research listed as the following three statements. First, it is critical subject to develop effective and sustainable water management system based on the view points of human security and well-being wherein as for the measure, participatory approach to water management is predictably-effective. Second, in social capital

there are ties that relate between actors or agents embedded in that in a result it may bring their movement to pursue their common goal. Third, there is no universal solution to deal with the problem of voluntary association due to their diverse characteristics, as well as legitimacy which it's local and individual contexts.

Chapter 3 portrays chronological and institution of community water supply system with respect to research area. In the inception development of water supply system, there was a mechanism that inhabitants who live near the water resource could not develop the water resource with their value and even more for several decades they were excluded from the piped clean water system that is constructed exclusively for certain community in a particular territory. Next, initiation of establishment of HIPPAM group is driven by internal notion of the community itself whereby they mimic their neighbor's behavior in Ngujung hamlet on establishment community based water supply system called HIPPAM Air Minum Bersaudara. Construction of public hydrant in Ngujung hamlet by Indonesian Army as part of the Social Responsibility Program gave stimulation to the residents to develop their community based water system that able to serve piped clean water connection to house. Last, scrutinize more detail about the development process of HIPPAM in Sumberawan hamlet wherein formal and informal leaders drive the residents to joint participate in HIPPAM groups. This case is quite different from Ngujung and RW 6 hamlet whereby decision to join HIPPAM more or less reflects an action of individual households.

Chapter 4 displays result of household questionnaire survey covering eight demographic characters of the households, issue of water supply system, and community network. There are five types' water resources in the research area. The first and the second are households who acquire clean water through piped clean water services with direct connection to house provided by (i) HIPPAM and (ii) PDAM. Whereas, the other three types could be categorized as non piping clean water system consist of individual wells, public hydrant – communal wells and public tap provided by some HIPPAM groups, and river. Multiple memberships in community groups, trust on lending and borrowing, concern to community welfare as well as opinion to living environment may illustrate the presence of social capital among households through their direct and indirect linkages. Moreover, relate to opinion about six closest people for the respondents it is illustrated that instead of all kin consist of father, mother, son, daughter, brother, and sister, generally neighbor is the closest people for respondents, particularly when they live in the same community or within hamlet. In this sense, we may reveal that closeness relationship has negative relation to social capital in which their closeness relationships are lessened sharply through further distance of residential place. Hence, we may conclude that

position of the neighbors who live in the same community may give strong ties towards respondents in the research area through their direct face to face contact in the daily activity.

Chapter 5 investigates social network in the community level focus upon pairs of respondents' memberships in community groups employing social network analysis. There are three types community in the research area. The first community is best described as a community with combination between (i) an existence of power relation driven by a formal and informal leader and (ii) a strong social tie within the community which enables them to establish and maintain their community based water management. The second is a community where (i) existence of power relation is less enough to drive the community member to reach a common goal, but (ii) they have moderate strong social tie within the community, also lack of bridging social capital. This situation may bring their current collective action on managing water supply system may difficult to sustain in the long term. The last community could be describing as the area which has characteristic between the two communities. In this community, there is a power relation but it is not as strong as the first community since the central is just occupying role position as informal leader. Moreover, in general there is moderate high social tie within the community that might enable the community reach their common goal driven by their demographic characteristic such as education background and a quite wide contact with other actor outside the community. Another important thing, in this community they able to 'formalize' their community based water supply system. In this sense, their social tie might bring them to have ability to maintain their community based water supply system in different way than the first community. Thus, in this chapter we may provide evidence about the linkage of collective action theory and social capital approach that bring access to community 'piped' clean water supply system in the community level.

Chapter 6 investigates the choice of individuals to piped clean water supply system that is determined by the influential others' interaction effect as well as the individual's intrinsic effect by employing spatial autoregressive (SAR) probit model. There are three types of weight matrices which are estimated covering (i) geographic distance, (ii) memberships in multiple community groups and (iii) attributes demographic. The entire three type weight matrices W – nearness of physical, emotional and attribute, the estimated parameters ρ show positive and significant result which might us to conclude that households' choice to community based water supply system is interdependent – display social interaction effects of significant respondents on individual households. Next, the entire estimated parameter working place is statistically negative and significant, whereas estimated parameter education is positive and significant for the six weight matrices W – geographic distance and community group, except the attribute

weight matrix W which is statistically positive but insignificant. In this sense, we may argue that households' behavior is also determined by their own local effect with respect to the six weight matrices W – geographic distance and community membership. Thus, through spatial autoregressive (SAR) probit model we might provide evident that individual households' behavior is determined by social interaction effect of the significant others on individual households as well as by their own local effect of the individual households that is represented by nearness of physical and emotional.

Chapter 7 summaries the research findings and notes the two topics for future research as follows. First, it is necessity to investigate the institution identity of community based water supply system as a part of proposing appropriate water governance in order to establish a more sustained collective action. Second, it is necessity to scrutinize into more detail the relation between social capital and power relation which we may assume that there is a significant influence from the prominence actor on choice to access community based water supply system.

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Chapter 2
Literature Review

2.1 Basic Idea

It is about 655 million people or around 17.6 percent of the world population still faces lack access to safe water (UNICEF, 2007). Moreover, UNICEF (2007) also reports that about 1.8 million children die annually and about 433 million school days are missed due to diarrhea from the unsafe water and poor sanitation. Water scarcity adversely affects human health and ecosystem as well as economic and social development. Scarcity of water is influenced by various factors covering population growth, technical progress, allocation mechanism, and environmental factors. The cause of water scarcity includes water shortage by overexploitation and deterioration of water quality due to contamination as well as high subtractability and excludability by privatization and conservation policy (Jeong, 2010).

Network of Asian River Basin Organizations (NARBO, 2007) reports about 600 million people in the Asia-Pacific region do not have access to clean water. Rapid growth of economic and population in Asian developing countries sort of China, India, and Indonesia generate an explosive growth in water demand, so that it is most pressing challenge to search for a safe, secure and reliable water supply measure.

Every country is searching for water supply systems for securing water accessibility for citizen through infrastructure improvement and expanding its services. Nevertheless, it is absolutely not easy to distribute a limited alternative water resource properly and objectively under the budget restrain of government. In order to address the problem, it has the development of technology but what's more enhancement of collaborative governance for water management is essential.

In many developing countries, difficulty of daily access to water occurs in rural areas, economically-deprived areas, and slums in urban areas. The current competition augmented from the rapid socio-economic change deepens the scarcity of water resource and makes the vulnerable residents more suffer. It is critical subject to develop effective and sustainable water management system based on the view points of human security and well-being wherein as for the measure, participatory approach to water management is predictably-effective (Jeong, 2010).

Participatory approach has been underlined in recent development projects leading value-oriented development, capability-oriented development, and human right-oriented development (Jeong, 2010). Then, following her previous statement participatory approach

takes a form of coordinated action for providing public service based on mutual decision making, operation, and management; and stimulates better matched services corresponding diverse needs than those provided by government and private company, and secures fair and adequate price of the service for the engaged civic members.

Under the water scarcity, there are many examples of self-help interaction and voluntary action to provide water service, though, collective action is hard to ensure. Rational choice theory and classic agency theory demonstrate collective action with self-interest based motivation (Jeong, 2010). The basic idea is that people will participate in collective action only when they can expect rewards from their participation, for example due to expectation of pecuniary benefit and non-pecuniary benefits. Olson (1965) and Hardin (1968, 1978) has modeled the failure of collective action as prisoner's dilemma and free-rider (or moral hazard) problem. The prisoner's dilemma could be expressed as a situation where communication failure and tit-for-tat strategy – for example 'I will help you if you help me' - occur partner's treachery. The free-rider problem could be expressed as a situation where cost and benefit sharing arrangement failure occurs partner's moral hazard and no obligation. Finally, she argues that the failure of collective action might be caused by the failure of coordination.

Hardin (1968, 1978) offered two solutions as the resolution of the failure of collective action consist of (i) privatize the commons – the commons controlled by market or (ii) kept as public property – the commons controlled by regulation to which rights to entry and use could be allocated, otherwise we acquiesce in the destruction of the commons. Meaning that the collective action models based on rational choice theory and classic agency theory depict the society without humanity – such as social capital (e.g., trust and norm), communicative action (e.g., consensus on plan or rule), and responsibility (Jeong, 2010). Moreover, P. Fracois and M.Vlassopoulos (2008) argue that pro-social motivation has effects on the provision of public good whereby collective actions depend on cost-benefit sharing, mobilizing people to trust, share knowledge, and collaborate on solution itself. In addition, social capital and communicative action could facilitate collective action, using exist mutual understanding and coordination based on mutual adjustment of members such as mutual aid in the day-to-day collaboration in community based water provision actions. Furthermore, the nonprofit, voluntary, or philanthropic behavior based on mutuality and fairness is a partial resolution (Lohmann, 1992).

This chapter aims to conduct literature review on social capital in collective action and voluntary association of public good to put grand knowledge of participatory approach to water supply system. What are the concept as well as the form of social capital relate to collective

action? What are the characteristic, legitimacy and professionals of voluntary association? How participatory approach mobilize collective action and enable people collaborate? Hence, the remainder of this chapter is consisted of two sections covering social action in collective action in section two and voluntary association in section three. And this chapter will closed by summary in section four.

2.2 Social Capital in Collective Action

2.2.1 The Concept

Within a decade, number of citation in the Web of Science on social capital increased dramatically from 2 in 1991to 220 in 2001 (Elinor Ostrom & TK. Ahn, 2003). Topic on social capital has been broadening discussed ranges across the whole social sciences, from economics, organizational sociology to political science. As a result, varied definition has been given to drawn the notion of social capital. Regarding our research objective, in this paper, we describe the concept of social capital in collective action based on argument of the five scholars as follows.

a) James S. Coleman (1988) clarify that "social capital is defined by its function. It is not a single entity but a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors (persons or corporate actors) within the structure. Like other forms of capital, social capital is productive, making possible the achievement of certain ends that in its absence would not be possible. … Unlike other forms of capital, social capital inheres in the structure of relations between actors and among actors."
b) Robert D. Putnam (2000) defines social capital as "connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them."
c) Francis Fukuyama (2000) defines social capital as an instantiated informal norm that promotes cooperation between two or more individuals.
d) Elinor Ostrom and AT. Ahn (2003) elucidate their definition of social capital as "all forms of capital involve the creation of assets by allocating resources that could be used up in immediate consumption to create assets that generate a potential flow of benefits for some set of individuals over a future time horizon." Furthermore, they scrutiny social capital "as an attribute of individuals and of their relationships that enhances their ability to solve collective action problems" with three significant forms of social capital namely (1) trustworthiness, (2) networks, and (3) formal and informal rules or institutions (2003: xiv).

Social capital such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated action (Bourdieu, 1983; Coleman, 1994). There are many findings that social capital derived from regional cultures, environments, and life style play role to manage commons in marginal areas (K. Kobayashi, H. Westlund, and K.Matushima, 2005). Social capital improves participants' monitoring, reduces free-riders, thus mutual bonds of trust. World Values Survey by World Bank (1991) demonstrates that social trust and civic engagement are strongly correlated; the greater the density of associational membership in a society, the more trusting its citizens. Putnam (1995 and 2000) also argued that quality of public life and the performance of social institutions are indeed powerfully influenced by norms and networks of civic engagement, and successful outcomes are more likely in civically engaged communities. As mentioned by Marc (2008) that "this definition is in broad agreement with major sociological researchers in the field who have defined social capital primarily as the characteristics of social networks and the resources embedded in these social ties."

Taylor (1993) demonstrated two roles of social norm. First role is to bring about cooperation is in coordinating the expectations of players in a repeated game. Social norms might provide the players with the correlated expectations that would enable them to overcome this problem (Kreps, 1990a and 1990b; Taylor, 1993). Second role is to bring about cooperation. Normative belief provides him/her with a motivating reason to act or in some other way influences his/her behaviour independently of the effects of sanctions. Normative motivations facilitate mutually beneficial exchanges of various kinds, exchanges that would not be consummated by rational egoists lacking such capital (Coleman, 1990; Putnam, 1992)

Alesina and La Ferrara (2000) show homogeneity within a community leads to higher participation in social activities. In their model membership is costless; group size has no effect on individual utility, and individuals have an exogenous preference for homogeneity within a social group. Barbieri and Mattozzi (2009) show that exogenous heterogeneity typically hampers participation to social activities can be reversed when heterogeneity arises endogenously in a dynamic setting. The role of seniority benefits is twofold: they directly increase the value of membership in the first period, and they introduce heterogeneity between prospective members.

2.2.2 The Forms of Social Capital

From the view of social relations, there are two basic forms of social capital, namely bonding and bridging social capital. The essential difference lies on homogeneity and heterogeneity of the structure relation ties between individuals or groups.

Moreover, Woolcock and Narayan (20006) describe social capital as "the norms and

networks that enable people to act collectively." Kerry et.al (2006), in term of community action, Putnam (1993; 2000) reveals that a well-connected community (i.e. one with "community social capital") should be better able to mobilize local and extra-local resources to effectively act, and indeed, this idea has been empirically supported.

Woolcock and Narayan (2000) identified three major types of social capital, namely:

a) Bonding social capital refers to the relationships that we have with people who are like us; i.e. relations among members of families and ethnic groups;
b) Bridging social capital refers to the relationships that we have with people who are not like us i.e. relationships with people from different socio-economic status and different ethnicity etc.; and
c) Linking social capital refers to the relationships or connections people have with those in power

Woolcock and Sweetser (2002), "bonding social capital refers to connections to people like you [family, relatives, kinship]… bridging social capital refers to connections to people who are not like you in some demographic sense," and "linking social capital pertains to connections with people in power, whether they are in politically or financially influential positions.' Linking social capital also includes vertical connections to formal institutions (Woolcock, 2001; Mayoux, 2001). Bonding social capital is the relationship within a homogeneous group and "bridging social capital tends to bring together people across diverse social divisions" (Field, 2003; ONS, 2001). Bonding and bridging social capital have resonance with Granovetter's ideas of 'strong ties' and 'weak ties' respectively (Krishna, 2008).

Defined by Kerry et.al (2006), bonding social capital, which is the close-knit ties among similar individuals or groups, is said to be good for "getting by," whereas the bridging form, representing "weaker" ties among heterogeneous individuals or groups, connects one to new resources, and is needed to "get ahead." The central difference between the two is whether the ties are homogeneous or heterogeneous. Bonding social capital is "inward looking and tends to reinforce exclusive identities and homogeneous groups" (Putnam, 2000). Bridging social capital, in contrast, connect people or groups who are different from each other in some way and addresses how social capital facilitates resource acquisition. Unlike bonding social capital, where networks are comprised of similar people with presumably similar resources, bridging social capital is crucial in acquiring a wider variety of resources and enhancing information diffusion within and between groups (Putnam, 2000).

It is important to note that evidence from the developing world demonstrates why merely having levels of social solidarity or informal groups does not necessarily lead to economic

prosperity. From the case of Kenya, Narayan and Nyamwaya (1996) conclude that even a participatory poverty assessment found over 200,000 community groups in rural areas, but most were unconnected to outside resources and were unable to lift the poor out of poverty.

Kerry et.al, (2006) reveals that distinction between homogeneous (bonding) and heterogeneous (bridging) ties are also relevant to social capital at the community level. And then, they cited opinion of Woolcock (1998) that the importance of "two distinct, but complementary forms of social capital" in a community – embeddedness and autonomy (p. 162). Embedded ties are those among members of a group, and are characterized by a "high degree of density and closure" (p. 163). Autonomous social ties are those between groups or ties that "provide access to a range of non-community members" (p. 164) that are analogous to vertical ties of bridging social capital. Furthermore, they also noted that according to Paxton (1999), social capital within a single group (bonding social capital) may be positive for that group, but does not necessarily "spill over into … social capital for the community" (p. 96), and she focused on horizontal form of bridging social capital – between-group ties.

Table 2.1. Dimensions of Social Capital at the Community Level

Extracommunity networks (bridging)	Intracommunity ties (bonding)	
	Low	High
Low	Outcasts	Poor villagers
High	Recent rural-to-urban migrants	Successful members of microfinance programs

Source: Woolcock, M., Narayan Deepa, 2000

2.3 Voluntary Association

Regarding Douglas (1987), voluntary association is becoming an integral service resource for providing public service in many developed countries. At least there are three types of organization that could be categorized in voluntary association covering Non-profit organization (NPO), non-governmental organization (NGO) as well as polymorphic organizations. According to Kobayashi et.al (2010), voluntary associations are polymorphic but their common characteristics can be described as follows. First, voluntary associations are not bound to the framework as an association, and second, voluntary associations are based on self motivated and self active participation. Furthermore, they mention that ligament among members is necessary because of the characteristics of voluntary association such as "A association is not organization" and "A free entry and exit association." Many voluntary associations tend to share values and behavior objectives among the members (Douglas, 1987). In Addition, voluntary association is based on trust meaning 'trust on individual resources such as knowledge and skills and the resources such as personality and sincere intention.'

Regarding Kobayashi et.al (2010) there is skeptical views towards ability of voluntary association on providing public service in a sense "whether entrust voluntary association which have limitation of responsibility performance or not." However, they continue their argumentation that motivation to use voluntary association in providing public service is, from the beginning, there is an implied understanding on the possibility that most voluntary associations are bubble-like being, e.g. mission oriented come up and go down. When a new need is appeared, a voluntary association is mobilized in order to response the need. When the need is disappeared, the voluntary association is demobilized. Plural society, as well as, the society has diverse interests, needs a large number of bubbles. Strategic complementarities in generating bubble may arise. If more people join voluntary association, than higher the value of being and well-known observation are employed. However, strategic complementarities are often associated with multiple equilibria, i.e., either nobody joins or everybody joins. Underlined by Waddock (1989) that trust based organization or a legitimate leader can facilitate collaboration formation legitimacy within a stakeholder group. Initial agreement on the problem definition can help clarify the stake or interest that an organization has in resolving the social problem and how much the organization needs other to solve the problem. Trust based legitimated association to select higher value of being, e.g., 'Bubbling up' is necessary. Regional learning approach fosters bubbling up.

Individual behavior is determined by decision making interaction of diverse stakeholders. It is most reasonable to understand that there is a quite small realm which individual can make a decision for maximizing his/her utility independently of the others' action, social custom and system (Kobayashi et.al, 2010). In the case in which single action is realized under the others' decision making and institutional complementarity, there are a lot of equilibria. It could be innumerableness. If an economy gets stuck at a low equilibrium level among the equilibria, a new policy to drive to a higher equilibrium level is necessary. The problem of selecting equilibrium level cannot be solved with traditional pricing policy internalizing of external economy. In order to select high level of equilibrium, 'bubbling up' is necessary. Important thing is whether it is possible or not to move more proper equilibrium by disciplining a bubble-generating mechanism with some way.

2.3.1 Characteristic of Voluntary Association

There is a possible link or connection between nonprofit and voluntary whereby the emphasis on social behavior evident in the voluntary action tradition can be seen as complimentary to nonprofit concept (Lohmann, 1992b). Rose (1960) determined that “voluntary association develops as a small group of people, finding that they have a certain interest or purpose in

common, agree to meet and act together in order to satisfy that interest or achieve that purpose." Moreover, Laskin (1962) and Kerry (1972) in Lohmann (1992b) define voluntary associations as "any private group, voluntarily and more or less formally organized, joined and maintained by members pursuing a common interest, usually by means of part-time, unpaid activities". Then, Smith (1966) in Lohmann (1992b) defines formal voluntary associations as "formal organizations the majority of whose members are neither paid for participation in the organization nor physically coerced into such participation." There is five basic categories of voluntary association encompass: occupational or self-interest; consummatory or self-expressed; philanthropic/funded; issue/cause oriented; and service oriented (Smith 1972; 1974 in Lohmann, 1992b).

Based on Handy (1988)'s classification, according to purpose Tao (1999) classified voluntary organization into three categories as follow (Kobayashi et.al, 2010).

a) Self-help group

   The purpose of this group is to support each other through mutual understanding, mutual friendly, mutual aid in the day-to-day collaboration. Therefore, self-help group is mobilized in more local level and more target specified. This is an original type of voluntary activity. Group members become even a provider or taker of collective service. Because of the characteristics of ambivalent actors, the members tend to delay in taking action of roll-sharing arrangement and management process. Parent-teacher association (PTA) for caring their children, gate ball group of elderly, women's association, resident's association such a community based association for community members, and alcoholics anonymous associated by themselves are the examples of self-help groups. These self-help groups can be developed to service delivery providers when there is surplus of the service.

b) Service delivery provider

   The purpose of this group is to provide service to people who need the service. This group specifies provider and taker of the service, and allocates the surplus service. The allocation of surplus service is enlarged from local level to global level, as well as, from specified target to public. By extending the scale and scope, system development and collaboration of public sector and outer sponsors become important for the sustainable and effective allocation of the service. Many voluntary associations are classified in the service delivery providers.

c) Campaign group

   The purpose of this group is to advocate some specific interest what they engage in. It is

called association of principle. This group's activities more focus on promoting awareness of public and making policy recommendation then providing service. Child poverty action group and Greenpeace are the examples.

There is a diverse definition of voluntary association which its common characteristics could be summarized as (i) free and unforced participation, (ii) common or shared purpose, (iii) common holdings, (iv) mutuality, and (v) fairness or justice (Lohmann, 1992a, 1992b). In general, the basic principle of voluntary association is 'free entry and free exit.' Voluntary association must get agreement on mission among association members in order to mobilize their common resources for the benefit of all members. Governance of voluntary association depends on trust relationship between association members, whereby equality and impartiality is emphasized rather than effectiveness of resource or role allocation of members. Consequently, behavior of voluntary association is controlled by the goal of the association means that the operation of voluntary association is not necessarily effective. In a sense, effectiveness of the operation mostly depends on leadership of the association leader. Meaning that voluntary association is 'sheep without a shepherd' and is not controlled by institutional system, so that voluntary association acts based on self-serving. There is a risk to be a strong interest group against government since government should follow universality principle.

Therefore, in order to produce appropriate public service by voluntary association, trustworthiness relationship between citizen and government as well as between public and voluntary association must be built.

2.3.2 Legitimacy of Voluntary Association

There are diverse voluntary associations that impossible for government to link partnership between all voluntary associations. Government places an exclusive partnership contract with a voluntary association. The legitimacy on 'which voluntary association must be accepted as a valid partnership?', 'whether achievement from the partnership is valid or not?' is important. Suchman (1995) defined legitimacy as 'generalized cognition that an agent or his/her behavior is appropriate and valid in structured system of normative, value, belief and justice. The definition is including the view of outside audience on government behavior. Among the audience, some have negative perspective on an agent behavior, but if the total behavior is accepted and supported, the behavior may have legitimacy.

Furthermore Suchman (1995) classified legitimacy into three categories consist of pragmatic, moral and cognitive legitimacy as follow (Kobayashi and Jeong, 2011).

a) Pragmatic legitimacy

Pragmatic legitimacy is based on whether the result of voluntary association activities affects the promotion of benefit of people who are involved in the voluntary association. Pragmatic legitimacy is given when behaviors of voluntary association bring concrete benefit to beneficiary and when benefit of whole society is expected. Monitoring whether activities and outputs of voluntary association is satisfied in pragmatic legitimacy or not by before-after evaluation is necessary.

b) Moral legitimacy

Second moral legitimacy is based on evaluation whether 'activities of voluntary association based on truster-trustee relationship are right in morality or not.' Evaluations on moral legitimacy are divided into three evaluations; (i) evaluation on output of voluntary association activities, (ii) evaluation on partnering process of voluntary association, and (iii) evaluation on selected trustworthy and abilities of voluntary association. Evaluation on output of partnership with voluntary association represents whether or not there are enough countermeasures in order to reduce negative effects and minimize the sphere of negative effects with consideration on not only for advantaged people but also disadvantaged. That is, the evaluation means whether there is enough countermeasures for reducing negative influence or not. Voluntary association is an organization to carry out specific mission. There is no guarantee that voluntary association considers all concerns and interests of citizen. However, government must evaluate benefit and loss of citizen based on universalism on the output of partnership with specific voluntary association. Sometimes, it is necessary to mitigate individuals and groups who have possibility to loss. The evaluation of partnership process means that the decision making process to contract partnership with specific voluntary association is realized when a fair rule and transparency of the process is ensured. The evaluation on voluntary association is problem whether an actor as a trustee has appropriate payoff structure or not. For example, if a voluntary association has a goal against to benefit, it is difficult to say that the voluntary association has appropriate payoff structure. The judgment on behavior of voluntary association having audience is appreciate or not is realized only when the association has appropriate payoff and ability in order to realize the behavior.

c) Cognitive legitimacy.

The cognitive legitimacy is based on cognition of social necessary on partnership with voluntary association. As legitimacy standards, there is comprehensibility and take-for-grantedness. Comprehensibility indicates whether behavior contents of voluntary association are easy to understand or not. Take-for-grantedness means that sufficient investigations and deliberations on outputs derived from partnership with a specific voluntary association are conducted and social members naturally accept the outcomes from the investigations and deliberations. To consider a behavior as the obvious means that partnership behavior between government and voluntary association become cause of internalization and rigidity in society. In order to solve the internalization of cognitive legitimacy, the two following conditions are necessary; one is to clear up the responsibility boundary of voluntary association. It must be clarified that the judgment of voluntary association based on which validity boundaries. The other is that government must ensure on voluntary association getting technical support from which professional and reflecting whose opinions and also must open the content.

2.3.3 Professionals of Voluntary Association

Kobayashi and Jeong (2011) reveal that a voluntary association's members who produce public service are not necessarily professionals. Users of public service and tax payers consist of diverse stakeholders having various values, such as residents, regional enterprise and any associations. Moreover, scientific and technical judgment by professionals plays important roles in obtaining legitimacy of voluntary association activities. However, there is a dilemma between rigidity and appropriateness in the judgment wherein many voluntary associations and general stakeholders consider the appropriateness of the professional's technical judgment than the rigidity meanwhile professionals are required for rigidity on their judgment. One of the reasons is the gap of validity-boundary between voluntary association, professionals and citizens. Then, there may be conflict between voluntary association and professionals. Meaning to achieve the necessary adjustment, it is necessary for each professional to relativize his/her own validity boundary through communication with other professionals and diverse stakeholders.

Then, Kobayashi and Jeong (2011) continue their previous argumentation that professionals must reaffirm that their perception are derived from limited condition as understanding context of dependent validity boundary in their expert knowledge. Since the validity boundary is often internalized in association, there is a possibility that professional accepts unconsciously. It is necessity to consider that residents have important existential information and local knowledge for social decision. If the validity boundary of professionals is established under the limited

condition, it is not necessary to correspond with validity standard adopted into the location. In this sense, professionals are requested to reflect their validity boundary and to listen to local voice.

2.3.2 Regional Learning Process

Since voluntary association is operated and maintained based on participation across members, question that always arises is "how participatory approach mobilizes the key factors in collective action and enables people collaborate?" Then the answer is always could not be so simple. One of the main reasons is voluntary association as a kind of participatory approach involving vulnerable people who attempt to manage their common goods which the purpose is to ensure coordination and consistency of stakeholders, enhancing empowerment of the vulnerable people, local initiative, and trust. Hence, based on morality and strong belief that coordinated joint voice, the idea of empowerment and local initiative could bring the successful collective action with consideration of vulnerable people to pursue their common goal.

Referring to Tyler (2011) that basically the sources of motivation for people to cooperate could be distinguished as the two following sources:

a) External, and reflects the contingencies in the environment, whereby the environment shapes behavior by altering the costs and benefits associated with various types of behavior.
b) Internal, and is shaped by the traits, values, and attitudes of the person.

Meaning that it is required an instrumental approach involves an authority with ability to give reward and punish for desired or un-desired behavior. Herein Tyler (2011) underlined that social motivations focuses upon creating and sustaining social links between people and groups in a long-term strategy begins with socialization into groups and continues with the exercise of an authority in ways that support and enhances social ties. In addition, this long-term connections are based upon attitudes, emotional connections, shared identities, common values, trust in the character and motivations of others, and a joint commitment to using fair procedures to exercise authority and make decisions. Hence, social is the core factor shaping cooperation in a voluntary association which is linked to the ability of groups to create and sustain supportive social motivations among their members.

Since there is no any universal solution to adjust failure of cooperation which is occurred in specific local and individual contexts, government, enterprise and citizen should collaborate each other and effort to find out solutions of current status. In other words, shared social links is a key element shaping the ability of society and government to motivate cooperative actions on the part of the members of groups (Tyler, 2011). Next, Kobayashi et.al (2010) suggest that

regional learning approaches which foster mutual learning among diverse stakeholders are necessary. There are three approaches to build up regional learning governance; (i) citizen participation approach, (ii) stakeholder approach, (iii) entitlement approach. Firstly, citizen participation approach is one of the ways that government provides a chance of regional learning to citizens by pilot programs. Secondly, stakeholder approach is an attempt to induce behavior changes of stakeholders by education. Thirdly, entitlement approach is a policy to give a chance to residents to involve public service production and policy planning.

In addition for the third approach, it is necessary to give some resources and decision making discretion to voluntary association and residents for their own public service planning and production to realize the active regional learning process. At the same time, it is necessary to require accountability of voluntary association and residents. In this sense, Sundeen (1985) suggests the necessity on consider co-production consist of three forms; (i) participation in producing service (joint creation), (ii) participation in policy decision making process (co-provision) and (iii) providing service resource (co-financing). In case a co-production takes a form of joint creation or co-provision, we may define the level of citizen participation is still low. Meanwhile for a co-production takes a form of co-financing, citizens are required to provide their own resources and assets for the collaboration. In this sense, the first form indicates that stakeholders of the public service might have participants' awareness higher than the second one. In order to realize joint creation, citizen participation to voluntary association is main premise. Brudney (1992) points out the condition for realizing joint creation as below.

- Citizen participation is necessary
- Participation is necessary sound
- It should be collaboration, not custom
- Active participation, not passive
- Taking group relationship into institution
- No relationship with specific individual and association

Next, it is necessary to create (i) institutional frame, (ii) using existed social capital, (iii) third party to evaluate regional learning, (iv) sharing vision in regional learning, (v) sharing sense of crisis, and (vi) leadership emphasizing vision (Wadock, 1989). As a note, an interdependent relationship between government and citizen which enable citizens to get self-sustainability is an ideal relationship whereby these establishing sound truster-trustee relationships will bring the necessary resources together.

2.4 Summary

So far the criticism of social capital is related to diverse concepts, forms and well as difficulty to have a single agreement on how to measure social capital. Nevertheless, we may see social capital as another form of capital that is different from human capital or physical capital for instance. Hence, in social capital there are ties that relate between actors or agents embedded in that in a result it may bring to their movement to pursue their common goal. In a sense of collective action, existence of social capital might reflected by density and cohesion of social ties throughout the community who engage in that it will be an important requirement whether they can achieve their common goal or not. Referring to the fact of low access to water in the research area whereby their area is blessed by abundant water resources, we may assume that one of the reasons is because the community has high bonding social capital, yet it combined with low bridging social capital.

There is no universal solution to deal with the problem of voluntary association due to their diverse characteristics, as well as legitimacy which it's local and individual contexts. There is a basic requirement of existence active participation on trust relationship between association members in order to mobilize their common resources on pursuing the goal. Based on the characteristic of voluntary associations as self motivated and self active participation, we focus our research upon individual choice on access to clean water to investigate their collaborative action. In this sense, it assumes that participatory approach is an effective and sustainable water management system in the view points of human security and well-being, and its important role in promoting water availability and accessibility.

In our research, we might define HIPPAM - a community based clean water supply system as a voluntary association wherein a group of people privately organized and maintained their common interest to serve access to piped clean water for their member by means of part-time and more or less it is an unpaid activities. Herein this research attempt to develop appropriate ways of thinking in the point of view of social capital in collective action on how households in the research area deal with their effort to develop access to clean water through their community based water supply system as a form of voluntary association.

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Chapter 3
Institution of Community Based Water Supply System

3.1 Introduction

Water is one of the most important matters among basic needs for people to survive. It goes to say that water is an essential need, one can live for one month without food, but he/she can only live for 5 to 7 days without water.

Lack of access to a clean water supply is today's world problem. Regarding to 2007 report of Network of Asian River Basin Organization (NARBO), around 600 million people in the Asia – Pacific region live in the area with no connection to water services. This is also true for Indonesia that is as an archipelago country, in the midst of total population 231.6 million inhabitants (2007), around 100 million people or 43% of the total population has no access to water supply. Moreover, among World's Water Resources Problem, Indonesia is categorized as a country that deals with management problem of economic water scarcity (Directorate of Water Resources and Irrigation, 2008). Some of the water resources issues related to drinking water in Indonesia are (i) degradation of water resources, both quantity and quality; (ii) lack of beneficiaries role and community participation; and (iii) suspiciously low effectiveness of government investment on water resources infrastructures due to supply-side approach of investment. Therefore, concern to water demand as mandated in various government regulations, Agenda 21 and Millennium Development Goals, is getting stronger persistently.

According to President Regulation No. 7 Year 2005, The State Ministry of National Development Planning/National Development Planning Agency stipulated 14 important items as the Water Resources Management Target in the national level. Then, seventh of them are as follows.

a) To achieve water resources management pattern in integrated and sustainable manner;

b) To Control the potential of water conflict;

c) To control groundwater usage;

d) To improve the water capacity to fulfil the needs for household, settlement, agriculture, and industry with the priority for domestic use and traditional agriculture

e) To enhance public participation;

f) To improve the quality of coordination and cooperation among stakeholders;

g) To establish sustainable mechanism for water resources financing.

Malang Regency is one of regencies in East Java Province which has plenty of water resources at around 588 numbers. In addition, regarding the result of analysis about Water

Balance Projection by Kabupaten/Kota (Regency/City) of Java and Madura, as a whole Malang Regency is one of the cities with water balance in normal condition classification that there is no deficit month within a given year. However, among total population of 2,389,928 inhabitants, it is only around 24% of citizen has access to piped drinking water system, 13% is supplied by PDAM – a local drinking water company, 10% is supplied by HIPPAM – community managed water system, and small rest of it is supplied by another system (PDAM Malang Regency, 2008). This circumstance is lower than national level that 39.7% people in urban area having access to water through PDAM services, while 10% people in rural area through HIPPAM (Statistic Centre Board, 2005).

There were two conflicts toward water access in Singosari District related to Candi Sumberawan Spring as one of important natural spring for most community in this district, particularly towards four stakeholders comprise of PDAM, HIPPAM, Indonesian Military (Army and Air Force) and Education institution (BLK Industry). It was reported in a local news paper namely Malang Post on May 21st in 2008 that in 2001 there was a conflict between HIPPAM and PDAM. PDAM as a formal drinking water agent forbade HIPPAM groups acquiring fresh water from the spring. But after HIPPAM users protested, then the prohibition was revoked. Second occurrence was on July 1st in 2002, hundreds residents from Toyomarto and Candirenggo Village demonstrated at the vicinity spring with some assertions toward bad performance of PDAM. Customer of PDAM had objection of the PDAM's plan on increasing tariff at 122% started on June but no improvement toward water supply system yet. Moreover, villagers at nearby the spring also demanded the share of profit allocation for village from PDAM's gains in utilizing water resources.

That kind of incident seems having potential to be repeated in the future. At the end of December 2009, there was a community meeting held in Singosari District Hall attended by four types of group related to Candi Sumberawan Spring. The first group consists of HIPPAM groups' management in both Toyomarto and Candi Renggo village. The first village was represented by HIPPAM groups from Sumberawan, Ngujung, and Bodean Krajan hamlets, whereas the latter was from Karangwaru and Tejosari hamlets. Second group was PDAM Malang regency which represented by the head of Production Division. Third group encompasses delegation from the Army, Air Force and BLKI (Industrial Education Training Centre) in Singosari district. Then, the last group consists of the head of three villages – Toyomarto, Candi Renggo and Ardimulyo village, the Secretary of Singosari district, and two delegations from Malang regency – Cipta Karya District and Local Development Planning Agency. The meeting was facilitated by the Community Services Agency from Brawijaya

University and it came out with agreement that all users of Candi Sumberawan Spring will not allow to increase utilization of water, except physical improvement of the pipeline. In addition, in January 2010, those representative people together with the villagers planted Akar Wangi trees to lessen soil erosion as well as to increase soil water absorption in order to conserve the water resource by reforestation surrounding area of the spring.

The problems seems analogous with a statement of the former President of Asian Development Bank, Tadao Chino (2007) that water crisis is essentially a crisis of water governance. Obscurity of water right allocation, tend to bring to further problem such as conflict of water as public goods, water for the base of sustainable societies, as well as water as a key prerequisite for the food security. In this case, it can say that water is a political issue and it is need proper solution from the side of water governance. Additionally, there was a conclusion from Asian Water Development Outlook (AWDO) report that the future water crisis in Asian countries, it will not be because of physical scarcity of water, but because of inadequate or inappropriate water governance, including management practices, institutional arrangements, and socio-political conditions, which leave much to be desired (Bird et.al, 2008).

The complexity problem in water supply system has been studying broadly in this recent decade, but it seems as never ending problem, especially for Asian region as well as in case of overall city and regency in Indonesia. Moreover, having a proper grand knowledge towards local characteristics will help scholars to propose appropriate water governance. Therefore, conducting empirical research is one possibility to develop adequate theory and model that will describe the reality in a better way.

Hence, objective of chapter 3 is to describe the development of water supply system chronologically and to investigate institution of the presence community based water management in the research area. In other words, here we summarize field observation and interview based on 2008 and 2010 field survey. We search the information directly from the field through observation survey in Toyomarto and Candi Renggo village. The first village covered Sumberawan, Ngujung and Glatik hamlet, whereas RW 6, RW 8 and RW 12 are the three hamlets in the latter village. We conducted face to face interview to 16 representative people encompass 2 head of villages - Toyomarto and Candi Renggo - whereby the head of Candi Renggo village was represented by the head of social welfare division, and 6 head of hamlets – Sumberawan, Ngujung, Glatik, RW 6, RW 8 and RW 12. Hence, in order to capture better understanding of the characteristics for each HIPPAM, we interviewed 6 head of HIPPAM groups in Toyomarto village, and another one head of HIPPAM in Candi Renggo village. We organize this chapter consist of 4 sections that is preceded by introduction in the

first part. Then, section 2 reveals general situation of clean water system in Indonesia. In the following section 3, we describe chronological progress of clean water system in the research area and current types of access to clean water. Moreover, we will scrutinize in to more detail the profile of the presence community based water management in section 4. This chapter will finalized with summary in section 5.

3.2 Clean Water Supply System

In accordance with UUD (Indonesian Constitution) 1945 Section 33 Article (2), (3), and (4), the natural resources including water should be managed by the state and optimally used for the prosperity of people. Consequently, water is owned communally by all citizens; and no individual ownership can be claimed over water. The idea also provides the basis for the state right to control – but not to own – water. In other words, the state right to control water is exercised by the government (Samad, 2005).

Part of the first Five-Year Development Plan from period of April 1, 1969 to March 31, 1974 Indonesian government started water service planning in 1969. In 1974 and 1975, supported by the international aid, Jakarta and other cities launched to scale up the water service. In the mid of 1980, local government formed PDAM as an operational body to provide pure drinking water. In 1985, small size of water service plan was designed for small town, which is must have equal level with the infrastructure of urban areas.

Drinking Water Management Institution under the management of Department of Public Works was the previous body of the present PDAM. The organization and management of PDAM are fully under the responsibility of regency/city government in which the PDAM is located. The PDAM as a body of Local Drinking Water Company has the main task to manage the piped drinking water to serve the public. However, regarding PDAM (2001), 80% of 303 PDAMs spread all over Indonesia were in a critical condition whereby they face serious difficulties in financing their risen operational costs as well as efficiency problem make it unable to serve the public optimally. For this reason, generally their coverage service is still focused on supplying the urban area.

According to Law No. 7/2004 on Water Resources, Article 1 (13) that general provision of water right - rights to obtain and to use water or use for various needs is divided into two types. Communal water use rights Article 1 (14) – rights to obtain and use water, and Commercial water use rights in Article 1 (15) – rights to obtain and use commercially. In Article 8 (1) it is stipulated that method to obtain rights for the first type is available for two options of individual and or group targets with purpose for daily basic needs, social needs, and agriculture. It does not

need licence for the capacity equal or less than 2 litter per second with requirement that the utilization will not change the water condition (Article 8 (1)), and it needs licence if the utilization will change the water condition (Article 8 (2)). Meanwhile for the second type of water rights, it is obligatory to have a licence if individual, group or organization will utilize water for the needs of business or commercial use. Next, in Article 9 (1) it is stipulated that use water right can be granted to individuals or corporations with a license from the Government or regional governments in accordance with the relevant authority. Then, it is stipulated in Article 78 (1) that financing of water resources management as intended under Article 77, paragraph (1) should be charged to the Government, regional governments, state-owned/region-owned enterprises that manage water resources, cooperatives, other business entities, as well as individuals, individually as well as in other forms of cooperation.

3.2.1 Coverage Services of Clean Water Supply System

Refer to Data Base of Water Connection in Malang Regency (2008), there are two types of piped clean water supply system in Malang regency. In general, the piped water supply system covers 24 % inhabitants among total population of 2,389,928 inhabitants spread in 33 districts covering 390 villages. First type is a piped drinking water supplied by PDAM Malang regency that was established on June 4th, 1981 with 23 unit branches. Water services of PDAM cover 322,168 or 13% inhabitants in 23 districts covering 117 villages. Second type is a piped drinking water initiated by local community namely HIPPAM (Resident Association of Drinking Water User) and other type of community based water management with different name. HIPPAM groups in Malang regency exist in 31 districts covering 147 villages which it covers 233,583 or 10% inhabitants of Malang regency. And, the last type of community based water management serves 16,995 or 1% inhabitants who live in 4 districts covering 18 villages.

In Singosari district, piped drinking water to household is supplied by PDAM Malang regency unit branch of Singosari district and HIPPAM groups, the presence community based management water supply system in the community level. Total number of inhabitants with access to piped drinking water is only 28% whereby PDAM serves 24% inhabitants and HIPPAM serves another 4% of it. Table 3.1 below summarizes the piped drinking water supply system in Singosari district.

Table 3.1 Piped Drinking Water Supply Systems in Singosari District

No	Village	Water Resources	Capacity Litter/sec.	Number of Population (Person)	Population with Water Services	Services in %	Transmission System	Year of Budget	Organization Management
1	Candi Renggo	Spring	10	14,243	5,050	35	Gravitation	1984	PDAM
2	Pagetan	Spring	7	13,958	3,355	24	Gravitation	1984	PDAM
3	Banjararum	Drill Well	17	10,053	10,755	107	Pump	1995	PDAM
4	Watugede	Spring	3	5,615	7,85	14	Gravitation	1985	PDAM
5	Losari	Spring	5	4,737	1,355	29	Gravitation	1985	PDAM
6	Randuagung	Spring	10	11,543	2,435	21	Gravitation	1985	PDAM
7	Toyomarto	Spring	3	10,145	1,500	15	Gravitation	1999	HIPPAM
8	Klampok	Spring	2	9,338	75	1	Gravitation	2006	HIPPAM
9	Ardimulyo	Spring	15	8,418	7,620	91	Gravitation	1985	PDAM
10	Gunungrejo	Spring	5	7,683	2,500	33	Gravitation	-	HIPPAM
11	Wonorejo	-	-	7,605	0	0	-	-	-
12	Baturetno	Spring	1	7,390	350	5	Gravitation	1985	PDAM
13	Tunjungtirto	-	-	7,242	0	0	-	-	-
14	Tamanharjo	Spring	5	6,574	1,555	24	Gravitation	1985	PDAM
15	Dengkol	Drill Well	15	6,245	1,500	24	Pump	2002	HIPPAM
16	Lang Lang	-	-	5,357	0	0	-	-	-
17	Purwoasri	-	-	4,099	0	0	-	-	-
	Total Population			**140,245**	**38,835**	**28**			

Source: Data Base of Water Connection in Malang Regency, 2008

It is illustrated in Table 3.1 that 35% inhabitants in Candi Renggo village get access to piped drinking water from PDAM that has been operated since 1984. Whereas, in Toyomarto village, there are only 1,500 people who get piped water connection to house among total 10,145 inhabitants (15%), and it comes from HIPPAM that has been operated by local community since 1991. According to Law No. 7/2004 in Article 8 (1), since the HIPPAM utilize fresh water at 3 litter per second, then this community based water management must have a license from the local government of Malang regency. But, unfortunately there is no evident information regarding the license, except in fact the community organizations utilize water from Candi Sumberawan Spring.

Next, referring to observation field result, some residents in Candi Renggo also have access to piped clean water from Cooperative 'Koperasi Primer Tirta Perwita which utilize fresh water from Ken Dedes Pond in RW 6. Then, some residents in Toyomarto village also have access to piped drinking water from PDAM, particularly the residents in Ngujung hamlet. Last are the villagers who do not have access to water pipeline connection either from PDAM or HIPPAM. These residents acquire fresh water from individual well, communal well, public tap as well as river, but the valid statistic data of their numbers are not available. Then from now on, the

residents who fetch clean water from communal well and public tap as the residents who get access to clean water through public hydrant.

3.2.2 Access to Clean Water Supply System

There are two types of fresh water resources utilized by the respondents in the study area. Firstly, surface water consists of natural spring and river. There are three major natural springs called Candi Sumber Awan Spring at 671 meter above sea level and Sumber Banyon in Toyomarto village and Ken Dedes Pond at around 450 meter above sea level in Candi Renggo village. The other surface water comes from two rivers named Sumber Awan River and Petung River flowing away through the area of study. Secondly, shallow ground water is utilized by individual household who builds their individual well to get fresh water for domestic purposes.

Based on categorization of goods, in the beginning, both types of fresh water resources could be categorized as common-pool resources (CPRs) which share a pair of common characteristics (i) their consumption is rival, but (ii) it is non-excludable (Wydick, 2008). Rivalry means that consumption by one person/group/institution precludes consumption by another. In this case, water in the spring or river or shallow ground water that it utilized by A person is one that B person cannot consume it. Excludability means that it is easy to control access to a resource, and to exclude others from consuming it. A person can't exclude B person from using water in the spring, river, as well as shallow ground water to fulfill their domestic purposes. In other words, there is everyone rights to use water from the spring or river or shallow ground water, but their utilization is rival because since one utilize a part of it then there is no rest for others to consume it. Furthermore, the change combination of water usage form the starting point as the common-pool resources will form to different type categorization of goods. In detail, Figure 3.1 shows the categorization of goods by rivalry and excludability.

	Excludable	Non-Excludable
Rival	Private Goods (e.g. banana, tooth brush)	Common-Pool Resources (e.g. forests, fisheries)
Non Rival	Club Goods (e.g. cable TV, honor society)	Public Goods (e.g. light house, national defense)

Figure 3.1 Categorization of Goods by Rivalry and Excludability
Redraw from Wydick (2008)

PDAM Branch Unit Singosari district utilize Candi Sumberawan Spring to supply a piped drinking water the customer in Singosari district. The residents who join PDAM's facility are the residents who officially registered as PDAM's customer and pay monthly charge of water usage. In order to get water services, each house need to construct distribution pipeline from

transmission pipeline that is conducted by an individual or a group of households. For this reason, the residents have to pay their first physical installation of water connection at around IDR 1,500,000 (JPY 15,000). In additional, there is a fixed price for the first $10m^3$ of water usage per month at IDR 11,500 (JPY 115) and for the next water usage, the price per cubic meter for domestic purpose is IDR 1,500 (JPY 15). A group of resident who join PDAM is the one who has possibility to obtain a piped drinking water access from PDAM as the local water provider. In this sense, water from PDAM could be categorized as club goods that it is non-rival among its members but prohibit others from consuming it.

In general, a group of household establishes a community drinking water association namely HIPPAM which main purposes is to supply piped drinking water to member of the group. Clean water that is provided by this community group also can be categorized as club goods consist of combination of non-rivalry and excludable for member and non-member. In other words, excludability here means that only the member has access to water from HIPPAM and excludes non-member from consuming it. In addition, to get water services from HIPPAM, a household necessary to construct distribution pipeline from their main transmission pipeline as the first physical installation of water connection which prices vary from IDR 500,000 (JPY 5,000) to IDR 1 Million (JPY 10,000). Then, for the monthly water usage, each group of HIPPAM set up a fixed water price varies from IDR 2,000 (JPY 20) up to IDR 15,000 (JPY 150) per month.

The following Figure 3.2 illustrates access to water supply system based on categorization of goods by rivalry and excludability provided by PDAM and HIPPAM.

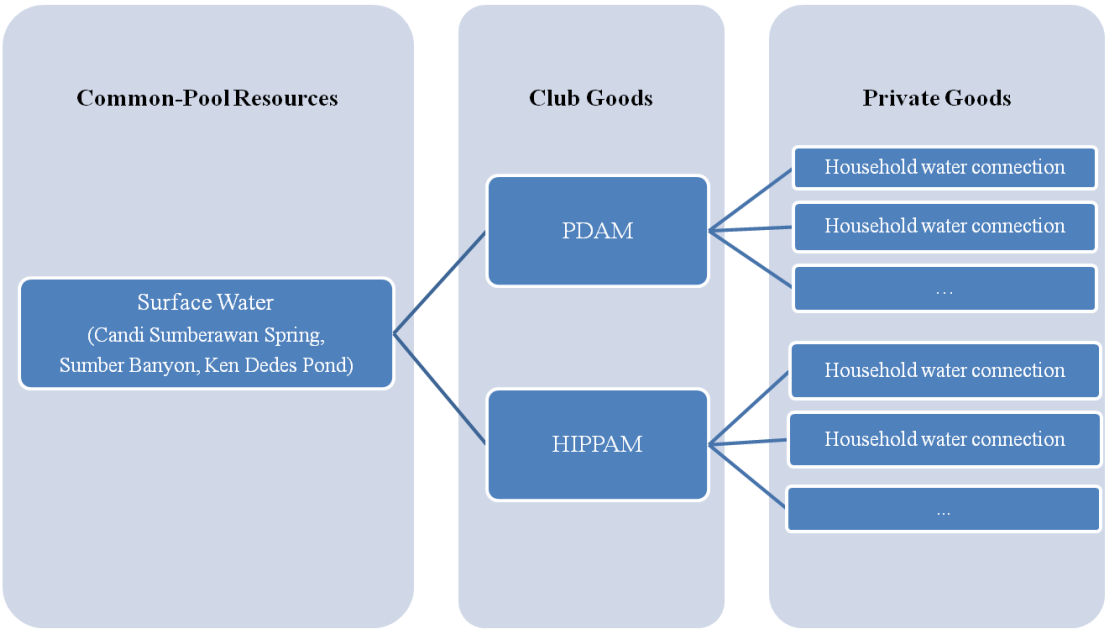

Figure 3.2 Accesses to Piped Clean Water from PDAM and HIPPAM

Beside piped clean water supply system, there are another two clean water access that

acquired by residents. First type is the residents who fetch clean water from several public taps that is provided by some HIPPAM groups. And the second type is the residents who obtain clean water from well utilize shallow ground water.

Several HIPPAM groups utilize similar natural springs for the piped clean water connection construct public water tap called Public Hydrant that is possibly for everyone to fetches clean water for their domestic purposes sort of drinking and cooking using a plastic bucket. Based on categorization of goods by rivalry and excludability, water in this public facility could be categorized as common-pool resources. In this sense, consumption by one preclude consumption by another in the vicinity of the public facility from utilize it. Moreover, there is no available record data for list of users who utilize clean water in this public facility. Therefore, it is difficult or even impossible to exclude someone from using it. Figure 3.3 depicts access to clean water from public tap provided by some HIPPAM groups.

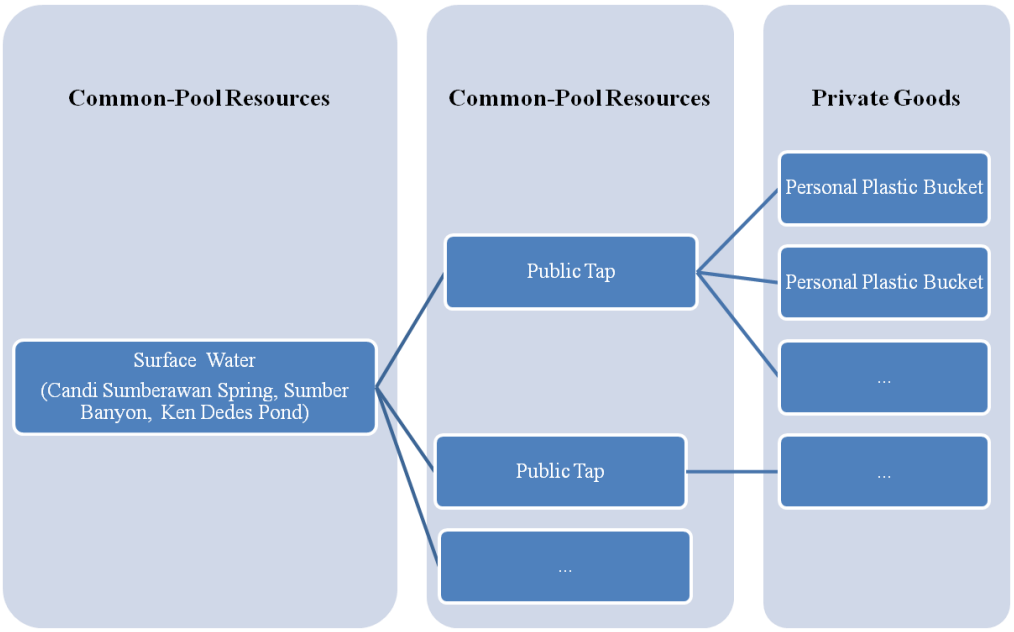

Figure 3.3 Clean Water Access to Public Tap Provided by HIPPAM

The residents who have enough parcel land develop their private well with maximum depth 20 meter and utilize water as their private goods in their own individual well. According to Law No. 7/2004 on Water resources, Article 8 (1) it is stipulated that individual has rights to obtain clean water for daily basic needs, and social needs without licence when their water usage is equal or less 2 litter per second. In this sense, all water that individually consumed by the owner is purely become private goods and exclusively exclude non owner member from utilize it. Whereas, another residents who do not have affordability to build their own private well, they acquire clean water from communal well provided voluntarily by individual well owner. It means that utilization of water from the communal well no longer become 'exclusive' private

goods, but it becomes a kind of common-pool resources that possibly for non owner to freely fetch it. Access to clean water from the well is illustrated in the next Figure 3.4.

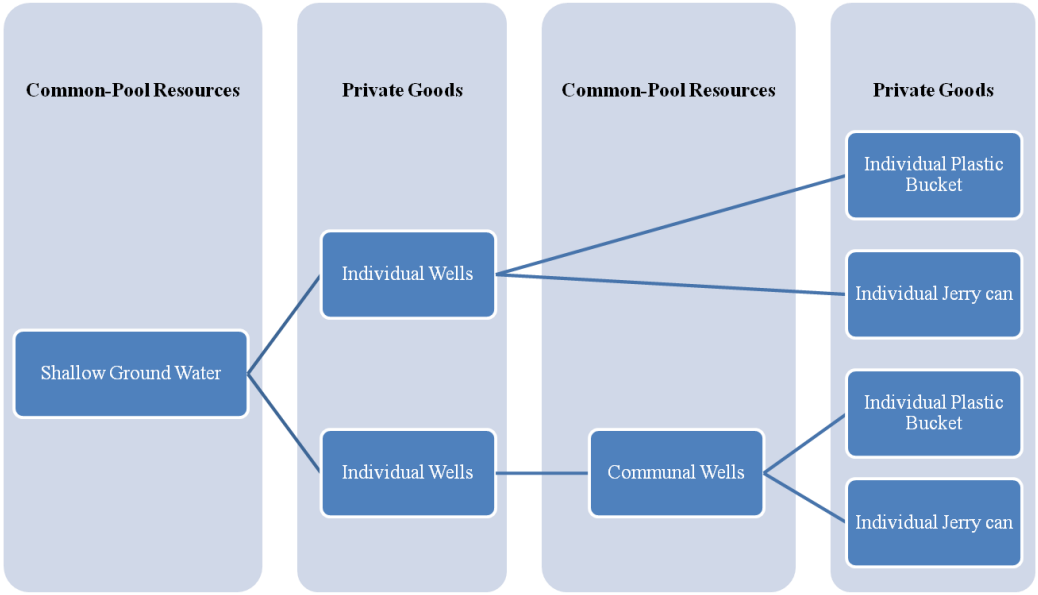

Figure 3.4 Clean Water Access to the Wells

It is illustrated in Figure 3.5 that next to Candi Sumberawan Spring, PDAM collects fresh water from the spring into an artificial pond that functions as a main water reservoir. Employing gravitation system method, fresh water is transported to some branches water reservoir and then distributed to each household using iron pipe. Furthermore, every house has water metered to measure their monthly water usage. Basically, water supply is available along 24 hours.

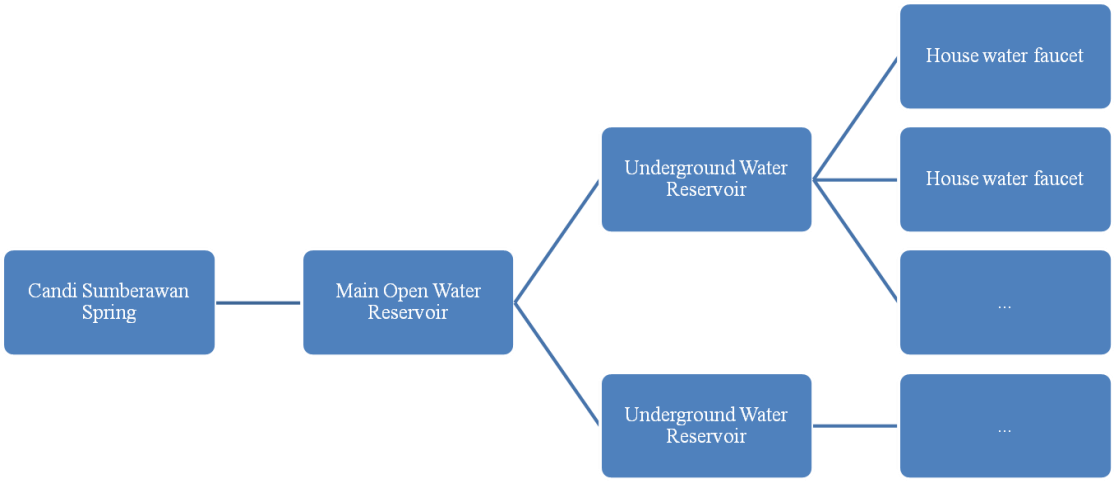

Figure 3.5 Piped Clean Water Supply System from PDAM

As depicted in Figure 3.6 below, water supply system from HIPPAM is based on gravitation system that fresh water from the spring transmits to a building water reservoir belong to certain

HIPPAM's group using polyvinyl chloride (PVC) pipe. Then it distributes to upper water reservoir or directly to water tap of each house of HIPPAM's member. There is a common regulation that each household is only allow to have two water taps for the whole domestic purposes. In addition, some HIPPAM groups use water metered to measure water usage, however they define a fixed charge of monthly water usage. Furthermore, water flows for the whole day.

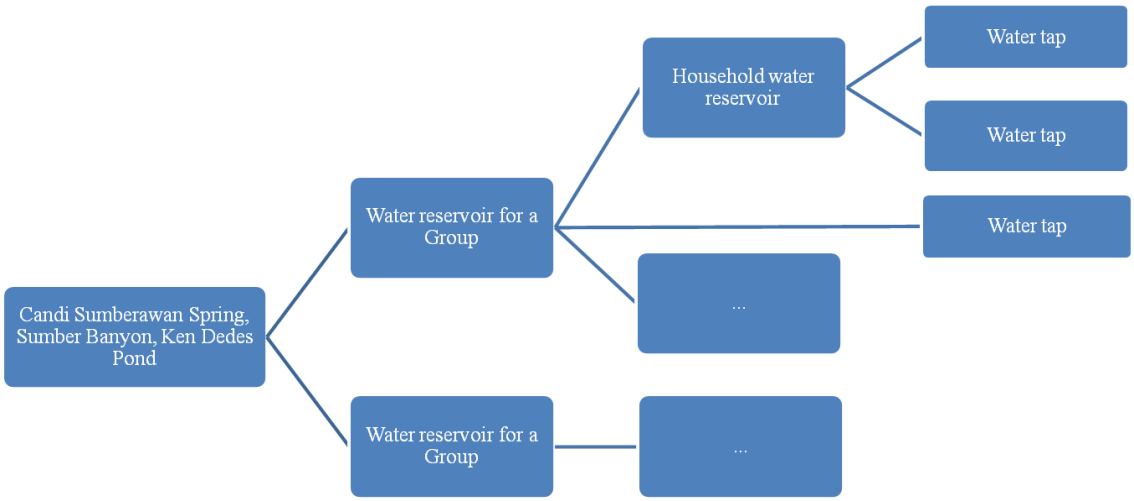

Figure 3.6 Piped Clean Water Supply System from HIPPAM

Figure 3.7 shows that using PVC pipe, fresh water from Candi Sumber Awan Spring transmits to a public water reservoir functions as public hydrant for any resident nearby who fetches clean water carrying one or two plastic buckets or plastic jerry cans size 5 or 10 liters. Majority respondents acquire fresh water in the spot of public facility 3 times in a day.

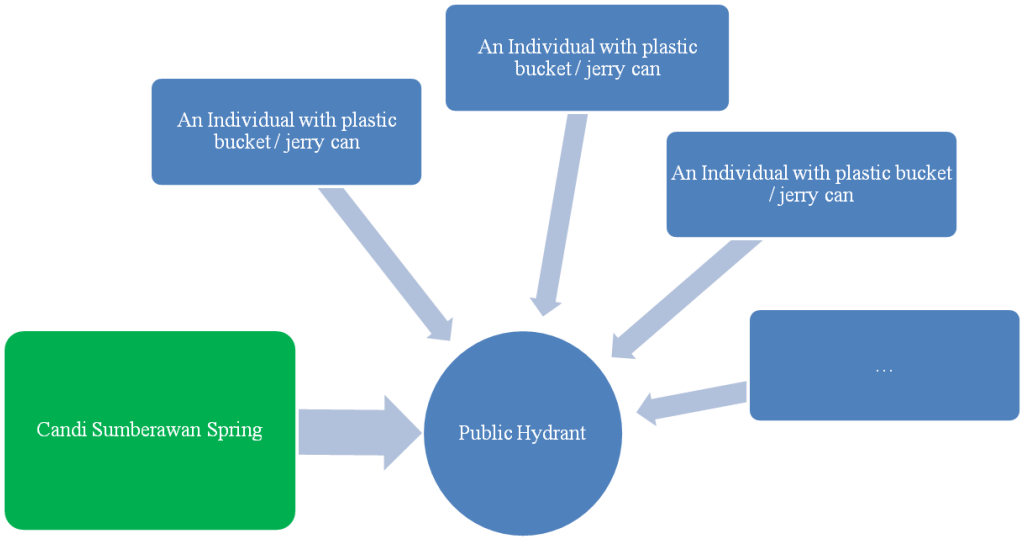

Figure 3.7 Public Hydrant Supplied by HIPPAM

3.3 Chronological Development of Clean Water Supply System

Lies in altitude 671 meter above sea level, a Candi Sumberawan Spring is located in administrative area of Sumberawan hamlet, Toyomarto village in Singosari district. This spring plays very important role on supplying clean water to the resident in Singosari district covering several hamlets in Toyomarto village such as Sumberawan and Ngujung. Moreover, its water also covers another village in the downstream sort of Candi Renggo village encompasses RW 12 and RW 8 for example. In addition, its water has been utilized by the resident for domestic purposes (drinking and cooking, and also bathing and cleaning), as well as irrigation water for their paddy land.

In general, main spring of the Candi Sumberawan Spring is located in a conservation land area under the jurisdiction of Ministry of Forestry. There is a sharing system that it gave to the local resident to utilize some forest productions such as collecting fire woods for cooking purposes as well as collecting wild grass for fodder. Moreover, there is also a cooperation mechanism between the local people and the Ministry of Forestry whereby together they develop a production forests to propagate seedlings. Another one special thing relates to the spring is that people believe that the point of origin of spring water source is located under the Sumberawan temple which is one of the preserved archaeological objects managed by Archaeological Department. In distance of 500 meter from the village road, this temple and green pines scenery lies on the south side of lower slopes Arjuno Mountain is one object of

tourist destination, besides its function as Buddhist temple particularly in Waisak Day.

The second natural spring that employed by the resident is Sumber Banyon lies in the higher altitude than Candi Sumberawan Spring, but it has smaller capacity. Particularly, this spring is utilized by HIPPAM Sumber Banyon for domestic purpose such as drinking water for the member. More detail information of HIPPAM Sumber Banyon is revealed in section 3.4.

Thirdly is Ken Dedes Pond in RW 6 Candi Renggo village. A natural pond that serves as a local recreation swimming pool managed by the Indonesian Air Force in Singosari district. Then, the pond also supplies clean water through piped drinking water for the Indonesian Air Force at their base camp in Pakis district – the neighbor district of Singosari district. Next, they give a sharing clean water usage for local residents in RW 6 through the cooperative association namely Primer Koperasi Tirta Perwita. The more detail explanation is available in section 3.4.

3.3.1 Clean Water Supply System in Toyomarto Village

Toyomarto village consist of 7 hamlets namely Sumberawan, Bodean Klutuk, Bodean Krajan, Ngujung, Glatik, Petung Wulung, and Wonosari. In general, majority residents in Sumberawan and Bodean Krajan hamlet get access to clean water from being member of HIPPAM groups, meanwhile the rest of it fetch clean water from several public hydrants that provided by some HIPPAM groups. The hamlet residents of Bodean Klutuk, Glatik and Petung Wulung fetch water from individual well as private property and communal well that is supplied voluntarily by individual well owner for freely utilization by his or her neighbors. Ngujung residents get access to clean water from two options i.e HIPPAM and PDAM, but unfortunately there is no available record data for each type. In the last hamlet – Wonosari, a part of residents acquire piped drinking water connection from PDAM, but the others fetch clean water from public tap. Then, similar to other hamlets, there is no available record data for each type of clean water resources in the village.

There are two rivers flow through Toyomarto village namely Sumberawan and Glatik river. The residents who live nearby the river such as residents in Sumberawan hamlet get used with these common pool resources as one of their sources of clean water from a long time ago. Consequently, it is more difficult to get statistical record about number of the residents in this group. Moreover, it is also no available record data for some HIPPAM's members who still use water from the river and the spring directly beside the piped clean water supply system.

Table 3.2 summarizes type of clean water for each hamlet in Toyomarto village based on interview survey to the 11 representative residents in Toyomarto village. It consists of the head of Toyomarto village, the head of three hamlets – Sumberawan, Ngujung and Glatik, the chairman of five HIPPAM groups – HIPPAM GOTONG ROYONG 1, 3, and 4, HIPPAM

Sumber Banyon, HIPPAM Air Minum Bersaudara, and the head of HIPPA (Residents Association in Irrigation Water) Toyomarto village. In general, there is no sufficient record data for number of the residents differentiated by their access to clean water.

Table 3.2 Clean Water Source in Hamlets of Toyomarto Village

No	Hamlet	No. of Household	Clean Water Source
1	Sumberawan	836	678 households are HIPPAM's member, and the rest of it fetches water from public tap.
2	Bodean Klutuk	717	The households utilize clean water from individual well or communal well.
3	Bodean Krajan	689	616 households are HIPPAM's member, and the rest of it fetches water from public tap.
4	Ngujung	424	The residents get access to clean water from HIPPAM or PDAM, but no statistical record available.
5	Glatik	389	The households utilize clean water from individual well or communal well.
6	Petung Wulung	356	The households utilize clean water from individual well or communal well.
7	Wonosari	248	The residents get access to clean water from PDAM or public tap.

The inception of piped clean water system was introduced by two types of agent namely Indonesian military and BLKI (Industrial Education Training Centre) Singosari. Divided in to three periods, they constructed iron pipeline of clean water utilize Candi Sumberawan Spring which its clean water exclusively supply only their territory, without any connection to the local resident.

First of piped clean water system in Toyomarto village was developed by KOSTRAD (Army Strategic Reserve Command) in Singosari district. In 1961 this Indonesian army constructed water pipeline from Candi Sumberawan Spring to supply their military base in Ardimulyo village. Then, in the period of 1962 – 1963, BLKI (Industrial Education Training Centre) Singosari developed another water pipeline that has been also utilize clean water from the same spring to supply their education training centre in Ardimulyo village. Additionally, gradually from 1962 – 1980s other water pipelines were constructed by other two divisions of the Indonesian Army, and the Indonesian Air Force in Singosari district. The entire clean water from the same spring transmits to the military base of YON ARMED (Army Field Artillery Battalion) in Candi Renggo village and YONKAV (Army Cavalry Battalion) in Ardimulyo village. Meanwhile, clean water for the Indonesian Air Force has transmitted to a main water reservoir inside their military base in Pakis district. So far, there are no available record data for the water capacity that they use in their iron pipes. Moreover, the entire water pipeline has developed exclusively to supply clean water for the five exclusive territories.

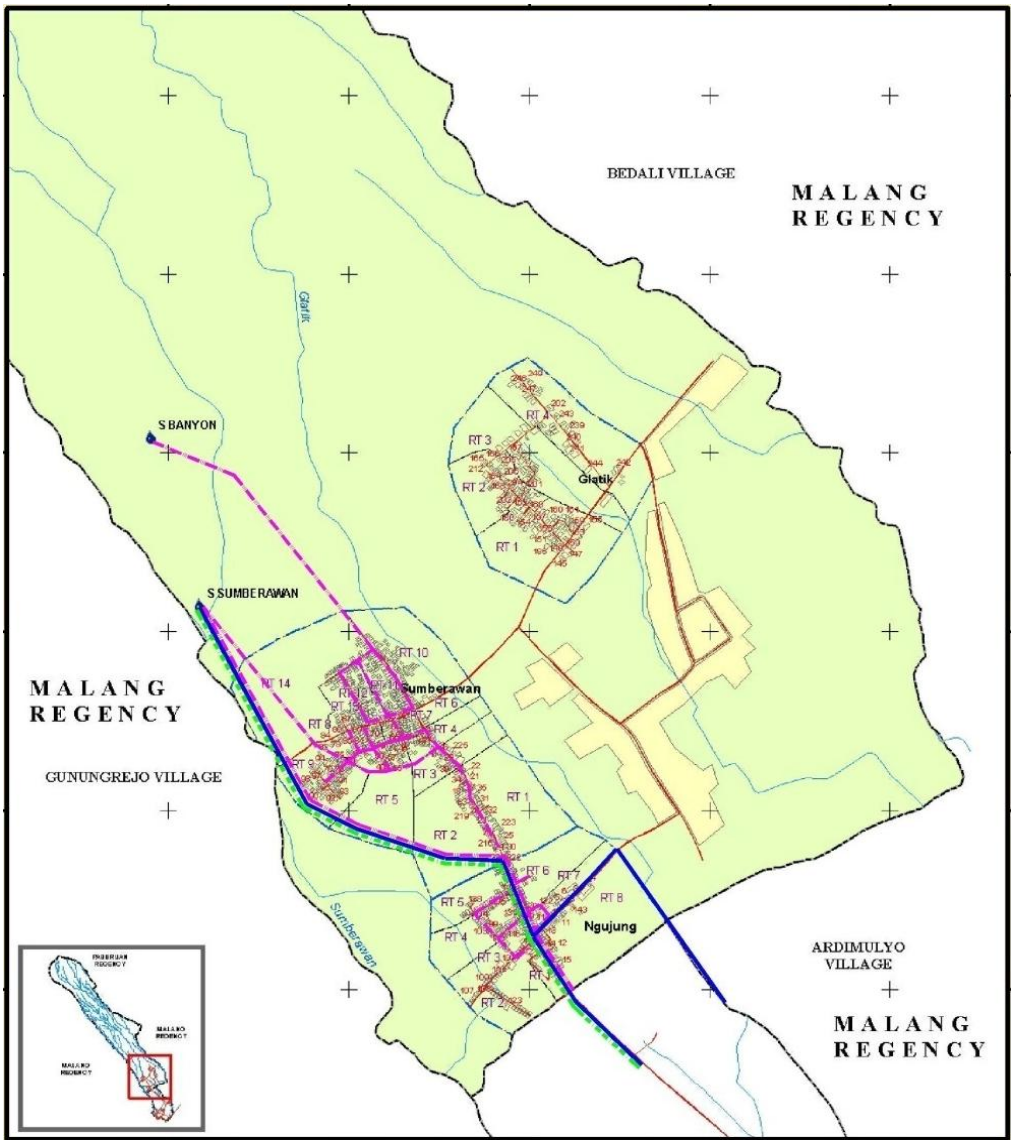

Figure 3.8 Piped Clean Water Supply System in Toyomarto Village
Note: Blue solid line is main pipeline of PDAM, magenta dash line is main pipeline of HIPPAM, and green dash line is main pipeline of Indonesian Military and Education Institution

In 1984, PDAM Branch Unit Singosari constructed piped drinking water using iron pipe at diameter 200 – 250 millimeter to transmit clean water from Candi Sumberawan Spring with capacity 10 liter per second to the main water reservoir in Candi Renggo village. Fresh water from the spring is pooled in open water storage at size around 20 x 20 square meters next to the spring. In inception of the construction work, PDAM gave offer to the resident in Toyomarto village particularly community in Sumberawan hamlet to have piped drinking water connection to house. In fact, it was too difficult for the resident to join PDAM because they have no affordability to pay the water system connection, particularly for the physical installation of distribution pipeline from transmission pipeline to house. Even more, the residents get used to

acquire clean water directly from the spring as well as from the river in their vicinity area. This situation may lead the pipeline did not pass through Sumberawan hamlet, but directly passed through Ngujung hamlet as the other previous clean water pipelines in Toyomarto village.

University student in Indonesia must participate in a community service activity as a requirement for graduation from the Bachelor degree. In 1996, a group of student from Brawijaya University initiated construction of the first public hydrant in Toyomarto village called HIDRAM in the vicinity area of Candi Sumberawan spring. This communal facility had been utilized by resident in the upper part area of Sumberawan hamlet until 1996.

In the tranquility period, Military of Indonesia (ABRI) conducts a social responsibility program that together with the residents they develop some basic public infrastructures in order to improve quality of life of the particular marginal area all over Indonesian territory. Between 1991 and 1992, a group of ABRI conducted their social responsibility program in Toyomarto and Candi Renggo village. One of their activities was constructing new water transmission pipeline network from Candi Sumberawan Spring to Ngujung hamlet, whereby the pipeline network followed the earlier one. Pipeline from the spring was developed along the river in the southwest of Sumberawan hamlet and transmitted fresh water to a main water reservoir at Ngujung hamlet in Toyomarto village. Besides that, the fresh water was also transmitted for villagers at Karangwaru hamlet in Candi Renggo village, the nearest neighbor of Ngujung hamlet. This facility becomes the first public hydrant for residents in the vicinity area who fetch it using plastic bucket or jerry can for domestic purposes. Then, this public hydrant stimulated the resident to develop piped clean water connection to house and established their first and only one HIPPAM group in the hamlet, called HIPPAM Air Minum Bersaudara.

Learning from their neighbor in Ngujung hamlet, driven by the head of hamlet (Mr. Suwandi) and one informal leader (the deceased Mr. H. Ashari – religious figure), at around year 1994, residents in Sumberawan hamlet started to construct their piped clean water supply system with connection to house as well as developed some public hydrants. Then, through the time as the number of users increased, in 1996 the community leaders initiated to grouping the users into 4 HIPPAM groups, namely Gotong Royong I – IV. At around 1996, the area which used fetch clean water from HIDRam also initiated to search a new spring that possible to supply clean water for Sumberawan hamlet in the upper part. And its spring comes from Sumber Banyon as it naming for the newest HIPPAM group. In general, we may say that all the effort to establish HIPPAM groups in Toyomarto village can be categorized as self-help support. Action of planning – implementing/constructing – operating and maintaining are done by the community. Then, in 1991 they received a financial support from the local government to improve the

pipeline network.

The following Table 3.3 is summarized the progress of clean water pipeline development in Toyomarto village which had been started at around half century ago. But, in fact the pipeline system is only connected very few residents – at around 15% from the total villagers as reported in the Data Base of Clean Water in Malang Regency (2008). Or in other words, majority residents need to fetch clean water in a certain distance from their house or even from the river directly.

Table 3.3 Chronological Development of Clean Water Supply in Toyomarto Village

No.	Actor	Year	Incident
1	Indonesian Army	1961	The first development of water pipeline utilizes clean water from Candi Sumberawan Spring, and transmits it to their exclusive territory.
2	BLKI Singosari	1962– 1963	
3	Indonesian Army and Indonesian Air Force	1962– 1980s	
4	PDAM of Singosari district	1984	The first introduction of water piping systems to the villagers.
5	Community Services Activity	1986	The first introduction of public taps system initiated by the student of Brawijaya University.
6	Social Responsibility Program by Indonesian Army	1991-1992	The inception of public hydrant in Ngujung hamlet, which stimulated residents to established piped clean water supply system through community based water management.
7	Community in Sumberawan hamlet	1994	The establishment of HIPPAM groups driven by the formal and informal leader in Sumberawan hamlet.

Glatik hamlet lies in altitude 800 - 1200 meter above sea level do not have pipeline water connection system through both PDAM and HIPPAM due to geographical reason. But, fortunately this hamlet has sufficient shallow ground water that utilized by the resident by constructing the well in the depth of less than 20 meter.

3.3.2 Clean Water Supply System in Candi Renggo Village

Candi Renggo village consists of 15 hamlets which are named based on sequence numbers from one to fifteen. In general, piped clean water supply system from PDAM Unit Branch Singosari district able to serves majority residents in Candi Renggo village, except hamlet 10 and 11 which the whole residents acquire from HIPPAM groups. PDAM in this village distributes clean water to the resident from the reservoir whereby the original water source from Candi Sumberawan Spring in Toyomarto village.

Table 3.4 summarizes type of clean water for each hamlet in Candi Renggo village based on interview survey to the five representative residents covering the section chief of social welfare of Candi Renggo village, the head of hamlet RW 6, RW 8 and RW 12 as well as the head of HIPPAM in Primer Koperasi Tirta Perwita. In general, there is no sufficient record data for number of the residents differentiated by their access to clean water.

Table 3.4 Clean Water Source in Hamlets of Candi Renggo Village

No	Hamlet	No. of Household	Clean Water Source
1	1	155	The residents get access to clean water from PDAM
2	2	191	
3	3	286	
4	4	252	
5	5	243	The residents get access to clean water from HIPPAM, PDAM, and Public Hydrant
6	6	353	The residents get access to clean water from HIPPAM (150), PDAM, Individual Well, and Public Hydrant
7	7	403	The residents get access to clean water from HIPPAM, PDAM, and Individual Well
8	8	323	The residents get access to clean water from PDAM, Individual Well, and Public Hydrant
9	9	284	
10	10	196	The residents get access to clean water from HIPPAM
11	11	254	
12	12	572	The residents get access to clean water from PDAM (459), and Individual Well (113)
13	13	258	The residents get access to clean water from PDAM
14	14	337	
15	15	90	

The following Table 3.5 summarizes the chronological progress of water pipeline connection in the village relates to the research survey area.

At around 1950s, Indonesian Air Force in Singosari district received a group water use rights to manage Ken Dedes Pond. There had been two main purposes of water usage. First, utilize fresh water for recreation area which provides public swimming pool. Second, the institution utilizes the pond as water source to supply clean water to their military bases in Pakis district exclusively. They constructed piped clean water network for capacity of 20 liters per second. But, in the present time, due to water leakage – very old pipeline and free riding by some residents along the pipeline, this institution only received clean water at around 5 liters per second. This situation triggers a conflict between the military and the residents, particularly for the newer building that covered the pipeline under their building and hindered the repairmen activity. Thirdly, the institution has been gave a water share to the community nearby for drinking water as well as irrigation. Explanation for the third will be combined in the story of cooperative Primer Koperasi Tirta Perwita.

Under the same period with the piping construction in Toyomarto village, PDAM constructed main piped drinking water utilize fresh water from Sumberawan Spring at capacity of 10 liter per second. The fresh water has been transmitted to a main water reservoir in Candi Renggo village using iron pipe at diameter around 200 – 250 millimeters. The main pipeline was constructed along the village road and served piped clean water connection to house for the resident along the road including the three investigated hamlets (RW 6, RW 8 and RW 12).

At around 1989 a new residential area – currently become RW 12 was developed. This was a specific residential area that is provided for the Indonesian Military member, particularly from the Army. There was an agreement that in first 3 years the residents need to acquire clean water from their personal well, then after completing the pipeline construction, they will get access to piped clean water supply system from PDAM. This is a main reason of the current situation whereby majority residents get connection to clean water services from PDAM, while the rest of it still keep acquires clean water from their individual well. Moreover, some residents utilize the two water sources to get more sufficient water supply due to some limitation of water services from PDAM.

There were a lot of fertile land in RW 6 that utilized by villagers for planting rice paddy. The inception of community managed water system is based on their needs to have equal share irrigation water for their rice paddy fields. This is an initiation of establishment a kind of agricultural cooperative for the farmers. Through the time, since in the village there is no formal agricultural cooperative which able to give sufficient supply of agriculture activity such as providing good paddy seeds, fertilizer, and the like, the residents initiated to establish a voluntary association for the purpose. Then in 1998, this association became an incorporated cooperative institution namely the Primer Koperasi Tirta Perwita. The cooperative provides products supporting agricultural activities as well as agricultural microcredit for the members. In the same time a group of people also formed a voluntary community water association to provide clean water supply for domestic purposes. Then, in 2006 when structuring cooperative became stronger, they decided to merge the two main activities into one organization in order to be able to give more sufficient and effective services to the members. All these things were done smoothly because of a good relationship between the residents and the Indonesian Air Force. In one side, there is a cohesive relation among residents in RW 6 that it matched with the idea of the Indonesian Air Force to share their water usage with the residents in the vicinity area of the pond. This mutual collaboration may bring good impact for both sides. Even though, needless to say that there is a problem in their piped clean water supply network due to free riding action done by a few residents along the pipeline.

The following Table 3.4 is summarized the progress of clean water pipeline development in Candi Renggo village which had been started at around half century ago. But, in fact the pipeline system is only connected very few residents – at around 35% from the total villagers as reported in the Data Base of Clean Water in Malang Regency (2008). Or in other words, majority residents need to fetch clean water in a certain distance from their house.

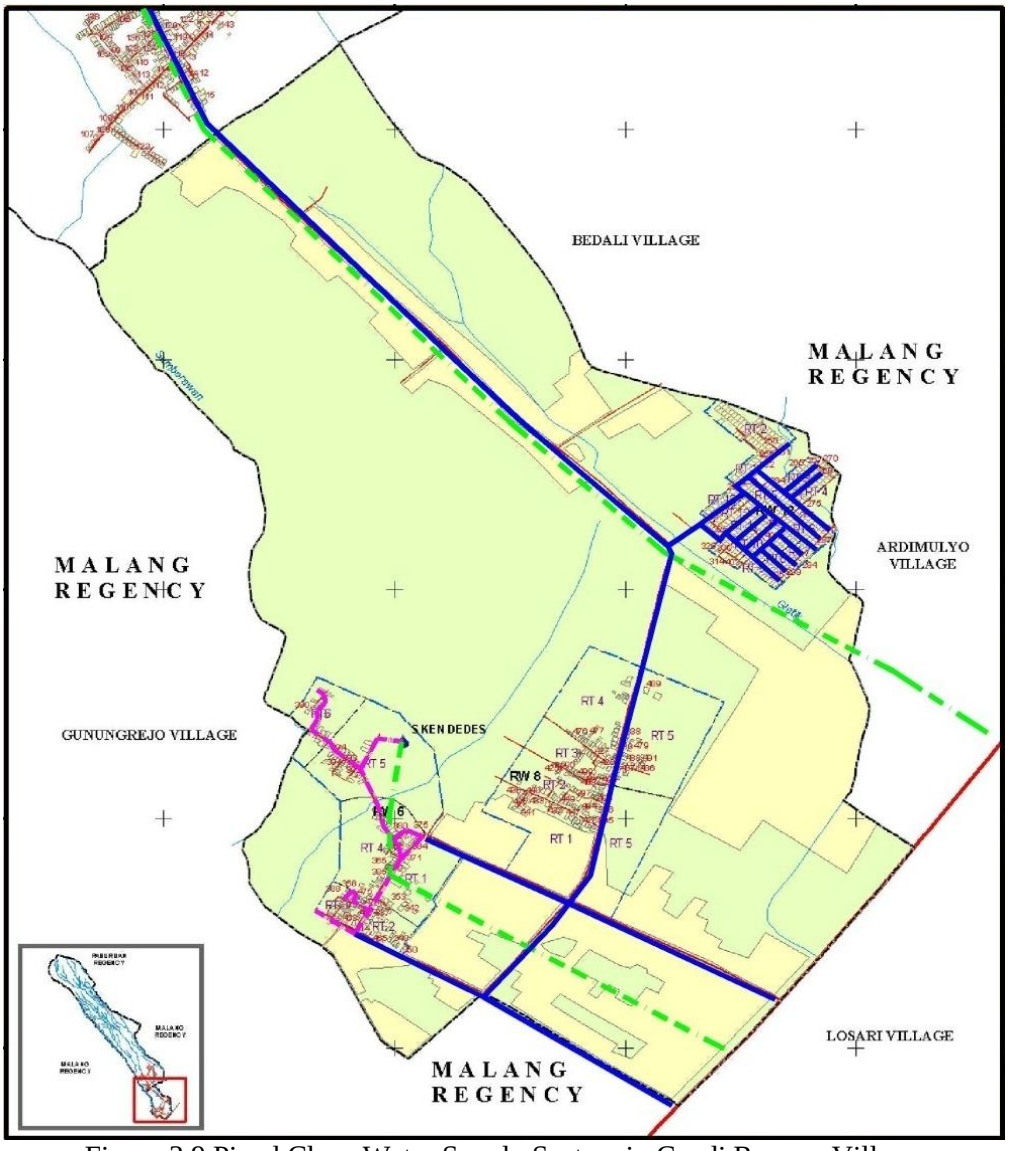

Figure 3.9 Piped Clean Water Supply System in Candi Renggo Village

Note: Blue solid line is main pipeline of PDAM, magenta dash line is main pipeline of HIPPAM, and green dash line is main pipeline of Indonesian Military and Education Institution

Table 3.5 Chronological Development of Clean Water Supply in Candi Renggo Village

No	Actor	Year	Incident
1	Indonesian Air Force	1950s	The first development of water pipeline in Candi Renggo village utilizes clean water from Ken Dedes Pond, and transmits it to their exclusive territory.
2	PDAM of Singosari district	1984	The first introduction of water piping systems to the villagers.
		1992	Piped drinking water connection to house as one package of house construction.
3	Cooperative "Primer Koperasi Tirta Perwita"	1998	The first initiation of piped clean water connection to house developed by the community in RW 6.

3.4 Community Based Water Supply System

In this section we explain in detail about organization character of HIPPAM groups. There are six HIPPAM groups in Toyomarto village consists of five HIPPAM groups in Sumberawan hamlet and one group in Ngujung hamlet. And, another single HIPPAM organization serves clean water piping system for residents in RW 6 hamlet, Candi Renggo village. Then, the following Figure 3.10 illustrates the structure of organization of HIPPAM in the research area.

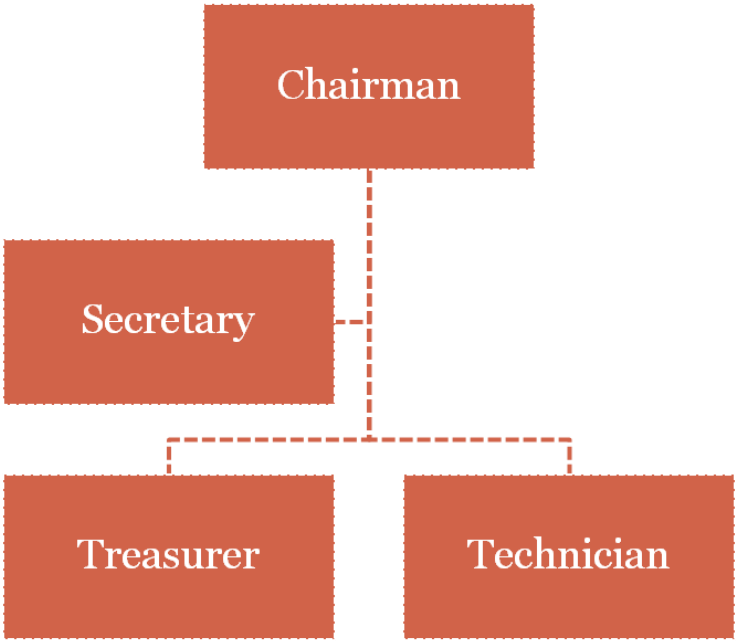

Figure 3.10 Structure of Organization of HIPPAM

HIPPAM GOTONG ROYONG I have a board member consist of head of the group, secretary, treasurer and technician. Until February 2009, they serve 45 households as their members and this group may increase their size of organization up to serve 65 households. Under the chairman of Mr. Tiknan, the secretary of Ms. Nur Hilal, the treasurer Mr. Susanto and

the technician Mr. Suradi, they have weekly meeting which conducted in the same time with their religious activity on recitation Quran. In the more precise sentence, here the regulation that they make to regulate their community group as follows:

1. The group set up a fixed price at IDR 1,500,000 (JPY 15,000) for the first physical pipeline installation of the new household water connection, and at IDR 3,000 (JPY 30) for monthly payment of water usage per household. Please bring this payment card each pay in installments;
2. Each pay in installments ask for proof of lawful;
3. Installments 5 days late will be fined IDR 1,000 (JPY 10).

Moreover, they also have two common norms. First, payment of the dues is no need payment card for member and its payment system is done one time in a year at the recitation forum. Therefore, each household directly pay to the treasurer once in a year at cost of IDR 36,000 (JPY 360) for one year utilization of fresh water. Second, the board system on monitoring water usage is based on awareness and trust. Therefore, technicians only work based society calls, and paid in respect of work done. Then, in order to give services for the non-member, this group provides 4 public taps located in the neighborhood mosques and the vicinity resident allows taking water sufficiently. Every resident is free to fetch the water from it, but it is forbidden for the one to build direct house pipe line

A slightly different from HIPPAM GOTONG ROYONG I, HIPPAM GOTONG ROYONG II has board member consist of one chairman, one secretary, one treasurer, and two technicians. Under the chairman of Mr. H. Toha lives in RT 1 sub-hamlet, the secretary of Ms. Sunarti live in the same sub-hamlet with the chairman, the treasurer Mr. Sukar from RT 2 sub-hamlet and the technician Mr. Sueb (RT 2) and Mr. Abdul Madjib (RT 3), they have monthly meeting for the whole members. Until February 2009, they serve quite big number of members covering 137 households and this group still has ability to serve for maximum 160 households whereby the decision of acceptance a new member will be done in the board meeting. The group set up similar cost to HIPPAM GOTONG ROYONG I for the first physical pipeline installation of the new household water connection, but they set up a higher fixed price at IDR 5,000 (JPY 50) for monthly payment of water usage per household. Compare to the first group, this group has more complete regulation as well as sanction to operate their community water management. The group develops a rule for the one who want to be a member as follows:

1. The resident must register to the committee;
2. Make full payment in accordance with the collective decision or the community agreement;

3. Comply with board rules.

If the candidate member agrees he/she will sign a letter of statement that is signed by the head of village, the head of HIPPAM and the secretary. And then, if they become a member, they will get payment card. Next, every member should fulfill membership regulation covering 10 items as illustrated in the following sentences:

1. Forbidden to channel water into someone's house unless a permit administrators for certain important purpose;
2. Must use water sufficiently;
3. Have to turn off faucets when not in use;
4. Non-consumers is prohibited to use the water for the building or ceremonial without committee approval;
5. If no water flow the user must report to the committee and should not change stop valve or main pipeline by yourself;
6. There should be no leaky pipe or faucet;
7. The consumer must pay individual house connection from main pipe;
8. Must pay dues each month that determined by committee;
9. Compulsory voluntary work and help administrators;
10. Obligatory for each member to keep harmony and mutual assistance.

This community group also stipulates a sanction system for the member who does not comply the regulations. The type of sanctions could be (i) a temporary disconnection or (ii) required to fill the cash group at amount of minimum IDR 5,000 (JPY 50). And there are three steps of sanctions as follows:

1. Warning I (no water connection for a month);
2. Warning II (no water connection for 3 month);
3. Severance water connection and lost all the costs.

Considering the facts of (i) lessened of water capacity, and (ii) no water metered in the house connection, then in order to sustain water supply the board always monitors water usage carefully. Every day technicians will control the pipeline condition as well as water usage of the member. And they will also give certain sanction to the violator. Meanwhile, we could not get any information whether this HIPPAM group provides public hydrant for the non-member or not.

Structure of Organization of HIPPAM GOTONG ROYONG III is similar to HIPPAM GOTONG ROYONG II as well as the price for the first physical installation and the monthly dues of water usage. Under the chairman of Mr. Suraji lives in RT 7 sub-hamlet, the secretary of

Mr. Nuryadi live in the same sub-hamlet with the chairman, the treasurer Mr. Subandi from RT 8 sub-hamlet and the technician Mr. Sudiono (RT 8) and Mr. Harto (RT 8), they conduct monthly meeting for the whole members. Until February 2009, they serve 32 households and this group still has ability to serve for maximum 50 households whereby the decision of acceptance a new member will be done in the board meeting. The group stipulates membership regulation as follows:

1. Please bring this payment card each pay in installments;
2. Each pay in installments ask for proof of lawful;
3. Installments 5 days late will be fined IDR 1,000 (JPY 10).

Moreover, there are two common norms that understood by the member as well as by the non-member who live in the service area of the HIPPAM group, as follows:

1. Due to abundant water availability and no monitoring system, the member able to use water freely but its utilization has to be wisely;
2. In case of non member, they are allowed acquiring water from the member, but remains banned from having direct pipe connection to house.

From the common norm that they have, we may understand of the group's decision not to build a public hydrant for the non-member.

Structure of Organization of HIPPAM GOTONG ROYONG IV similar with HIPPAM GOTONG ROYONG I consist of one chairman, one secretary, one treasurer and another one technician. Under the chairman of Mr. Jayadi, the secretary of Mr. Atim, the treasurer Mr. Kastomo and the technician Mr. Asmain, they conduct monthly meeting for the whole members. Then, the group also determines similar price as HIPPAM GOTONG ROYONG II and III for the first physical pipeline installation and monthly charge of water usage. Until February 2009, they serve 68 households and this group still has ability to serve for maximum 75 households whereby the decision of acceptance a new member will be done in the board meeting. The most different between this group and the three previous groups is that there is no card payment for the group member. Furthermore, there is no information about the membership regulation or the norm or sanction in the group. Meanwhile, the group provides a public tap locates in the mosque, which the non member obtains this clean water for cooking and drinking.

The fifth HIPPAM group in Sumberawan hamlet is called HIPPAM SUMBER BANYON since the group utilizes fresh water from the Sumber Banyon spring. In general, this water association serves the residents in the upper part of Sumberawan hamlet. They established a HIPPAM group with ability to transmit piped clean water to the member since the HIDRAM – the first public hydrant in this area contructed by the Brawijaya University student could not

function well after the use of nearly ten years. Structure of Organization of HIPPAM SUMBER BANYON is similar with HIPPAM GOTONG ROYONG I, III and IV that the board member consists of one chairman, one secretary, one treasurer and another one technician. Under the chairman of Mr. M. Sholeh Suadmadji lives in RT 10 sub-hamlet, the secretary as well as the technician of Mr. Ngatuji lives in the same sub-hamlet with the chairman, and the treasurer Mr. Djianto lives in RT 7 sub-hamlet, the group conduct one meeting for every three months. Until February 2009, this community water management group has ability to serves the highest number of households compare the other four groups. They serve 140 households and this group still has ability to serve for maximum 170 households whereby the decision of acceptance a new member will be done in the board meeting. The group set up a lower cost than others for the first physical pipeline installation of the new household water connection at IDR 1,250,000 (JPY 12,500), and a slightly cheaper for monthly payment of water usage per household at IDR 4,000 (JPY 40). In operationalization, the board members will send a warning letter to the member who does not pay their monthly dues. Hence, after three months violation, the board asks the violator to make a letter of statement that they will change their attitude. In this case, there is no sanction for the violator such as termination of clean water connection and the like. The group provides 3 public taps which the non member obtains clean water by paying at IDR 1,000 (JPY 10) per month. But due to disorderly payment, its regulation is changed to a voluntary payment that non-member user could pay their water usage through the treasurer as their willingness to pay.

Different from the circumstances in Sumberawan hamlet which have five HIPPAM groups serve a group of residences in a smaller areas. In Ngujung hamlet, number of HIPPAM group since the first inception of the establishement, there is one and only one HIPPAM group namely HIPPAM Air Minum Bersaudara. As it mentioned in the previous section, the emergence of this group at around 1991-1992 stimulated their neighbors to establish a similar voluntary water association. Unfortunately, the existence of this group have decreased function. Under the chairman of Mr. Tasmin lives in RT 4 sub-hamlet, the secretary of Mr. Sulaiman lives in RT 8 sub-hamlet, the treasurer Mr. Buang Salim lives in RT 5 sub-hamlet, and the technician Mr. Khoiri lives in RT 1 sub-hamlet, the group suppose to conduct monthly meeting. The community water management group that has ability to serves 300 households do not have ability to hold meeting since three years ago. There is no coordination between the board and the member. And it is estimated that only 25% of the member who pays monthly dues regularly. For the first physical pipeline installation the member has to pay at IDR 800,000 (JPY 8,000) and IDR 5,000 (JPY 50) for monthly water usage. On their card payment, there is listed a

membership regulation such as payments are made every once month at amount IDR 5,000 (JPY 50) at home of Mr. Buang Salim – the group treasurer. Moreover, there are recommendations to members for having a fully awareness to (i) closed or shut off faucets when not needed; (ii) Immediately repair the damaged pipes or faucets; and (iii) immediately report to officers or contact (0341) 451-460 if your water flows stop. There is also a warning for member that is forbidden to distribute water to other people's homes. They also called for members to not use water excessively and to obey the rule for the sake of your own water sufficiency and the crowds. Into more detail, there is a statement that technician will be the one who responsible to repair the physical damage. Then, in general the cost will be bear to the group, except for individual damage because of individual carelessness. Lastly, the group does not provide a public tap but they individual member to build open faucets in the front house that allows neighbor to utilize in a proper water usage.

As it illustrated in section 3.3, structural organization of HIPPAM group in RW 6 hamlet is very much different from the HIPPAM groups in both Sumberawan and Ngujung hamlet. Since 2006 this informal voluntary association on water management became part of a formal cooperative organization under the name of cooperative Primer Koperasi Tirta Perwita. Nevertheless, this community group has similar board member as the others. In addition, since the group utilizes water from Ken Dedes Pond as they received water sharing from the Indonesian Air Force in Singosari district, the group also received some guidances from the Indonesian Military. Under the chairman of Mr. Kasmad lives in RT 4 sub-hamlet, the secretary of Mr. Mawanto Hadi lives in RT 2 sub-hamlet, the treasurer Mr. Pardi lives in RT 4 sub-hamlet, and the technician Mr. Saturi lives in RT 6 sub-hamlet, the group conducts regular monthly meeting. They serve 150 households and still have ability to serve for maximum 160 households for the residence in RW 6 hamlet whereby the decision of acceptance a new member will be done in the board meeting. There are two different tariffs for physical pipeline installation. Old tariff is IDR 850,000 (JPY 8,500) whereby IDR 600,000 (JPY 6,000) for cost of participating on self-supporting, and the rest of IDR 250,000 (JPY 2,500) for working expenses and material cost. Meanwhile, the new tariff is IDR 1,500,000 (JPY 15,000) with additional equipment of water metered for each house connection. The board determines a set of membership regulation as follows:

1. Basic contribution, obligatory savings and voluntary savings and the clean water dues paid before the date of 15 each month.
2. If the members who still have loan then not pay in installment during the three month of consecutive, they will be subject to sanctions which apply to cooperative “Tirta Perwira”.

3. For members and or water users for three consecutive months of not paying water dues, water flow will be disconnected temporarily until water users pay their dependents.
4. For savings and water dues will be withdrawn by officers, or can pay for itself to the treasurer of the cooperative.
5. This card should be kept well and if the missing card immediately contact the cooperative board
6. If there is a mismatch in payments expected to contact the board of cooperation brings a payment card.

Moreover, the group also determines a clean water regulation for the members as follows:

1. Save water, and if water is not used, faucets must be in the closed state.
2. Water must not be distributed to other people.
3. All consumers must participate to maintain clean water pipelines, because its controlling is shared responsibility.
4. When there is damage to waterways should not be handled individually, but must report to the cooperative board.
5. Rule number one to four apply to all consumers or users of clean water Tirta Perwira.

There is a specific regulation related to the dues since being a member of the HIPPAM means automatically become a member of the cooperative organization. There are four types of paymet for the members covering (i) basic contribution at IDR 30,000 (JPY 300), paid only once at the beginning of membership; (ii) obligatory savings at IDR 5,000 (JPY 50), paid monthly, (iii) voluntary savings at minimum IDR 3,000 (JPY 30), paid monthly, and (iv) clean water dues at IDR 8,000 (JPY 80), paid monthly. Since August 18, 2008, along with the establishment of cooperative, water dues card becomes one with monthly dues card members of cooperative association. Related to responsibility of the damage if it is damage in the main pipe line and it's costly, the board will held meeting with the whole member to decide the way to fix it. Meanwhile for a little damage caused by individual consumer, responsibilities will be borne by the individual concerned. Under this organization they also provide what they called a temporary water connection. This is a special case if someone will have celebration, they should report to the board, and the payments of compensation due to the excessive use of water at the discretion to user. Furthermore, the community group also constructed a public tap facility in the mosque mainly for religious activities, and yet residents were also allowed to take water sufficiently.

3.5 Summary

Indonesian Constitution 1945 section 33 gives the basis for the state right to control water. In this sense, PDAM as local drinking water company has duty to provide piping clean water of household connection to the residents. In fact, total number of inhabitants with access to piped drinking water is only 28% of the population whereby PDAM serves 24% inhabitants and HIPPAM serves another 4% of it. It indicates that majority residents acquire fresh water from individual well, communal well, public tap as well as river.

In general, resident in the research area get acquainted with piped clean water system in four different forms. First, the residents were introduced to piped clean water system with special purpose to supply clean water exclusively for a particular territory. The development of piped clean water network done by Indonesian military – Indonesian Air Force in 1950s and Inodnesian Army in 1961s was the example for this case. Even more, the service has gone across the distrcit when Indonesian Air Force constructed their pipeline network from Ken Dedes Pond and transmitted to Pakis district. Second, the community was introduced to water piping system of household connection by PDAM unit branch Singosari district in 1984. The piped clean water system that open to the public who wish to join. Third, the community was introduced to public hydrant whereby the piped clean water was developed to transmit water into certain point of public water reservoir. Through this public facility, the residents for the first time acquainted with public tap where they fecth clean water freely. This public facility was introduced to the community through a kind of community service program. It did by the student of Brawijaya University in 1986 thorugh community service activity, and by the Indonesian Army in 1991/1992 through social responsibility program. Fourth, the community get acquainted with piping system of household connection through community based water association. Impact from the construction of public hydrant by Indonesian Army, residents in Ngujung hamlet were stimulated to establish community based water association which provide water piping system of household connection. Next this idea spread to their nearest neighbor – the residents in Sumberawan hamlet. They constructed their water piping system of household connection which driven by their formal and informal leader. The notion of establishment community based water association in RW 6 was strengthened by sharing of water usage from Indonesian Air force.

There are five HIPPAM groups who serve the residents in Sumberawan hamlet through piping clean water system of household connection. Meanwhile, there is only one HIPPAM group in Ngujung hamlet as well as in RW 6. In general they have similar structural organization consist of the chairman, the secretary, the treasurer and the technician. Moreover,

each hamlet creates their own rule and norm, eventhough not all of them give sanction to the violator. Unfortunately, it indicates that HIPPAM Air Minum Bersaudara in Ngujung hamlet has quite serious problem whereby few members have willingness to pay their dues due to lack of communication between the committee and the members, HIPPAM in RW 6 is no longer just a voluntary drinking water association as other HIPPAMs in Sumberawan and Ngujung hamlet, since the cooperative Primer Koperasi Tirta Perwita is an institution incorporated. They build stronger rule towards members. In addition, some HIPPAM groups also provide public tap for non-member to fecth clean water freely. In case of the group does not provide a kind of public tap, they let non-member to fetch fresh water from the faucet in front of the house's member. It may argue that there is a bridging social capital developed by HIPPAM's member for the non-member.

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Chapter 4
Household Questionnaire Survey on Water Supply

4.1 Introduction

Having access to safe drinking water is one of the most indispensable human necessities. WHO (2010) stated that six out of the seven people without access to an improved water source live in rural areas, moreover, regarding WHO and UNICEF (2006) the number of urban residents without adequate water services is increasing rapidly. Consequently, estimates of access to safe drinking water are a cornerstone of most international assessments of progress toward solving global and regional water problems, particularly to reach target 10 of the Millennium Development Goals (MDGs) that reduces by half the proportion of people without sustainable access to safe drinking water by 2015.

There is a mechanism that inhabitants who live near the water resource cannot develop the water resource with their value. In line with the report of Asian Water Development Outlook (AWDO) that the future water crisis in Asian countries, it will not be because of physical scarcity of water, but because of inadequate or inappropriate water governance, including management practices, institutional arrangements, and socio-political conditions, which leave much to be desired (Bird et.al, 2008).

In case of Indonesia, among total 231.6 million inhabitants only around 49.7% of the citizen has access to water which its 10% is obtained through community based water management (Statistic Centre Board, 2005).

Complexity of water supply problem in Singosari District, particularly case in Toyomarto village and Candi Renggo Village will be an excellent topic to understand more about the disregard place from the statement `prosperity place, prosperity people`. In the absent from proper understanding of the root problem may brings the policy does not work very well.

Singosari District is a district with the highest number of population (140,245 inhabitants) in Malang Regency. Moreover, this district has several natural springs with water flow more than 250 liter per second (3^{rd} to 2^{nd} magnitude level). Whereas, in fact, number of people with access to piped drinking water system through HIPPAM and PDAM are only 38,835 inhabitants or 28% from total inhabitants in the district.

Into more detail, Candi Sumberawan Spring which lies in Toyomarto village is one of main fresh water source that both HIPAM and PDAM Unit Branch Singosari utilize it to serve residents in the district. According to Data Base of Clean Water in Malang Regency (2008), number of Toyomarto villagers with access to piped water system is only around 1.500

inhabitants or 15% of the total villagers and it has supplied by HIPPAM groups. Meanwhile, number of Candi Renggo villagers with access to piped drinking water is 5,050 inhabitants or 35% of the villagers and it has provided by PDAM Unit Branch Singosari.

Main objective of this chapter is to capture suitable perceptive of water supply issues from an empirical case of two periods field survey in Toyomarto and Candi Renggo village, Singosari district, Malang regency, East Java province, Indonesia. The chapter comprises into six sections. Section two describes the field survey design consists of survey method, list of questions and general description of the research area. Then it continues with the depiction of the field survey results which are divided into three parts. First is about demographic attributes of the respondents that are illustrated in section three. Second is about water supply system in section four and third is about community network in section five. Finally, this chapter will closed with a conclusion remarks of the whole field survey activity. Additional note, in order of simplification without any effect of reducing the meaning, from this chapter we use terminology of PDAM to refer PDAM Unit Branch Singosari, except in particular case which we give more detail explanation for a specific purpose.

4.2 The Field Survey Design

This section describes the field survey design consist of survey method, list of questions, and general description of the research area. Field survey was conducted in two phases whereby the main goal is to investigate water supply system and social capital in Malang Regency, case study two villages in Singosari District. The first phase was on December 2008 covering three main items (demographic attributes, water supply system, and community network). The second phase was held around one year ahead on February 2010 in order to enrich the previous result of the field survey. In addition, we had done preliminary field survey to catch a general idea of the research area before we brought the first questionnaire survey to the community.

4.2.1 Survey Method

Face to face questionnaire interview survey method effectively had been done within 10 days by 20 surveyors with interview schedules from 07:00 a.m. to 09:00 p.m. depend on the respondent's readiness. Through systematic sampling, target for the household questionnaire survey is 500 households living at Toyomarto and Candi Renggo village, Singosari district which is selected as the respondents from two villages among 17 villages in Singosari district which inhabited by 24,388 residents. Hence the results and the substantial assessments replicate the essential characteristics of the contacted people. In order to optimize representativeness of the inhabitants, the respondents selected for the study are the husband, the wife or the head of

family that are chosen so as they represent typical precious inhabitants.

Since there is no available statistical record of the type of villagers' water usage in the village level or even in the more detail area, in the preliminary observation survey we visited the head of each village. The received information helped us to define the type of clean water sources exist in the village and to determine a set of respondents as well as a set of representative hamlets in the step of questionnaire sheet's distribution.

Figure 4.1 illustrates the map of research area which administrative area of Toyomarto village is huge covering forest area. In this case we focus upon the residential area in Toyomarto village as well as in Candi Renggo village as it is depicted in the small box.

4.2.2 List of Questions

Main research aims covering three items as follows:

1. To explore demographic characteristic of respondent;
2. To scrutinize water supply issues;
3. To investigate the community network.

Referring to the Instruments of the Social Capital Assessment Tools developed by World Bank (2004) and combining it with preliminary observation survey, we developed household questionnaire survey consist of three sections as shown in the following Table 4.1.

Table 4.1 Research Aims and Research Questions

Research Aims	Research Questions
To explore demographic data	Sex, age, education, occupation, income, working place, family member and length of stay
To explore water supply system	How does community get access to clean water? How does rule of water supply system? How does community solve their water problem? How does community opinion to improve water supply system?
To investigate the community network	How does their membership in community group? How does community level of trust? How does their concern towards community welfare? How does characteristic of community network based on the relationship with the closest people? How does their opinion towards community and living environment?

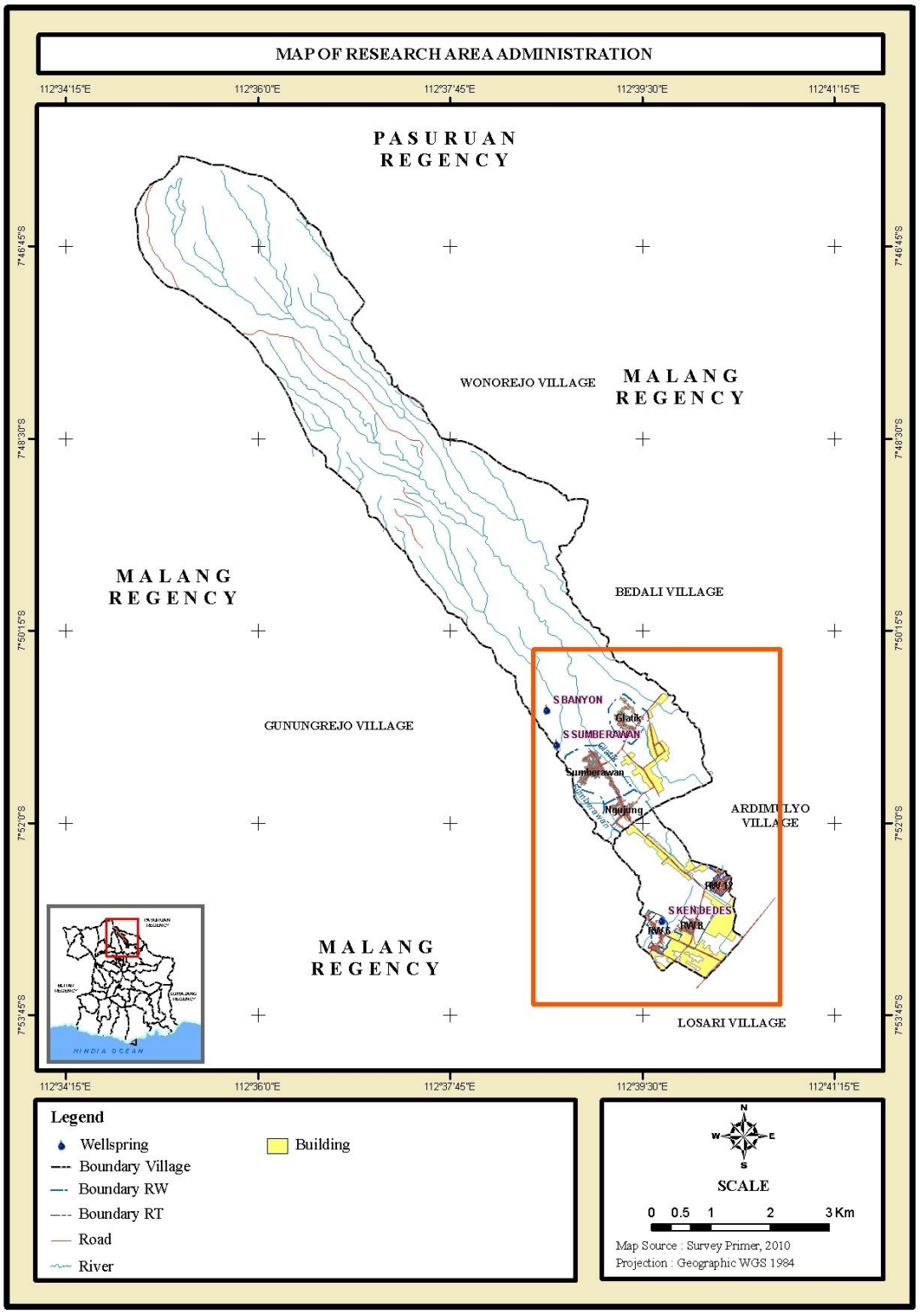


Figure 4.1 Map of Research Area

We distributed 250 sets of household questionnaire survey for each village as illustrated in Table 4.2. But, finally we declined one respondent for each village due to inconsistency of the answer. They are one respondent from Ngujung hamlet, Toyomarto village and another one

from RW 8, Candi Renggo village.

Table 4.2 Questionnaire Distributions

No	Village	Hamlet	Number Of Respondent
1	Toyomarto	Ngujung	64
		Sumberawan	104
		Glatik	81
2	Candi Renggo	RW 6	74
		RW 8	75
		RW 12	100

4.2.3 General Description of the Research Area

As we mention in the previous description, the field survey was conducted in two villages, namely Toyomarto village – upper part of the research area and Candi renggo village – the down part of the research area.

Firstly is Toyomarto village as depicted in the following Figure 4.2 Toyomarto village comprises into 7 sub villages, consist of (i) Bodean Krajan, (ii) Bodean Putuk, (iii) Ngujung, (iv) Sumberawan, (v) Glatik, (vi) Wonosari and (vii) Petung Wulung. In general, total area of Toyomarto village covers 1155.64 Ha, whereby the land use is dominated by (i) paddy & dry field (54%), (ii) government plantation & forest (28%); and (iii) residential (18%). This village lies on 600 to 1,500 meter above sea level, with distance to the closest capital city (Malang Regency) is around 40 km and distance to the closest district centre (Singosari district) is around 5 km.

Total inhabitants in Toyomarto village (2008) are 12,245, consist of 6,042 male and 6,203 female, and 3,272 households. Main livelihood of villagers is (i) worker in industrial sector (manufacturing) (62%); (ii) agriculture sector (23%); and (iii) worker in service/commercial sector (15%).

Table 4.3 Characteristic of Demography in Toyomarto Village

	2006	2007	2008
Level of employment	226.68	226.78	169.99
Total Dependency Ratio	53.37	50.56	49.12
Child Dependency Ratio	52.74	49.74	48.23
>10 year illiterate	147	132	121

Source: Calculated based on Toyomarto Village Basic Data 2006-2008

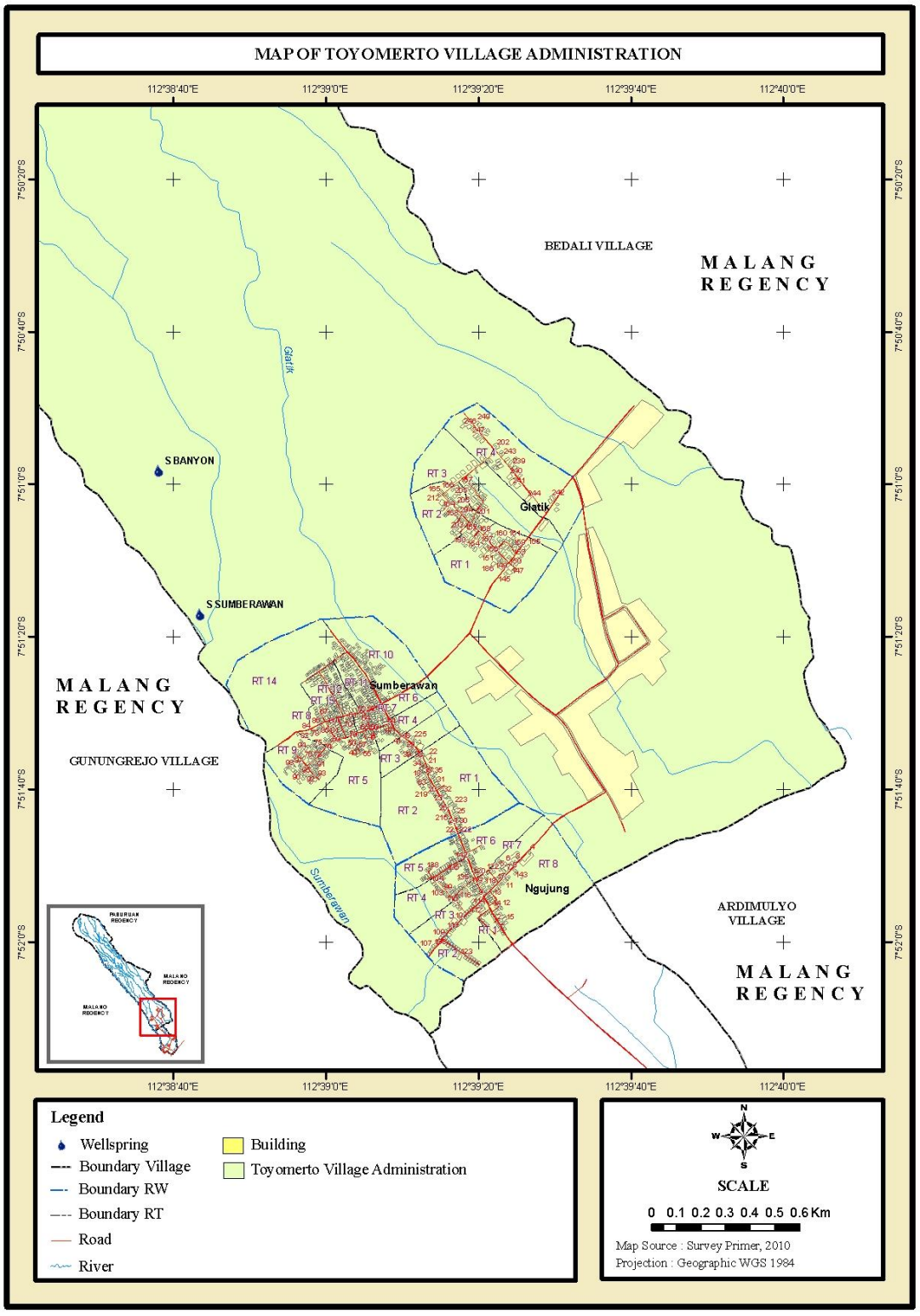


Figure 4.2 Map of Toyomarto Village

The second village is Candi Renggo that is illustrated in the following Figure 4.3.

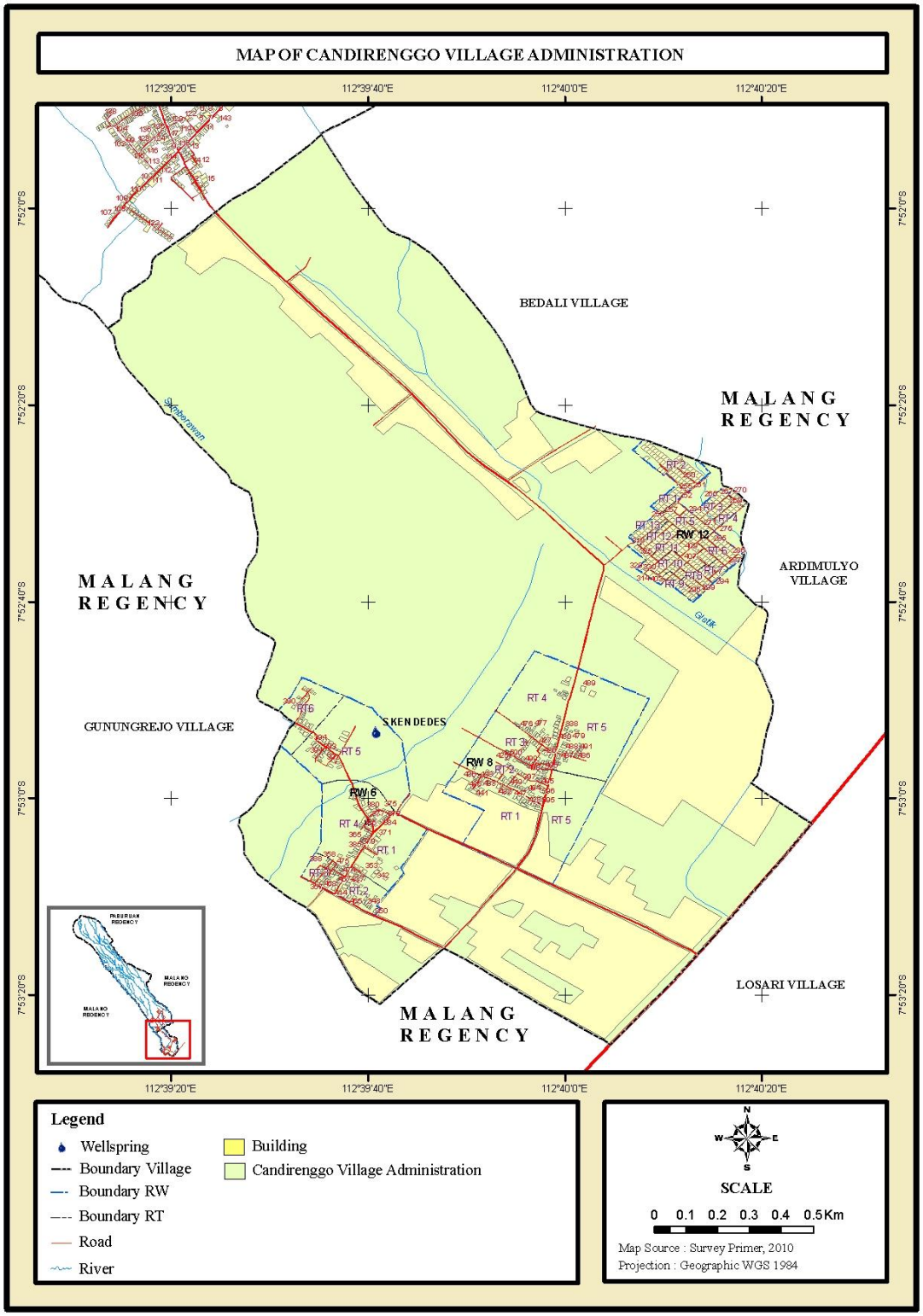


Figure 4.3 Map of Candi Renggo Village

Total area in Candi Renggo village is around 340.18 Ha, whereby the land use is dominated by (i) wet paddy and dry field (54%), (ii) residential (44%). This village lies on 341 to 550

meter above sea level and rainfall 331 mm per year, with distance to the closest capital city (Malang Regency) is around 12 km and distance to the closest district centre (Singosari district) is around 1 km.

Candi Renggo Village comprises into 12 sub villages, consist of RW 1 to RW 12. Total inhabitants (2008) are 15,254, consist of 7,714 male and 7,540 female, and 4,384 households. Major livelihood of villagers is (i) worker in industrial sector (83%); (ii) agriculture sector (11%); and (iii) worker in service/commercial sector (6%).

Table 4.4 Characteristic of Demography in Candi Renggo Village

	2007	2008
Level of employment	74.99	74.99
Total Dependency Ratio	54.42	57.84
Child Dependency Ratio	46.48	47.03
>10 year illiterate	111	98

Source: Calculated based on Candi Renggo Village Basic Data 2006-2008

4.3 Demographic Attributes

As mentioned in Chapter 3, we can classify the respondent in the research area based on their type of access to clean water into five. The first and the second types are the respondents who get access to piped clean water system connection to house through HIPPAM and PDAM. In these sense, we believe that a piped clean water system connection to house is the appropriate water supply system for all people in order to gain healthy and economically advantages of access to clean water for their basic daily life. The third type is the respondents who construct their private well inside their land territory which they fetch their clean water with manual plastic bucket or electric water pump. The fourth type is the respondents who fetch their clean water in a public water facility namely public hydrant which provided by some wells owners as well as some HIPPAM groups. The fifth type consists of a few respondents who utilize directly 'clean' water from the river.

Table 4.5 describes the number of respondent based on the type of access to clean water, which 2 respondents are excluded from the sample due to inconsistency of its answer. It is illustrated that HIPPAM supplies water for residents in Sumberawan and Ngujung hamlet of Toyomarto village, meanwhile the residents in Candi Renggo who get access to piped clean water from HIPPAM is limited for residents in RW 6 hamlet. In the smaller number of respondents, PDAM supplies piped drinking water to the residents in all three hamlets of Candi Renggo, but its only supplies only covering Ngujung hamlet in Toyomarto village. Particular

case for residents in Glatik hamlet that due to high altitude of geographic position currently none of water pipeline system neither from HIPPAM nor PDAM could reach the residents. But it is fortunate that this hamlet is blessed by sufficient shallow ground water which people utilize it by construct the wells.

Table 4.5 Number of Respondent Based on Water Sources

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	100	46	-	69	-	-
PDAM	-	18	-	1	1	91
Individual Wells	-	-	43	1	57	9
Public Hydrant	-	-	38	3	17	-
Other	4	-	-	-	-	-
Total	104	64	81	74	75	100

Referring to Table 4.6, there are most male respondents as compared to the females in the study area covering 70% households in the two villages. In indicates that the common head of households are the father.

Table 4.6 Sex Identity of Respondent

	Toyomarto						Candi Renggo					
	Sumberawan		Ngujung		Glatik		RW 6		RW 8		RW 12	
	M	F	M	F	M	F	M	F	M	F	M	F
HIPPAM	78	22	31	15	-	-	57	12	-	-	-	-
PDAM	-	-	12	6	-	-	0	1	0	1	62	29
Individual Well	-	-	-	-	24	19	1	0	42	15	6	3
Public Hydrant	-	-	-	-	20	18	3	0	14	3	-	-
Other	1	3	-	-	-	-	-	-	-	-	-	-
Total	104		64		81		74		75		100	

There are 74% of male as the head of households who get access to piped clean water supply system from HIPPAM and PDAM. Here, we propose dummy variable for male as 1, and 0 otherwise. The critical value of gender of the respondents show $\chi^2(df = 1, N = 326) = 4.19$ at $p < 0.041$. It indicates that gender and choice to join or not join HIPPAM are dependent. In other words, we may argue that male respondents tend to join HIPPAM group than female respondents. And it is depicted in Figure 4.4.

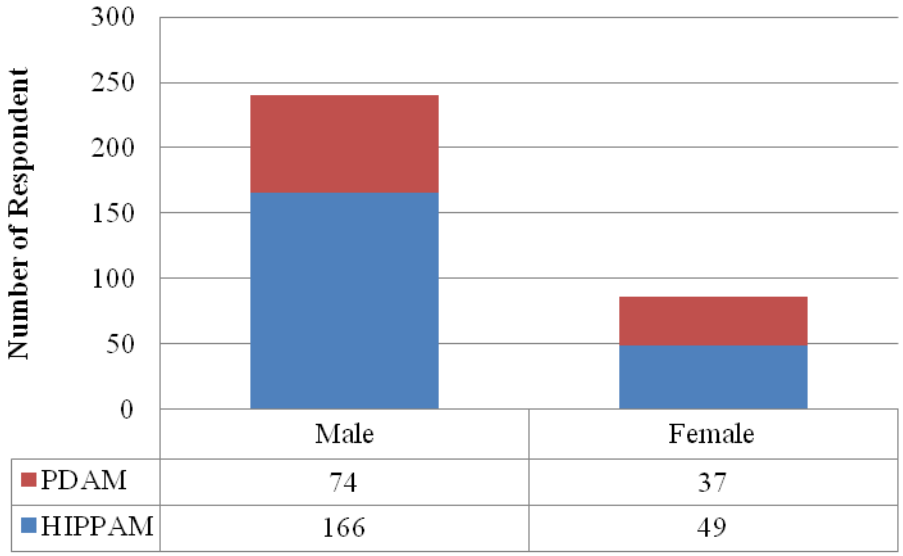


Figure 4.4 Gender of HIPPAM Members & PDAM Customers

Referring to Table 4.7, in general average age of the respondents is 47 years which the youngest age of 22 years and the oldest one is 90 years. According to standard population of Indonesia, age of 15 – 64 years is classified as productive age, which majority respondents in Toyomarto and Candi Renggo village are in it, 96% and 86% respectively. Aged Dependency Ratio (ADR) is defined as proportion between unproductive age and productive age whereas unproductive age is defined as people aged 65 and over times 100. Hence ADR of the respondents in Toyomarto and Candi Renggo village are 4.62 and 16.36 respectively. It means that in every 100 working aged (15 to 64 years) there are around 5 and 17 dependents in each village respectively, and this ratio is quite low. But if it combines 2 graphs of Age and Occupation of the family member, the real total dependency ratio is totally changed become 1.32. The group of population with occupation as unemployment, house wife, and retiree are the group of working age but they do not have enough capability on earning sufficient money. Therefore, in the real dependency ratio these parts of population become part of dependent age.

Table 4.7 Average Age of Respondent

	Toyomarto						Candi Renggo					
	Sumberawan		Ngujung		Glatik		RW 6		RW 8		RW 12	
	≤47	>47	≤47	>47	≤47	>47	≤47	>47	≤47	>47	≤47	>47
HIPPAM	70	30	25	21	-	-	34	35	-	-	-	-
PDAM	-	-	10	8	-	-	0	1	0	1	40	51
Individual Well	-	-	-	-	29	14	0	1	27	30	2	7
Public Hydrant	-	-	-	-	26	12	1	2	9	8	-	-
Other	3	1	-	-	-	-	-	-	-	-	-	-
Total	104		64		81		74		75		100	

There are 55% of the respondents who get access to piped clean water supply system from HIPPAM and PDAM have average age lower or equal to 47 years. Here, we propose dummy variable for respondent with average age lower of equal to 47 years as 1, and 0 otherwise. The critical value of average age of the respondents show $\chi^2(df = 1, N = 326) = 6.613$ at $p < 0.01$. It indicates that age and choice to join HIPPAM or PDAM are dependent. In other words, we may argue that respondents with average age at lower or equal to 47 years tends to join HIPPAM group as is also reflected in Figure 4.5.

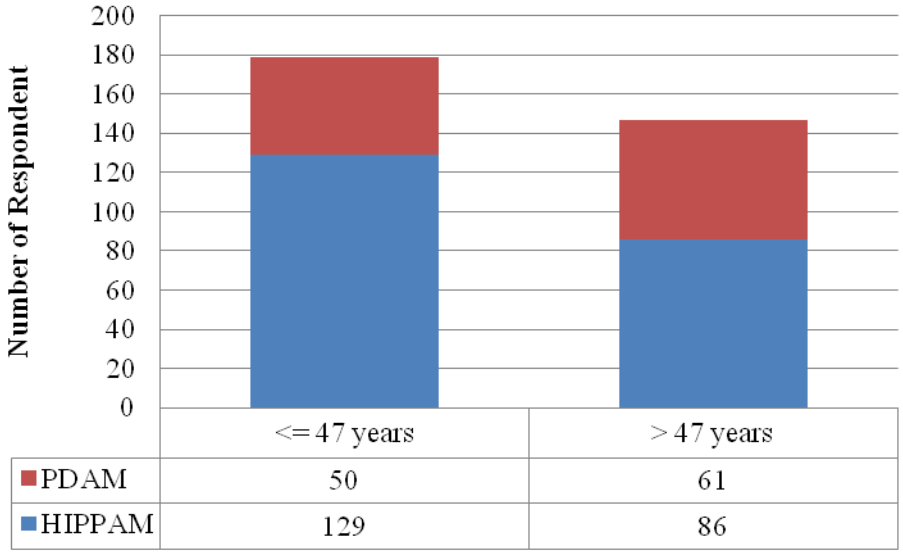


Figure 4.5 Average Age of HIPPAM Members & PDAM Customers

Majority villagers in Toyomarto and Candi Renggo have 4 family members in one household consist of parents and two children, 42% and 32% respectively. Maximum number of family member for each household in both villages is 7 members whereby the number of household with 5 to 7 family member is 26% and 30% respectively. In general, HIPPAM's users in the two villages have family member of 3 and 4, meanwhile PDAM's customers have slightly higher family member of 4 and 5. In Sumberawan hamlet, among four respondents who utilize water from river they have 4 family members.

There are 71% of the respondents who get access to piped clean water supply system from HIPPAM and PDAM have average 4 family members in their house. Here, we propose dummy variable for respondent with average family member at lower or equal to 4 members as 1, and 0 otherwise. The critical value of average age of the respondents show $\chi^2(df = 1, N = 326) = 0.008$ at $p < 0.929$. It indicates that number of people in the family and choice to join HIPPAM or PDAM are independent.

Table 4.8 Family Member of Respondent's Household

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	4	3	-	4	-	-
PDAM	-	5	-	5	4	4
Individual Wells	-	-	4	3	4	3
Public Hydrant	-	-	4	4	3	-
Other	4	-	-	-	-	-

There are four groups of education background of the respondents encompasses (i) elementary school, (ii) junior school, (iii) high school and (iv) university level. Elementary school has six years of education, whereas junior school as well as high school has three years. According to education statistics, average years of schooling of adults in Indonesia is 5 years (www.NationMaster.com). It is illustrated in Table 4.9 that the number of respondents with education background at level of junior school or higher than that is slightly higher than the number of respondents with education background at level of elementary school or even lower than that at 56% and 44%, respectively. It may imply that respondents in the research area have education level above the national average.

Into more detail, it indicates that majority respondents who get access to piped clean water supply system have average education level higher than elementary school. There are 53% members of HIPPAM have education background at junior school or higher. Even more, 88% customers of PDAM have level of education at junior school or above. In contrary, majority respondents who get access to clean water such as from individual wells, public hydrant and other water source have education level at elementary school or even lower than that. In this sense, some respondents did not finish their six years period of education in the elementary level. There are 55% households who get access to clean water by construct their own private wells with background of education at elementary school or lower than that. In addition, there are higher percentages of respondents who get access to clean water from public hydrant with education background at elementary school or lower than that compare to respondents who own their private wells (69%). Even more, there are very high percentages of respondents who acquire fresh water from other water source such as river which have education level at elementary school or lower than that (75%). Thus, majority respondents who get access to piped clean water supply system have average education level higher than elementary school.

Table 4.9 Education Level of Respondent

	Toyomarto						Candi Renggo					
	Sumberawan		Ngujung		Glatik		RW 6		RW 8		RW 12	
	≤ES	>ES	≤ES	>ES	≤ES	>ES	≤ES	>ES	≤ES	>ES	≤ES	>ES
HIPPAM	54	46	20	26	-	-	28	41	-	-	-	-
PDAM	-	-	4	14	-	-	0	1	0	1	9	82
Individual Well	-	-	-	-	28	14	1	0	26	31	5	4
Public Hydrant	-	-	-	-	30	8	2	1	8	9	-	-
Other	3	1	-	-	-	-	-	-	-	-	-	-
Total	104		64		81		74		75		100	

Note: ES = Elementary School

There are 35% of the respondents who get access to piped clean water supply system from HIPPAM and PDAM have level of education at lower or equal to elementary school, therefore we propose dummy variable for respondent with level of education lower or equal to elementary school as 1, and 0 otherwise. The critical value of education level of the respondents show $\chi^2(df = 1, N = 326) = \infty$ (infinite) at $p < 1.58E-10$. It indicates that education background and choice to join HIPPAM or PDAM are rigorously dependent. Here we may see that respondents with education background at junior school and higher have more than a six times greater rate of getting access to piped clean water supply system from PDAM. In other words, we may argue that respondents with education level at lower or equal to elementary school tends to join HIPPAM group as is also reflected in Figure 4.6.

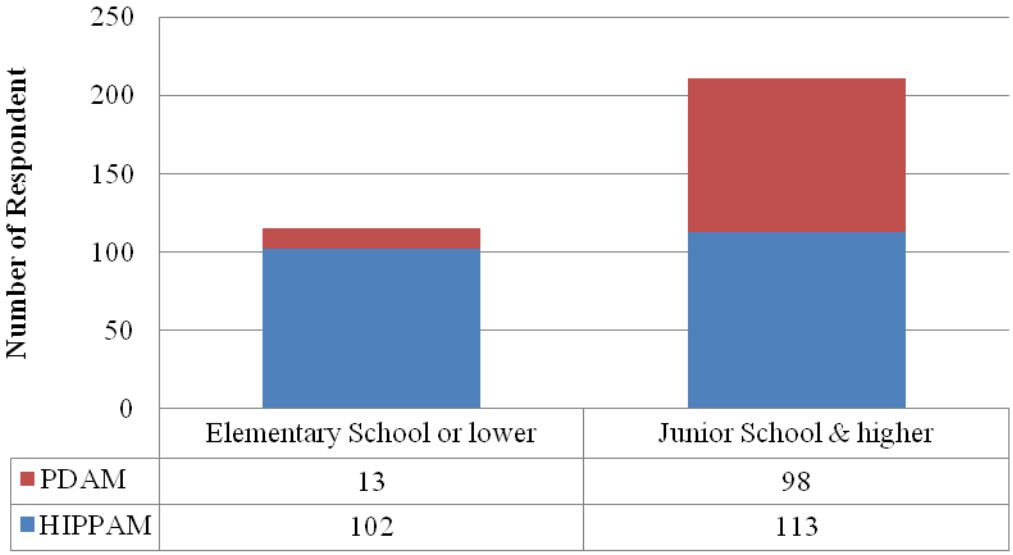


Figure 4.6 Education Level of HIPPAM Members & PDAM Customers

Table 4.10 illustrates that majority occupation of the respondents can be categorized as working in the service sector (70%) consist of civil servants of local government in Malang

regency, military/policeman, teacher, merchant, driver, tailor, staff in a private company, labor industry, retiree, housewife and 1 Protestant clergyman, as well as 8 unemployment. In the other hand, the rest of it works in the agriculture and manufacturing sector covering farmer, field hand, breeder, sandal maker, entrepreneur of small business "sandal home industry." In every hamlet, it shows that the numbers of respondents who work in the services sector are always higher than the number of respondents who work in the agriculture and manufacturing sector, except the respondents in Ngujung hamlet who have slightly higher number of respondents who work in the agriculture and manufacturing sector.

Table 4.10 Occupation of Respondent

	Toyomarto						Candi Renggo					
	Sumberawan		Ngujung		Glatik		RW 6		RW 8		RW 12	
	AM	S	AM	S	AM	S	AM	S	AM	S	AM	S
HIPPAM	43	57	26	20	-	-	18	51	-	-	-	-
PDAM	-	-	7	11	-	-	0	1	0	1	7	84
Individal Well	-	-	-	-	17	26	0	1	11	46	0	9
Public Hydrant	-	-	-	-	16	22	1	2	4	13	-	-
Other	0	4	-	-	-	-	-	-	-	-	-	-
Total	104		64		81		74		75		100	

Note: AM = Agriculture and Manufacturing, S = Services

In order to scrutinize the relationship between type of occupation and choice to access piped clean water supply system among the whole members of HIPPAM and customers of PDAM, we propose dummy variable for respondent with occupation as agriculture and manufacture sector as 1, and 0 otherwise. The critical value of occupation of the respondents show $\chi^2(df = 1, N = 326) = \infty$ (infinite) at $p < 2.56E-07$. It indicates that type of occupation and choice to join HIPPAM or PDAM are strictly dependent. In other words, we may argue that 86% of the respondents with occupation in agriculture and manufacturing sector tend to join HIPPAM group than the respondents with occupation in services sector (57%) as is reflected in Figure 4.7.

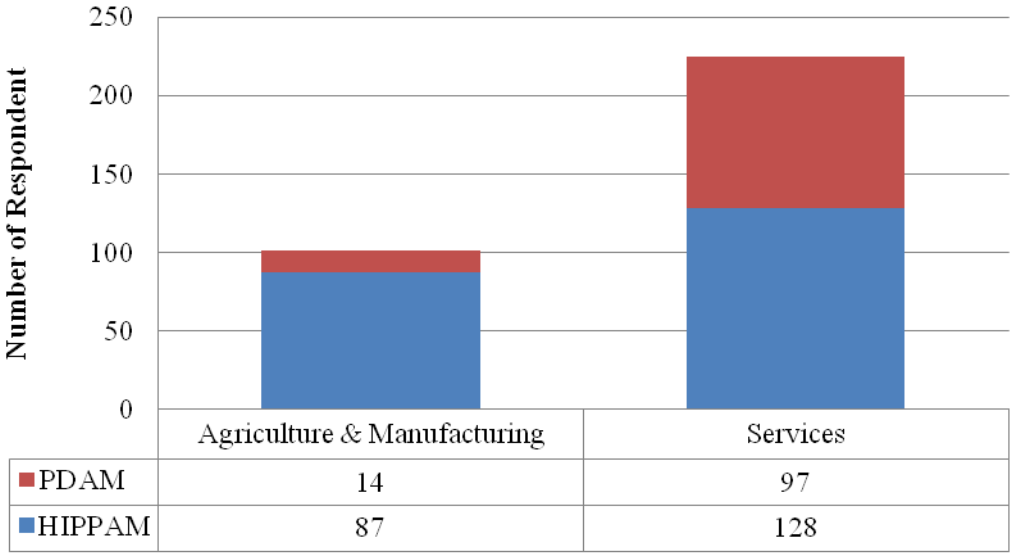


Figure 4.7 Occupation of HIPPAM Members & PDAM Customers

Referring Table 4.11, among 250 respondents, there are 227 families with complete parents (father and mother), 10 single parents (widower), and 13 single parents (widow). The most common size of family is families with 4 inhabitants live in the same one unit single house consist of parents (father and mother) plus two members (152 households or 61% of the total households). Another three types of family size are (i) family with 5 members (68 households or 27% of the total households), (ii) family with 6 members (28 households or 11% of the total households), and (iii) family with 7 members (2 households or 0.8% of the total households). Productive age is defined as people aged 15 to 64, and unproductive age is defined as people aged 65 and over, and people aged 0 to 14, so Total Dependency Ratio (TDR) in Toyomarto Village is 0.41, Child Dependency Ratio (CDR) is 0.38 and Aged Dependency Ratio (ADR) is 0.04. Except CDR, in average dependency ratio in this village is lower than dependency ratio in Malang Regency level.

Education level in Toyomarto Village is dominated by people with middle school (71% of the total 473 answers related to education background), meanwhile the fewest people has university background at bachelor and master degree (3.8%). Occupation of the father is dominated by livelihood as peasant, the mother is mostly as a house wife, and the other member of family is primarily with status as student.

Table 4.11 Sex, Age, Education & Occupation of Respondent in Toyomarto Village

	Father	Mother	Member 1	Member 2	Member 3	Member 4	Member 5
Sex							
Male	237		114	73	31	14	1
Female		240	110	82	37	14	1
Total	237	240	244	155	68	28	2
Age							
<15 years	-	-	100	103	39	14	1
15-64 years	227	237	124	53	25	13	0
>64 years	10	3	0	1	7	2	1
Total	237	240	224	157	71	29	2
Education							
Middle School	72	85	96	51	24	8	0
High School	25	15	37	18	9	2	0
Undergraduate	2	2	5	3	0	1	0
Graduate	9	5	3	0	1	0	0
Total	108	107	141	72	34	11	0
Occupation							
Peasant	47	24	3	1	4	1	0
Private	33	9	10	5	5	1	0
Entrepreneur	43	0	0	0	3	2	0
Teacher	2	2	2	0	2	0	0
Retiree	4	1	0	0	0	0	0
Military/Police	3	0	0	0	0	0	0
Merchant	18	25	2	1	2	0	0
Labor	40	17	5	1	3	0	0
Driver	11	17	0	1	0	0	0
Breeder	8	1	1	0	0	2	0
Official	8	1	1	1	0	0	0
Field Hand	11	8	0	1	0	0	0
Unemployment	3	1	7	1	1	0	0
House wife	-	113	5	10	4	1	1
Student	-	-	31	37	17	3	0
Total	231	238	58	65	41	10	1

Referring Table 4.12, there are 216 families with complete parents (father and mother), 8 single parents (widower), and 26 single parents (widow). The most common size of family is families with 4 members live in the same one unit single house consist of parents (father and mother) plus two members (127 households or 51% of the total households). Another three types of family size are (i) family with 5 inhabitants (85 households or 34% of the total households), (ii) family with 6 members (33 households or 13% of the total households), and (iii) family with 7 members (5 households or 2% of the total households). Productive age is defined as people aged 15 to 64, and unproductive age is defined as people aged 65 and over, and people aged 0 to 14, so Total Dependency Ratio (TDR) in Candi Renggo Village is 0.41, Child Dependency Ratio (CDR) is 0.32 and Aged Dependency Ratio (ADR) is 0.09. As a result, the whole dependency ratio in this village is lower than dependency ratio in Malang Regency level.

Education level in Candi Renggo Village is dominated by people with high school (49% among total 610 answers of education background). Meanwhile, fewest people have university

background at bachelor and master degree (3%). Occupation of the father is dominated by livelihood as private where he works in private company such as a staff as well as manager. The mother is mostly as a house wife, and the other member of family is primarily with status as student, except a member of family in the productive age, they are working at private sector primarily as staff in a certain company.

Table 4.12 Sex, Age, Education & Occupation of Respondent in Candi Renggo Village

	Father	Mother	Member 1	Member 2	Member 3	Member 1	Member 2
Sex							
Male	226	-	102	59	41	16	2
Female	-	240	90	72	44	17	3
Total	226	240	192	131	85	33	5
Age							
<15 years	-	-	79	71	44	44	4
15-64 years	194	226	140	70	34	34	1
>64 years	32	14	2	3	8	8	1
Total	226	240	221	144	86	86	6
Education							
Middle School	53	62	58	36	25	5	1
High School	85	71	81	39	12	9	0
Undergraduate	1	1	8	4	2	1	1
Graduate	21	17	9	6	2	0	0
Total	160	151	156	85	41	15	2
Occupation							
Peasant	18	8	1	0	1	0	0
Private	57	18	33	9	10	1	0
Entrepreneur	22	8	0	3	3	0	0
Teacher	4	9	1	0	0	0	0
Retiree	23	0	0	0	0	0	0
Military/Police	5	0	0	0	0	0	0
Merchant	13	17	3	1	1	1	0
Labor	38	17	17	1	2	2	0
Driver	15	0	2	1	0	0	0
Breeder	2	0	1	0	0	0	0
Official	15	2	3	1	0	0	0
Field Hand	4	1	0	1	0	0	0
Unemployment	2	0	6	1	2	1	0
House wife	-	137	6	10	6	0	0
Student	-	1	37	37	17	5	0
Total	218	218	110	65	42	10	0

There are six options to describe working place of the respondents covering working (i) at home, (ii) within the community, (iii) inside the village, (iv) outside the village, inside district, (v) outside district, inside regency, and (vi) another regency or city. Among total respondents, there are 23% of respondents who work at home and it is the highest number of respondents based on the six categorization of working place. Referring to Table 4.13 respondents in the two villages distinguished by type of water source, majority of them work outside home.

Table 4.13 Working Place of Respondent

	Toyomarto						Candi Renggo					
	Sumberawan		Ngujung		Glatik		RW 6		RW 8		RW 12	
	At home	Outside home	At home	Outside home	At home	Outside home	At home	Outside home	At home	Outside home	At home	Outside home
HIPPAM	16	84	21	25	-	-	12	57	-	-	-	-
PDAM	-	-	10	8	-	-	1	0	1	0	24	67
Individual Well	-	-	-	-	7	36	0	1	10	47	3	6
Public Hydrant	-	-	-	-	1	37	0	3	5	12	-	-
Other	2	2	-	-	-	-	-	-	-	-	-	-
Total	104		64		81		74		75		100	

Since the highest number of respondents who join HIPPAM and PDAM are working at home (26%), in order to scrutinize the relationship between working place and choice to access piped clean water supply system, we propose dummy variable for respondent who works at home as 1, and 0 otherwise. The critical value of level of working place of the respondents do not exceed the critical value of chi-square at $p < 0.05$ with $df = 1$ is 3.84 whereby it shows $\chi^2(df = 1, N = 326) = 3.531$ at $p < 0.06$. It indicates that working place and choice to join HIPPAM or PDAM are slightly independent in case of the whole members of HIPPAM and customers of PDAM. It is illustrated in the following Figure 4.8.

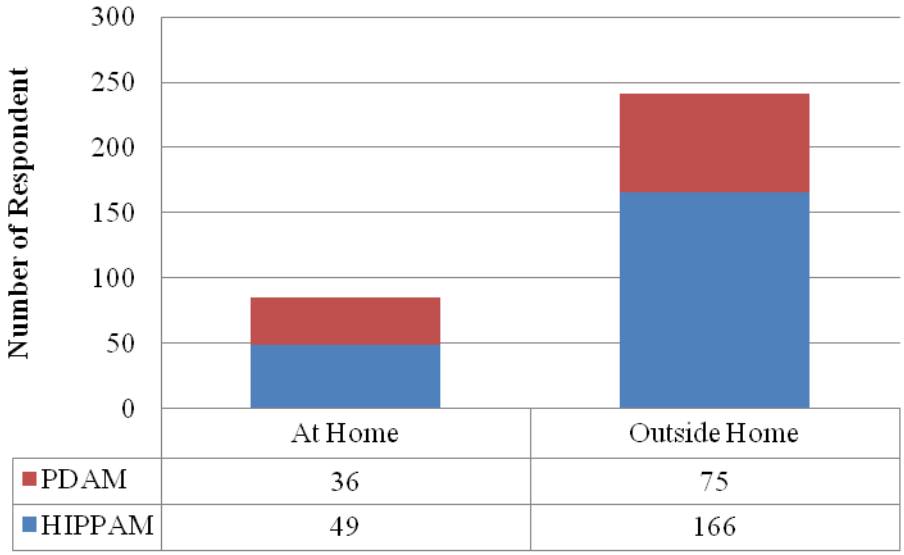


Figure 4.8 Working Place of HIPPAM Members & PDAM Customers

In the questionnaire survey, we asked respondents to reveal their household monthly income using 7 categories as follows: (i) less than IDR 500,000 (JPY 5,000), (ii) IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000), (iii) IDR 1,000,000 – 1,500,000 (JPY 10,000 – 15,000), (iv) IDR 1,500,000 – 2,000,000 (JPY 15,000 – 20,000), (v) IDR 2,000,000 – 2,500,000 (JPY 20,000

– 25,000), (vi) IDR 2,500,000 – 3,000,000 (JPY 25,000 – 30,000) , and (vii) more than IDR 3,000,000 (JPY 30,000). Table 4.14 illustrates the median monthly income level of households in the research area is in the level (ii) IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000) for 64% of the total respondents. It indicates that in general villagers live with household monthly income at equal or less than standard monthly minimum wage in Malang regency that its standard in 2009 is IDR 945,500 (JPY 9,455). Except customers of PDAM whereby 54% of them have monthly income higher than level (ii), 67% members of HIPPAM, and 70% users of private wells, as well as 79% users of public hydrant they have monthly income at level (ii) or lower than that. It is quite surprising that half users of other water source, they have quite high monthly income at level (iii) and level (v). It seems not so simple to justify the relationship between choice of access to water and level of income. We need to scrutinize into more detail using statistical method to get more appropriate understanding about it.

Table 4.14 Average Income of Respondent

	Toyomarto						Candi Renggo					
	Sumberawan		Ngujung		Glatik		RW 6		RW 8		RW 12	
	≤0.75	>0.75	≤0.75	>0.75	≤0.75	>0.75	≤0.75	>0.75	≤0.75	>0.75	≤0.75	>0.75
HIPPAM	63	37	38	8	-	-	44	25	-	-	-	-
PDAM	-	-	10	8	-	-	0	1	0	1	41	50
Individual Well	-	-	-	-	32	11	0	1	42	15	3	6
Public Hydrant	-	-	-	-	32	6	0	3	14	3	-	-
Other	2	2	-	-	-	-	-	-	-	-	-	-
Total	104		64		81		74		75		100	

Furthermore, we scrutinize relationship between income level and choice of access to piped clean water supply system among members of HIPPAM and customers of PDAM. Referring to Figure 4.9 we may see that 60% respondents have income level equal or lower than median IDR 0.75 million. In other words, majority households who get access to piped clean water supply system have monthly income lower or equal to level (ii) IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000). Using dummy variable for respondent with income level lower or equal to median IDR 0.75 million as 1, and 0 otherwise, it indicates that the critical value of income level of the respondents show $\chi^2(df = 1, N = 3261) = 14.11$ at $p < 0.0002$. It indicates that income level and choice to join HIPPAM or PDAM are dependent. In other words, we may argue that 74% of households with income level at lower or equal to IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000) tends to join HIPPAM group that households with higher income level (54%).

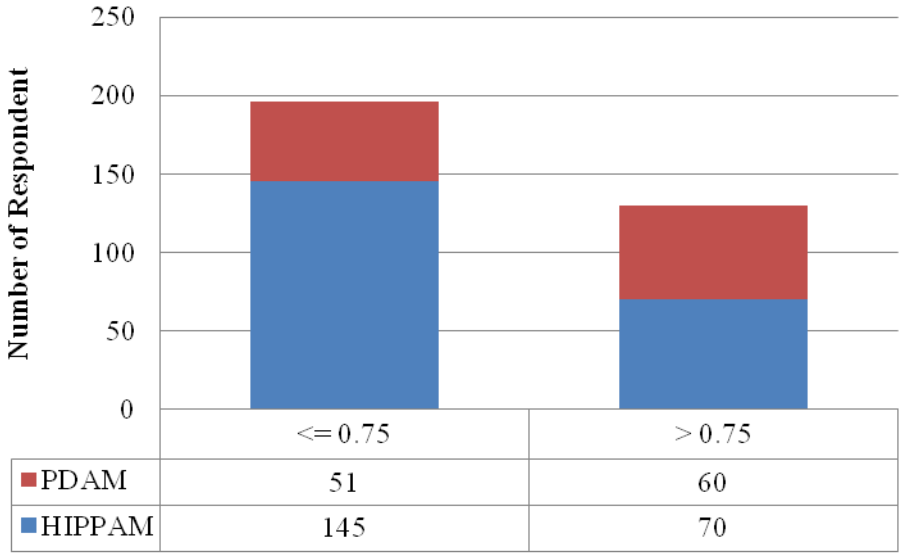


Figure 4.9 Income Level of HIPPAM Members & PDAM Customers

The longest travel time to reach work place is 2,160 minutes or 3 days has been done by 2 respondents. First, he works in another Malang Regency by ship with level (iv) IDR 1,500,000 – 2,000,000 (JPY 15,000 – 20,000). The second one is the fact that difficult to believe, she works as a labor in outside Singosari District, inside Malang Regency by foot with salary less than 500.000 per month. Meanwhile the regional minimum wage in East Java Province at 2008 is 802.000. The shortest time to reach work place is for the respondents who work at home with zero travel time, and the average travel time is 30 minutes. The following Table 4.15 depicts the working place and income level of respondents in Toyomarto village.

Table 4.15 Working Place & Income Level of Respondent in Toyomarto Village

Work Place	Number	Travel Time	Number
1.At home	57	1.0 minute	31
2.Within the community	62	2.0-15 minutes	66
3.Inside the Village	44	3.15-30 minutes	36
4.Outside the Village, inside district	37	4.30-45 minutes	61
5.Outside district, inside regency	22	5.45-60 minutes	0
6.Another regency/city	27	6.60-90 minutes	24
		7.>90 minutes	14
Total Answer	249	Total Answer	232
Means to	**Number**	**Salary**	**Number**
1. On Foot	100	1.Less than 500.000	72
2. Bicycle	4	2.500.000 – 1.000.000	105
3. Motor Bike	54	3.1.000.000 – 1.500.000	43
4. Private Car	7	4.1.500.000 – 2.000.000	17
5. Small Public Bus	7	5.2.000.000 – 2.500.000	5
6. Bus	4	6.2.500.000 – 3.000.000	2
7. Flight	0	7.More than 3.000.000	5
8. Ship	1		
9. Truck	6		
Total Answer	183	Total Answer	249

The longest travel time to reach work place is 2,160 minutes or 3 days has been done by 1 respondent that he works as entrepreneur in another regency/city of Malang Regency by private car with level 2 salaries (500.000-1.000.000). The shortest time to reach work place is for the respondents who work at home with zero travel time, and the average travel time is 30 minutes. The following Table 4.16 depicts the working place and income level of respondents in Candi Renggo village.

Table 4.16 Working Place & Income Level of Respondent in Candi Renggo Village

Work Place	Number	Travel Time	Number
1.At home	56	1. 0 minute	45
2.Within the community	34	2. 0-15 minutes	39
3.Inside the Village	22	3. 15-30 minutes	49
4.Outside the Village, inside district	37	4. 30-45 minutes	54
5.Outside district, inside regency	52	5. 45-60 minutes	1
6.another regency/city	48	6. 60-90 minutes	16
		7. >90 minutes	16
Total Answer	249	Total Answer	220
Means to	**Number**	**Salary**	**Number**
On Foot	35	1.Less than 500.000	62
Bicycle	9	2.500.000 – 1.000.000	82
Motor Bike	96	3.1.000.000 – 1.500.000	43
Private Car	13	4.1.500.000 – 2.000.000	24
Small Public Bus	11	5.2.000.000 – 2.500.000	12
Bus	9	6.2.500.000 – 3.000.000	13
Flight	1	7.More than 3.000.000	13
Total Answer	174	Total Answer	249

It is illustrated in Table 4.17 that the longest time of respondent stay in Toyomarto village is 70 years and the shortest one is 0.02 year. In case of villagers in Candi Renggo the longest time of respondent stay in the village is 85 years and the shortest one is 0.01 year. However, in general respondents in Toyomarto village had been stayed longer than majority respondent in Candi Renggo village, 50 and 15 years, respectively.

Additionally, even the respondents in Glatik hamlet have average length of stay 28.6 years for individual well owners and 30.8 years for a group of respondents with communal wells, but the longest people stayed in Toyomarto village is the one who live in Glatik hamlet (70 years). In other part, RW 12 hamlet could be concluded as the youngest hamlet within research area study that the longest time of stay of the respondents is 30 years and the newest residents just stay since a quarter-year prior to the field survey.

Table 4.17 Average Length of Stay of Respondent

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	29.8	31.6	-	27.5	-	-
PDAM	-	25.7	-	25.0	25.0	12.9
Individual Wells	-	-	28.6	53.0	25.7	10.5
Public Hydrant	-	-	30.8	39.3	32.2	-
Other	38.0	-	-	-	-	-

4.4 Clean Water Supply System

In this section we illustrate the current water supply system in the research area whereby we raise two types of question to the respondents. First, the semi-closed question whereby we ask respondents' opinion using 3 to 5 scales to categorize their opinion toward water supply system. Second, the opened question whereby we ask respondents to reveal their opinion for the current situation of water supply as well as how do to improve it.

4.4.1 Access to Clean Water

The term of clean water in this research depicts raw water or fresh water that require further treatment such as cooking process before it can be consumed. Moreover, the source of water is from earth's surface – i.e springs, ponds, lakes, rivers and the like, and groundwater. For this reason, we use the three terms interchangeably in this research to refer similar meaning. In addition, there are two types of water supply system that available in the research area. First is piped clean water supply system provided by a certain water provider namely HIPPAM and PDAM. Second is clean water supply system provided independently by each household.

Summarized in Table 4.5, there are five types of clean water sources in the research area. First, respondents who get access to piped clean water supply system from HIPPAM are 43% of total respondents covering 59% respondents in Toyomarto village and 28% respondents in Candi Renggo village. Second, respondents who get access to piped clean water supply system from PDAM are 22% of total respondents covering 75 respondents in Toyomarto village and 37% respondents in Candi Renggo village. Third, respondents who construct their own individual well are 22% of total respondents consist of 17% respondents in Toyomarto village and 27% respondents in Candi Renggo village. Fourth, respondents who fetch clean water from communal wells – provided voluntarily by owners of private wells or public tap – provided by some HIPPAM groups are 12% of total respondents consist of 15% respondents in Toyomarto village and 8% respondents in Candi Renggo village. Fifth, there are 4 respondents who fetch fresh water from other water sources than the previous four such as from river. The first and

second types of water sources are the household's piped clean water supply system provided by a certain water supply provider. The third type – private wells is a kind of water supply independently by each individual household. In general, they fetch clean water using a rope bucket. And, the two last types are categorized as common pool resources whereby users fetch water from public facility using plastic bucket or jerry can in a walking distance from their house. The following two maps depict the water supply system in the two villages including the location of some reservoirs and public hydrants (Figure 4.8 and 4.9). In addition, there is no different water source utilized by households between rainy season and dry season.

Scrutinize Figure 4.10, Glatik hamlet lies in the highest altitude than other two hamlets in Toyomarto village. Moreover, there is no clean water pipeline network from Candi Sumberawan Spring and Sumber Banyon that is constructed by HIPPAM groups and PDAM pass through this hamlet. In this sense, we may understand why none household in this hamlet which able to get access to piped clean water neither from HIPPAM nor from PDAM. Fortunately, this hamlet is blessed by abundant shallow ground water whereby residents construct their private drill wells or dig wells up to 20 meters inside their residential parcels. As a consequence, households in the hamlet acquire fresh water from private wells for the one who has ability to construct it and from communal wells for the one who does not have it. On the other hand, water pipeline network from the spring pass through both Sumberawan and Ngujung hamlet. As a result, households in both hamlets have access to piped clean water supply system from HIPPAM and PDAM as well as from public hydrant. Thereby, we may conclude that households in Glatik hamlet seem do not have choice to get access to piped clean water supply system provided by HIPPAM and PDAM as households in Sumberawan and Ngujung hamlet.

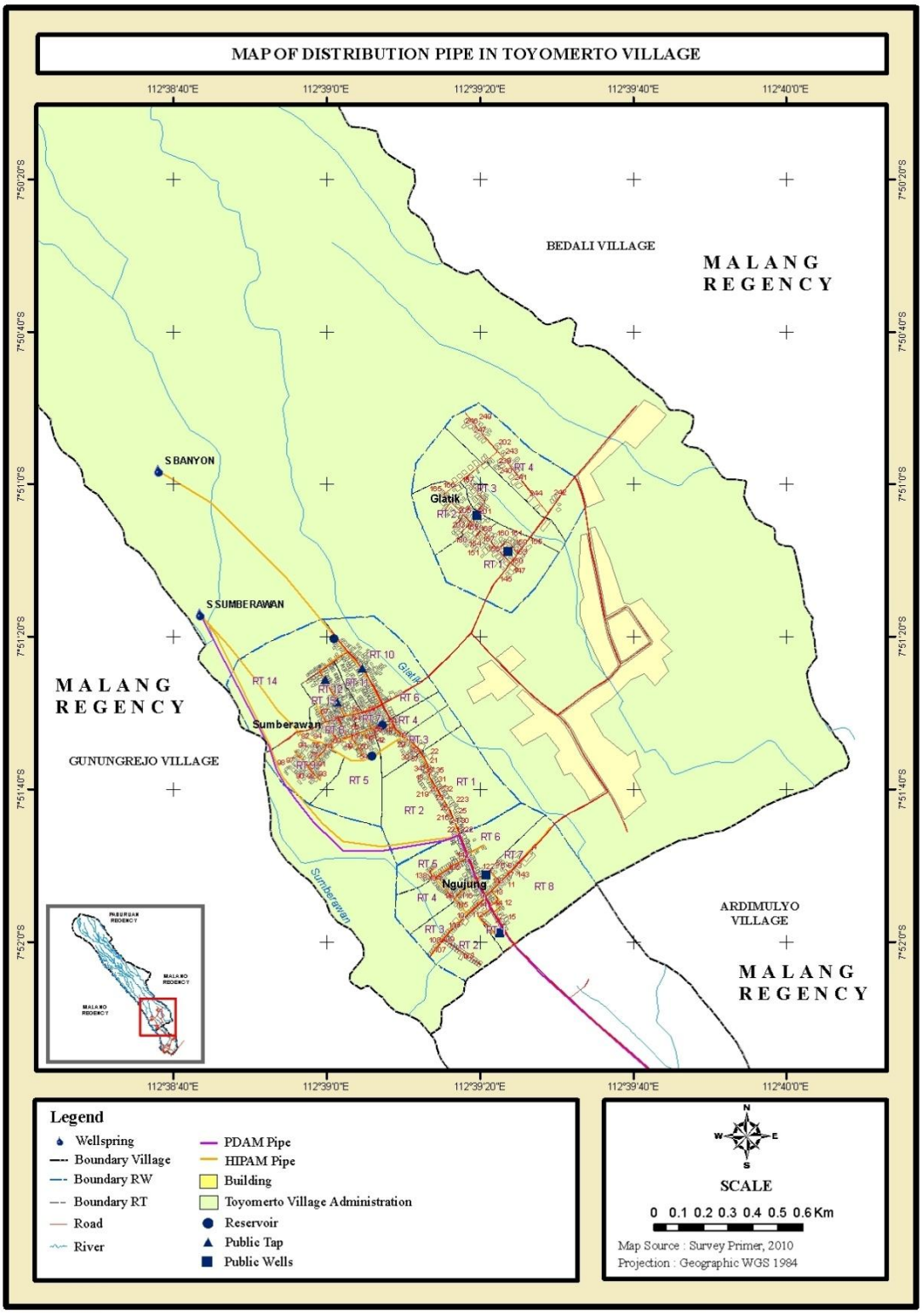


Figure 4.10 Map of Water Supply System in Toyomarto Village

Figure 4.11 Water Reservoirs of PDAM & HIPPAM

Figure 4.12 Main Pipelines of PDAM & HIPPAM

Scrutinize Figure 4.13 we may see that water pipeline network from PDAM able to reach the three hamlets in Candi Renggo village. Referring to historical development of RW 12 as a planned residential area, in the first early three years residents did not get connection to water pipeline from PDAM yet, other than acquire water from individual wells. Therefore, there are two types of water sources available in the hamlet. In case of households in RW 8 hamlet, since 1984 they have possibility to get access to piped clean water supply system from PDAM, completing their option to access individual wells and communal wells for particular households that do not have ability to construct their own private wells. In particular, households in RW 6 have more options to access clean water. Besides having possibility to construct their own private wells as well as having access to piped drinking water connection from PDAM, the households also have option to get access to piped clean water supply system provided by HIPPAM (Primer Koperasi Tirta Perwita). Moreover, for some particular households which have possibility to fetch clean water from public tap provided by the HIPPAM. Please refer to Chapter 3 for more detail information.

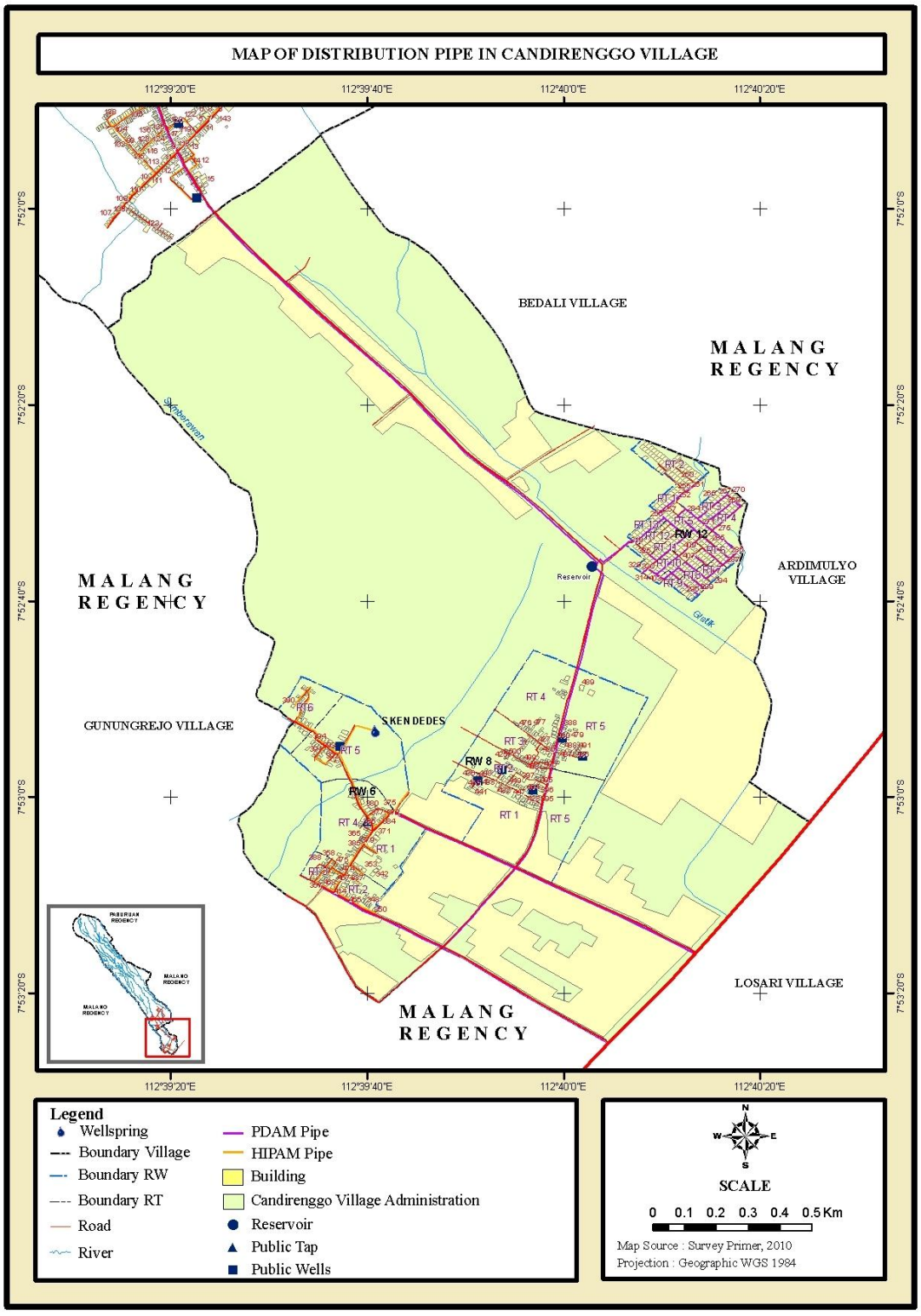


Figure 4.13 Map of Water Supply System in Candi Renggo Village

Figure 4.14 Private Wells & River

4.4.2 Rule of Clean Water Usage

There is no specific rule of clean water usage for customer of PDAM. Even more, there is no different rule between water usage in rainy season and dry season. Basically, customer has 24 hours per day to utilize their clean water without any limitation amount of water usage. As a consequence, they have to pay more expensive at around IDR 1,500 (JPY 15) per cubic meter after water usage exceeds 10 cubic meters. In other words, the respondents who join PDAM's facility are the respondents who officially registered as PDAM's member and pay monthly charge of water usage. Household must pay the installation construction of service pipeline that connect distribution pipeline of PDAM to respondent house at cost around IDR. 1,500,000 (JPY 15,000) in order to get access to piped drinking water from PDAM. And there is a fixed price for the first $10m^3$ of water usage at IDR. 11,500 (JPY 115). Hence, they need to pay more once their water usage exceeds 10 cubic meters. The determination of tariff is equally implemented for all households within administrative area of Malang regency. Every house will be equipped with water metered as an equipment to measure water usage. In addition, service pipeline usually use material from iron pipe or Polyvinyl Chloride (PVC) pipe at diameter of 50, 80 or 100 millimeters.

Summary from the answer of HIPPAM members, it is indicated that there is no particular differ between water usage during rainy season and dry season. In general, there is no limitation of amount of water usage per day for each household. But, it is suggested to use water sufficiently and it does not allow for member to use the clean water for washing motor or motor bike or even their car. There is a public washing place for vehicles. Basically, the member is

allowed to utilize water 24 hours per day, but there is alternation time for water distribution among members for some HIPPAM groups. The member of HIPPAM group gets access to piped clean water supply system through direct pipeline connection to house. The service pipe use PVC or plastic pipe with maximum number of water tap is two for each household. Determinations of tariff vary from one HIPPAM group to another, but in general each group determines a fixed price for monthly dues. The prices per day vary from IDR 67, 82, 83, 133, 150, 167 until 1,000. It means the cheapest price is IDR 2,000 per month (JPY 20) for member of HIPPAM GOTONG ROYONG 2, and the most expensive price is IDR 30,000 per month (JPY 300) for member of Primer Koperasi Tirta Perwita in RW 6 hamlet. Moreover, some respondents reveal that they do not pay the monthly dues as well as for some the head of HIPPAM's group who gets privilege to be free of charge. Referring to Chapter 3, which is written in the document of each HIPPAM group whereby the fixed prices between HIPPAM groups vary from IDR 3,000; 4,000; 5,000 and 30,000 (JPY 30, 40, and 50) per month. In indicates that some HIPPAM groups able to implement their rule and obeyed by its members, but other HIPPAM groups may find difficulty to put into practice their group's regulation. Furthermore, generally the members understand that cost of water system improvement is a responsibility of all members. Thus, we may argue that even relationships among members are close, but somehow 'transfer of information' could not be done effectively, particularly from the HIPPAM committee to the members.

Similar to member of HIPPAM and customer of PDAM, households who fetch water from public hydrant there is no limitation of water usage during 24 hours for the whole year. By walking from their house, household member usually fetches water using plastic bucket or jerry can size 5 to 10 liters. In general, there is no specific rule for users on how they fetch fresh water neither from communal wells nor public taps. There is no list of permanent users for each public hydrant, except that each of them knows each other as a fellow user. As a consequence, there is no clear ruling how they fix the water problem if it occurs, except they will try to fix it together. For example, if they need to change the old string bucket, then together they will bear the cost of the new string. But, it will be difficult to solve when they need expensive cost for renovation of the public facility. Consequently, they will continue using the public facility in worse condition while they are waiting for a volunteer to fix it. The following Figure 4.15 shows two public facilities which less well maintained.

Figure 4.15 Communal Wells & Public Tap

In contrast Figure 4.16 shows one public tap inside the mosque which more well-maintained. This public tap is provided by HIPPAM group and is placed inside the mosque for pilgrims on doing purification before prayer. Moreover, this facility is open for residents to fetch clean water. In general, this public facility has better physical condition because of regular treatment from the mosque caretaker.

Figure 4.16 Public Tap inside the Mosque

In case of households who use river as their water source such as for cleaning and bathing, there is no rule among users. The following Figure 4.17 shows river as a women public bathing and as a place to wash the cow. In case of households who fetch water from river for cooking, usually the fetch water from the upstream or the river nearby of the spring where quality of water is cleaner than the downstream.

Figure 4.17 Pubic Bath in the River

4.4.3 Satisfaction of Clean Water

Table 4.9 to 4.13 shows mean value of water satisfaction through question "do you satisfied in current drinking water condition?" using three categorize (good = 3, average = 2 and bad = 1). In this case, we distinguish respondents' water satisfaction through five categories covering taste, quantity, quality, price and availability.

Referring to Table 4.18 it indicates that average satisfaction of water 'taste' of the respondents in the research area has a high level of satisfaction on a scale of 2.8. The whole HIPPAM's members in the three hamlets show a high level of satisfaction at 2.9 from utmost scale of 3. Meanwhile, PDAM customers show quite wide variation in the level of satisfaction from moderate on scale of 2.0 for customer in RW 8 up to high on scale of 2.8 to 3.0 for customer in Ngujung and RW 6, respectively. It is pretty sad to be disclosed that perfect value of 3.0 in RW 6 is revealed by one PDAM customer only. Meanwhile, for respondents in RW 8 and RW 12 where PDAM is the one and only available option towards piped clean water supply due to absent of HIPPAM's services, in average they have moderate level of satisfaction on a scale of 2.0 and 2.5, respectively.

Table 4.18 Mean Value of Water Satisfaction towards Taste

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	2.9	2.9	-	2.9	-	-
PDAM	-	2.8	-	3.0	2.0	2.5
Individual Wells	-	-	2.9	3.0	2.9	2.9
Public Hydrant	-	-	2.8	3.0	2.8	-
Other	2.8	-	-	-	-	-

Referring to Table 4.19 it indicates that average satisfaction of water 'quantity' of the respondents in the research area has a high level of satisfaction on a scale of 2.6. It is interesting that the four households in Sumberawan who fetch water from 'other' water source such as from river nearby their residence show a high level of satisfaction on a top scale of 3. It may indicate that they feel quantity of water from the river still sufficient for their daily domestic purposes. Meanwhile, customers of PDAM have only moderate level of satisfaction on a scale of 2.1 that is the lowest level of satisfaction amongst other types of water source. Into more detail, customers of PDAM in Ngujung hamlet have slightly lower than moderate level of satisfaction on a scale of 1.9. But, in contrary customers of PDAM in RW 12 have the highest level of satisfaction amongst other PDAM customers on a scale of 2.5. In general, users of private wells have high level of satisfaction on a scale of 2.8 to 2.9, except users of private wells in RW 6 that has level of satisfaction on a scale of 2.0. On the one hand, among the six hamlets, the whole households in Ngujung and RW 8 hamlet have only moderate level of satisfaction on a scale of 2.2 and 2.3, respectively. On the other hand, the other four hamlets have high level of satisfaction on a scale of 2.5 to 2.9.

Table 4.19 Mean Value of Water Satisfaction towards Quantity

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	2.9	2.5	-	2.8	-	-
PDAM	-	1.9	-	2.0	2.0	2.5
Individual Wells	-	-	2.8	2.0	2.9	2.9
Public Hydrant	-	-	2.9	2.3	2.7	-
Other	3.0	-	-	-	-	-

Referring to Table 4.20 it indicates that average satisfaction of water 'quality' of the respondents in the research area has a high level of satisfaction on a scale of 2.8. Even though, households in RW 12 hamlet have a slightly lower level of satisfaction than the other hamlets on a scale of 2.7 for PDAM customers. As a whole, it may argue that households as a whole feel satisfied toward quality of water from springs – Candi Sumberawan spring and Sumber Banyon, pond – Ken Dedes Pond, shallow ground water and even from rivers – Sumberawan river and Glatik river.

Table 4.20 Mean Value of Water Satisfaction towards Quality

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	2.9	2.9	-	2.9	-	-
PDAM	-	2.8	-	3.0	N.A	2.2
Individual Wells	-	-	2.9	3.0	2.8	3.0
Public Hydrant	-	-	2.8	3.0	2.6	-
Other	2.8	-	-	-	-	-

Referring to Table 4.21 it indicates that average satisfaction of water 'price' of the respondents in the research area has a high level of satisfaction on a scale of 2.6. Once again, the four households which utilize fresh water from the rivers have utmost satisfaction on a scale of 3.0. In this sense, we may guess the cause is traditional habit to utilize fresh water directly from rivers, and a fact of free of charge. Furthermore, according to Wydick (2008) we may categorize rivers as Common-Pool Resources (CPRs) whereby every one may consume the fresh water freely, even though once it consumed by someone means another one do not have chance to consume it. Thus, free usage without any charge may give users utmost satisfaction. Meanwhile, the households who get access to piped clean water supply system from PDAM have the lowest level of satisfaction compare to the other water sources on average scale of 2.2. Moreover, special for the households in Ngujung hamlet, they have low level of satisfaction on a scale of 1.6. Although, the households of HIPPAM in Ngujung hamlet have high level of satisfaction toward price on a scale of 2.7 – a slightly higher than the average water satisfaction for the whole households, in fact it is the lowest scale compare to other two HIPPAM's members in Sumberawan and RW 6 hamlet.

Table 4.21 Mean Value of Water Satisfaction towards Price

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	2.8	2.7	-	2.9	-	-
PDAM	-	1.6	-	3.0	2.0	2.2
Individual Wells	-	-	2.8	2.0	2.8	3.0
Public Hydrant	-	-	2.8	2.3	2.5	-
Other	3.0	-	-	-	-	-

Referring to Table 4.22 it indicates that average satisfaction of water 'availability' of the respondents in the research area has a high level of satisfaction on a scale of 2.6. Related to types of water source, customers of PDAM have the lowest average satisfaction of water availability compare to the other four types of water source on a scale of 2.3. Furthermore, households in Ngujung hamlet which show on a scale of 2.2, this is the lowest average satisfaction of water availability amongst the other five hamlets.

Table 4.22 Mean Value of Water Satisfaction towards Availability

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	2.9	2.5	-	2.9	-	-
PDAM	-	1.9	-	3.0	2.0	2.3
Individual Wells	-	-	2.7	2.0	2.9	2.9
Public Hydrant	-	-	2.8	2.7	2.6	-
Other	2.5	-	-	-	-	-

4.4.4 Solving Water Problems

To the respondents who joint participation in HIPPAM or PDAM, we raised further question related to solving water problem. Table 4.23 illustrates the respondents' preferences when they deal with water problem whereby in the questionnaire survey they are requested to choose one among five options. Option 1 is the respondent will fix the water problem by him/her self if he/she find it. Option 2, the respondent will ask neighbor any help to fix it together. Option 3, the respondent will contact to water management body whether PDAM or HIPAM for asking to fix it. Option 4, the respondent think he/she has no idea, therefore he/she just leaves it. The last option is if the respondent has different option than four options, whereby we asked the respondent to specify it.

It indicates that members of HIPPAM in Sumberawan and Ngujung hamlet have similar pattern on solving their water problem. Firstly, they will contact to water technician staff of HIPAM committee for asking to fix it (Option 3). Secondly, they will fix the water problem by him/her self if he/she found it (Option 1). Thirdly, they will ask neighbor any help to fix it together (Option 2). Meanwhile, HIPPAM members in RW 6 have a slightly different opinion whereby they will choose Option 1 as the first choice, followed by Option 3 and Option 2. In addition, no member of HIPPAM in Toyomarto village that chooses Option 4 whereby they just will leave it because they do not have any idea how to fix it.

Except customer of PDAM in Ngujung hamlet, customer of PDAM in the three hamlets of Candi Renggo village have tendency to choose Option 1 as the initial choice, followed by

Option 3 and Option 2. Meanwhile, customer of PDAM in Ngujung hamlet seems to choose Option 3 as their first choice, followed by Option 1 and Option 2.

Table 4.23 Option to Fix Water Supply Problem

Option	1	2	3	4	5
Sumberawan					
HIPPAM	32	12	50	0	5
Ngujung					
HIPPAM	19	7	20	0	0
PDAM	7	0	10	1	0
RW 6					
HIPPAM	31	7	28	1	1
PDAM	1	0	0	0	0
RW 8					
PDAM	1	0	0	0	0
RW 12					
PDAM	41	8	39	0	2

Related to the previous question of solving water problem, we requested the respondent to reveal the reason of their answer through this question “Regarding to your answer in 2.7 (the previous question), what is the main reason to choose the answer?” Using five categories consist of (1) Cost, (2) Time, (3) Effort, (4) Quality, and (5) Safety.

The following Table 4.24 shows the reason of their option on solving water problem. HIPPAM members in Sumberawan hamlet reveal their three main reasons are safety, cost, and effort chosen by 33%, 28%, and 18% members, followed by time and quality at 13% and 8%, respectively. HIPPAM members in RW 6 hamlet show almost similar tendency to HIPPAM members in Sumberawan hamlet, except the second reason. They choose effort as the second reason at 27%, meanwhile as the first and the third reasons are safety and cost at 29% and 23%, respectively. In the mean time, members of HIPPAM in Ngujung hamlet reveal a different tendency whereby cost and effort as two main important reasons at the same percentage (14%), followed by safety, quality and time.

Customers of PDAM in Ngujung and RW 12 hamlet reveal that effort and quality are two main important reasons for their option to fix water problem by contact to management of PDAM or by them self. Whereas, the two customers of PDAM in RW 6 and RW 8 hamlet reveal that their reason to fix their water problem by them self is due to cost.

Table 4.24 Reason of the Option

Reason	1	2	3	4	5
Sumberawan					
HIPPAM	26	12	17	7	31
Ngujung					
HIPPAM	14	4	14	6	8
PDAM	3	2	5	5	3
RW 6					
HIPPAM	14	8	17	5	8
PDAM	1	0	0	0	0
RW 8					
PDAM	1	0	0	0	0
RW 12					
PDAM	15	14	28	18	13

Finally, we raised one last question related to water supply issues using the following query: "What is your opinion to improve or solve the problem related to the current water supply system?" There are 88% of member of HIPPAM and customer of PDAM who answer the question, and 30% of them think that there is no water problem, except the needs of maintenance actions to maintain the current good conditions. There are 27% of the respondents suggest improving water supply system through enhancing water services, and 14% of them is revealed the need of community participation to improve water supply system. It indicates that respondents have fairly high awareness of environmental whereby 11% of them mention about importance of conducting landscape preservation and network improvement. Issue related to the need to improve performance of the institution or organization seems a few respondents think that it is a kind of important aspect to improve it can be seen that 10% respondents point out about management improvement and another 5% point out about official performance. In line with their satisfaction towards price, fare betterment is suggested by 3% respondents. The following Table 4.18 illustrates opinions of the respondents to improve the current water supply system.

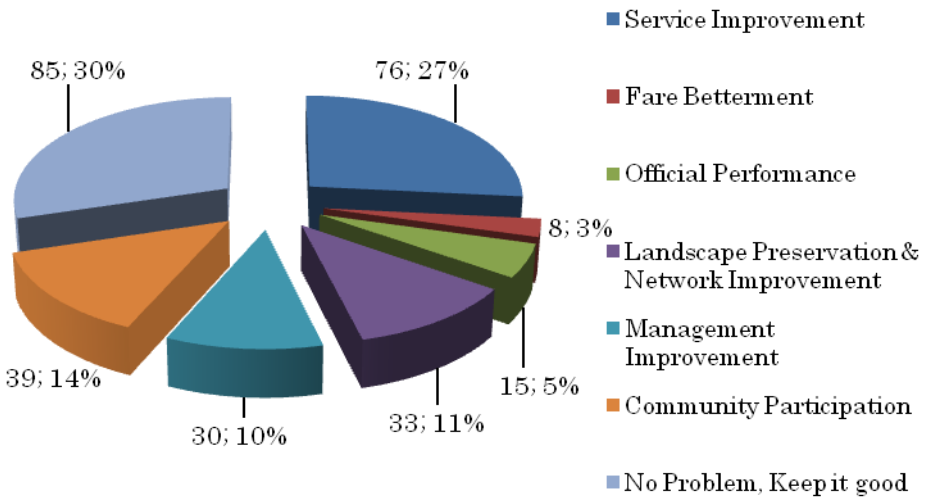


Figure 4.18 Opinions to Improve the Current Water Supply System

4.5 Community Network

4.5.1 Multiple Memberships in Community Group

There are two considerations to determine the option of community groups in the research area. First, we define terminology of community group following (i) three types of voluntary association defined by Tao (1999), and (ii) three categorization of community defined by Aoki (2009). Second, we conducted preliminary survey for investigating what types of community groups that exist in the research area.

According to Tao's classification (1999) that the voluntary organization may has one of the three categories. First category is self-help group – whereby each group has purpose to support each other through mutual understanding, mutual friendly, mutual aid in the day-to-day collaboration. Second category is service delivery providers – whereby the purpose of the group is to provide service to people who need the service. Third category is campaign group – whereby the purpose of the group is to advocate some specific interest what they engage in. In addition, Aoki (2009) defined the community as a group of agents who repeatedly interact with each other in social and economic domains, and thus are mutually identifiable. Thus, a group of agents can be categorized as the community if they fulfill three characteristics as follows. Firstly, membership is relatively stable that they share (limited) information or the use of certain local commons. Secondly, they create internal rule as substantial regulation or able to form their community norms as endogenous rules. Thirdly, they utilize the community norms for self-enforceable without third-party involvement.

Henceforth, we classify the presence community groups into 14 types as one of main parts in

the section three of the household questionnaire survey. It encompasses (1) religious, (2) cultural/social, (3) PDAM, (4) HIPPAM, (5) HIPPA, (6) ethnic based, (7) community organization, (8) finance, (9) production, (10) union (labor/trade), (11) political party, (12) professional association, (13) business association, (14) social movement. In the household questionnaire survey, we add 'other' as options number fifteen in case the respondent may involve in different community group outside the fourteen. In addition, HIPPA is a resident association for water distribution of agriculture activity, particularly to manage distribution of water for wet paddy field among the member. The last group is a supplementary option that the respondent should specify the name of association when they mention that they belong in it.

In the questionnaire survey, we asked respondents to state in which community groups they participate with five options among fifteen choices. The following six tables illustrate the multiple memberships in community groups for each hamlet divided by their type of access to clean water.

Table 4.25 shows membership of the two type's water users – HIPPAM members and river users - in Sumberawan hamlet whereby they joint participate in 12 community groups. Since 96% of the respondents in Sumberawan get access to piped clean water system supplied by HIPPAM groups, so that we can see that HIPPAM groups is a community group with the highest number of members in this hamlet than the other community groups. Instead of being a member in HIPPAM group, there are four popular community groups in Sumberawan hamlet. First is religious group and second is cultural/social group whereby 86% and 13% respondents from both water users join in, respectively. The third and fourth popular community groups are community organization and finance group whereby 11% respondents from member of HIPPAM join in.

Table 4.25 Membership of Respondent in Sumberawan Hamlet

n = 104	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HIPPAM	86	12	0	100	1	1	11	11	2	0	1	1	0	0	1
PDAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Individual Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Public Hydrant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Member	89	13	0	100	1	1	11	11	2	0	1	1	0	0	1
	86%	13%	0	96%	1%	1%	11%	11%	2%	0	1%	1%	0	0	1%

Table 4.26 shows membership of the two types water user – member of HIPPAM and customer of PDAM - in Ngujung hamlet whereby they joint participate in 9 community groups. Instead of participating in HIPPAM groups and PDAM, there are two popular community groups in Ngujung hamlet. First is religious group and second is cultural/social group whereby 70% and 19% respondents from both water users join in, respectively. In addition, there are other two community groups that respondents from both water user types like to join, i.e. community organization and finance group.

Table 4.26 Membership of Respondent in Ngujung Hamlet

n = 64	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HIPPAM	42	13	0	46	0	0	4	3	3	0	0	0	1	0	0
PDAM	15	2	18	0	0	0	1	1	0	0	1	0	0	0	0
Individual Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Public Hydrant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	0	-	0	-	-
Total Member	57	15	18	46	0	0	5	4	3	0	1	0	1	0	0
	70%	19%	22%	57%	0	0	6%	5%	4%	0	1%	0	1%	0	0

There are two types of water user in Glatik hamlet. First is type of household which acquire fresh water from their private wells. Second is type of household who fetch fresh water from communal wells as the type of public hydrant in this hamlet due to inability to construct their own wells. Table 4.27 show four popular community groups among respondents in the hamlet. The most popular community group is religious group consist of 97% respondents. The second and third popular community groups are finance group and community organization whereby 17% and 16% respondents from both water users become involved, respectively. The fourth popular is cultural/social group whereby 6% of respondent join in. In addition, in total there are 8 community groups which respondents in the hamlet join in. Instead of the four popular community groups, the other four community groups are HIPPA, professional association, and business association – each of them consist of 1 respondent from private wells user, and another 2 users of private wells who join ‘other’ community group.

Table 4.27 Membership of Respondent in Glatik Hamlet

n = 81	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HIPPAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PDAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Individual Well	37	2	0	0	1	0	8	6	0	0	0	1	1	0	2
Public Hydrant	25	2	0	0	0	0	2	5	0	0	0	0	0	0	0
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Member	62	4	0	0	1	0	10	11	0	0	0	1	1	0	2
	97%	6%	0	0	2%	0	16%	17%	0	0	0	2%	2%	0	3%

From Table 4.25 to Table 4.27 regardless HIPPAM groups and PDAM, we may argue that in general there are four popular community groups in Toyomarto village. The forth of them are religious group (84% of the respondents), cultural/social group (13% of the respondents), community organization and finance group at 10% from the total respondents of each group.

Table 4.28 shows membership of the four types of water user which with exception of none respondent in RW 6 hamlet who acquire water from river for instance. In total they joint participate in 9 community groups. Instead of participating in HIPPAM groups, religious group is the most popular community group for the villagers (68%). Then, it followed by cultural/social group and community organization with 9% respondents for each. Last is finance group with 7% respondents. In similar pattern with Glatik hamlet, there are another four community groups which private wells users joint participate in.

Table 4.28 Membership of Respondent in RW 6 Hamlet

n = 74	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HIPPAM	45	7	0	69	0	0	7	5	0	0	0	1	0	0	2
PDAM	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Individual Well	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Hydrant	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Member	50	7	1	69	0	0	7	5	0	1	0	1	0	0	2
	68%	9%	1%	93%	0	0	9%	7%	0	1%	0	1%	0	0	3%

Among 75 respondents in RW 8, there is one respondent of PDAM's customer. But from Table 4.29 we may see that the respondent is not joint participate in any kind of community groups in the hamlet. Referring to Table 3.4 Clean Water Source in Hamlets of Candi Renggo Village (Chapter 3), we may guess that customer of PDAM in this hamlet is fewer compare to users of individual wells and public hydrant. Furthermore, Table 4.29 shows membership of the two types water user – private wells and communal wells - in RW 8 hamlet whereby they joint participate in 9 community groups. The most popular community group is religious group covering 89% respondents. The second popular is community organization whereby 175

respondents join in. Meanwhile, the third and fourth popular are finance group and cultural/social group with 9% and 7% respondents, respectively.

Table 4.29 Membership of Respondent in RW 8 Hamlet

n = 75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HIPPAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PDAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Individual Well	51	4	0	0	0	0	9	4	0	1	0	0	2	1	1
Public Hydrant	16	1	0	0	0	4	4	3	0	0	0	0	0	0	0
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Member	67	5	0	0	0	4	13	7	0	1	0	0	2	1	1
	89%	7%	0	0	0	5%	17%	9%	0	1%	0	0	3%	1%	1%

Table 4.30 shows membership of the two type's water user – customer of PDAM and private wells users - in RW 12 hamlet whereby they joint participate in 9 community groups. Instead of participating in PDAM, there are three popular community groups in RW 12 hamlet. The first is religious group covering 58% respondents, whereas the second and the third popular are community organization and cultural/social group covering 42% and 36% respondents, respectively. In addition, there are other two community groups that respondents from both water user types like to join, i.e. finance group and ethnic based group covering 10% and 7% respondents, respectively.

Table 4.30 Membership of Respondent in RW 12 Hamlet

n = 100	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HIPPAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PDAM	55	32	18	0	0	6	39	8	0	0	0	0	2	1	0
Individual Well	3	4	0	0	0	1	3	2	0	1	0	0	0	0	0
Public Hydrant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Member	58	36	18	0	0	7	42	10	0	1	0	0	2	1	0
	58%	36%	18%	0	0	7%	42%	10%	0	1%	0	0	2%	1%	0

Regardless HIPPAM groups and PDAM, from Table 4.28 to Table 4.30 we may argue that in general the four popular community groups in Candi Renggo village is also popular in Toyomarto village. The forth of them in order are religious group (70% of the respondents), community organization (25% of the respondents), cultural/social group (19% of the respondents) and finance group (9% of the respondents).

Moreover, we raised three more details questions related to the chosen community group as follows:

a. How many community groups they are belong?
b. How many times their regular meeting in every month?

c. Considering level of importance and level of benefit of the group, what is the meaning of the group that you belong to?

There are 5 scales to answer question c (1 = the group has no meaning/benefit and 5 = the group has very important/benefit). Following Table 4.31 and 4.32 summarize the value of community groups for the both villagers.

Table 4.31 illustrates that among 15 types of community group, there are two community groups that no respondent join namely Union (Labor/Trade) and Social Movement. In general, respondent join in one group of a particular type of community group. Among the four popular community groups in Toyomarto village, except community organization which has monthly meeting, the other three groups have weekly meeting. Regarding 208 respondents who belong to Religious group, existence of the group means very important as well as gives very high benefit for them – at scale of 5 for both values. Meanwhile the other three popular community groups have slightly less important and benefit compare to the religious group at scale of 4.

There are 5 types of respondent's membership based on the number of community groups that they conjoint. The types of respondent are as follows:

1. Type I : respondent who only join into one group (65 respondents)
   Type I consists of 8 combination of group clustering. The types are 1, 2, 3, 4, 7, 8, 11, 13.
2. Type II: respondent who join in two groups simultaneously (107 respondents)
   Type II consists of 5 combinations of group clustering. The types are 1 and 3, 1 and 4, 1 and 6, 1 and 7, 1 and 8. Every choice of group clustering always put religious as one of their choice.
3. Type III: respondent who join in three groups simultaneously (49 respondents)
   Type III consists of 16 combinations of group clustering. The types are 1-2-3, 1-2-4, 1-2-7, 1-2-8, 1-2-9, 1-3-4, 1-3-7, 1-4-5, 1-4-7, 1-4-5, 1-4-7, 1-4-8, 1-4-9, 1-4-11, 1-7-8, 1-7-13, 1-7-15, 2-3-7. Every choice of group clustering always put religious as one of their choice, except the last combination (2-3-4).
4. Type IV: respondent who join in four groups simultaneously (11 respondents)
   Type IV consists of 9 combinations of group clustering. The types are 1-2-4-7, 1-2-7-8, 1-2-3-7, 1-3-7-8, 1-4-6-7, 1-4-78, 1-4-7-9, 1-4-11-15, 1-7-12-13. Every choice of group clustering always put religious and community organization as one set of their choice, except type 1-4-11-15.
5. Type V: respondent who join in five groups simultaneously (1 respondents)
   Type V consists of 1 combination of group clustering that is 1-4-7-8-12.

Meanwhile, there are 16 respondents who do not join at any community group.

Table 4.31 Value of Community Groups for Toyomarto Villagers

Type of Community Group		Number of Member	Mode			
			No. of Group	Meeting/Month	Level of Important	Level of Benefit
1	Religious	208	1	4	5	5
2	Cultural/Social	32		4	4	4
3	PDAM	18		-	4	2
4	HIPPAM	146		1	4	4
5	HIPA	2		-	-	-
6	Ethnic Base	1		-	-	-
7	Community Org.	26		1	4	4
8	Finance	26		4	4	4
9	Production	5		2	4	5
10	Union (Labor, Trade)	0		-	-	-
11	Political Party	2		-	3	3
12	Professional Assoc.	2		-	4	-
13	Business Assoc.	2		-	-	-
14	Social Movement	0		-	-	-
15	Other	3		-	4	4

Among 15 types of group, there are three groups that no respondent joint into it namely Production, Political Party, and Professional groups. Similar to Toyomarto Village, most respondent belongs to Religious group with 176 numbers (70% of total respondent). In case of PDAM, Union (labor/trade), Social Movement, and Others, there is no repeated number; therefore there is no mode on the Table 4.32.

There are 5 types of respondent's membership based on the number of community groups that they conjoint. The types of respondent are as follows:

1. Type I : respondent who only join in one community group (88 respondents)

   Type I consists of 7 combination of group clustering. The types are 1, 2, 3, 6, 7, 8,13.

2. Type II: respondent who join in two groups simultaneously (96 respondents)

   Type II consists of 14 combinations of group clustering. The types are 1 and 2, 1 and 3, 1 and 4, 1 and 6, 1 and 7, 1 and 8, 1 and 10, 1 and 13, 1 and 14, 1 and 15, 2 and 10, 2 and 14, 3 and 7, 4 and 8.

3. Type III: respondent who join in three community groups simultaneously (37 respondents)

   Type III consists of 12 combinations of group clustering. The types are 1-2-3, 1-2-4, 1-2-7, 1-2-8, 1-2-10, 1-3-7, 1-4-8, 1-6-7, 1-7-8, 1-7-13, 2-3-7, 6-7-8. Every choice of group clustering always put religious as one of their choice, except the last two combinations (2-3-7 and 6-7-8).

4. Type IV: respondent who join in four groups simultaneously (6 respondents)

   Type IV consists of 4 combinations of group clustering. The types are 1-2-3-7, 1-3-7-8,

1-4-7-8, 1-6-7-8. Every choice of group clustering always put religious and community organization as one set of their choice.

5. Type V: respondent who join in five community groups simultaneously (1 respondents)

   Type V consists of 1 combination of group clustering that is 1-4-7-8-12.

Meanwhile, there are 21 respondents who do not join in any community group.

Table 4.32 Value of Community Groups for Candi Renggo Villagers

Type of Community Group		Number of Member	Mode			
			No. of Group	Meeting/Month	Level of Important	Level of Benefit
1	Religious	176	1	4	5	5
2	Cultural/Social	48		1	4	4
3	PDAM	18		-	3	3
4	HIPPAM	23		0.5	4	4
5	HIPA	0				
6	Ethnic Base	11		1	4	3
7	Community Org.	60		1	4	4
8	Finance	22		1	4	4
9	Production	0				
10	Union (Labor, Trade)	3		-	3	3
11	Political Party	0				
12	Professional Assoc.	0				
13	Business Assoc.	3		1	5	5
14	Social Movement	2		-	4	-
15	Other	1		-	-	-

It is interesting that the two respondents who have 5 multiple memberships in community groups, they also belong to the same types of community groups consist of religious group – cultural/social group – community organization – finance group – professional association. The first respondent is Mr. Suwandi lives in Sumberawan hamlet which occupies position as the head of hamlet as well as the secretary of HIPPAM in Singosari district. The second respondent is Mr. Supomo from RW 6 hamlet and he is a farmer with monthly salary less than IDR 0.5 million per month.

Identification multiple memberships in community groups are a way to investigate the closeness relationship of among respondents within one similar community group, and between different community groups. Here we may presume that the higher frequency of the group chosen by a set of respondents the closer relationship they have. Moreover, the more popular community groups among the respondents the wider contact that they might link. In the sense of effectiveness of the spread of information, thus the more popular community group may have higher ability in transmitting the effect. The following four paragraphs explain the characteristic

of the fourth popular community groups in the research area.

Religious group encompasses a collection of residents who voluntary establish a community group whereby the main purposes are to deepen understanding of religion. Since religion of most of the residents is Islam, in general, they have weekly meeting for recitation the Qur'an. It is usually conducted on Thursday night after Isha pray which alternately in the home of group members. Periodically, they also organize special meeting where they learn together on how to care for the Muslim corpse. This is an informal community association whereby structurally the organization consists of the head, secretary and treasurer of the group that voluntarily chosen among members for a certain period. Together they develop community norms, sort of how they determine the committee member for the next one year, how they determine the rotation of house for their weekly activity, how they encourage the passive member and the like. Referring to Tao's classification (1999) this religious group may close to character as self-help voluntary group.

Cultural/social group is a kind of regular social gathering for purposes of conducting a lottery what they called "arisan" in Indonesian language. Similar to religious group, structure of organization also consists of the head, secretary and treasurer of the group which voluntarily chosen among members for a certain period. This voluntary associations not only has social domain as the religious group, but it has also economic domain which mutually beneficial for its members. Moreover, compare to the previous group, this voluntary association has more stringent rules in order to run steady and sustained organization for a certain period. For instance, a social gathering group consists of 35 members which has regular meeting one time per month for conducting a money lottery. If the members agree for having one winner at each meeting, it means they need around 3 years to finish one round lottery which allows for each member get their turn to win the lottery. The money that they use in lottery is a cash contribution of each member, which is paid at the beginning of the meeting. Therefore, to finish completely one round they need a strong commitment from each member that they will participate for the whole period in a fairness manner. It means they need to compose their endogenous rule to tie up their membership in order to govern their voluntary association properly. How they determine the capital that they will use in lottery, how they determine the winner for each round, how they anticipate the member who has difficulty in paying dues and the like. In addition, the capital that they use for lottery is not only limit for money but also possible to use some daily goods for example a number of eggs, amounts of sugar or a litter of cooking oil and the like. And similar to the earlier group, referring to Tao's classification (1999) this social gathering group may close to character as self-help voluntary group.

The most common type of community organization where the respondents participated is a

kind of cooperative organization; refer to "koperasi" in Indonesian language. In accordance with UUD (Indonesian Constitution) 1945 Section 33, cooperative is considered as a business organization that cooperative has principals and basic values which are relevant to the characteristics of Indonesian. Referring to Tao's classification (1999) this community group could be categorized as a service delivery provider, whereby the purpose of the group is to provide service to people who need the service. For instance, a farmer cooperative will provide a kind of service to support agriculture activity such as providing qualified paddy seeds, fertilizer and the like. In another case, the cooperative will arrange product marketing produced by the members such as sandals as handicraft production of the villagers. Additionally, structural organization of this community group is more establish than the other three groups which is most of it in the form of incorporated organization.

Finance group is a type of a community microcredit based on traditional informal groups, which the groups provide micro loan for their member or non member who needs financial support from their savings and loan voluntary associations. This voluntary association usually consists of the head of organization, secretary and treasurer which is elected by and from the members for a particular period. All the rules and norms are purely set up by the group members without any intervention from third party. In this sense, they will determine their own rule such as how much money that each member must deposit to the association to form a joint capital, how much the maximum amount of money that can be borrowed by a member, how much interest rate for the member, how the rules of benefit sharing among members, and how the rules for a member who late in paying their debts, and the like. Moreover, in case their capital is more than enough to provide services for the members, how the rules for non member who might want to borrow the money from the group, and the like.

4.5.2 Opinions on Society and Living Environment

Using Yes or No answer, we raised question to the respondent: "Do people in the community generally trust one another in matters of lending and borrowing?" The term of lending and borrowing here refer to lending and borrowing in daily needs such as amount of money for urgent needs – to go to hospital for instance, amount of rice before harvest time, or just lending and borrowing for some simple things such as domestic tools.

In general, we may see from Table 4.33 that trusts on lending and borrowing among households in the research area is very high. Average percentage of respondents who answer yes is 87%. Among the six hamlets, respondents in RW 12 occupy the lowest rate at 81%, and respondents in RW 8 occupy the highest 91%. Thus, once again, this condition indicates that villagers have high mutual trust each other in the community.

Table 4.33 Trust on Lending and Borrowing

	Toyomarto						Candi Renggo					
	Sumberawan		Ngujung		Glatik		RW 6		RW 8		RW 12	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
HIPPAM	86	10	40	6	-	-	56	9	-	-	-	-
PDAM	-	-	16	2	-	-	1	0	1	0	74	17
Individal Well	-	-	-	-	36	6	1	0	50	7	9	0
Public Hydrant	-	-	-	-	34	4	3	0	17	0	-	-
Other	4	-	-	-	-	-	-	-	-	-	-	-
Total	100		64		80		70		75		100	

Furthermore, we continue the previous question by asking respondents' opinion whether "In the last three years, the level of trust has improved, worsened, or stayed the same." Table 4.34 illustrates that majority respondents in Sumberawan and Glatik hamlet reveal that their level of trust has remained the same in the last three years, 55% and 60%, respectively. However, 61% respondents in Ngujung hamlet express that their level of trust has improved in the last three years.

Table 4.34 Progress of Trust on Lending and Borrowing in Toyomarto Village

	Toyomarto								
	Sumberawan			Ngujung			Glatik		
	Improved	Same	Worsened	Improved	Same	Worsened	Improved	Same	Worsened
HIPPAM	28	55	13	27	13	6	-	-	-
PDAM	-	-	-	12	2	4	-	-	-
Individual Well	-	-	-	-	-	-	15	21	6
Public Hydrant	-	-	-	-	-	-	4	27	7
Other	3	0	1	-	-	-	-	-	-
Total	100			64			80		

Following Table 4.35 depicts that majority respondents in the three hamlets think that their level of trust has remained the same in the three last years at average 52%. Even more, 30% respondents think that their level of trust has improved within the same time frame. Thus, from the previous three tables related to trust, we may argue that, in general, households in the research area have high mutual trust with a tendency to increase.

Table 4.35 Progress of Trust on Lending and Borrowing in Candi Renggo Village

	Candi Renggo								
	RW 6			RW 8			RW 12		
	Improved	Same	Worsened	Improved	Same	Worsened	Improved	Same	Worsened
HIPPAM	17	38	10	-	-	-	-	-	-
PDAM	0	1	0	0	0	1	35	37	19
Individual Well	1	0	0	16	33	8	1	6	2
Public Hydrant	2	0	1	3	9	4	-	-	-
Other	-	-	-	-	-	-	-	-	-
Total	70			74			100		

Moreover, in order to catch deeper character of community network by asking the respondents whether they agree or disagree with the following statement: People here look out mainly for the welfare of their own families and they are not much concerned with community welfare. The answer is using three scales covering strongly agree = 1, agree = 2, disagree = 3, and strongly disagree = 4. In this sense, we may assume that the stronger disagree the respondents to the statement means the higher their concern to community welfare.

Table 4.36 depicts that average concern to community welfare for the whole respondents in the research area is quite high on scale of 2.7. Respondents of individual wells have the highest concern on scale of 2.9 which is a slightly higher than respondents of HIPPAM, public hydrant and other on a scale of 2.8. Meanwhile, respondents of PDAM have the lowest concern on a scale of 2.4. Referring to each hamlet, respondents in RW 12 have the highest concern on a scale of 2.9, following by three hamlets – Sumberawan, Glatik and RW 8 on a scale of 2.8. The other two hamlets – RW 6 and Ngujung occupy the lower concern to community welfare on a scale of 2.6 and 2.5, respectively.

Table 4.36 Concern to Community Welfare

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	2.8	2.8	-	2.8	-	-
PDAM	-	2.1	-	3.0	3.0	2.6
Individual Wells	-	-	2.7	3.0	2.7	3.1
Public Hydrant	-	-	2.9	2.7	2.8	-
Other	2.8	-	-	-	-	-

In the questionnaire survey, there are 13 questions to describe respondent's opinion about their living environment using 5 scales where 5 means very much until 1 means least meaning, as follows:

A) I feel proud of this area/community

B) I think nature and scenery in this area/community is great

C) I think availability of foods in this area/community is great

D) It is important to participate in the local event

E) It is important to collaborate with to make this area/community better

F) It is important to join in educational activities for the growth of local children

G) It is important to listen other's problem

H) It is important to keep having a daily relationship with neighbors

I) It is important to take care of a single or elderly person

J) It is important to maintain regional grave yard

K) It is important to manage relationship with your relatives in the area/community

L) People in this area/community are important for me

M) I want to continue living in this area/community

In general, we may see from Table 4.37 that community and living environment in Toyomarto village have very high meaning or value for villagers. Except toward nature and scenery in their area that has slightly less meaning than others on a scale of 3 – 4. Moreover, there are 3 items that have absolutely very high meaning for villagers in the three hamlets on a scale of 5. The items are (A) I feel proud of this area/community; (E) It is important to collaborate with to make this area/community better, and (L) People in this area/community are important for me. In other words, we may argue that villagers love their area and their community, as well as they want to make it better through cooperate with each other. In addition, in the view of villagers in Sumberawan hamlet their community and living environment have the highest meaning on average scale of 4.6 which is slightly different from Ngujung and Glatik hamlet than on average of 4.5 and 4.4, respectively.

Table 4.37 Value of the Living Environment in Toyomarto Village

	A	B	C	D	E	F	G	H	I	J	K	L	M
Sumberawan													
HIPPAM	5	3	5	5	5	5	5	5	5	5	5	5	5
Other	5	3	5	5	5	5	5	5	4	5	5	5	5
Average	4.5	3.8	4.6	4.7	4.7	4.8	4.8	4.7	4.5	4.9	4.8	4.7	4.6
Ngujung													
HIPPAM	5	4	5	5	5	5	5	5	5	5	4	5	5
PDAM	5	5	3	5	5	4	5	5	5	5	5	5	5
Average	4.6	4.0	3.9	4.6	4.3	4.4	4.8	4.4	4.4	4.8	4.3	4.8	4.7
Glatik													
Individual Well	5	4	5	5	5	5	5	5	4	5	5	5	5
Public Hydrant	5	4	5	4	5	4	4	4	4	4	5	5	4
Average	4.6	3.8	4.7	4.5	4.5	4.3	4.5	4.4	4.2	4.5	4.7	4.7	4.5

Almost similar to respondents in Toyomarto village, Table 4.38 illustrates that community and living environment in Candi Renggo village have very high meaning or value for villagers. There are 12 items with average scale equal or higher than 4.0, except item (B) whereby the residents think their nature and scenery in this area/community is great on average scale less than 4.0. In general, respondents in Candi Renggo village have a slightly less meaning than respondents in Toyomaro village. But if we look at detail per item, respondents in Candi Renggo village may show more items which have mode on a scale of 5 for the three hamlets. There are 5 items as follows: (D) It is important to participate in the local event, (G) It is important to listen other's problem, (J) It is important to maintain regional grave yard, (K) It is important to manage relationship with your relatives in the area/community, (L) People in this area/community are important for me. It may indicate that villagers appreciate their area as well as their community and have high tendency to collaborate each other to improve their living environment.

Table 4.38 Value of the Living Environment in Candi Renggo Village

	A	B	C	D	E	F	G	H	I	J	K	L	M
RW 6													
HIPPAM	5	4	4	5	5	5	5	4	4	5	5	5	5
PDAM	5	4	5	5	5	5	5	5	5	5	5	5	5
Individual Well	4	3	4	5	5	5	5	5	4	5	5	5	4
Public Hydrant	N.A	4	5	5	N.A	5	5	N.A	4	5	5	N.A	N.A
Average	4.3	3.6	4.4	4.7	4.5	4.6	4.7	4.4	4.0	4.7	4.8	4.6	4.4
RW 8													
PDAM	4	3	5	5	4	5	5	4	4	5	5	5	4
Individual Well	5	4	5	5	5	5	5	5	4	5	5	5	5
Public Hydrant	5	4	4	5	4	4	5	5	3	5	5	5	4
Average	4.5	3.8	4.4	4.7	4.5	4.6	4.8	4.4	4.0	4.9	4.7	4.6	4.3
RW 12													
PDAM	5	4	5	5	5	5	5	5	4	5	5	5	5
Individual Well	4	5	5	5	5	5	5	5	4	5	5	5	5
Average	4.2	3.7	4.4	4.6	4.4	4.5	4.7	4.4	4.1	4.8	4.8	4.6	4.5

4.5.3 Relationship to the Closest People

In the face to face interview, we asked respondent to list up six people outside his or her household that he or she feel closest to. The following Table 4.39 describes the relationship between the closest people and their residence whereby the respondents in Toyomarto village feel closest to. Here, we may see that neighbors are the closest people for majority respondents, even higher than their closeness to the all kin (father, mother, son, daughter, brother and sister). In addition, the second and the third closest people for respondents in Toyomarto village are other relative and friend, respectively.

Table 4.39 Residence of Intimate by Relationship to Toyomarto's Respondents

	Father	Mother	Son	Daughter	Brother	Sister	Other Relative	Neighbor	Friend	Other U Person	Total
Same Community	18	17	22	34	60	22	92	265	49	4	583
%	60	81	71	66.7	66.7	64.7	68.1	74.4	51.6	40	68.3
Same Village	3	2	6	9	11	5	20	50	18	1	125
%	10	9.5	19.4	17.6	12.2	14.7	14.8	14	18.9	10	14.7
Same District	6	1	1	3	11	3	8	18	10	1	62
%	20	4.8	3.2	5.9	12.2	8.8	5.9	5.1	10.5	10	7.3
Same Regency	2	1	2	1	1	2	12	20	15	2	58
%	6.7	4.8	6.5	2	1.1	5.9	8.9	5.6	15.8	20	6.8
Same Province	1	0	0	4	7	1	3	3	3	2	22
%	3.3	0	0	3.9	7.8	2.9	2.2	0.8	3.2	20	2.6
Different Province	0	0	0	2	0	1	0	0	0	0	3
%	0	0	0	2	0	1	0	0	0	0	3
Total Closest People	30	21	31	51	90	34	135	356	95	10	853
%	3.5	2.5	3.6	6	10.6	4	15.8	41.7	11.1	1.2	100

It is depicted in Figure 4.19 that most type of relationship to respondent, except intimacy with other unrelated person, shows that distance is a significant burden towards closeness of relationship. Therefore, the closer distance of residence on intimate person to respondent, the more intimate their relationship. Closeness towards neighbor is the highest ranked among other intimates by relationship, even if it compares to the summing of all kin (father, mother, son, daughter, sister and brother).

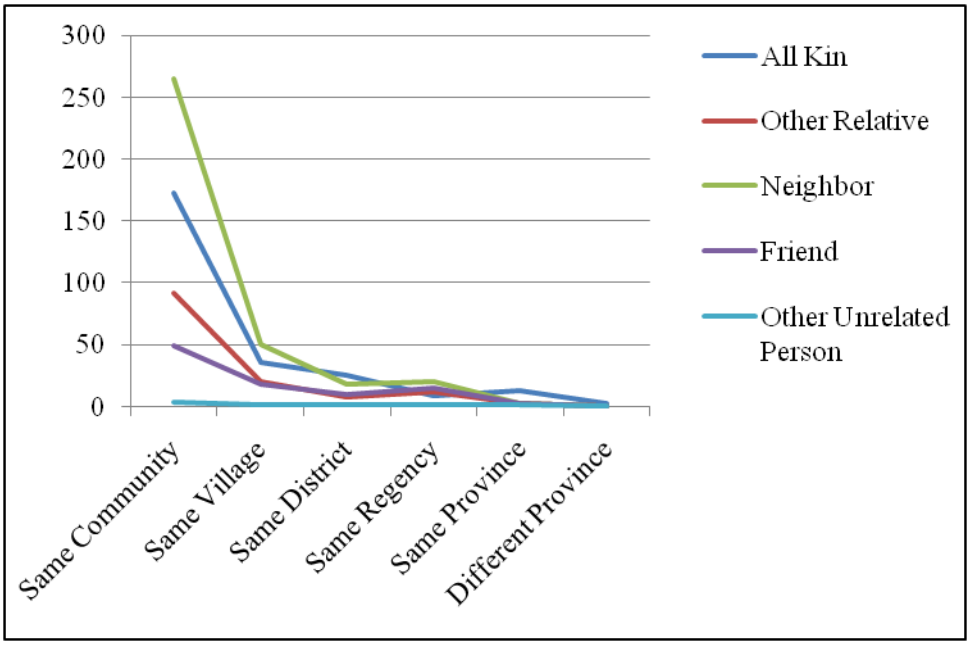


Figure 4.19 Residence of Intimate by Relationship in Toyomarto Village

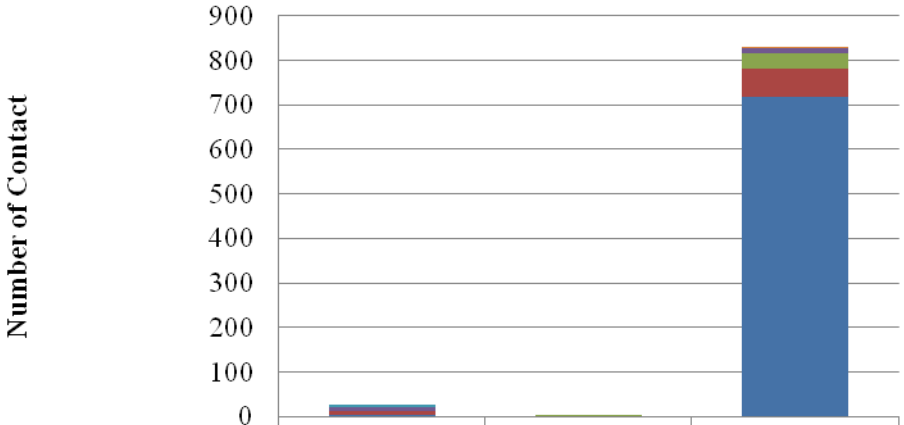
In general Table 4.40 depicts that respondents in Candi Renggo village have similar tendency to which they feel closest to as respondents in Toyomarto village. They feel that neighbors are the closest people for them in their daily life. And, it is followed by closeness to their kin when the six types of family members are summed up. Again, similar to respondents in Toyomarto village, respondents in Candi Renggo village also feel that closeness to brother occupy the highest percentage compare to other family members.

Table 4.40 Residence of Intimates by Relationship to Candi Renggo's Respondents

	Father	Mother	Son	Daughter	Brother	Sister	Other Relative	Neighbor	Friend	Other U Person	Total
Same Community	4	4	13	7	35	19	27	376	9	0	494
%	57.1	44.4	68.4	36.8	58.3	52.8	69.2	89.3	26.5	0	76.4
Same Village	1	1	1	3	10	0	5	23	7	0	51
%	14.3	11.1	5.3	15.8	16.7	0	12.8	5.46	20.6	0	7.9
Same District	0	0	0	1	3	1	0	1	1	0	7
%	0	0	0	5.3	5	2.8	0	0.24	2.9	0	1.1
Same Regency	1	4	2	3	6	7	4	12	9	2	50
%	14.3	44.4	10.5	15.8	10	19.4	10.3	2.85	26.5	66.7	7.7
Same Province	1	0	0	1	6	6	3	6	8	0	31
%	14.3	0	0	5.3	10	16.7	7.69	1.43	23.5	0	4.8
Different Province	0	0	3	4	0	3	0	2	0	1	13
%	0	0	15.8	21.1	0	8.3	0	0.48	0	33.3	2
Abroad	0	0	0	0	0	0	0	1	0	0	1
%	0	0	0	0	0	0	0	0.24	0	0	0.2
Total Closest People	7	9	19	19	60	36	39	421	34	3	647
%	1.1	1.4	2.9	2.9	9.3	5.6	6	65.1	5.3	0.5	100

Following the question about six closest people outside their home, we asked respondents to reveal "By what are you in touch with him/her?" using three options consist of (a) phone, or (b) letter, or (c) face to face. In order to investigate their frequency of contact, we continue the question with the following six categories as follows: (i) Daily contact (5 times or more a week), (ii) 2-4 times a week, (iii) once a week, (iv) 1-2 times a month, (v) 2-11 times a year, and (vi) once a year or less.

The following Figure 4.20 depicts frequency of contact differed by means for Toyomarto villagers to their six closest people. It indicates that villagers prefer to have face to face contact with daily meeting rather than by phone or even more by letter.



	By Phone	By Letter	Face to Face
Once a year or less	0	0	2
2-11 times a year	7	0	0
1-2 times a month	7	0	14
Once a week	2	5	34
2-4 times a week	6	0	63
Daily (5>= a week)	5	0	717

Figure 4.20 Frequency of Contact of Toyomarto Villagers

The next Figure 4.21 indicates similar pattern of residence intimate in Candi Renggo village with in Toyomarto village. Most type of relationship to respondent, except intimacy with friend and other unrelated person, shows that distance has a significant burden towards closeness of relationship. Therefore, the closer distance of residence on intimate person to respondent, the more intimate their relationship. Closeness relationship towards neighbor is the highest ranked among other intimates by relationship; even more the gap is very high. It seems that distance of residence plays very important role towards intimate relationship.

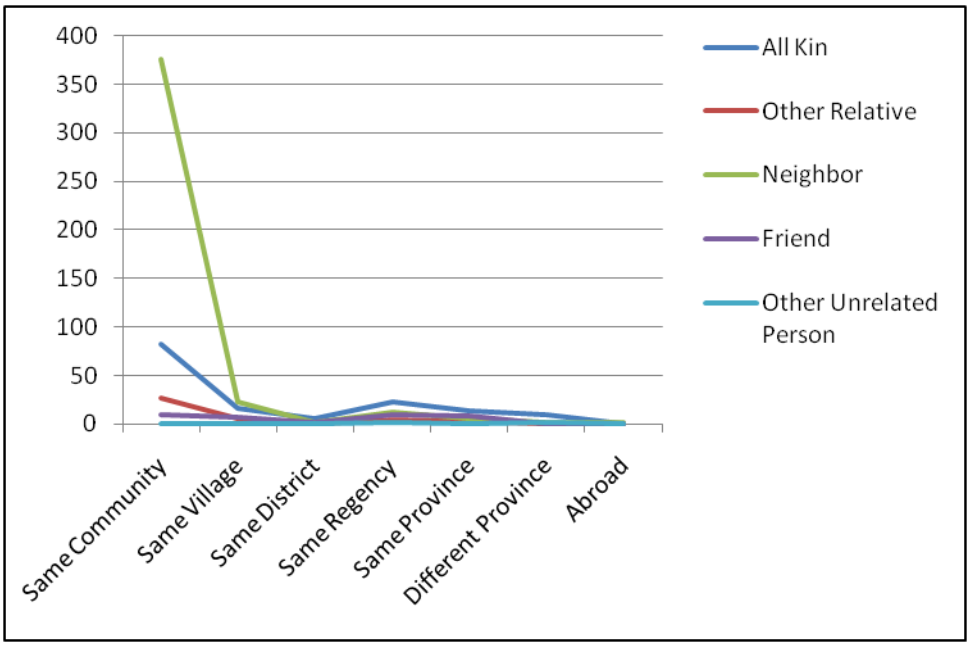
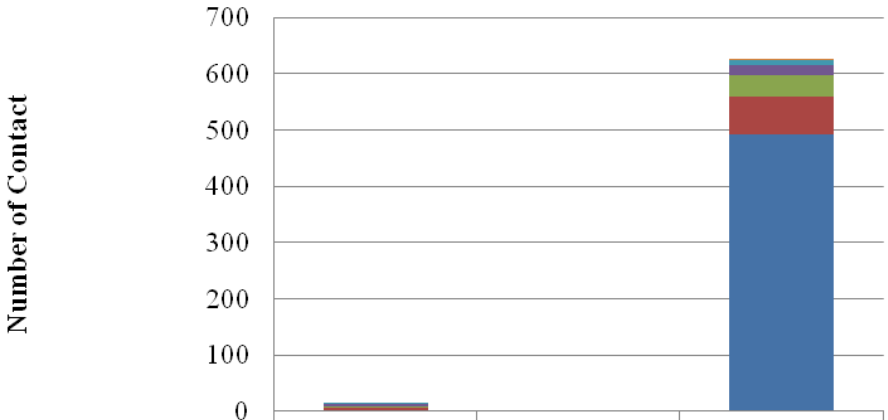


Figure 4.21 Residence of Intimate by Relationship in Candi Renggo Village

Figure 4.22 below depicts frequency of contact differed by means for Candi Renggo villagers to their six closest people. Similar to respondents in Toyomarto village, respondents in Candi Renggo village prefer to have face to face contact with daily meeting rather than by phone or even no one choose contact by letter.



	By Phone	By Letter	Face to Face
Once a year or less	0	0	1
2-11 times a year	2	0	10
1-2 times a month	5	0	17
Once a week	1	0	39
2-4 times a week	7	0	67
Daily (5>= a week)	0	0	492

Figure 4.22 Frequency of Contact of Candi Renggo Villagers

In the last part of questionnaire, we asked respondent to list up six people outside his or her household that he or she feel closest to. It indicates that neighbor as a whole is the closest person outside household at every level of closeness relationship (strength of relationship 1 to 6). In this sense, we may argue that position of the neighbor occupy very important role for the respondents. Even more, the closeness of relationship of neighbor to respondent is higher than the closeness of all kin to respondent, except in the first closest level which the number of closest people between the two is only slightly different, 212 and 213, respectively.

Table 4.41 Strength of Intimates by Relationship to Respondents

	All Kin	Parent	Child	Sibling	Other Relative	Neighbor	Friend	Others	Total
1	213	39	49	79	46	212	32	1	458
%	32.1	53.4	32.7	32.1	23.7	24	23.9	9.1	32
2	187	16	45	76	50	212	27	3	429
%	28.2	21.9	30	30.9	25.8	24	20.1	27.3	26
3	131	14	27	52	38	175	24	5	335
%	19.8	19.2	18	21.1	19.6	19.8	17.9	45.5	22
4	66	2	14	21	29	112	23	1	202
%	10	2.7	9.3	8.5	14.9	12.7	17.2	9.1	9
5	40	1	8	11	20	91	14	1	146
%	6	1.4	5.3	4.5	10.3	10.3	10.4	9.1	6
6	26	1	7	7	11	81	14	0	121
%	3.9	1.4	4.7	2.8	5.7	9.2	10.4	0	4
Total	663	73	150	246	194	883	134	11	1,691
%	39.2	4.3	8.9	14.5	11.5	52.2	7.9	0.7	100

4.6 Summary

This chapter describes the result of field survey in Indonesian rural areas covering design of the survey, demographic attributes, clean water supply system, and community network. Main objective of this chapter is to capture suitable perceptive of water supply issues from an empirical case in Toyomarto and Candi Renggo village, Singosari district, Malang regency, East Java province, Indonesia.

Face to face questionnaire interview survey method was conducted in two periods on December 2008 and February 2009. Through systematic sampling, 500 selected respondents for the study are the husband, the wife or the head of family that are chosen so as they represent typical precious inhabitants. Hence the results and the substantial assessments replicate the essential characteristics of the contacted people. Referring to the Instruments of the Social Capital Assessment Tools developed by World Bank (2004) and combining it with preliminary

observation survey, we developed household questionnaire survey consist of three parts. Namely as follows (i) To explore demographic characteristic of respondent; (ii) To scrutinize water supply issues; and (iii) To investigate the community network. The selected respondents live in six hamlets covering Sumberawan (104 respondents), Ngujung (64 respondents) and Glatik (81 respondents) hamlet in Toyomarto village, and RW 6 (74 respondents), RW 8 (75 respondents) and RW 12 (100 respondents) in Candi Renggo village.

The demographic characteristic of respondents consists of 6 attributes. The first part is household attributes covering sex identity, age, education background, and occupation of the head of household and the family member within the same house. The second part is working place and length of stay of the head of household in the research area.

There are most male respondents as compared to the females in the study area covering 70% households in the two villages. Majority households comprise of 4 family members who live in the same house (56% from total households). In additional, total inhabitants of 500 households are 1866, that ratio male to female is 49 : 51. Maximum number of family member for each household in both villages is 7 members whereby the number of household with 5 to 7 family member is 26% and 30% respectively. Average age of the respondents is 47 years which the youngest age of 22 years and the oldest one is 90 years. According to standard population of Indonesia, age of 15 – 64 years is classified as productive age, which majority respondents in Toyomarto and Candi Renggo village are in it, 96% and 86% respectively.

The number of respondents with education background at level of junior school or higher than that is slightly higher than the number of respondents with education background at level of elementary school or even lower than that at 56% and 44%, respectively. It implies that respondents in the research area have education level above the national average (5 years schooling for adults). Majority respondents who get access to piped clean water supply system from HIPPAM or PDAM have average education level higher than elementary school or lower. In contrary, respondents with access to fresh water from individual wells, public hydrant and other source such as river, majority of them have education background at lower or equal to elementary school. Thus, majority respondents who get access to piped clean water supply system have average education level higher than elementary school.

Majority occupation of the respondents can be categorized as working in the service sector (70%). In every hamlet, it shows that the numbers of respondents who work in the services sector are always higher than the number of respondents who work in the agriculture and manufacturing sector, except the respondents in Ngujung hamlet who have slightly higher number of respondents who work in the agriculture and manufacturing sector. Among total

respondents, there are 23% of respondents who work at home and it is the highest number of respondents based on the six categorization of working place. Referring to Table 4.13 respondents in the two villages distinguished by type of water source, majority of them work outside home.

In general villagers live with household monthly income at equal or less than standard monthly minimum wage in Malang regency that its standard in 2009 is IDR 945,500 (JPY 9,455). Except customers of PDAM whereby 54% of them have monthly income higher than IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000), 67% members of HIPPAM, and 70% users of private wells, as well as 79% users of public hydrant they have monthly income at level (ii) or lower than that. Most respondents work at home, therefore time to reach work place is zero minute and reached by foot. In general, the average travel time is 30 minutes. Motor bike is the most favorite vehicle used by respondent to reach work place, comparing to public transportation such as small public bus.

Using Chi-square test with the tabled critical value $\chi^2 = 3.84$ at $p < 0.05$ $with\ df = 1$, we scrutinize the relationship between respondents who join to HIPPAM or PDAM ($N = 326$) and their choice to piped water supply system (HIPPAM or PDAM). There are 5 significant attributes to choice to piped water supply system as follows:

1. The critical value of gender of the respondents show $\chi^2(df = 1, N = 326) = 4.19$ at $p < 0.041$. It indicates that male respondents tend to join HIPPAM group than female respondents;
2. The critical value of average age of the respondents show $\chi^2(df = 1, N = 326) = 6.613$ at $p < 0.01$. It indicates that respondents with average age at lower or equal to 47 years tends to join HIPPAM group;
3. The critical value of education level of the respondents show $\chi^2(df = 1, N = 326) = \infty$ (infinite) at $p < 1.58E - 10$. It indicates that education background and choice to join HIPPAM or PDAM are rigorously dependent. Here we may see that respondents with education background at junior school and higher have more than a six times greater rate of getting access to piped clean water supply system from PDAM. In other words, we may argue that respondents with education level at lower or equal to elementary school tends to join HIPPAM group;
4. The critical value of occupation of the respondents show $\chi^2(df = 1, N = 326) = \infty$ (infinite) at $p < 2.56E - 07$. It indicates that type of occupation and choice to join HIPPAM or PDAM are strictly dependent. In other words, we may argue that 86% of the respondents with occupation in agriculture and manufacturing sector tend to join

HIPPAM group than the respondents with occupation in services sector (57%);

5. The critical value of income level of the respondents show $\chi^2(df = 1, N = 3261) = 14.11$ at $p < 0.0002$. It indicates that households with income level at lower or equal to IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000) tends to join HIPPAM group that households with higher income level.

Meanwhile, the critical value of level of working place of the respondents do not exceed the critical value of chi-square at $p < 0.05$ with $df = 1$ is 3.84 whereby it shows $\chi^2(df = 1, N = 326) = 3.531$ at $p < 0.06$. It indicates that working place and choice to join HIPPAM or PDAM are slightly independent in case of the whole members of HIPPAM and customers of PDAM.

There are five types of clean water sources in the research area as follows:

1. The piped clean water supply system from HIPPAM serves 43% of total respondents covering 59% respondents in Toyomarto village and 28% respondents in Candi Renggo village.
2. The piped clean water supply system from PDAM supplies 22% of total respondents covering 75 respondents in Toyomarto village and 37% respondents in Candi Renggo village.
3. The individual wells are owned by 22% of total respondents consist of 17% respondents in Toyomarto village and 27% respondents in Candi Renggo village.
4. The communal wells – provided voluntarily by owners of private wells or public tap – provided by some HIPPAM groups are fetched by 12% of total respondents consist of 15% respondents in Toyomarto village and 8% respondents in Candi Renggo village.
5. There are 4 respondents who fetch fresh water from other water sources than the previous four such as from river.

In addition, there is no significant different water source utilized by households between rainy season and dry season.

Scrutinize two maps of water supply system in the research area that depicted in Figure 4.10 and 4.10, main pipelines of PDAM pass through Toyomarto and Candi Renggo village, except Glatik hamlet. Meanwhile, main pipelines from HIPPAM groups cover smaller area than PDAM, i.e. Sumberawan, Ngujung in Toyomarto village, and RW 6 in Candi Renggo village. From the fact, we may argue that altitude geographic position of particular hamlet from the spring, as well as the physical distance from main pipeline are important determinant of the availability of access to piped clean water supply system.

Except for members of HIPPAM, there is no specific rule on water usage for customer of

PDAM, owner of private wells, as well as households who fetch fresh water from public hydrant and river. In principal, every household has 24 hours access to fresh water without any limitation of amount of water. In particular for customer of PDAM, the more water they use the more expensive their monthly charge of water usage since the price per cubic meter will increase once their water usage exceeds 10 cubic meters. In the other hand, there is no different price for members of HIPPAM for how many cubic meters their water usage since HIPPAM groups set up a fixed price for their members. In addition, there is a limitation number of faucet per household at two point taps for each member of HIPPAM and a suggestion to utilize water efficiently during the dry season.

In general, physical condition of public hydrant - communal well shared by private wells' owner or public tap supplied by HIPPAM group – are not good. It might cause by absence of norms about how to utilize the source amongst users. Except, the public taps that is located inside the mosque whereby the mosque care taker will maintain it. Moreover, some public facility located in and nearby the river, the physical condition is even worse than the pubic hydrant. In this sense, there is no specific difference between different purposes such as bathing and washing at the same place. Even more, there is no distinction between spaces of river for human beings and vehicles or animals.

In general, we may see that respondents have high level of satisfaction towards their current access to water supply. In detail, the following description illustrates the respondents' water satisfaction through five categories covering taste, quantity, quality, price and availability:

1. It indicates that average satisfaction of water 'taste' of the respondents in the research area has a high level of satisfaction on a scale of 2.8. The whole HIPPAM's members show a high level of satisfaction at 2.9 from utmost scale of 3. Meanwhile, PDAM customers show quite wide variation in the level of satisfaction from moderate on scale of 2.0 up to high on scale of 2.8 to 3.0.
2. It indicates that average satisfaction of water 'quantity' of the respondents in the research area has a high level of satisfaction on a scale of 2.6. It is interesting that the four households in Sumberawan who fetch water from 'other' water source show a high level of satisfaction on a top scale of 3. It may indicate that they feel quantity of water from the river still sufficient for their daily domestic purposes. Meanwhile, customers of PDAM have only moderate level of satisfaction on a scale of 2.1 that is the lowest level of satisfaction amongst other types of water source.
3. It indicates that average satisfaction of water 'quality' of the respondents in the research area has a high level of satisfaction on a scale of 2.8. Even though, households in RW 12

hamlet have a slightly lower level of satisfaction than the other hamlets on a scale of 2.7 for PDAM customers. As a whole, it may argue that households as a whole feel satisfied toward quality of water from springs and even from rivers.

4. It indicates that average satisfaction of water 'price' of the respondents in the research area has a high level of satisfaction on a scale of 2.6. The four households which utilize fresh water from the rivers have utmost satisfaction on a scale of 3.0. Meanwhile, the customer of PDAM has the lowest level of satisfaction compare to the other water sources on average scale of 2.2. In this sense, we may guess the cause is traditional habit to utilize fresh water directly from rivers, and a fact of free of charge. Thus, free usage without any charge may give users utmost satisfaction.
5. It indicates that average satisfaction of water 'availability' of the respondents in the research area has a high level of satisfaction on a scale of 2.6. Related to types of water source, customers of PDAM have the lowest average satisfaction of water availability compare to the other four types of water source on a scale of 2.3.

To the respondents who joint participation in HIPPAM or PDAM, we raised further question: "If there is any problem with water such as a water pipe broke, what would you do?" with five options. Option 1 is the respondent will fix the water problem by him/her self if he/she find it. Option 2, the respondent will ask neighbor any help to fix it together. Option 3, the respondent will contact to water management body whether PDAM or HIPAM for asking to fix it. Option 4, the respondent think he/she has no idea, therefore he/she just leaves it. The last option is if the respondent has different option than four options, whereby we asked the respondent to specify it.

It is interesting that, HIPPAM members and PDAM customers in the same village have similar response on option to solve water problem, but they have different pattern between distinct villages. HIPPAM members in Sumberawan and Ngujung hamlet tend to contact the water management body rather than directly fix it by them self or even ask neighbor to fix it together. Meanwhile, HIPPAM members in RW 6 tend to fix by them self as the first choice, and then it followed by contact to the water management body and asks their neighbor to fix it together. It may indicate that relation between the board committee and the members of HIPPAM groups in Toyomarto village is closer than the relation of HIPPAM group in Candi Renggo village. Furthermore, it might caused by the different institution of HIPPAM between the two villages. In the meantime, PDAM customers in Toyomarto village have similar response with HIPPAM member in the same village, as well as similar pattern of option to solve water problem between PDAM customer and HIPPAM member in Candi Renggo. In this sense, we

may argue that the respondents in Toyomarto village may have tendency to act in collective decision than individual decision, and in contrary the respondents in Candi Renggo village may have tendency to act in individual decision rather than to collective decision.

Related to the previous question of solving water problem, we requested the respondent to reveal the reason of their answer through this question "Regarding to your answer in 2.7 (the previous question), what is the main reason to choose the answer?" Using five categories consist of (1) Cost, (2) Time, (3) Effort, (4) Quality, and (5) Safety.

Between HIPPAM members and PDAM customers, they have a slightly different reason toward their choice on solving water problem. In general, HIPPAM members reveal three main important reasons consist of safety, cost and effort on solving the water problem. Meanwhile, PDAM members put more attention towards cost, effort, and quality on their choice to the problem solving.

Finally, we raised one last question related to water supply issues using the following query: "What is your opinion to improve or solve the problem related to the current water supply system?" Among 58% answer, 17% of respondents think that there is no water problem, except the needs of maintenance actions to maintain the current good conditions. Meanwhile, another 26% of the respondents suggest improving water supply system through enhancing water services, fare betterment, improvement the performance of water officer and management of the water body.

Following Tao's classification (1999) about voluntary organization and Aoki (2009) definition about community and combining with preliminary survey, there are 14 types of community group that exist in the research area. It encompasses (1) religious, (2) cultural/social, (3) PDAM, (4) HIPPAM, (5) HIPPA - a resident association for water distribution of agriculture activity, (6) ethnic based, (7) community organization, (8) finance, (9) production, (10) union (labor/trade), (11) political party, (12) professional association, (13) business association, (14) social movement. In the household questionnaire survey, we add 'other' as options number fifteen in case the respondent may involve in different community group outside the fourteen.

Instead of being member of HIPPAM and PDAM, in difference number of participant, there are four popular community groups amongst respondents Toyomarto village. The forth of them are religious group (84% of the respondents), cultural/social group (13% of the respondents), community organization and finance group at 10% from the total respondents of each group. Amongst respondents in Toyomarto village, number of community group whereby respondents in Sumberawan hamlet joint participate in is the most consist of 12 community groups. Then, it followed by respondents in Ngujung hamlet with 9 community groups and respondents in Glatik

hamlet with 8 community groups. Respondents in Candi Renggo village also have similar four popular community groups to respondents in Toyomarto village. The forth of them in order are religious group (70% of the respondents), community organization (25% of the respondents), cultural/social group (19% of the respondents) and finance group (9% of the respondents). In addition, all respondents in the three hamlets joint participate in 9 community groups. Furthermore, religious group is one of community group which has high regular meeting (4 times in a month) with a very important meaning and a very high benefit towards community.

Using Yes or No answer, we raised question to the respondent: "Do people in the community generally trust one another in matters of lending and borrowing?" The term of lending and borrowing here refer to lending and borrowing in daily needs such as amount of money for urgent needs – to go to hospital for instance, amount of rice before harvest time, or just lending and borrowing for some simple things such as domestic tools.

In general, we may conclude that a trust on lending and borrowing among households in the research area is very high. Average percentage of respondents who answer yes is 87%. Among the six hamlets, respondents in RW 12 occupy the lowest rate at 81%, and respondents in RW 8 occupy the highest 91%. Thus, once again, this condition indicates that villagers have high mutual trust each other in the community.

Furthermore, we continue the previous question by asking respondents' opinion whether "In the last three years, the level of trust has improved, worsened, or stayed the same." Except respondents in Ngujung hamlet express that their level of trust has improved in the last three years, majority respondents in other five hamlets reveal that their level of trust has remained the same in the last three years. Thus, we may argue that, in general, households in the research area have high mutual trust with a tendency to increase.

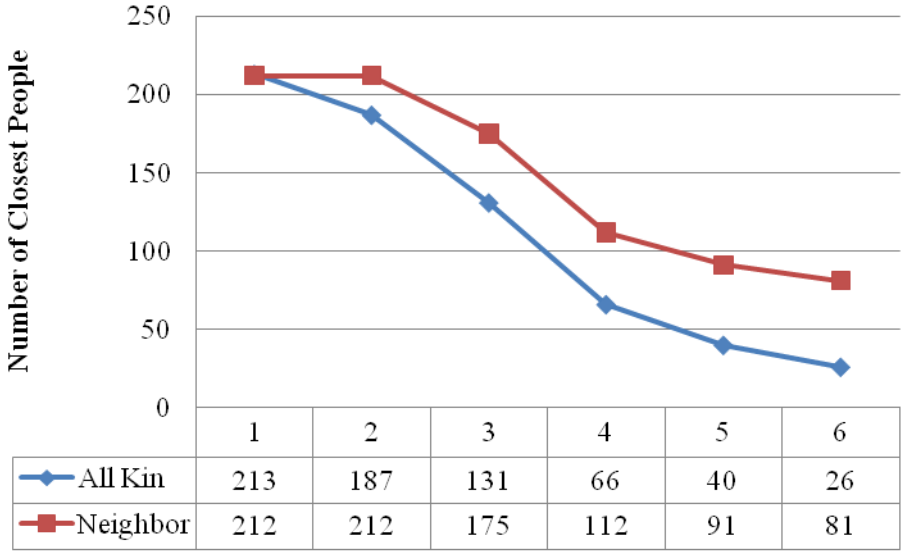
Moreover, in order to catch deeper character of community network by asking the respondents whether they agree or disagree with the following statement: People here look out mainly for the welfare of their own families and they are not much concerned with community welfare. The answer is using three scales covering strongly agree = 1, agree = 2, disagree = 3, and strongly disagree = 4. In this sense, we may assume that the stronger disagree the respondents to the statement means the higher their concern to community welfare.

As a result, average concern to community welfare for the whole respondents in the research area is quite high on scale of 2.7. Respondents of individual wells have the highest concern (2.9) followed by three types of water users in the same scale (2.8) i.e. members of HIPPAM, public hydrant and other. Meanwhile, respondents of PDAM have the lowest concern (2.4). Referring to each hamlet, respondents in RW 12 have the highest concern on a scale of 2.9, following by

three hamlets – Sumberawan, Glatik and RW 8 on a scale of 2.8. The other two hamlets – RW 6 and Ngujung occupy the lower concern to community welfare on a scale of 2.6 and 2.5, respectively.

In general, villagers in Toyomarto and Candi Renggo village think that their community and living environment have very high meaning or value for them. Moreover, we may argue that villagers love their area and their community, as well as they want to make it better through cooperate with each other.

In the last part of questionnaire, we asked respondent to list up six people outside his or her household that he or she feel closest to. It indicates that neighbor as a whole is the closest person outside household at every level of closeness relationship (strength of relationship 1 to 6). Form the respondents' answer about their six closest people, we may argue that position of the neighbor occupy very important role for the respondents as it is depicted in Figure 4.42 whereby the closeness of relationship of neighbor to respondent is higher than the closeness of all kin to respondent, except in the first closest level with only very slight different.



	1	2	3	4	5	6
All Kin	213	187	131	66	40	26
Neighbor	212	212	175	112	91	81

Figure 4.42 Closeness Relationships to the Respondents

Most type of relationships to respondent, except intimacy with friend and other unrelated person, shows that distance has a significant burden towards closeness of relationship. Therefore, the closer distance of residence on intimate person to respondent, the more intimate their relationship. Closeness relationship towards neighbor is the highest ranked among other intimates by relationship; even more the gap is very high. It seems that distance of residence plays very important role towards intimate relationship. In addition, respondent still has intimate relationship when residence of intimates in East Java Province.

The most intimate by relationship to respondent is the person who lives in the same

community with them. The number of closeness relationship decrease sharply when the person lives in difference community, in the same sub village. It shows in the Figure 4.43.

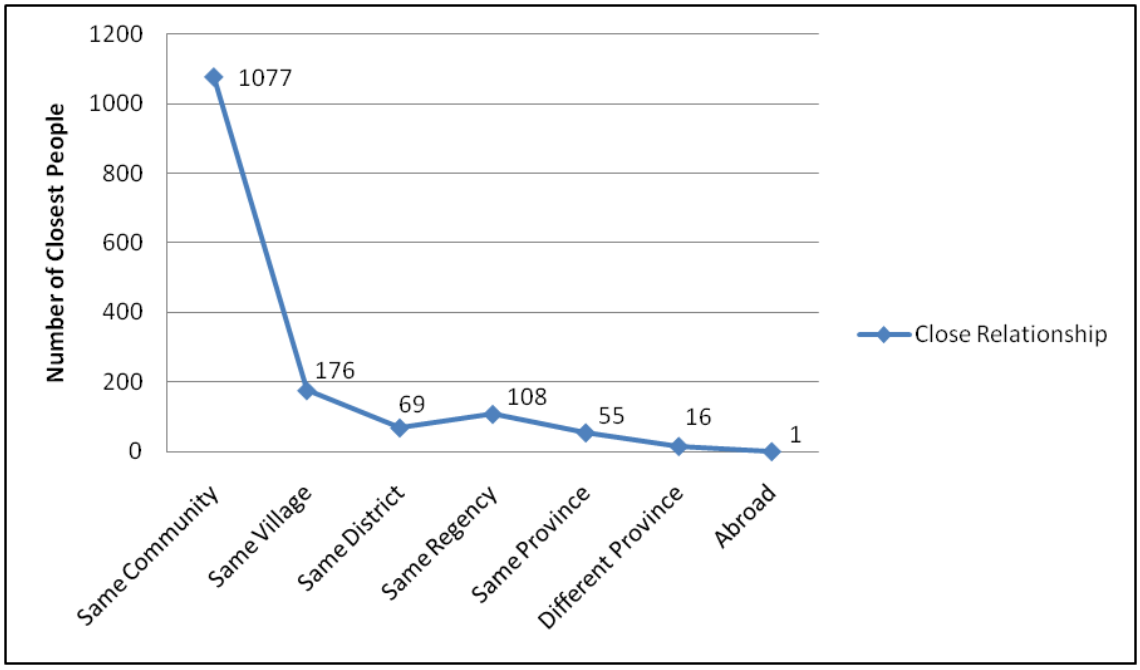
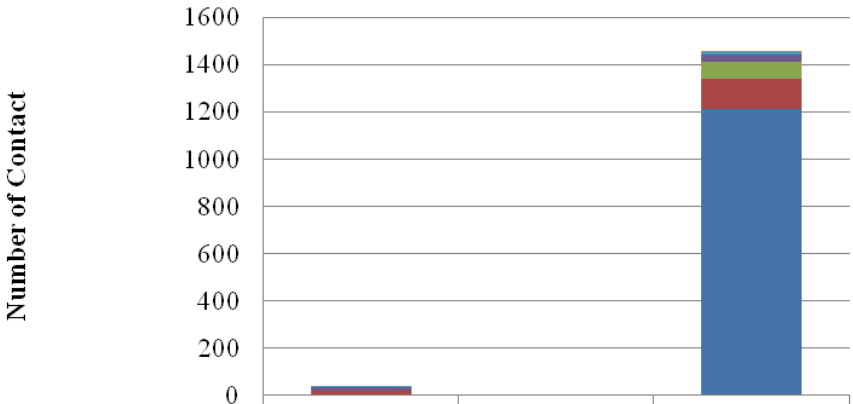


Figure 4.43 Concerns to Community Welfare

Furthermore this very close distance of residence of intimate relationship (residence in the same community to respondent) in this district could be more understandable when it looks at the Figure 4.44 about what means respondent make contact to intimate person. It shows that most respondent use face to face communication (96%) than telephone (3.5%) and letter (0.5%). Additionally, most of them make daily contact with frequency more than 5 times in a week. Finally, we may conclude that position neighbor who live in the same community occupy very important role towards respondents in the research area.



	By Phone	By Letter	Face to Face
Once a year or less	0	0	3
2-11 times a year	9	0	10
1-2 times a month	12	0	31
Once a week	3	5	73
2-4 times a week	13	0	130
Daily (5>= a week)	5	0	1209

Figure 4.44 Frequency of Contact Differed by Means

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Chapter 5
Social Network of Memberships in Community Groups

5.1 Introduction

Having access to safe drinking water is one of the most indispensable human necessities. Regarding WHO and UNICEF (2006) the number of urban residents without adequate water services is increasing rapidly. Moreover, WHO (2010) stated that six out of the seven people without access to an improved water source live in rural areas. Consequently, estimates of access to safe drinking water are a cornerstone of most international assessments of progress toward solving global and regional water problems, particularly to reach target 10 of the Millennium Development Goals (MDGs) that reduces by half the proportion of people without sustainable access to safe drinking water by 2015.

There is a mechanism that inhabitants who live near the water resource cannot develop the water resource with their value. In line with the report of Asian Water Development Outlook (AWDO) that the future water crisis in Asian countries, it will not be because of physical scarcity of water, but because of inadequate or inappropriate water governance, including management practices, institutional arrangements, and socio-political conditions, which leave much to be desired (Bird et.al, 2008).

Under the situation of lack access to water, collaboration activities for water supply system by community members becomes one of strong alternatives to get access to water. In case of Indonesia, among total 231.6 million inhabitants only around 49.7% of the citizen has access to water whereby at around 10% is supplied by a sort of community based water management (Statistic Centre Board, 2005). Moreover, though in general Malang regency has blessed by abundant water resources but it is only around 24% of residents get access to piped clean water supply system whereby at around 11% is provided by a kind of community based water management. Then, in case of Singosari district among piped clean water connection that serves 28% of the inhabitants, there are 4% of it is supplied by HIPPAM.

Focusing on the respondents who have option to access piped clean water supply system from HIPPAM and PDAM, objective of this chapter is to scrutinize social network of the residents through memberships in community groups whereby affiliation data are collected as refer to respondent-by-community group participations. The collection is in order to understand social relations among the respondents, specifically, whether respondents tended to have social relations primarily within their own social classes. Furthermore, it is to investigate how the structure of his/her connectivity affects their choice of access to piped clean water supply

system. In this sense, we propose Social Network Analysis approach to investigate important indices of social ties through centrality and cohesion with respect to empirical case in Singosari district Malang regency Indonesia. Moreover, we focus upon affiliation network that represents the affiliation of a set of respondents with respect to a set of events, on the basis of shared members of community groups in the local area. Here we associate social capital with local level voluntary associations which individuals joint participate in collectivities of community groups that exist in their neighborhood.

The whole chapter consist of five sections started by describing some basic idea of the chapter in section one. In section two, we discuss literature review on social network analysis to give grand concept of understanding about social relations. Then, section three portrays empirical case study which focus upon the respondents who live in the area where access to community based water supply is available. Next, in section four, we attempt to apply the methods to measure level of social capital which refers to the network an individual belongs to. Last, this paper will finalized with conclusion in section five.

5.2 Social Network Analysis (SNA)

Inception notion of social network started at the end of 18^{th} century by the work of Durkheim and Tonnies who clarify that existence of social structure is as in the form of personal ties that either link people who share similar values and beliefs or impersonal, formal and instrumental social links. Its progress has demonstrated astonishingly escalation in latest years at diverse application such as psychology, health, business organization, political, and electronic communications.

5.2.1 The Concept

The general concept of SNA could be defined as the study of social relations among a set of actors or individuals or agents.

Wasserman and Faust (1994) define social network as "the social network perspective encompasses theories, models, and applications that are expressed in terms of relational concepts or processes. That is, relations defined by linkages among units are a fundamental component of network theories." In addition, they declare four tenets of social network analysis as follows:

- Actors and their actions are viewed as interdependent rather than independent, autonomous units. Human behavior is embedded in networks of interpersonal relationships;
- Relational ties (linkages) between actors are channels for transfer of "flow" of resources

(either material or non material). Network connections constitute social capital, and rich and well-structured networks can provide high levels of social capital to actors within them;

- Network models focusing on individuals view the network structural environment as providing opportunities for, or constraints on, individual action;
- Network models conceptualize structure (social, economic, political, and so forth) as lasting patterns of relations among actors.

Serrat (2009) defines social networks as "nodes of individuals, groups, organizations, and related systems that tie in one or more types of interdependencies: these include shared values, visions, and ideas; social contacts; kinship; conflict; financial exchange; trade; joint membership in organizations; and group participation in events, among numerous other aspects of human relationships." Moreover, he argues that application of social network analysis will able to help scholars to understand 'when, why and how' the social networks function best to construe the public and organizational power.

Referring to Borgatti [forthcoming], he defined "social network as a collection of nodes (also referred to as vertices or actors) together with a set of ties (also known as edges or links) that connect pairs of nodes." Hence, he argues that in general, it is accustomed to represent social relations such as who are friends with whom, or who is the supervisor of whom.

In this chapter, we focus upon social network as to represent social relations between a set actors and a set of ties through multiple memberships of actors in community groups.

5.2.2 Affiliation Network

In general, there are two types of two-mode social network (Wasserman and Faust,1994). First, it is relations in a two-mode network measure ties between two sets of actors. Secondly, two-mode social network whereby one set of actors is measured with respect to affiliation with a set of events. In this sense, chapter five focuses upon the second type of two-mode social network to represent affiliation network.

Affiliation network could be defined as a two-mode network between a set of actors and a collection of subsets of actors (Faust, 1997; Everett and Borgatti, 2005). This collectivity creates a network ties among actors through the multiple memberships of actors. Moreover, Faust (1997) also described an affiliation network as a non-dyadic network whereby the affiliation relation relates each actor to a subset of events, and relates each event to a subset of actors.

Table 5.1 illustrates an example taken from the field survey data represent as respondents's memberships in 4 community groups. In the household questionnaire survey, we asked

respondents to state in which community groups they participate. And the following figure describes the multiple memberships of 15 respondents amongst total 64 respodents in Ngujung hamlet. In this original data, we put a sign of "x" for attendance in a particular community group, and "-" for the absence. In a sense, we might collect data on who has social relation with whom within a community group.

Table 5.1 Respondents-by-Community Groups Matrix

Respodents in Ngujung hamlet		Community Groups			
No. of ID	Name	Religious	Cultural/Social	Community Org.	Finance
I-01	Mr. Agus	x	x	-	-
I-02	Mrs. Dian	x	-	-	-
I-03	Mr. Sunari	x	-	-	-
I-05	Mr. M. Ismadi	x	-	-	-
I-06	Mr. Suparto	x	-	-	-
I-07	Mrs. Farida	x	-	-	-
I-08	Mrs. Tinayah	x	-	-	-
I-09	Mr. Suripto	x	-	-	-
I-10	Mr. Kusnan	x	-	-	-
I-11	Mrs. Jumiati	x	x	x	-
I-12	Mr. Paidi	x	-	-	-
I-14	Mr. Sukadi	x	-	-	x
I-15	Mr. Sudandi	x	-	-	-
I-16	Mr. H. Ali	x	-	-	-
I-17	Mrs. Jariyah	x	-	-	-

Referring to Borgatti [forthcoming] distinguished the term "mode" data correspond to a class of entities, we may compose two types of networks namely (i) two-mode network - whose members have social ties with members of another class and (i) one-mode network - whose members have social ties with other members.

Along with the notion of Everett and Borgatti (2005), two-mode network consist of two kinds of entities, namely actors and events, and a binary relation, that connects the actors to the events. In the form of two-mode affiliation matrix X whereby the rows represent actors and the columns represent events. In addition, regarding Wasserman and Faust (1994) the affiliation

network will called an affiliation matrix, $X = \{x_{ij}\}$, is a two-mode matrix in which each actor i in rows is affiliated with events j in column.

$$x_{ij} = \begin{cases} 1 \text{ if actor } i \text{ is affiliated with event } j \\ 0 \text{ otherwise} \end{cases} \quad (5.1)$$

Referring to Figure 5.1, we could construct a 2-mode affiliation network "respondents-by-community groups" matrix X in which $x_{ij} = 1$ if a respondent i joint participate in community group j, and $x_{ij} = 0$ otherwise as it is depicted in the following Table 5.2.

Table 5.2 Affiliation Network "Respondents-by-Community Groups" Matrix

Respodents in Ngujung hamlet		Community Groups			
No. of ID	Name	Religious	Cultural/Social	Community Org.	Finance
I-01	Mr. Agus	1	1	0	0
I-02	Mrs. Dian	1	0	0	0
I-03	Mr. Sunari	1	0	0	0
I-05	Mr. M. Ismadi	1	0	0	0
I-06	Mr. Suparto	1	0	0	0
I-07	Mrs. Farida	1	0	0	0
I-08	Mrs. Tinayah	1	0	0	0
I-09	Mr. Suripto	1	0	0	0
I-10	Mr. Kusnan	1	0	0	0
I-11	Mrs. Jumiati	1	1	1	0
I-12	Mr. Paidi	1	0	0	0
I-14	Mr. Sukadi	1	0	0	1
I-15	Mr. Sudandi	1	0	0	0
I-16	Mr. H. Ali	1	0	0	0
I-17	Mrs. Jariyah	1	0	0	0

From the term "mode" refers to a class of entities, the second form is one-mode network - whose members have social ties with other members. In other expression, Faust (1997) defined affiliation networks as the set of actors denoted by $N = \{n_i, n_2, \ldots, n_g\}$ and the set of events is denoted by $M = \{m_i, m_2, \ldots, m_h\}$. Thus, it will be g actors and h events in study of affiliation networks. Referring Figure 5.2, the case of affiliation network

respondents-by-community groups matrix X in which $x_{ij} = 1$ if a respondent i belongs to community group j, we assume that every respondent in the group knows every respondent else. Then, following Breiger (1974) as mentined by Faust (1974), we can derived from the affiliation network, a 1-mode network the actor co-membership matrix, denoted by $X^N = AA'$, in both valued and binary relation as well.

Table 5.3 illustrates the valued relation co-membership matrix that we may assume an acquaintance network such that $a_{ij} = 1$ indicates the presence of a network of ties between respondent n_i and respondent n_j through their joint participation in a one similar event, and $a_{ij} = 0$ indicates the different membership that then it does not create a network of ties between them. The diagonal cell illustrates the number of events with which an actor is affiliated, so that $a_{ii} \neq 0$.

Table 5.3 Valued Relation Actor Co-membership Matrix

	Agus	Dian	Sunari	Ismadi	Suparto	Farida	Tinayah	Suripto	Kusnan	Jumiati	Paidi	Sukadi	Sudandi	Ali	Jariyah
Agus	2	1	1	1	1	1	1	1	1	2	1	1	1	1	1
Dian	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sunari	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ismadi	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Suparto	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Farida	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Tinayah	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Suripto	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Kusnan	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Jumiati	2	1	1	1	1	1	1	1	1	3	1	1	1	1	1
Paidi	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sukadi	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
Sudandi	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ali	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Jariyah	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

The following Table 5.4 depicts the number of multiple memberships shared by each pair of respondents called as actor co-membership matrix. This is the binary relation actor co-membership matrix, that we may assume an acquaintance network by constructing a 1-mode matrix such that $a_{ij} = 1$ indicates the presence of a network of ties between respondent n_i and respondent n_j through their joint participation in at least one similar event, and $a_{ij} = 0$ indicates the different membership that then it does not create a network of ties between them. The diagonal cell are set to zero, because it refers to ties from a respondent n_i to himself (loops) in which $a_{ii} = 0$.

Table 5.4 Binary Relation Actor Co-membership Matrix

	Agus	Dian	Sunari	Ismadi	Suparto	Farida	Tinayah	Suripto	Kusnan	Jumiati	Paidi	Sukadi	Sudandi	Ali	Jariyah
Agus	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dian	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Sunari	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
Ismadi	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Suparto	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Farida	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
Tinayah	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
Suripto	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Kusnan	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
Jumiati	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
Paidi	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
Sukadi	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
Sudandi	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
Ali	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Jariyah	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

Referring to Breiger (1974) in Faust (1997), next Table 5.5 illustrates the one-mode matrix of event overlaps derived from the affiliation matrix, denoted by $X^M = A'A$. Each cell illustrates the number of actors shared by each pair of events. Regarding the example, a 15 in row and column religious indicates the number of actors who joint participate in religious group, while a 2 in row religious and column cultural/social shows the number of actors who similarly join religious and cultural/social group at once, and the like for other cells. In a sense of value 0 for a certain cells, it indicates that none of respondents shared by each pairs of the community groups.

Table 5.5 Event Overlap Matrix

	Religious	Cultural/Social	Community Organization	Finance
Religious	15	2	1	1
Cultural/Social	2	2	1	0
Community Organization	1	1	1	0
Finance	1	0	0	1

Another approach to study the affiliation network is in the form of a square bipartite adjacency matrix, denoted by X^{NM} with two-mode data seeks to analyze both modes simultaneously as it shows in Table 5.6. In the a rectangular bipartite incidence matrix X as it shown in Table 5.2 the node can be partitioned into two subsets where presence or absence of line indicates the presence or absence of affiliation relation between node of respondent and node of community group. In this sense, there are two sets of nodes consist of the set of respondents, N, and the set of community groups, M. And, g be the size of the node set of respondents, N, and h be the size of node set of community groups, M. Then, the total sets of matrix become $g + h$ nodes, and it has the form:

$$X^{NM} = \begin{bmatrix} 0 & A \\ A' & 0 \end{bmatrix} \quad (5.2)$$

Table 5.6 Bipartite Adjacency Matrix

	Agus	Dian	Sunari	Ismadi	Suparto	Farida	Tinayah	Suripto	Kusnan	Jumiati	Paidi	Sukadi	Sudandi	Ali	Jariyah	Religious	Cul/Soc.	ComOrg.	Finance
Agus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Dian	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Sunari	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Ismadi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Suparto	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Farida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Tinayah	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Suripto	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Kusnan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Jumiati	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
Paidi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Sukadi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Sudandi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Ali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Jariyah	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Religious	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Cul/Soc.	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ComOrg.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Finance	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Thus, in this chapter we investigate the social network of respondents focus upon affiliation network of membership in community organizations at one-mode relation of actor co-memberships for properties of actors, as well as at two-mode relation for both properties of actors and events simultaneously, in a dichotomous non−directional relation.

5.2.3 Centrality

Regarding Wasserman and Faust (1994), the notion of centrality is to identify the most important actors in a social network that located in strategic locations within the network. Or in other words, Borgatti [forthcoming] defines centrality as a family of concepts of characterizing the structural importance of an actor's position in a network. It means that the actor centrality is that central actors must be the most active in that they have the most ties to other actors in the network. In the other words, an actor will be consider to be prominent if the ties of the actor make the actor particularly visible to the other actors in the network. The use of centrality measures is to understand group structure which those actors with the most access will be the most central in the network. Three indices to quantify the prominence of an individual respondent embedded in a network are (i) degree, (ii) closeness, and (iii) betweenness. In addition, index of centralization is between 0 and 1.

In this chapter, referring to Wasserman and Faust (1994), we scrutinize affiliation network as a nondirectional relation in which the ith row of the matrix X, $(x_{i1}, x_{i2}, \dots, x_{ig})$, is identical to the ith column $(x_{1i}, x_{2i}, \dots, x_{gi})$. Thus, the prominence of actor i within a network is based on the pattern of these $g-1$ possible ties in the affiliation network matrix, defining the location of actor i. Moreover, since our research focus upon non directional relation, in line with Knoke and Burt (in Wasserman and Faust, 1994), centrality might be the most appropriate indices to define better the important actors as those with more visibility and to understand better meaning

of the concept. Thus, for nondirectional relation, we define a central actor as one involved in many ties, regardless the receiving (being the recipient) as well as the transmission (being the source) of many ties.

a) Bipartite Degree Centrality

According to Everett and Borgatti (2005), in the two-mode network, the raw degree centrality for an actor n_i is defined as the number of events that is participated by the actor, $C_D(n_i)$. And, the number of actors participating that event or the number of members in that event m_k is a definition for the raw a degree centrality for an event, $C_D(m_k)$.

Modified from Everett and Borgatti (2005) and referring to Figure 5.4, the two-mode normalization of degree centrality for an actor and an event is represented by the following formula. The h is defined as the number or the size of events, M, and the g is the number of the size of actors, N. In addition, this is a nonlinear whereby the two-mode normalization towards actors and events could be scaled in a different way depend on the size of actors as well as events.

$$\text{Actor } n_i \text{ normalized centrality} = \frac{C_D(n_i)}{h} \quad (5.3)$$

$$\text{Event } m_k \text{ normalized centrality} = \frac{C_D(m_k)}{\text{g}} \quad (5.4)$$

Since we normalized the measure of centrality, it means we will able to compare the centrality for different size of actors as well as for different size of events.

Referring to Figure 5.4 bipartite adjacency matrix, we may see that respondent Jumiati joint participation in 3 community groups as the highest number of multiple memberships in the example. It means she has raw degree centrality of 3. Meanwhile, there are another two respondents – Agus and Sukadi join in 2 community groups, and the other 12 respondents join in 1 community group. Additionally, there are two respondents – Widi and Nur who do not join in any kind of community group, so that $(n_i) = 0$ because they are completely isolated for the network. Since the number of community groups are 4, then the actor normalized means divided raw degree of each respondent with 4 in order to get the standardized indices which have values {0.75, 0.5, 0.25, 0}. In these sense, respondent Jumiati is occupying a central actor in the network.

Continue the measurement for central event, we may see that religious group is the most popular community group whereby all 88% respondents belong to the group. We can simply sum up the number of member in each community group to get raw degree centrality for each event as follows: religious group = 15, cultural/social group = 2, and community organization and finance group = 1. Then, we make normalization by dividing the raw degree with the number of respondents (17), so that the standardized indices for community groups have values {0.88, 0,12,

0.06} whereby community organization and finance group have the same lowest normalized degree centrality. In this sense, there is clearly one maximally central event which may become a major channel location of relational information in the network.

Referring to Wasserman and Faust (1994), particularly for isolated actor, $d(n_i) = 0$ or event without member, $d(m_k) = 0$, we may eliminate them from the network that has no effect on the current ties of actors or events. As a consequence, so that it will form higher actor or event normalized degree centrality since the number of denominator in standardized indices is reduced, but it will not change the order level of centrality.

b) One-mode Degree Centrality

The notion of degree centrality is to find actors who occupy important position due to their high level of activity or the number of links that they have. Degree centrality measures activity of the actors, that the very active actor should those have a maximal central index.

Regarding Wasserman and Faust (1994), in two-mode data, the degree of centrality for an actor is the degree of the node, $d(n_i)$ and hence they define $C_D(ni)$ as an actor-level degree centrality index. In addition, since we deal with a nondirectional relation, then $x_{ij} = x_{ji}$ in the form of symmetric adjacency matrix.

$$C_D(n_i) = d(n_i) = x_{i+} = \sum_j x_{ij} = \sum_j x_{ji} \tag{5.5}$$

Then, in order to able to measure degree of centrality that can be compared across networks of different size of data, we need to normalized the raw degrees of nodes. This measure is depends on the event size g, that its maximum value is $g - 1$. Thus, the normalized degree of centrality is the proportion of nodes that are adjacent to n_i

$$C_D'(n_i) = \frac{d(n_i)}{g-1} \tag{5.6}$$

Referring to the Figure 5.3 respondents co-membership matrix, the degrees for the fifteen respondents in the respondents co-membership matrix are 14, since all the fifteen respondents joint participation in religious group. It means that each respondent is adjacent to each other as denoted by $a_{ij} = 1$ indicates the presence of a network of ties between respondent n_i and respondent n_j through their joint participation in at least one similar event. There is an exception for the two respondents who isolated from the network meaning that they are disjointed from the others, so that their degrees are 0. Then, the denominator for the normalized actor-level indices $C_D'(n_i)$ is $g - 1 = 16$. Since all the fifteen respondents have similar raw degree, so that they all have $C_D'(n_i)$ = 0.875, except the two respondents in which $C_D'(n_i)$ = 0.

Since the all fifteen respondents are equally occupying central location due to their adjacency

to other respondents, in this case we might not find "someone as the most visible actor in the network." In a sense, it might better to combain information of measure degree centrality in one-mode data with two-mode data as presented in subsection a) Bipartite Degree Centrality to get more comprehensive understanding of the social structure in the network.

c) One-mode Closeness Centrality

According to Wasserman and Faust (1994), actor closeness centrality measures how close "the distance" an actor is to all the other actors in the network as it has been developed in six seminal papers by Bavelas (1950), Harary (1959), Beauchamp (1974), Sabidussi (1966), Moxley and Moxley (1974), and Rogers (8974). They continued that the notion is that an actor is central if it can quickly interact with all others, so that centrality is inversely related to distance. It means that increasing geodesics in length between actors mening decreasing the centrality of the actors. In this sense, we may see that measure of closeness centrality depends on both direct and indirect ties, particularly for non-adjacent pair of actors.

Following Freeman (1979), Wasserman and Faust (1994) define the simple measure for closeness centrality as a function of geodesic distance as proposed by Sabidussi (1966). The distance between actors i and j, denoted as $d(n_i, n_j)$ be the number of lines in the geodesic linking actors i and j, as a distance function and it is the length of any shorthest path between the actors. Hence, the total distance that i is from all other actors is $\sum_{j=1}^{g} d(n_i, n_j)$, in which the sum is taken over all $j \neq i$. Thus, the index of actor closeness as defined by Sabidussi (1966) is

$$C_C(n_i) = \left[\sum_{j=1}^{g} d(n_i, n_j)\right]^{-1} \quad (5.7)$$

The maximum value attained by this index depends on g, hence taken a suggestion from Beauchamp (1965) Wasserman and Faust (1994) defined standardized closeness centrality in order to make comparisons of values across networks of different sizes as expressed as follows.

$$C_C'(n_i) = \frac{g-1}{\left[\sum_{j=1}^{g} d(n_i, n_j)\right]} \quad = (g-1)C_C(n_i) \quad (5.8)$$

The normalized index ranges between 0 and 1, and can be viewed as the inverse average distance between actor i and and all the other actors (Faust and Wasserman, 1994).

In line with the previous researchers, Faust (1997) also defined closeness centrality is based on geodesic distances - shortest paths of the central actors from other actors in the network, and is only applicable to dichotomous relations. Moreover, she also mentioned that in case of some pairs of actors have no link between them, then the distance between them will be infinite and the closeness centrality will be undefined. In other words, as defined by Wasserman and Faust

(1994), the geodesic distances of the isolate actor, n_k – with degree 0 because the actor is not reacheable from another actors from all the other actors are infinitely long, $d(n_i, n_k) = \infty$ for all $i \neq k$.

Returning again to Figure 5.3, there are two respondents who do not join in any kind of community group, so that, we should eliminate it from the measure closeness centrality and a square adjacency matrix size of (15 x 15). All the fifteen respondents are connected each other through membership in at least one community group, in a sense that each respondent is to all other respondents. Thus, all the respondents are at a maximum index equals $(\mathrm{g}-1)^{-1}$ have indicies $C_C^{'}(n_i) = 1.0$. In case of transfering information, all respondents may have to make efficient communication equally without any one of them occupying central location being the most dynamic in communicating information to the other respondents in the network.

d) One-mode Betwenness Centrality

The notion of betweenness centrality is that an actor is central if it lies between other actors on their geodesics, implying that to have a large "betweenness" centrality, the actor must be many of the actors via their geodesic. In this sense, the actors who lie on the many shortest between the pairs of other actors – these "other actors" potentially might have some control over the interactions between the two non-adjacent actors (Wasserman and Faust, 1994). Wasserman and Faust (1994) argue that this "actor in the middle," the one between the others indeed central to the network as argued by Bavelas (1948) and Shaw (1954), which they play important roles in the network as noted by Shimbel (1953) and Cohn and Marriot (1958). As a consequence, the actors' betweenness may have more interpersonal power on the others.

In order to quantify the notion of betweenness, firstly Wasserman and Faust (1994) the probability of a communication flow, by proposing two assumption: (i) lines of a path whereby the communications will travel along the shortest route to reach actor k from actor j have equal weight, so that (ii) such that a communication follows one of the geodesics. Then, as Freeman (1977) estimated that the probability of a communication from actor j to actor k a particular route is denoted as g_{jk} be the number of geodesics linking the two actors. So that, probability of the communication using any one of the chosen path is inverse g_{jk}. Secondly, they consider the probability a different actor, i, is "involved" in the communication between two actors in which $\mathrm{g}_{jk}(n_i)$ be the number of geodesics linking the two actors that contain actor i. Thus, along with estimation of Freeman (1977), actor betweenness index for n_i is the sum of these estimated probabilities over all pairs of actors not including the *i*th actor for *i* from *j* and *k*.

$$C_B(n_i) = \sum_{j<k} g_{jk}(n_i)/g_{jk} \quad (5.9)$$

Referring to equation (5.8), Wasserman and Faust (1994) suggested to firstly calculate the number of geodesics linking actors j and k, whereby $d(n_j, n_k)$ will be the same length, and then determine how many of these geodesics contain actor i, for all distinct indicies i, j, k.

Betweenness of actor centrality is a sum of probabilities that a minimum value is zero when n_i falls on no geodesics. And then, the number of pairs of actors not including n_i is the maximum value that is $(g-1)(g-2)/2$. Hence, value of the actor betweenness is between 0 and 1 as formulate in the following model.

$$C_B^{'}(n_i) = C_B(n_i)/[(g-1)(g-2)/2] \quad (5.10)$$

Just like degree centrality, the betwenness indices can be computed even if the graph is not connected or it is different from closeness indices that it has to be reachable actors in the network.

Referring to Figure 5.3, we find that all respondents $C_B^{'}(n_1) = \ldots = C_B^{'}(n_{17}) = 0$. It may indicate that every respondent is adjacent to every other respondents and none of them occupy mediator position which is none of the shortest path between pairs of actors go through the other actors. Thus, in this example, none of the respondents have more interpersonal influence on the others since none of the respondents are as the actors in the middle.

Reffering to Brandes and Pich (2006), closeness centrality and betwenness centrality are based on shortest-path distances (geodesic distances). Moreover, Everett and Borgatti (2002) defined a geodesic distance matrix as a matrix of geodesic distances among pairs of nodes. It is the number of links in the shortest path between them. It means that influence or communication of one node on another decline with the distance between them. Therefore, the geodesic distance matrix can be used as index of influence or cohesion. As a consequence, an actor has high closeness centrality when the total (and therefore also average) distance of the actor to all other actors is small, meanwhile an actor has high betweenness centrality when the actor is located in relatively many shortest paths connecting pairs of others.

5.2.4 Rate of Participation and Size of Events

In the previous subsection, we scrutinize the prominence actors in the network through three indices of centrality consist of degree, closeness and betweenness in one-mode and two-mode network as well. The basic concept of centrality is implemented to investigate the central actors with respect to Indonesian case, particularly the affiliation relationship of respondents multiple memberships in community groups in distinct size of communities at the level of hamlet in Toyomarto and Candi Renggo village, Singosari district, Malang regency, Indonesia.

Then in this section, we investigate deeper connectedness of the affiliation network through rate of participation by the actors and the size of events.

a) Rate of Participation

Referring to McPherson (1982) note, measure of rates of participation could describe people's rates of participation in social activities. Moreover, the rate of participation is the mean rate of affiliation for actors in the bipartite matrix that might one to compare people's rate of participation in voluntary organization between communities (Wasserman and Faust, 1994).

According to Wasserman and Faust (1994), measure of rates of participation is set by the row totals of an affiliation matrix, A or the entries on the main diagonal of actor co-memberships matrix, X^N in a valued relation matrix. The number of events with which actors i is affiliated is denoted by $a_{i+} = \sum_{j=1}^{h} a_{ij} = x_{ii}^N$. The h is defined as the number or the size of events, M, to which actor i belongs.

The average number of memberships for actors in the bipartite matrix could be used to compare actor's rates of participation in voluntary organizations between communities. It is calculated as follows:

$$\bar{a}_{i+} = \frac{\sum_{i=1}^{g}\sum_{j=1}^{h} a_{ij}}{g} = \frac{a_{++}}{g} = \frac{\sum_{i=1}^{g} x_{ii}^N}{g} \tag{5.11}$$

b) Size of Events

We might able to study the average sizes of voluntary organizations in different communities by measure of the average number of actors in each event, or mean degree of events in the bipartite matrix. According to Wasserman and Faust (1994), the size of each event refers to the number of actors affiliated with event j is given by the column total of affiliation matrix, A, or the entries on the main diagonal of the event overlap matrix, X^M, is denoted by $a_{+j} = \sum_{i=1}^{g} a_{ij} = x_{jj}^M$.

Furthermore, they defined the size of events whereby the number of events with which an

actor is affiliated is equal to the degree of the node representing the event in the bipartite matrix. Then, in order to investigate the average sizes of voluntary organizations in different communities, the mean number of actors in each event is counted as:

$$\bar{a}_{+j} = \frac{\sum_{i=1}^{g}\sum_{j=1}^{h} a_{ij}}{h} = \frac{a_{++}}{h} = \frac{\sum_{j=1}^{\mathrm{h}} x_{ii}^{M}}{h} \tag{5.12}$$

Referring to Figure 5.4 bipartite matrix, the average number of memberships for actors is $\bar{a}_{i+} = 1.27$, while the number of events with which an actor is affiliated is $\bar{a}_{+j} = 4.75$.

There is an important note mentioned by Wasserman and Faust (1997) that the sample in the study should be all the actors or events in the data set, so that the measure of rate of participation and the size of events will give appropriate description for affiliation network. The previous example represent a set of sample (15 respondents) taken from the population (64 respondents). In a sense, determination size of sample is a critical point in the study.

5.3 Description of An Empirical Case

Notion of this chapter is initiated by the belief that piped clean water supply conncetion to house is the most appropriate water supply system for people to life with healty water. Consequently, with respect to the case study, water supply services from HIPPAM (Residents Association of Water Users) and PDAM (Local Drinking Water Company) are the suitable options of access to clean water for the villagers. Upto now, due to budget constraint, PDAM services still give more priority to residents in urban areas. Meanwhile, piped clean water supply from HIPPAM that created by residents association in the community level may open more opportunity even for villagers to get better access to piped clean water supply system. Therefore, in this section we will describe our empirical case study focus upon the respondents who live in area where access to association of community based water management is available.

5.3.1 Determination Size of Sample

In the area of study, we can classified types of piped clean water supply connection to house into two based on water service provider namely PDAM and HIPPAM. PDAM as formal and conventional local drinking company belong to Malang regency serves residents in Ngujung hamlet of Toyomarto village, and residents in Candi Renggo village covering RW 6, RW 8 and RW 12. Unfortunately, except data of number of households, no valid record for number of PDAM customer in hamlet level (please refer to chapter 3 for more complete information). HIPPAM associations services cover the respondents in three hamlets consist of Sumberawan and Ngujung in Toyomarto village, and RW 6 hamlet in Candi Renggo village. Into more detail,

there are 5 HIPPAM associations in Sumberawan hamlet, and total services covers 422 households or 50% households of the hamlet. Four of the five HIPPAM associations utilize water from Candi Sumberawan Spring that is HIPPAM Gotong Royong 1, 2, 3 and 4. And the fifth association is called HIPPAM Sumber Banyon that named according to the name of their spring. Next, there is one HIPPAM association in Ngujung hamlet as well as in RW 6 hamlet which covers 300 and 160 households in the two hamlets, respectively. The HIPPAM Air Minum Bersaudara in Ngujung hamlet serves around 71% of the total households, meanwhile Primer Koperasi Tirta Perwita as HIPPAM association serves 42% of the total households. The following Table 5.7 illustrates the circumstances of clean water services from HIPPAM associations in the research area. Column three shows total household which is served as member in each group of HIPPAM based on representative interview to the head of hamlet and village. And last column describes number of respondent in the study as representative unit of household.

Table 5.7 Service Area of HIPPAM Associations

Name of HIPPAM	Service Area	Total Member (household)	No. in Sample (household)
Gotong Royong 1	Sumberawan, Toyomarto village	45	20
Gotong Royong 2	Sumberawan, Toyomarto village	137	21
Gotong Royong 3	Sumberawan, Toyomarto village	32	23
Gotong Royong 4	Sumberawan, Toyomarto village	68	24
Sumber Banyon	Sumberawan, Toyomarto village	140	12
Air Minum Bersaudara	Ngujung, Toyomarto village	300	46
Primer Koperasi Tirta Perwita	RW 6, Candi Renggo village	150	69

Since we raise a hypothesis that households with better community tie have ability to organize "community based" management system, then through investigation of social structure of the households represented by the respondents with option to join community based water supply system, we define sample of respondent in two premises as follows:

1. The respondent is currently HIPPAM member or PDAM customer on getting access to piped clean water supply system;
2. The respondent lives in the hamlet where currently water services from HIPPAM and PDAM is available as it represented by geographic distance of each respondent's house to main pipeline of HIPPAM and PDAM.

Thus sample of respondent is the member of HIPPAM or the customer of PDAM who live in Sumberawan and Ngujung hamlet in Toyomarto village as well as the respondent in RW 6 of Candi Renggo village.

The following three figures illustrate geographic distance in unit measurement of meter from

the house of each respondent to main pipeline of PDAM and HIPPAM in scatter chart. First, Figure 5.1 depicts that the 100 respondents in Sumberawan hamlet are HIPPAM's member who live closer to main pipeline of HIPPAM than main pipeline of PDAM. It is indicates that distance to main pipeline may play essential consideration of choice to type of water supply system for residents in Sumberawan hamlet.

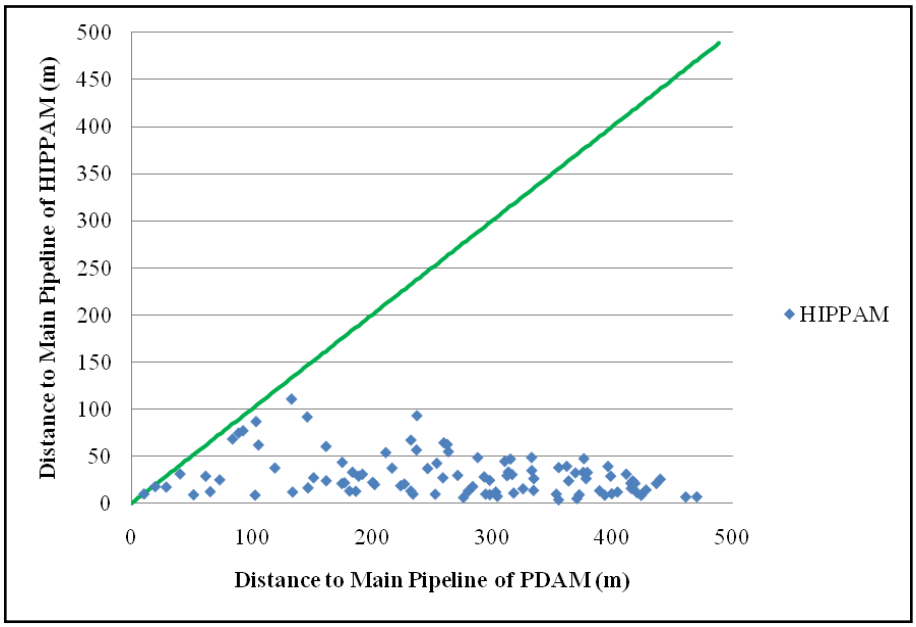

Figure 5.1 Position of Respondent's House in Sumberawan Hamlet

Second, the following Figure 5.2 illustrates interesting different tendency between member of HIPPAM and customer of PDAM in Ngujung hamlet. In one side, among 18 customers of PDAM there are 16 respondents live closer to main pipeline of HIPPAM than main pipeline of PDAM itself. In other side, among 46 members of HIPPAM there are 12 respondents live closer to main pipeline of PDAM rather than to main pipeline of their HIPPAM associations. In this sense, distance to main pipeline may less important factor for most customer of PDAM in Ngujung hamlet in choosing water supply system, but for majority member of HIPPAM they may think in the opposite way.

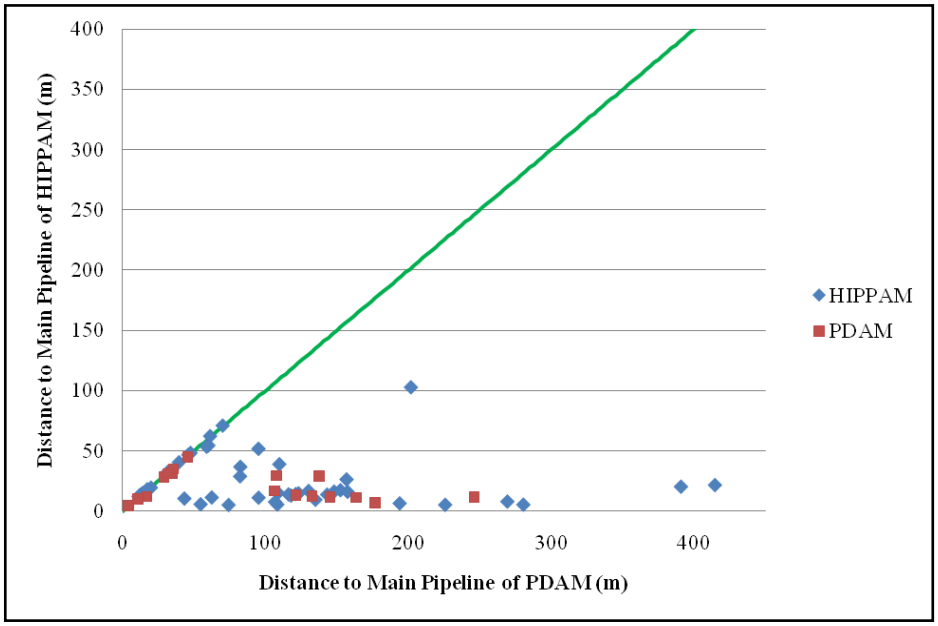

Figure 5.2 Position of Respondent's House in Ngujung Hamlet

Thirdly, the next Figure 5.3 portrays the scatter chart of house position for both PDAM's customer and HIPPAM's member that may indicates similar tendency on choice of water supply system. Among 69 members of HIPPAM, there are 13 respondents who live closer to main pipeline of PDAM rather than to main pipeline of HIPPAM itself. And another one PDAM's customer lives closer to main pipeline of PDAM than main pipeline of HIPPAM. In case of respondents in RW 6 it seems that distance to main pipeline is important factor that may affect their water choice.

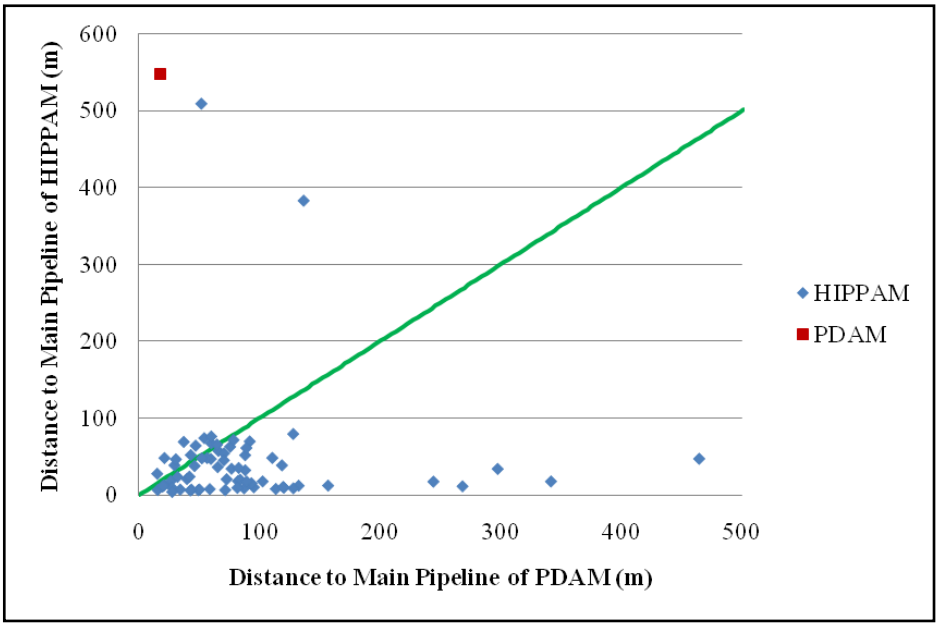

Figure 5.3 Position of Respondent's House in RW 6 Hamlet

From the three scatter charts we may conclude that distance from house to main pipeline of water supply provider may become important factor to consider of choice of water supply system, except for some customers of PDAM in Ngujung hamlet. Thus in this chapter we attempt to investigate social affiliation network of the 234 respondents as depicted in Table 5.8.

Table 5.8 Sample Size Based on Water Source

Type of Water Services	Toyomarto village		Candi Renggo village	Total Sample (n = 234)
	Sumberawan (n = 100)	Ngujung (n = 64)	RW 6 (n = 70)	
HIPPAM	100	46	69	215
PDAM	0	18	1	19

5.3.2 Multiple Memberships in Community Groups

In this research, we attempt to measure social network of a set of respondents and a set of voluntary organizations with respect to the field survey for Indonesian rural areas. The relation forms a collection of ties of the respondent memberships to voluntary organizations.

Primary data on this paper, as mentioned by Narayan and Pricehett (1999) employing an index of social capital at the household and community level which included characteristic of informal and formal groups and networks to which people belonged. In this respect, we asked respondents to mention in which community groups they participate. There are 15 community groups namely (1) religious, (2) cultural/social, (3) PDAM, (4) HIPPAM, (5) HIPPA, (6) ethnic based, (7) community organization, (8) finance, (9) production, (10) union (labor or trade), (11) political party, (12) professional association, (13) business association, (14) social movement, and (15) other. In addition, HIPPA is a resident association for water distribution of agriculture activity, particularly to manage distribution of water for wet paddy field among the member. Then the last group is an option that the respondent should specify the name of association when they mention that they may involve in different community organization outside the fourteen. The following Table 5.9 illustrates the number of respondents in each community groups.

Table 5.9 Number Of Respondents In Each Community Group

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sumberawan	86	12	0	100	1	1	11	11	2	0	1	1	0	0	1
%	0.86	0.12	0.00	1.00	0.01	0.01	0.11	0.11	0.02	0.00	0.01	0.01	0.00	0.00	0.01
Ngujung	58	15	18	46	0	0	5	4	3	0	1	0	1	0	0
%	0.91	0.23	0.28	0.72	0	0	0.08	0.06	0.05	0	0.02	0	0.02	0	0
RW 6	46	7	1	69	0	0	7	5	0	0	0	1	0	0	2
%	0.66	0.1	0.01	0.99	0	0	0.1	0.07	0	0	0	0.01	0	0	0.03
Total	190	34	19	215	1	1	23	20	5	0	2	2	1	0	3
%	0.81	0.15	0.08	0.92	0	0	0.1	0.09	0.02	0	0.01	0.01	0	0	0.01

In general, beside HIPPAM, respondents in the three hamlets like to join in (1) Religious group at average above than 80%. Meanwhile, none of respondents participate in (10) union (labor or trade) and (14) social movement. Into more detail, among 100 respondents in Sumberawan hamlet, there are four community groups and another five community groups which number of member in each group are 0 and 1, respectively. Then, among 64 respondents in Ngujung hamlet, there are six types of community group and two types of community groups with the same situation as in Sumberawan hamlet that only one and none of respondent belong in it. Next for 70 respondents in RW 6 hamlet, there are seven presence community groups and another two community groups have similar situation as the other two hamlets. In this sense, Table 5.5 shows that RW 6 has smallest variety of community groups at number of 8 types compare to other two hamlets at 11 and 9 types for Sumberawan and Ngujung hamlet, respectively. Last, from the avegare of rate of participation of the respondents to join in community group is also indicate similar situation that RW 6 (13%) has the lowest percentage following by Sumberawan and Ngujung at 15% and 16%, respectively.

In addition, when we look at the participation of respondents based on the type of piped clean water supply system, whether they are member of HIPPAM groups or they are customer of PDAM, it indicates that HIPPAM's members have higher tendency not join in any kind of community group. There are 5 HIPPAM's members in Sumberawan hamlet who do not participate at all in the community groups. It is followed by 2 and 13 respondents in Ngujung and RW 6 hamlets, respectively. Meanwhile, there is only 1 customer of PDAM in Ngujung hamlet who does not participate at all in the community groups.

Then since we will measure affiliation relation of a set of respondents in joint participation to a set of community groups as a kind of voluntary association that exist in the community level, we may include in the analysis for some particular community groups which have characteristics as determined by the following scholars. Firstly is classification of voluntary organization by Tao (1999) into three categories. Secondly is three characteristics of the community as a group defined by Aoki (2009). Third, following the notion of Wasserman and Faust (1994) in which we may exclude the community group which no longer exist due to no participant and the community group which is only has one respondent belong due to inability to illustrate social interaction among members.

Next, in order to be able to describe the three hamlets in a form of affiliation network of multiple memberships in a set of community associations, we may exclude 10 community groups due to very few membership or even no one joint participation in the hamlet level. The list of them are (3) PDAM, (5) HIPPA, (6) ethnic based, (9) production, (10) union (labor or

trade), (11) political party, (12) professional association, (13) business association, (14) social movement, and (15) other. Last, we may also exclude HIPPAM group from sample of the community groups in the analysis, since objective of the research is to investigate the social networks relations between a set of respondents - who are the member of HIPPAM association or the customer of PDAM – and a set of community groups or voluntary associations. Thus, in this chapter we scrutinize social structure of the community in the research area in affiliation networks of collectivities linked through 4 multiple memberships of the respondents as the data presented in Table 5.10.

Table 5.10 Sample Respondent of Memberships in Community Groups

	Religious	Cultural/Social	Community Org.	Finance
Sumberawan				
HIPPAM	86	12	11	11
Ngujung				
HIPPAM	42	13	4	3
PDAM	16	2	1	1
RW 6				
HIPPAM	45	7	7	5
PDAM	1	0	0	0

The type of social activity that majority respondents engage is religious group. It encompasses a collection of residents who voluntary establish a community group whereby the main purposes are to deepen understanding of religion. Since religion of most of the residents is Islam, then in general, they have weekly meeting for recitation the Qur'an. It is usually conducted on Thursday night after Isha pray which alternately in the home of group members. Periodically, they also organize special meeting where they learn together on how to care for the Muslim corpse. This is an informal community association whereby structurally the organization consists of the head, secretary and treasurer of the group that voluntarily chosen among members for a certain period. Then, together they develop community norms, sort of how they determine the committee member for the next one year, how they determine the rotation of house for their weekly activity, how they encourage the passive member and the like. Referring to Tao's classification (1999) this religious group may close to character as self-help voluntary group.

In the questionnaire survey we also asked the respondents to give their opinion of "what is the meaning of the group that you belong to?" using 5 scales (1 = the group has no meaning/benefit and 5 = the group has very important/benefit). It is illustrated in Table 5.11 majority respondent join 1 religious group, except 3 members of HIPPAM who join 6 religious

groups at once and 1 customer of PDAM who joins 4 religious groups. Then, in general the religious group has regular meeting around 4 times per month, except 1 member of HIPPAM who join 1 religious group which has 12 times meeting per month and another three HIPPAM members who also join 1 religious group which has 8 times meeting per month. The members put the highest level of important and benefit for the presence of religious group in their community life, except a slightly lower for customer of PDAM for level of benefit (on scale of 4). Eventhough, the meaning of religious group ofr member of HIPPAM is slightly higher than customer of PDAM, Figure 5.4 illustrates that HIPPAM's members slightly have lower tendency to join Religious group than PDAM's customers.

Table 5.11 The Membership in Religious Group

	All members				HIPPAM's member				PDAM's customer			
	No. group	Meeting/ month	Important	Benefit	No. group	Meeting/ month	Important	Benefit	No. group	Meeting/ month	Important	Benefit
average	1.28	3.97	4.64	4.51	1.26	3.95	4.64	4.53	1.47	4.24	4.59	4.25
min	1	1	2	2	1	1	2	2	1	4	3	3
max	6	12	5	5	6	12	5	5	4	8	5	5
mode	1	4	5	5	1	4	5	5	1	4	5	4

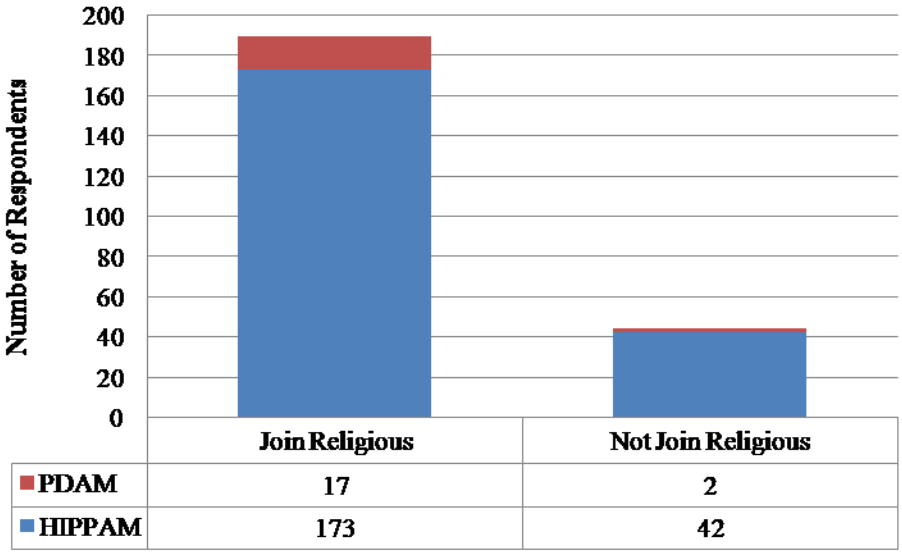

Figure 5.4 Membership in Religious Group

Among total sample of 234 respondents in the three hamlets, there are 34 respondents who participate in cultural/social group. The cultural/social group that they join is a kind of regular social gathering for purposes of conducting a lottery what they called "arisan" in Indonesian language. Similar with religious group, structure of organization also consists of the head, secretary and treasurer of the group which voluntarily chosen among members for a certain period. This voluntary associations not only has social domain as the religious group, but it has also economic domain which mutually beneficial for its members. Moreover, compare to the

previous group, this voluntary association has more stringent rules in order to run steady and sustained organization for a certain period. For instance, a social gathering group consists of 35 members which has regular meeting one time per month for conducting a money lottery. Then, if the members agree for having one winner at each meeting, it means they need around 3 years to finish one round lottery which allows for each member get their turn to win the lottery. The money that they use in lottery is is a cash contribution of each member, which is paid at the beginning of the meeting. Therefore, to finish completely one round they need a strong commitment from each member that they will participate for the whole period in a fairness manner. It means they need to compose their endogenous rule to tie up their membership in order to govern their voluntary association properly. How they determine the capital that they will use in lottery, how they determine the winner for each round, how they anticipate the member who has difficulty in paying dues and the like. In addition, the capital that they use for lottery is not only limit for money but also possible to use some daily goods for example a number of eggs, amounts of sugar or a litter of cooking oil and the like. And similar to the earlier group, referring to Tao's classification (1999) this social gathering group may close to character as self-help voluntary group.

Table 5.12 illustrates that majority respondents for both member of HIPPAM and customer of PDAM, they join one cultural/social group. In general, the cultural/social group of HIPPAM member has more frequent meeting than the cultural/social group of PDAM customer. Then, in the point of view member for HIPPAM the cultural/social group has more important meaning for their community than for customer of PDAM. Meanwhile, benefit from participate in the group seems slightly lower for HIPPAM member than for PDAM customer at scale of 3 and 4, respectively. Next, Figure 5.5 illustrates that HIPPAM's members have slightly higher tendency to participate in the Cultural/Social group than PDAM's customers.

Table 5.12 The Membership in Cultural/Social Group

	All members				HIPPAM's member				PDAM's customer			
	No. group	Meeting/ month	Important	Benefit	No. group	Meeting/ month	Important	Benefit	No. group	Meeting/ month	Important	Benefit
average	1.03	2.61	4.00	3.94	1.03	2.52	4.03	3.94	1.00	4.00	3.50	4.00
min	1	1	3	3	1	1	3	3	1	4	3	4
max	2	4	5	5	2	4	5	5	1	4	4	4
mode	1	4	4	4	1	4	4	4	1	4	#N/A	4

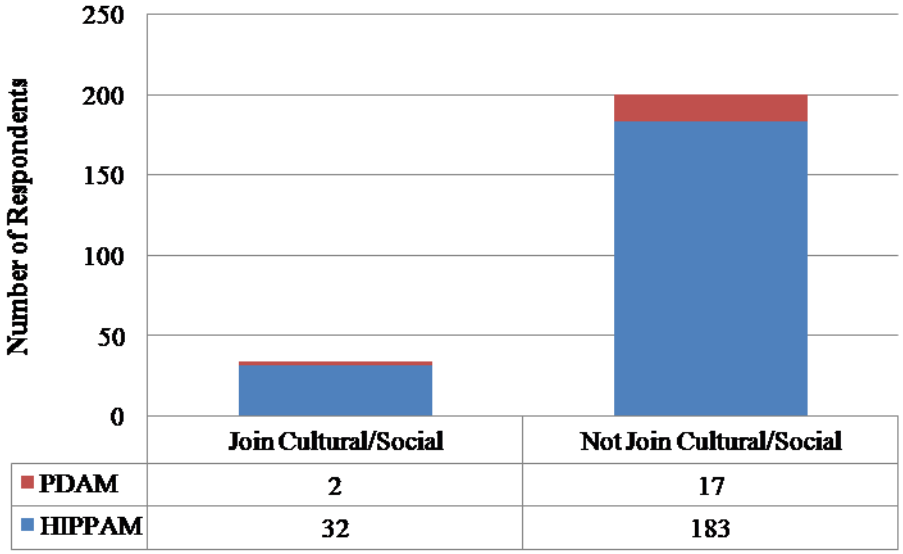

Figure 5.5 Membership in Cultural/Social Group

Among total sample of 234 respondents in the three hamlets, there are 23 respondents who participate in community organization group. The most common type of community organization where the respondents participated is a kind of cooperative organization, refer to "koperasi" in Indonesian language. In accordance with UUD (Indonesian Constitution) 1945 Section 33, cooperative is considered as a business organization that cooperative has principals and basic values which are relevant to the characteristics of Indonesian. Referring to Tao's classification (1999) this community group could be categorized as a service delivery provider, whereby the purpose of the group is to provide service to people who need the service. For instance, a farmer cooperative will provide a kind of service to support agriculture activity such as providing qualified paddy seeds, fertilizer and the like. In another case, the cooperative will arrange product marketing produced by the members such as sandals as handicraft production of the villagers. Additionally, structural organization of this community group is more establish than the other three groups which is most of it in the form of incorporated organization.

Table 5.13 shows that in general the 23 respondents participate in one community organization with average meeting one time per month. Some respondents mentioned about one meeting per year that it may refer to their annual meeting. The meaning of community organization for HIPPAM members have higher average level of important and benefit than for PDAM customer. Then, Figure 5.6 indicates that HIPPAM's members have higher tendency to join Community Organization than PDAM's customers.

Table 5.13 The Membership in Community Organization Group

	All members				HIPPAM's member				PDAM's customer			
	No. group	Meeting/ month	Important	Benefit	No. group	Meeting/ month	Important	Benefit	No. group	Meeting/ month	Important	Benefit
average	1.04	1.72	3.95	3.81	1.00	0.08	3.00	3.00	1.00	4.00	4.00	2.00
min	1	0.08	3	2	1	0.08	3	3				
max	2	8	5	5	2	8	5	5				
mode	1	1	4	3	1	1	4	3				

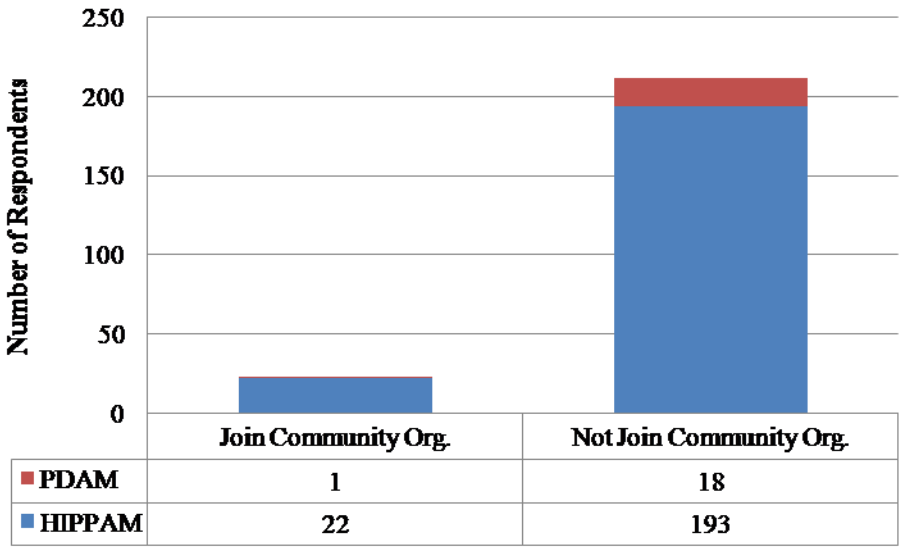

Figure 5.6 Membership in Community Organization

Among total sample of 234 respondents in the three hamlets, there are 20 respondents who participate in a kind of community 'finance' group. It is a type of a community microcredit based on traditional informal groups, which the groups provide micro loan for their member or non member who needs financial support from their savings and loan voluntary associations. This voluntary association usually consists of the head of organization, secretary and treasurer which is elected by and from the members for a particular period. All the rules and norms are purely set up by the group members without any intervention from third party. In this sense, they will determine their own rule such as how much money that each member must deposit to the association to form a joint capital, how much the maximum amount of money that can be borrowed by a member, how much interest rate for the member, how the rules of benefit sharing among members, and how the rules for a member who late in paying their debts, and the like. Moreover, in case their capital is more than enough to provide services for the members, how the rules for non member who might want to borrow the money from the group, and the like.

Table 5.14 indicates that HIPPAM members have higher tendency to joint participate in fincance group than PDAM customer, as well as more frequent monthly meeting and higher level of important and benefit of the group toward community member. Referring the fact from the questionnaire survey, which shows that in general HIPPAM members have lower level of

income than PDAM customer, and then this tendency may shows its relevancy. Hence, we may understand that in Figure 5.7 depicts that members of HIPPAM have higher tendency to join in Finance group than customers of PDAM.

Table 5.14 The Membership in Finance Group

	All members				HIPPAM's member				PDAM's customer			
	No. group	Meeting/ month	Important	Benefit	No. group	Meeting/ month	Important	Benefit	No. group	Meeting/ month	Important	Benefit
average	1.80	3.26	3.90	4.00	1.84	3.39	3.95	4.16	1.00	1.00	3.00	1.00
min	1	1	2	1	1	1	2	3				
max	10	8	5	5	10	8	5	5				
mode	1	4	4	4	1	4	4	4				

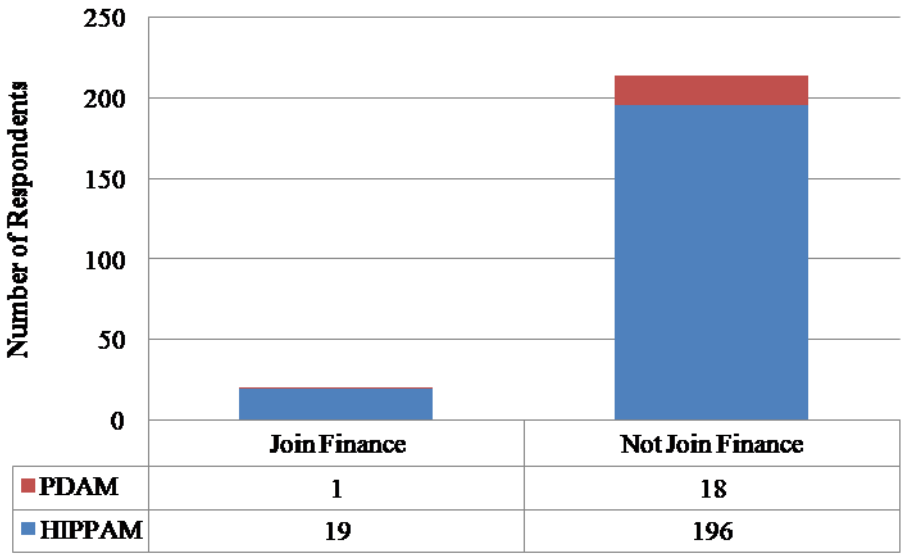

Figure 5.7 Membership in Finance Group

Under this circumstances, we have three empirical cases to study social structure on affiliation network which we define size of sample in the level of hamlet. There will be three sets of actors covering 100 respodents in Sumberawan hamlet, 64 respondents in Ngujung hamlet and 70 respondents in RW 6 hamlet, in multiple memberships into 4 types of community group.

5.4 Social Structure in Affiliation Network

Here we denote the set of actors by $N = \{n_i, n_2, \dots, n_g\}$ as a compilation of the respondents in each hamlet. There are three size of the g actors consist of (i) 100 respondents in Sumberawan hamlet, (ii) 64 respondents in Ngujung hamlet, and (iii) 70 respondents in RW 6 hamlet. And the set of events is denoted by $M = \{m_i, m_2, \dots, m_h\}$ with h events consist of 4 community associations namely (i) Religious group, (ii) Cultural/Social group, (iii) Community Organization and (iv) Finance group. Thus in this section we illustrates social structure of the

respective respondents through multiple memberships in voluntary associations in the three different hamlets by analyzing centrality and rate of participation of the affiliation network.

5.4.1 Centrality

Here we measure of centrality in two types where the first measurement we involve all the respondents in each hamlet, without any further consideration whether they belong to a certain community group or not. And in the second term, we exclude the non-participant respondent with assumption that this respondent could not show their affiliation to the network since they do not joint participate in any kind of community group. In other words, since they do not involve in any memberships in collectivities, it means they are in isolated position from the network and they are not reachable from each other. Thus, in the second measurement we exclude 11 isolated respondents in Sumberawan hamlet, 6 and 18 isolated respondents in Ngujung and RW 6 hamlet, respectively.

We may loss some importants information, since we use customary way to measure degree centrality by dichotomous relations for one-mode networks, as well as since the measurement focus upon a pair of actors rather than affiliation relation between a set of actors and a set of events as non-dyadic (Wasserman & Faust, 1994). Therefore, in order to have comprehensive understanding of the central actors we measure degree centrality in two ways as in which two-mode network in the form of bipartite matrix as well as one-mode actor co-membership matrix.

In the context of bipartite adjacency matrix, raw degree centrality for a respondent is simply the number of community groups that they participate, and for a community group is the number of respondents participating that community group. It means the maximum raw degree centrality for a respondent in the three hamlets is 4 due to the total number of community groups. Meanwhile, the maximum raw degree centrality for a community group in Sumberawan hamlet is 100 due to the total number of respondents, and for a community group in Ngujung and RW 6 hamlet is 64 and 70, respectively. Then, we continue to measure the degree centrality for each hamlet without isolated respondent for further checking of the most central person in each hamlet due to the highest number of their memberships. In Table 5.15 the first result is denoted by $C_D(y)^1$ and the latter is denoted by $C_D(y)^2$.

We define measure of centrality into three levels (0 – 0.333 = low, 0.334 – 0.666 = moderate and 0.667 – 1 = high). From Table 5.15 we find 4 central respondents as the stars in the three hamlets. There are two stars in Ngujung hamlet, whereas the others have only one respondent exclusively. All of the four most central respondents have similar measure of degree centrality at $C_D(x)$ = 0.75 whereby they joint participate in the three of among four community groups.

Thus, from the overall result, we may conclude that the central respondent in Sumberawan hamlet play more important role compare to the other two hamlets, even compare to Ngujung hamlet since particularly in this hamlet there are two respondents occupy the highest level. In different expression, the result may indicate that there is a more significant meaning of power relation among respondents that may occurs in Sumberawan hamlet compare to the others.

From Table 5.15, we may also see that among four community groups, the religious group always occupies the highest level of centrality than the others, except one occurrence where the religious group only occupy moderate level in RW 6 when we involve all respondents in hamlet in the measurement.

Table 5.15 Two-Mode Degree Centrality of the Respondents

	Sumberawan			Ngujung			RW 6		
	$C_D(x)$	$C_D(y)^1$	$C_D(y)^2$	$C_D(x)$	$C_D(y)^1$	$C_D(y)^2$	$C_D(x)$	$C_D(y)^1$	$C_D(y)^2$
Mean	0.300	0.290	0.326	0.320	0.320	0.353	0.232	0.232	0.313
Min	0.000	0.110	0.124	0.000	0.063	0.069	0.000	0.071	0.096
Max	0.750	0.820	0.921	0.750	0.906	1.000	0.750	0.657	0.885
Std Dev	0.163	0.353	0.397	0.169	0.398	0.439	0.172	0.284	0.382
Variance	0.027	0.125	0.158	0.029	0.159	0.193	0.030	0.080	0.146
No. of Denominator	4	100	89	4	64	58	4	70	52
Level of centrality (number of respondents)									
0 - 0.333	71	3	3	42	3	3	58	3	3
0.334 - 0.666	28	0	0	20	0	0	11	1	0
0.667 - 1	1	1	1	2	1	1	1	0	1

*$C_D(y)^1$: two-mode events overlap degree centrality with the total number of respondents
$C_D(y)^2$: two-mode events overlap degree centrality without isolated respondents

It is illustrated in Table 5.16 to Table 5.18 the summary result of measure of centrality for one-mode networks that capture the affiliation linkages between respondents and community groups through overlapping memberships of each pair of respondents. In general we may argue that order measure of degree centrality indicates that respondents in Ngujung hamlet has the highest level, follow by Sumberawan and then RW6 at the least order.

Next, when we define measure of centrality into three levels (0 – 0.333 = low, 0.334 – 0.666 = moderate and 0.667 – 1 = high), we may find similar order of the one-mode degree centrality for the hamlets. But in this case, we have difficulty in determining the central actor due to some actors having similar measure of centrality. Then, in the second measurement which we only include the respondents who join in at least one membership in the community group, there is similar pattern of degree centrality between the hamlets. In the one-mode context, we measure respondent degree centrality with dichotomous relations of actor co-memberships matrix. Last, since each respondent participates in at least one of the fourth community groups, as a result the degree centrality for each actor become very high and its results has a little variation. The most obvious occurrence happens in Ngujung hamlet where all the 58 respondents have degree

centrality at 1. In this sense, its membership affiliation forms a complete network where each node linkages to every other node. Therefore, in order to define the central respondent in the hamlets, we must continue measuring degree centrality using two-mode degree centrality in the bipartite matrix.

Table 5.16 Respondents Co-membership in Sumberawan Hamlet

	g = 100 respondents		g = 89 respondents		
Centrality	C'_D	C'_B	C'_D	C'_C	C'_B
Mean	0.745	0.0005	0.941267	0.956	0.0007
Min	0	0	0.113636	0.530	0
Max	0.889	0.0051	1	1	0.0065
Std Dev	0.293	0.0011	0.154241	0.080	0.0014
Variance	0.086	0	0.02379	0.006	0
Level of Centrality (number of respondents)					
0 - 0.333	14	100	3	0	89
0.334 - 0.666	0	0	0	3	0
0.667 - 1	86	0	86	86	0

In general, we may see from the three hamlets that has almost each respondent has direct contact with every other respondents. Therefore, the betweeness centrality for each respondent in the three hamlets is almost zero. It indicates that there is none of respondent that occupies position as a mediatory between others. In this sense, we may guess that there is no bridging social capital between respondent in each hamlet. In one side, we may conclude that the respondents in each hamlet tend to form closed network which they tend to rely on their internal group. But, in the other side, they might find difficulty when they have a problem beyond the group capacity to solve it due to lack of connection from external the group or their community. Moreover, it might not to easy to introduce 'new knowledge or innovation' once they believe that their current circumstances is the most suitable for them.

Table 5.17 Respondents Co-membership in Ngujung Hamlet

	g = 64 respondents		g = 58 respondents		
Centrality	C'_D	C'_B	C'_D	C'_C	C'_B
Mean	0.820	0	1	1	0
Min	0	0	1	1	0
Max	0.905	0	1	1	0
Std Dev	0.266	0	0	0	0
Variance	0.071	0	0	0	0
Level of Centrality (number of respondents)					
0 - 0.333	6	0	0	0	0
0.334 - 0.666	0	0	0	0	0
0.667 - 1	58	0	58	58	0

Since closeness centrality is only applicable to define the presence shortest path between the actors, for an isolated actor whereby its position in the graph is disconnected, in this sense the actor becomes unreachable and the closeness centrality will be undefined. Therefore, at the first step we need to exclude some respondents who do not joint participation in any kind of community group. Hence, we may assume that influence of one respondent on another decline with the distance between them, whereby the minimum distance formulation of respondent closeness may give more effective contagion information to others. In this sense, we may see that transfering information among respondents in RW 6 will occur in the shortest path since each respondent is adjacent to all other respondents. Then it followed by Sumberawan hamlet in the second position and it closed by Ngujung hamlet. Next, we may also see that every respondent in Ngujung hamlet has maximally close to all other respondents, so it has equal influence in social interaction to each other. In Sumberawan hamlet, average closeness of the respondents is 0.956. It means that almost every respondent has almost a path linking to all of the others. Additionally, there is one respondent who has maximum closeness that he can reach all the other actors in a minimum number of steps. He is a driver at 50 years old with level of income at average between IDR 500,000 – 1,000,000 per month (JPY 5,000 – 10,000) where he has been in the hamlet since he was born. Moreover, he has education background of high school and his household consists of 4 family members and they are member of HIPPAM group. Average closeness centrality of respondents in RW 6 is slightly lower compare to the other two hamlets at 0.858. But, again in general the respondents have almost equal minimum steps to reach to all other respondents.

Table 5.18 One-Mode Centrality of the Respondents in RW 6 Hamlet

	g = 70 respondents		g = 52 respondents		
Centrality	C'_D	C'_B	C'_D	C'_C	C'_B
Mean	0.439	0.0016	0.800	0.858	0.0041
Min	0	0	0.078	0.505	0
Max	0.725	0.0385	0.980	0.981	0.0708
Std Dev	0.307	0.0059	0.257	0.125	0.0124
Variance	0.094	0	0.066	0.016	0.0002
Level of Centrality (number of respondents)					
0 - 0.333	24	70	6	0	52
0.334 - 0.666	34	0	0	6	0
0.667 - 1	12	0	46	46	0

Table 5.19 illustrates demographic characteristics of the most central respondents in the three hamlets. If we may consider the central respondent as the influential actor with high ability to influence others, then we may categorize the central respondent as one who has role as an

informal leader due to their central position in the network. It is interesting that the central respondent in Sumberawan hamlet is very much different from the others, particularly in the point of view of occupation. This central respondent is the head of Sumberawan hamlet that in the same time he occupies position as the secretary of HIPPAM association in the level of Singosari district. In this sense, centralization of the respondent occupies both formal and informal leader as unity. In case of Ngujung hamlet, there are two stars, whereby both of them are female with type of occupation related to entrepreneurship, though in the very small business scale and it has done at home. Then, it is interesting that they join different piped clean water supply system (PDAM, and HIPPAM). In this sense, they can be categorized occupy position as informal leader through their wide contacts to others, but their influence may not as high as the leader in Sumberawan hamlet. Next, there is one central respondent in RW 6 whereby his occupation is farmer and his household income per month is less than IDR 500,000 per month (JPY 5,000). In this sense, we may guess that role of the leader in RW 6 may not as high as the leader in Sumberawan hamlet, but it might be higher than the leader in Ngujung hamlet. Thus, we may guess that the central actor in Sumberawan hamlet has the highest influence to his community compare to other stars. Hence, it may followed by the central actor in RW 6, and in the last order it may closed by the two central actors in Ngujung hamlet.

Table 5.19 Demographic Characteristics of the Central Respondents

	Sumberawan	Ngujung		RW 6
No. of ID	I-60	I-11	I-133	II-96
Name	Mr. Suwandi	Mrs. Jumiati	Mrs. Suyati	Mr. Supomo
Water Source	HIPPAM	PDAM	HIPPAM	HIPPAM
Gender	Male	Female	Female	Male
Age	60	48	41	42
Income	0.5 - 1.0	0.5 - 1.1	< 0.5	< 0.5
Education	Middle School	Elementary S.	Middle School	Elementary S.
Occupation	Head of hamlet	Small private business	Sandal maker	Farmer
	Secretary HIPPAM in District level			
Working Place	In the district	At home	At home	Inside the village
Family Member	2	3	4	3
Length of Stay	58	48	36	20

The estimated centrality is attached in Appendix A.

5.4.2 Rate of Participation and Size of Events

Referring to vary types of water source utilized by residents, it is difficult to get precise number

of residents for each type of water source, particularly even more difficult to have sufficient statistical data in the level of rural area or even smaller administrative boundary. In case of residents who get access to piped clean water supply system, there is a recorded data of the members of HIPPAM groups or customers of PDAM , but again sufficient statistical data for residents in the rural area is not available yet. Therefore, it is difficult or even impossible to able to draw a particular population of the residents based on their clean water sources for this study. Next, in case of number of community groups that exist in the community level, we may say the similar situation with the number of residents. There are so many types of voluntary associations that we may find difficulty to get the precise number of community groups in the level of village or hamlet in order to determine a population of events. Then, referring subsection 5.3.1 we may assume that 234 respondents are a population of actors based on piped clean water supply system in the study area. Lastly about a population of events, since this chapter focus upon affiliation network through memberships in community groups, hence we do not merely deal with events as a single item, in this sense we may assume that the four community groups give an appropriateness figure of a population of events in the research area.

Following Table 5.20 illustrates the rate of participation and the size of event in the research area. There are two column for each hamlet whereby the first column referring all respondents including the isolate respondents due to their absence from membership in the community group, while the second column we exclude the isolate respondents.

The mean number of memberships for total 100 respondents in Sumberawan hamlet is 1.281. It means that on average, each respondent belongs to 1.281 of the fourth community groups in the hamlet. Second, the mean number of memberships for total 64 respondents in Ngujung hamlet is 1.2. It indicates that on average, each respondent belongs to 1.2 of the fourth community groups in the second hamlet. Third, the mean number of memberships for total 70 respondents in RW 6 hamlet is 0.929. It may shows that on average, each respondent belongs to 0.929 of the fourth community groups in the third hamlet. Thus, we may conclude that in general respondent in Sumberawan may show the highest rate of participation than the two other hamlets. Or in other words, we may assume that respondents in Sumberawan hamlet have the highest cohesion than the other hamlets.

Table 5.20 Rate of Participation

	Sumberawan		Ngujung		RW 6	
	g=100	g=89	g=64	g=58	g=70	g=52
$\bar{a}_{i+}$	1.281	1.414	1.2	1.348	0.929	1.25
$\bar{a}_{+j}$	20.5		30		16.25	

Moreover, Table 5.20 also depicts the mean number of memberships only for the respondent

who joint participation in at least one of the fourth community groups. In other words, here we measure rate of participation for each hamlet where we exclude the respondent who does not join any kind of community group. In these sense, that respondent could not show relationship among respondents since they are isolated by being non-member of any community group. First, the mean number of memberships for 89 participated respondents in Sumberawan hamlet is 1.41. It means that on average, each respondent in sumberawan hamlet belongs to 1.41 of the fourth community groups in the hamlet. Second, the mean number of memberships for 68 respondents in Ngujung hamlet is 1.35. It indicates that on average, each respondent in Ngujung hamlet belongs to 1.35 of the fourth community groups in the hamlet. Third, the mean number of memberships for 52 participated respondents in RW 6 hamlet is 1.25. It may shows that on average, each respondent in RW 6 hamlet belongs to 1.25 of the fourth community groups in the hamlet. Thus, again we may conclude that in general respondent in Sumberawan may show the highest cohesion than the two others hamlet.

From comparison of the rate of participation among three hamlets as it describes in Table 5.20, we may conclude that a set of respondents with high social ties may support the establishement and the sustainaibility of voluntary action sort of community based water management called as HIPPAM. The initiation formation of HIPPAM in Sumberawan hamlet could be categorized as purely created by villagers without any particular intervention from third party. Meanwhile, the emerging of HIPPAM "Air Minum Bersaudara" in Ngujung hamlet was stimulated by a social responsibility program from Military of Indonesia (ABRI) in 1991/1992. Then, 13 years aftermath or since around 2005 there was no longer regular meeting between the committee and the member, and as a result it is estimated that only 25% of member pays monthly dues. Next, under the auspicies from the Indonesian Air force that shares the fresh water from Ken Dedes Pond to the community in the vicinity area, in 1998 a group of residents established their community water supply management that in 2006 then it formalized their water institution under the cooperative "Primer Koperasi Tirta Perwita". There are two main functions of the cooperative. First, as an agriculture cooperative that supplies sufficient paddy seeds, fertilizer and the likes for agriculture sector. Second, as a community based water supply management that provides piped clean water connection for around 150 members. Since the form of organization is no longer voluntary association or it becomes more formal organization, it seems the changes of institution also may creates different social interaction where the ties between members somehow it shows lower cohesion than the other hamlets.

5.5 Conclusion

We define sample of respondent in two premises consist of (i) the respondent is currently HIPPAM member or PDAM customer on getting access to piped clean water supply system, and (ii) the respondent lives in the hamlet where currently water services from HIPPAM and PDAM is available as it represented by geographic distance of each respondent's house to main pipeline of HIPPAM and PDAM.

Structure of social network of the residents in Sumberawan hamlet may described as a combination between (i) one central actor that occupies as a formal and informal influential leader which might have high ability to influence villagers through minimum steps when relating to all others, (ii) very low or almost no one place position mediator for a pair of residents, (iii) middle and high level of closeness to each other, and (iv) every respondent has tie to each other through their membership in at least one community group. Hence, we may develop assumption that single choice of piped clean water supply system from HIPPAM is a result of their a collective action driven by central leader since in general every respondent may has high equal influence to each other within the community.

Structure of social network of the residents in Ngujung hamlet may illustrated as a combination of (i) less power relation due to two different informal leaders with different choices of piped clean water supply system, (ii) no one in position of mediator since (iii) every respondent is adjacent to every other respondents within internal community, and (iv) every respondent has tie to each other through their membership in at least one community group. And, in case of RW 6 social structure of the residents are a combination between (i) one informal leader who has equal distance of influence as the others, (ii) very low betweenness – but it is slightly higher than respondents in Sumberawan, (iii) middle and high level of closeness to each other, and (iv) moderate cohesion between respondents since some of them do not participate in a kind of community group. Then, we may assume that their choices upon piped clean water supply system is a result of an individual action, whereby among residents they might have quite high connectedness and equal ability to influence each other, but there is no major power relation that able derived them to the similar option. In other words, there is a social interaction that may influence their decision but in the same time there is no central influential actor that able to encourage them to behave homogenously.

Finally we may conclude that there are three characteristics of community in the research area. The first community is best described as a community with combination between (i) an existence of power relation driven by a formal and informal leader and (ii) a strong social tie within the community which enables them to establish and maintain their community based

water management. The second is a community where (i) existence of power relation is less enough to drive the community member to reach a common goal, but (ii) they have moderate strong social tie within the community, also lack of bridging social capital. This situation may bring their current collective action on managing water supply system may difficult to sustain in the long term. The last community could be describing as the area which has characteristic between the two communities. In this community, there is a power relation but it is not as strong as the first community since the central is just occupying role position as informal leader. Moreover, in general there is moderate high social tie within the community that might enable the community reach their common goal driven by their demographic characteristic such as education background and a quite wide contact with other actor outside the community. Another important thing, in this community they able to 'formalize' their community based water supply system. In this sense, their social tie might bring them to have ability to maintain their community based water supply system in different way than the first community.

Thus, we may conclude that by investigating respondents multiple memberships in community groups, we may provide evidence the linkage of collective action theories and the social capital approach that choice to join community based water supply system may reflect their individual choice as well as collective action. But, in a sense of collective action, we may argue that the stimulation is derived by the power relation initiated by a central respondent. Then, we may have more comprehensive and appropriate approach model of the finding by implementeing spatial autoregressive (SAR) probit model in the next chapter.

In this chapter we focus upon social tie among respondents through memberships in community groups and did not take up the institution of community based water supply system. Needless to say, however, it is necessity to investigate the institution identity of community based water supply system as a part of proposing appropriate water governance in order to establish a more sustained collective action. These are remained for the future research.

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Chapter 6
Community Based Water Supply System in Choice Model

6.1 Introduction

Having access to safe drinking water is one of the most indispensable human necessities. Regarding WHO and UNICEF (2006) the number of urban residents without adequate water services is increasing rapidly. Moreover, WHO (2010) stated that six out of the seven people without access to an improved water source live in rural areas. Consequently, estimates of access to safe drinking water are a cornerstone of most international assessments of progress toward solving global and regional water problems, particularly to reach target 10 of the Millennium Development Goals (MDGs) that reduces by half the proportion of people without sustainable access to safe drinking water by 2015.

There is a mechanism that inhabitants who live near the water resource cannot develop the water resource with their value. As a consequence, even though villagers live in the area which is blessed by abundant water resources, in general they could not get proper access to clean water sufficiently. In line with the report of Asian Water Development Outlook (AWDO) that the future water crisis in Asian countries, it will not be because of physical scarcity of water, but because of inadequate or inappropriate water governance, including management practices, institutional arrangements, and socio-political conditions, which leave much to be desired (Bird et.al, 2008).

In case of Indonesia, among total 231.6 million inhabitants only around 49.7% of the citizen has access to piped clean water supply system consist of 39% citizen who get services from the local drinking company enterprise namely PDAM as a public sector of clean water providers in the municipality/city level, and another 10% citizen who obtain it from community based water supply system namely HIPPAM in the community level (Statistic Centre Board, 2005). Referring to Tao's classification (1999), its character of the community based water supply system may close to the first type of voluntary organization 'self-help group' – whereby the purpose of the group is to support each other through mutual understanding in the daily collaboration which group members become even a provider of collective 'piped clean water' service for the members in the community level. In other words, this is a kind of collective action which has action on the part of one or more people striving to achieve objective common interest of the group, implies creating frameworks that limit the pursuit of individual self interest and sustain the benefit shared by the group. In a sense, this circumstance also underlined by Elinor Ostrom (2009) through her statement that *'From a centralistic, technocratic*

perspective a landscape of local and regional institutions which were set up to deal with local problems are often regarded as "chaotic". But this labeling is wrong. In fact, the capacity of associations set up by responsible citizens to find solutions for real problems is outstanding and more human.' Hence, we may assume that community based water supply system – HIPPAM is one of strong alternatives to existing water supply system by the public sector – PDAM.

Then, we raise two basic questions as follows: Why people join or not join in the community based water supply system for access to water? How do social influence processes give effect to their choice to access community based water supply system? In this sense, we may argue that individual choice decision toward access to community based water supply system is determined by an interaction effect of the influential others as well as individual's own preference. Whereby, main objective of this chapter is to investigate the mechanism of the social relation effect of choice to access water which we may formulate a hypothesis that households with better community tie have ability to organize "community based" water supply system. The following two statements are basic theory of social influence process in the formulation of hypotheses of this study. First, referring to statement of Mancur Olson (1971) about individual behavior relate to collective action that *'But it is not in fact true that the idea that groups will act in their self-interest follows logically from the premise of rational and self-interested behavior. It does not follow, because all of the individuals in a group would gain if they achieved their group objective, that they would act to achieve that objective, even if they were all rational and self-interested. Indeed unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, rational-interested individuals will no act to achieve their common or group interests.'* Second one about influence process that is labeled as contagion by Leenders (2002) whereby he stated that *'In determining their opinions and behavior, in accordance with the constraints and possibilities imposed by the network, actors are assumed to be responsive to the contextual cues provided by the opinions and behaviors of significant others.'*

Finally, structure of this chapter consists of four sections. Following introduction illustrates in the first section, section two presents general information of the empirical dataset with respect to field survey in Indonesia covering description of the survey and access to clean water. Section three is main part discussion of the chapter which we propose a spatial autoregressive (SAR) probit model with three types of the weight matrix W representing nearness of physical, emotional and attribute to scrutinize households interdependencies preference in the network. Then, this chapter closed by conclusion in section four which presents summary and future research.

6.2 An Empirical Research

6.2.1 Description of the Survey

To illustrate the model in an applied setting, we used data from the field survey which was conducted on December 2008 and February 2010. Through systematic sampling, 500 households living at Toyomarto village and Candi Renggo village, Singosari district, Malang regency, East Java Province Indonesia, are selected as the respondents for the study. Three hamlets are selected in Toyomarto village covering Sumberawa, Ngujung and Glatik. Then, similar to the first village, three hamlets are selected in Candi Renggo village covering RW 6, RW 8 and RW 12. Data are collected employing face to face interview method that effectively had been done within 10 days by 20 surveyors with interview schedules from 07:00 a.m. to 09:00 p.m. depend on the respondent's readiness.

In this chapter, we focus upon 234 respondents who have connection to either piped clean water supply system from HIPPAM or PDAM based on argument that piped clean water supply system with connection to individual houses is an appropriate type of access to clean water. From the field survey we may understand that it is difficult to get valid number of households which get services from the two water supply providers in the level of sub village or even in the hamlet area. Even this data is not fully accurate, if we refer to recorded Data of Water Connection in Malang Regency (PDAM Malang Regency, 2008) we may have 4% sample from total 6,550 inhabitants who get access to PDAM and HIPPAM. Nevertheless, we may argue that statistically we employ sufficient number of sample for the purpose of research. Next, in this study we assume that individual respondent preference on choice to water supply system might seen as a household's decision since once he or she decided to join or not join community based water supply system, it becomes the choice of each representative household. Then, we may also use term of 'respondent' and 'household' interchangeably.

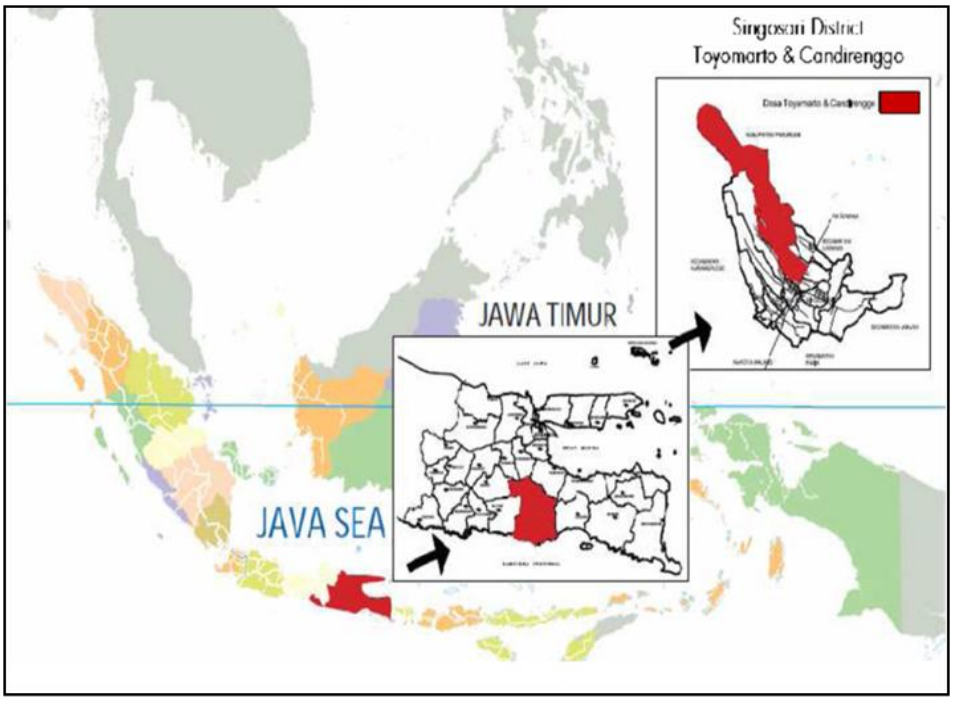


Figure 6.1 Location of the Research Area

In this research, we scrutinize three sources of dependence consist of geographic, demographic and community network neighbors. Next, through the field observation survey, we could develop a map of location of respondent's house which might to measure in term of geographic distance among individuals' places of residence as the source of dependence of the geographic neighbors. Then, for demographic neighbors, we create attribute proximity through 8 demographic questions to each respondent in the questionnaire sheets covering age, sex, education, income, occupation, working place, family member and length of stay in the research area. Last, in order to form emotional nearness in term of community network, in the questionnaire survey we ask the respondent to reveal their participation in the community group. This affiliation data make us able to construct multiple memberships in community groups which represent their presence or absence at a kind of voluntary association in the community level.

6.2.2 Access to Clean Water

In general, there are two types of fresh water resources utilized by the respondents in the study area, namely surface water and shallow ground water.

Firstly, surface water consists of natural spring and river. There are three natural springs called Candi Sumber Awan Spring and Banyon Spring in Toyomarto village, and Kendedes Pond in Candi Renggo village. The other surface water comes from two rivers named Sumber Awan River and Petung River flowing away through the area of study. Secondly, shallow

ground water is utilized by individual household who builds their individual well to get fresh water for domestic purposes. Based on categorization of goods, both types of fresh water resources could be categorized as common-pool resources (CPRs) which share a pair of common characteristics (i) their consumption is rival, but (ii) it is non-excludable (Bruce Wydick, 2008). Rivalry means that consumption by one person/group/ institution precludes consumption by another. In this case, water in the spring or river or shallow ground water that it utilized by A person is one that B person can't consume it. Excludability means that it is easy to control access to a resource, and to exclude others from consuming it. A person can't exclude B person from using water in the spring, river, as well as shallow ground water to fulfill their domestic purposes.

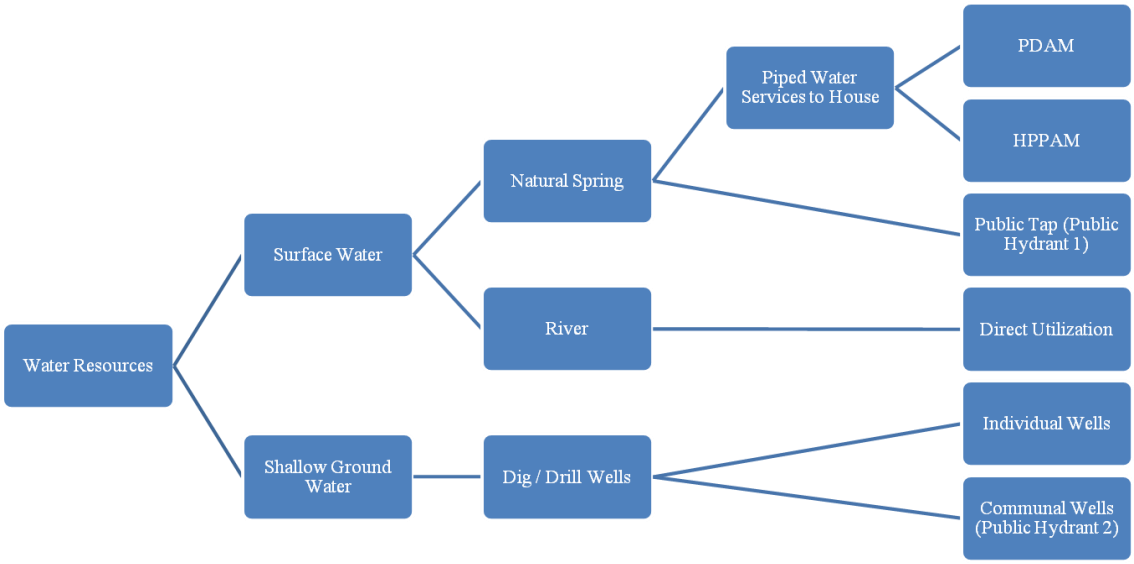


Figure 6.2 Accesses to Clean Water

Furthermore, we put more detail explanation of the five type access to water in the research area as follow. First, water services supplied by group of community based water management namely HIPPAM (Resident Association of Drinking Water Users). The HIPPAM serves 42% respondents who become a member of certain group of HIPPAM. These community water providers utilize the three natural wellsprings to supply their member. A group of HIPPAM encompasses around 30 to 300 households living in a certain neighborhood association through direct home water connection. This community group can be categorized as club goods consist of combination of non-rivalry and excludable. Non-rivalry here means that water consumption by one member permit water consumption by another. Excludability means only the member has access to water from HIPPAM and excludes others from consuming it. Structural organization of HIPPAM encompasses 1 leader, 1 treasurer and 2 technician staffs that are selected among the whole member once in a year. Main task of the leader is to maintain

management system of HIPPAM. The member goes to treasurer to pay their monthly charge of water usage that the price is set up under their agreement in the community meeting. Water pricing per group employs various fixed monthly price from IDR 2,000 (JPY 20) up to IDR 15,000 (JPY 150). For the first physical installation of water connection, each member needs to pay at around IDR 500,000 (JPY 5,000) to IDR 1 Million (JPY 10,000). In addition, specific task for technicians are to monitor and maintain water facility, and then try to fix the physical problem if it occurs. Finally, the whole money that compiles in the treasurer functions as capital source to keeping good the performance of water facility, and also to pay a kind of service fee for the committee member that basically their jobs are a type of voluntary work.

Secondly, a drinking water company in Malang regency namely PDAM (Local Company of Drinking Water) serves 22% respondents who become customers. This local water provider employ Candi Sumberawan wellspring to provide water for their customers in the two villages. The respondents who join PDAM's facility are the respondents who officially registered as PDAM's member and pay monthly charge of water usage. Price for the first physical installation of water connection is around IDR 1,500,000 (JPY 15,000), and there is a fixed price for the first $10m^3$ of water usage at IDR 11,500 (JPY 115). Then, for the next water usage, the price per cubic meter for domestic purpose is IDR 1,500 (JPY 15). A group of respondent who join PDAM is the one who has possibility to obtain fresh water access from PDAM as the local water provider. In this sense, water from PDAM could be categorized as club goods that it is non-rival among its members but prohibit others from consuming it.

Thirdly is access to clean water through private or individual well. The residents build their own well inside their land property to obtain drinking water and it covers 23% of the respondent as pure private goods. They usually utilize shallow ground water in depth less than 20 meter, where some of them also develop water pipeline installation from the well to the house (e.g. bathroom and kitchen) using electric pump. Meanwhile, others have to draw water from the well manually using plastic bucket and bring it to the kitchen or bathroom.

Then, the fourth type is access to water through public hydrant that serves 12% respondents. There are two types of public hydrant. First, several groups of HIPPAM in addition to serving member, they also build some public taps in vicinity residential area to serve the residents without access to direct water pipeline connection to house, or explicitly reveal that purpose of public tap is to serve non member of the community based water management. And second one is communal well where residents have to draw water using plastic bucket in the public well that is built or provided by someone who like to shares his or her private good with others who cannot afford to have their own wells. This circumstance shows the existence of bridging social

capital among groups in the community, as mentioned by Woolcock and Narayan (2000) that bridging social capital refers to the relationships that we have with people who are not like us i.e. relationships with people from different socio-economic status and different ethnic. In this sense, we could also find how the community through their collective action tries to get access to water.

The last type of access to water resources is for the respondents who still use water from rain water or river such as Sumberawan River and Glatik River where the water flows in the two villages (1%).

Table 6.1 describes the type of access to clean water of the 498 respondents, which 2 respondents are excluded from the sample due to inconsistency of its answer. Among the three hamlets in Toyomarto village, there is an only respondent in Ngujung hamlet that has access to both the piped clean water supply system – HIPPAM and PDAM. Meanwhile, all respondents in Sumberawan join in HIPPAM, even though there are a water pipeline network from PDAM close their residences.

Almost all respondents in Sumberawan hamlet obtain piped clean water supply system from HIPPAM groups at 96%, meanwhile another four households fetch fresh water from river. Respondents in Ngujung hamlet get access to two types of piped clean water supply system – HIPPAM and PDAM, nevertheless more than two-thirds obtain from HIPPAM meanwhile rest of it obtain from PDAM at 72% and 28%, respectively. Additionally, respondent in Glatik hamlet – the third observed hamlet in Toyomarto village do not have access to the piped clean water supply system. The respondents get access to fresh water from individual well – private ownership and public hydrant in the form of communal well provided by some owners of private wells. Statistically almost half of the respondents do not own private wells (47%) that it might reflect to their socio economic status whereby they do not have affordability to construct their own wells.

Table 6.1 Type of Access to Water

	Toyomarto			Candi Renggo		
	Sumberawan	Ngujung	Glatik	RW 6	RW 8	RW 12
HIPPAM	100	46	-	69	-	-
PDAM	-	18	-	1	1	91
Individual Wells	-	-	43	1	57	9
Public Hydrant	-	-	38	3	17	-
Other	4	-	-	-	-	-
Total	104	64	81	74	75	100

Referring to Table 6.1 we may see that respondents in the three hamlets in Candi Renggo village have access to piped clean water supply system from PDAM. Meanwhile it is only

respondents in RW 6 hamlet who also get access to piped clean water supply system provided by HIPPAM.

Figure 6.3 HIPPAM's reservoir, Public Hydrant, PDAM's reservoir, Individual Well, River

In this chapter we focus upon the respondent who joint participation in HIPPAM or PDAM with argumentation that piped clean water services with direct home connection is the most appropriate access to water supply system than the others access to water such as fetching clean water from the wells, public hydrant and river. Therefore, scrutinize behavior of these respondents on choice to access water is a straightforward approach to understand their interdependent preference on participatory approach to community based water supply system.

6.3 Results and Discussions

6.3.1 Lesson Learned from the Previous Chapters

From Chapter 3 we could see that initiation of establishment of HIPPAM group is driven by internal notion of the community itself whereby they mimic their neighbor's behavior – called HIPPAM Air Minum Bersaudara in Ngujung hamlet. Construction of public hydrant in Ngujung hamlet by Indonesian Army as part of the Social Responsibility Program gave stimulation to the residents to develop their community based water system that able to serve piped clean water connection to house. Then, this occurrence at around 1991-1992 imitated by community in Sumberawan hamlet and RW 6 to established their own HIPPAM groups in 1994 and 1998, respectively. Furthermore, scrutinize more detail about the development process of HIPPAM in Sumberawan hamlet wherein formal and informal leaders drive the residents to joint participate in HIPPAM groups. In this sense, we may see that decision to join HIPPAM is a result of collective action driven by power relation of the influential people. This case is quite different from Ngujung and RW 6 hamlet whereby decision to join HIPPAM more or less reflects an action of individual households.

Form Chapter 4 we may argue that instead of all kin consist of father, mother, son, daughter, brother, and sister, neighbor is the closest people for general respondents, particularly when they live in the same community or within hamlet. In this sense, we may reveal that closeness relationship has negative relation to social capital in which their closeness relationships are

lessened sharply through further distance of residential place. Hence, we may conclude that position of the neighbors who live in the same community may give strong ties towards respondents in the research area through their direct face to face contact in the daily activity.

There are two insights that we may argue from Chapter 5 under assumption that piped clean water supply system with direct connection to house – HIPPAM and PDAM is the appropriate clean water services for the community. Hence, focus upon households as member of HIPPAM and customer of PDAM, firstly we note that geographic position may become important consideration on decision to join or not join community based water supply system with respect to (i) distance to main pipeline of HIPPAM and PDAM, and (ii) distance between houses of each pair of respondents. Second, employing social network analysis of multiple memberships in community groups, there may show three types of structure of social network for each hamlet. Sumberawan hamlet is best described as a community with combination between (i) an existence of power relation driven by a formal and informal leader and (ii) a strong social tie within the community which enables them to establish and maintain their community based water management. Hence we may assume that their single choice to HIPPAM is a result of a collective action driven by central leader. Ngujung hamlet is characterized as combination between (i) less power relation to drive the community member to reach a common goal, and (ii) moderate strong social tie within the community. Hence, we may assume that their choices upon piped clean water supply system are a result of individual action wherein an equivalence social interaction among households may occur. RW 6 hamlet could be describing as the area which has characteristic between the two previous hamlets. There is a less power relation in a moderate high social tie within the community, so that their choice to join 'incorporate organization' of community based water supply system might a product of individual action.

In this sense, we assume that we might able to capture their interdependence preference on choice to water system through 'nearness' of (i) physical, (ii) emotional, and (iii) attribute/nature in order to give appropriate answer for our hypothesis by operationalize a spatial autoregressive (SAR) probit model.

6.3.2 The Model

Referring to Yang and Allenby (2003), spatial autoregressive (SAR) probit model can reflect patterns of heterogeneity where influence propagates within and across networks. The autoregressive model relates an individual's latent utility to the utility of other individuals, reflecting the potential interdependence of preferences. Explanatory variables are incorporated into autoregressive process through a weighting matrix that describes the network. Referring to Leenders (2002) we reasoned that the source of influence in our research is that respondents'

behavior is the result of mimic significant others' behavior so that in determining his opinion and behavior, individual household takes into account the opinions and behaviors of his significant others who make up his frame of reference. Thus, in this research we focus on the preference interdependence among individual households in the level of individual choice whether individual household join HIPPAM or not as their access to piped clean water supply system.

We start by introducing main assumptions in the model and the notation that will be used for the rest of the paper. Let n be the number of individual households. For each household we observe whether the household joins HIPPAM or PDAM and model it as the realization of a random variable y_i. So that, each household as dependent variable has two alternatives labeled as 1 for joining HIPPAM and 0 for joining PDAM.

$$y_i = \begin{cases} 1 & \text{if household } i \text{ join HIPPAM} \\ 0 & \text{if household } i \text{ join PDAM} \end{cases} \tag{6.1}$$

Economic theory suggests that the decision to join a certain group or association is primarily made to maximize the discounted value of future profits, so we assume that the choice of whether to join HIPPAM or PDAM is the result of a household's decision to maximize their utility. We denote z_i be the difference in the utility from alternatives 1 and 0. An event will occur with a certain probability P if the utility derived from choosing that alternative is greater than the utility from the other alternative. These explanations can be written as binary choices in the following equation:

$$y_i = \begin{cases} 1 & if \quad z_i > 0 \\ 0 & if \quad z_i \leq 0 \end{cases} \tag{6.2}$$

$$P_i = P(y_i = 1) = P(z_i > 0) \tag{6.3}$$

Since our hypothesis here is that people with better community ties have ability to organize community based water supply system, we employ spatial econometric approach which can express effects of social interaction among households. In this sense, individual behavior is determined by interaction of influential actor(s) on individual actor represented by ρWz and individual's intrinsic opinion represented by $X\beta$. LeSage and Pace (2009) set forth a spatial autoregressive (SAR) probit model and it is shown in the form (6.3),

$$z = \rho Wz + X\beta + \varepsilon, \ \varepsilon \sim N_n(0_n, I_n) \tag{6.4}$$

$$z = (I_n - \rho W)^{-1} X\beta + (I_n - \rho W)^{-1}\varepsilon \tag{6.5}$$

where $X = (x_i' : i = 1, \cdots, n)$ is $[n \times k]$ matrix of observed household specific attributes,

$\beta = (\beta_k : k = 1, \cdots, K)'$ is a vector of unobserved parameters to be estimated, and ε is a stochastic error vector with $\varepsilon \sim N_n(0_n, I_n)$ wherein it is assumed that the error terms are normally distributed with zero means and equal variances. The spatial lag of the dependent variable Wz involves the $[n \times n]$ spatial weight matrix $W = (w_{ij} : i, j = 1, \cdots n)$ that is row standardized such that $\sum_{j=1}^{n} w_{ij} = 1$. The result is in the $[n \times 1]$ vector Wz consisting of an average of neighboring household's utility, creating a mechanism for modeling interdependence in household decisions to join HIPPAM. The scalar parameter ρ can be interpreted as the degree of spatial dependence across households. It means that households established their behavior by taking into consideration the opinions and behavior presented by their significant others. Positive (negative) value of ρ indicates positive (negative) correlation among households. Clearly, when $\rho = 0$ a conventional non-spatial probit model is emerged, referring to households' opinion and behavior is purely determined by his own opinion and behavior due to the absence of social influence from others. While, when $\beta = 0$ it becomes purely spatial model in which the opinion and behavior of households are solely determined by interaction of others. Thus, by operationalizing spatial autoregressive (SAR) probit model as shown in equation (6.4) we may able to estimate ρ as well as β in order to investigate the interaction and intrinsic effects among households in the social influence process on choice to participate in community based water supply system.

In addition, maximum likelihood estimation of limited dependent variable models in a spatial context is quite difficult since it is necessary to evaluate an n-dimensional normal probability function in order to estimate the parameters. Then, we use the Bayesian inference approach to estimate each parameters of equation by using the Markov Chain Monte Carlo method that sample sequentially from the complete set of conditional posterior distributions for the parameters. The MCMC method provides a powerful tool for simulating complicated posterior distributions.

The more detail explanation of the estimation algorithm is attached in Appendix C.

6.3.3 Determination Size of Sample

In the area of study, we can classified types of piped clean water supply connection to house into two based on water service provider namely PDAM and HIPPAM. PDAM as formal and conventional local drinking company belong to Malang regency serves residents in Ngujung hamlet of Toyomarto village, and residents in Candi Renggo village covering RW 6, RW 8 and RW 12. HIPPAM association's services cover the respondents in three hamlets consist of Sumberawan and Ngujung in Toyomarto village, and RW 6 hamlet in Candi Renggo village.

Since our research aim is to investigate whether social tie has influence on choice to water in the community level, in this chapter we define sample of the study with two considerations as follows:

3. The respondent is currently HIPPAM member or PDAM customer on getting access to piped clean water supply system;
4. The respondent lives in the hamlet where currently water services from HIPPAM and PDAM is available as it is represented by geographic distance of each respondent's house to main pipeline of HIPPAM and PDAM.

Thus sample of respondent is the members of HIPPAM or the customers of PDAM who live in Sumberawan and Ngujung hamlet in Toyomarto village, and in RW 6 of Candi Renggo village. Figure 6.4 and 6.5 in Appendix D illustrate main pipeline of clean water supply system developed by HIPPAM groups and PDAM.

The following five figures illustrate geographic distance in unit measurement of meter from the house of each respondent to main pipeline of PDAM and HIPPAM in scatter chart. Figure 6.6 and 6.7 depict the position of all houses of HIPPAM members and PDAM customers in each village.

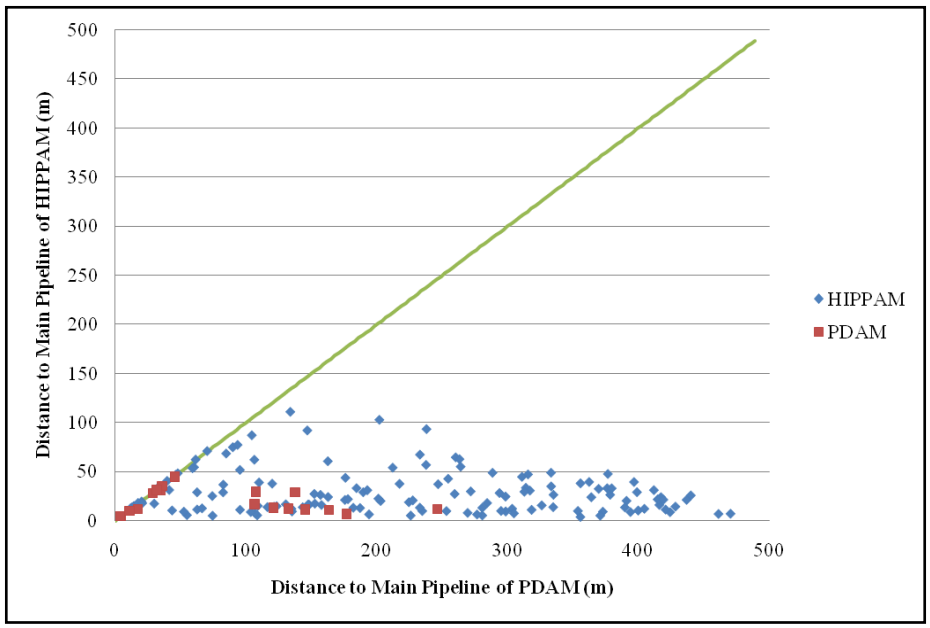


Figure 6.6 Position of Respondent's House in Toyomarto Village

From Figure 6.6 we may see that in general residence of HIPPAM members are very close to the main pipeline of HIPPAM (less than 150 meter) compare to the main pipeline of PDAM. Whereas, residence of PDAM customer lies in the closer distance to the main pipeline of HIPPAM than the main pipeline of PDAM. In a sense, we may argue that geographic distance

to the main pipeline is one of important considerations for the member of HIPPAM in Toyomarto village.

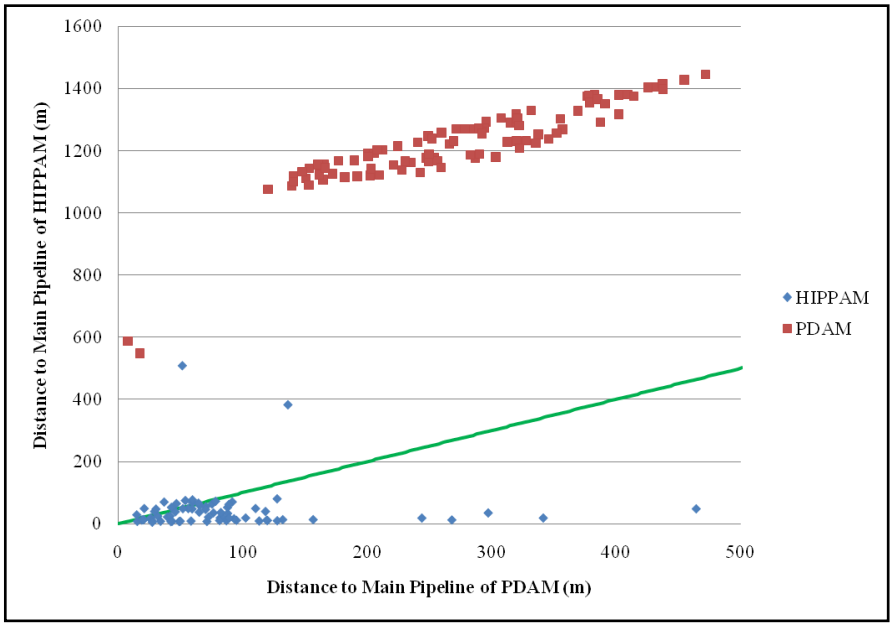


Figure 6.7 Position of Respondent's House in Candi Renggo Village

In case of households in Candi Renggo village, based on distance to the main pipeline we may see that there are two different locations for each residential group regarding their access to water services as illustrated in Figure 6.7. In general, a group of residence of HIPPAM member lies closer to the main pipeline of HIPPAM than to the main pipeline of PDAM. Meanwhile, position of residence of PDAM customer clearly lies far from the main pipeline of HIPPAM group.

Then, Figure 6.8 depicts that the 100 respondents in Sumberawan hamlet are HIPPAM's member who live closer to main pipeline of HIPPAM than to main pipeline of PDAM. It is indicates that distance to main pipeline may play essential consideration of choice to type of water supply system for residents in Sumberawan hamlet.

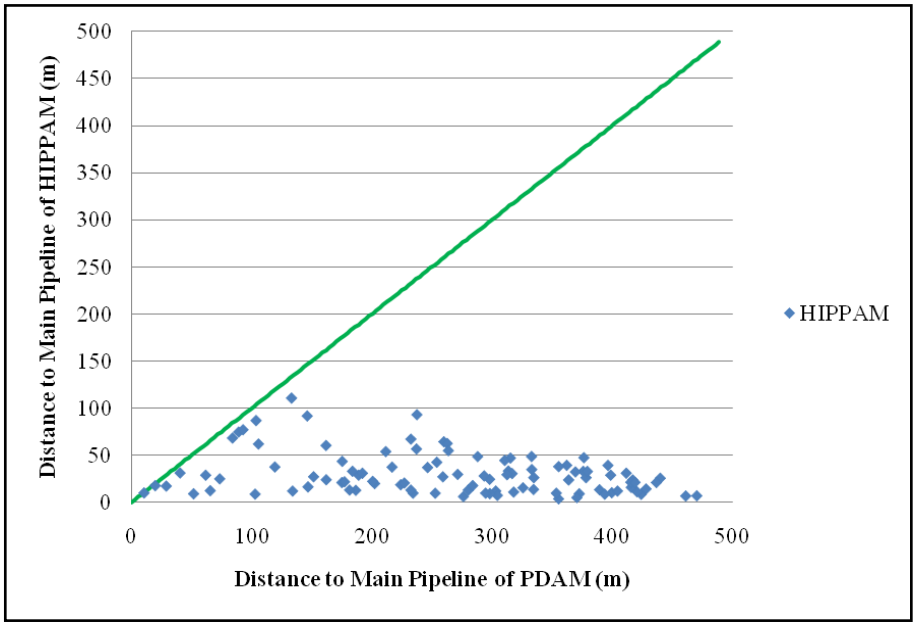


Figure 6.8 Position of Respondent's House in Sumberawan Hamlet

Next, Figure 6.9 illustrates interesting different tendency between member of HIPPAM and customer of PDAM in Ngujung hamlet. In one side, among 18 customers of PDAM there are 16 respondents live closer to main pipeline of HIPPAM than main pipeline of PDAM itself. In the other side, among 46 members of HIPPAM there are 12 respondents live closer to main pipeline of PDAM rather than to main pipeline of their HIPPAM associations. In this sense, distance to main pipeline may less important factor for most customer of PDAM in Ngujung hamlet in choosing water supply system, but for majority member of HIPPAM they may think in the opposite way.

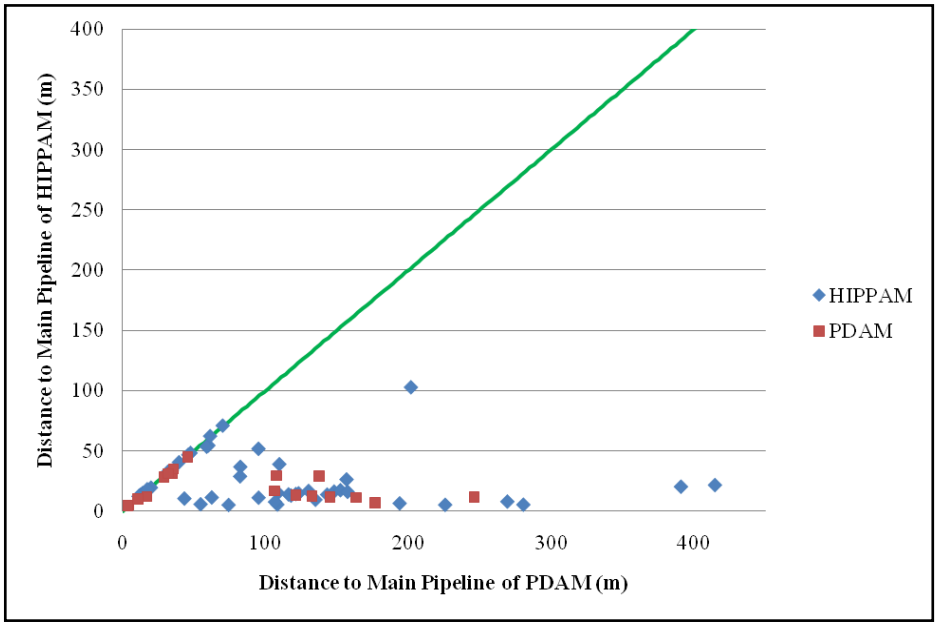


Figure 6.9 Position of Respondent's House in Ngujung Hamlet

Last, Figure 6.10 portrays the scatter chart of house position for both PDAM's customer and HIPPAM's member that may indicates similar tendency on choice of water supply system. Among 69 members of HIPPAM, there are 13 respondents who live closer to main pipeline of PDAM rather than to main pipeline of HIPPAM itself. And another one PDAM's customer lives closer to main pipeline of PDAM than main pipeline of HIPPAM. In case of respondents in RW 6 it seems that distance to main pipeline is important factor that may affect their water choice.

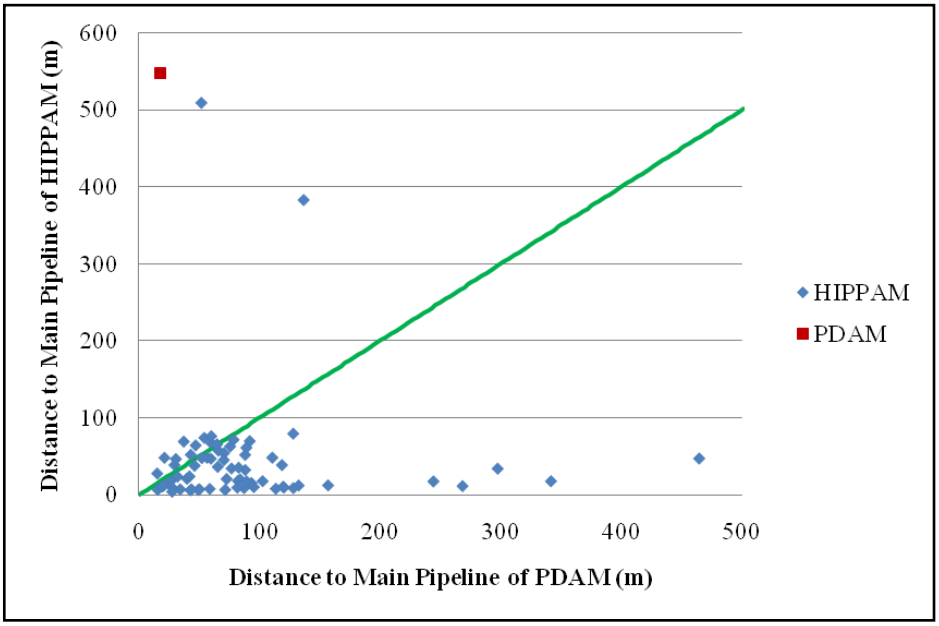


Figure 6.10 Position of Respondent's House in RW 6 Hamlet

From the three scatter charts above we may conclude that distance from house to the main

pipeline of water supply provider may become important consideration of choice to water supply system, except for some customers of PDAM in Ngujung hamlet. Thus in this chapter we attempt to investigate social influence effect in the network of the 234 respondents as it shown in Table 6.2.

Table 6.2 Sample Size of the Respondent

Type of Water Services	Toyomarto village		Candi Renggo village	Total Sample (n = 234)
	Sumberawan (n = 100)	Ngujung (n = 64)	RW 6 (n = 70)	
HIPPAM	100	46	69	215
PDAM	0	18	1	19

6.3.4 Explanatory Variables

In the household questionnaire survey, we investigated 8 demographic attributes for each household consist of age, gender, family member, length of stay, income, education, occupation and working place. Divided into member of HIPPAM and customer of PDAM, Table 6.3 and 6.4 depict the best result of chi-square test for each demographic attribute in dummy variable. In general, for the sample size of 234 respondents we may conclude that only two attributes consist of education and working place which the derive value does exceed the tabled critical value of chi-square equal to 3.84 at $p < 0.05$ with $df = 1$ (Coolidge, 2006). Thus, we may consider household attribute of education and working place as explanatory variables in the estimation model.

Table 6.3 Chi-Square of Demographic Attributes A

	Gender		Age		Family Member		Length of Stay	
	Male	Female	≤ 46	> 46	≤ 4	> 4	≤ 29	> 29
No. of HIPPAM's member	166	49	126	89	152	63	110	105
No. of PDAM's customer	12	7	10	9	10	9	12	7
Dummy	Male = 1		≤ 46 years= 1		≤ 4 = 1		≤ 29 = 1	
p	0.169		0.613		0.102		0.316	
χ^2	1.89		0.26		2.67		1.007	

There are majority male respondents (76%) as compared to the females in the study. The derive value of $\chi^2 = 1.89$ does not exceed the tabled critical value of chi-square. It indicates that gender and choice to join or not join HIPPAM are independent. The average age of the respondents is 46 years old that around 94% respondents can be classified into productive age (22 - 65 years). The derive value of $\chi^2 = 1.89$ does not exceed the tabled critical value of chi-square. Similar to gender, it indicates that age and choice to join or not join HIPPAM are independent.

Average number of family in the household is 4 members. The derive value of $\chi^2 = 2.67$

does not exceed the tabled critical value of chi-square. Similar to gender and age, it indicates that family size and choice to join or not join HIPPAM are independent. In average length of stay the head of household in the village is 29 years. The derive value of $\chi^2 = 1.007$ does not exceed the tabled critical value of chi-square. Similar to gender, again it indicates that length of stay and choice to join or not join HIPPAM are independent.

Table 6.4 Chi-Square of Demographic Attributes B

	Household Income		Education		Occupation		Working Place	
	≤ 0.75	> 0.75	≤ ES	> ES	AM	S	At home	Outside home
No. of HIPPAM's member	145	70	102	113	87	128	49	166
No. of PDAM's customer	10	9	4	15	7	12	11	8
Dummy	≤ 0.75 = 1		≤ ES = 1		AM = 1		At home = 1	
p	0.191		0.027		0.757		0.001	
χ^2	1.71		4.91		0,10		11.28	

Furthermore, we scrutinize relationship between income level and choice of access to piped clean water supply system between members of HIPPAM and customers of PDAM. In this case, we measure level of significant household income in two set samples and in three ways.

First sample, we measure 234 respondents which majority household income of the respondents is less than or equal to IDR 1 million (JPY 10,000) per month (66%) consist of 30% respondents with monthly income less than IDR 500,000 (JPY 5,000) and another 36% with monthly income between IDR 500,000 - 1 million (JPY 5,000 – 10,000). This indicates that the residents are in the lower middle class of socio-economic status whereas the monthly minimum wage of Malang regency in 2009 is determined at IDR 945,500 (JPY 9,455). Next, the critical value of chi-square at $p < 0.05$ with $df = 1$ is 3.84, household income categorized at a dummy variable for household with income level less than or equal to median IDR 0.75 million (JPY 7,500) = 1, and 0 otherwise, shows $\chi^2(df = 1, N = 234) = 1.71$ at $p > 0.191$. In a sense, it indicates that level of household income and choice to join or not join HIPPAM are independent. Then, we continue the investigation by differentiated between a group of respondent with dummy variable for household with income level at less than or equal to IDR 1.75 million = 1, and 0 otherwise, we may not too easy to say that between household income and choice to join or not join HIPPAM are independent since the derive value of $\chi^2\ (df = 1, N = 234) = 3.693$ at $p > 0.055$ is very closed to the tabled critical value of chi-square.

Indonesian elementary level has six years of education; then it continues with three years of education in middle school and also in high school. According to education statistics (source: www.Nation Master.com), average years schooling of adults in Indonesia is 5 years. In the

survey, we asked respondent about their education background within 4 categories as follows. First option is elementary school which covering the head of household who has background of education at lower or equal to 6-year school period. Second option is middle school expressing the head of household who studied in the junior school whether they completed the school period by three years or just drop out from it. Third option is high school with similar circumstances with the middle school. Forth option is university level – it reflects the head of household who graduated from bachelor degree, master degree and the like. Moreover, if the respondent did not finish the university level or drop out in the mid-term, we may also categorize the education background of the respondent as the university level. There are 106 respondents who have education background of elementary school or even did not did not finish the school year at elementary level (45%). Since almost half of the respondents have level of education at lower or equal to elementary school, so that we propose dummy variable for respondent with level of education lower than or equal to elementary school as 1, and 0 otherwise. The critical value of level of education of the respondents show $\chi^2(df = 1, N = 234) = 4.91$ at $p < 0.03$. It indicates that education background and choice to join or not join HIPPAM are dependent. In other words, we may argue that respondents with education level at lower than or equal to elementary school have higher tendency to join HIPPAM group than respondents with higher level of education than elementary school as reflected in Figure 6.11.

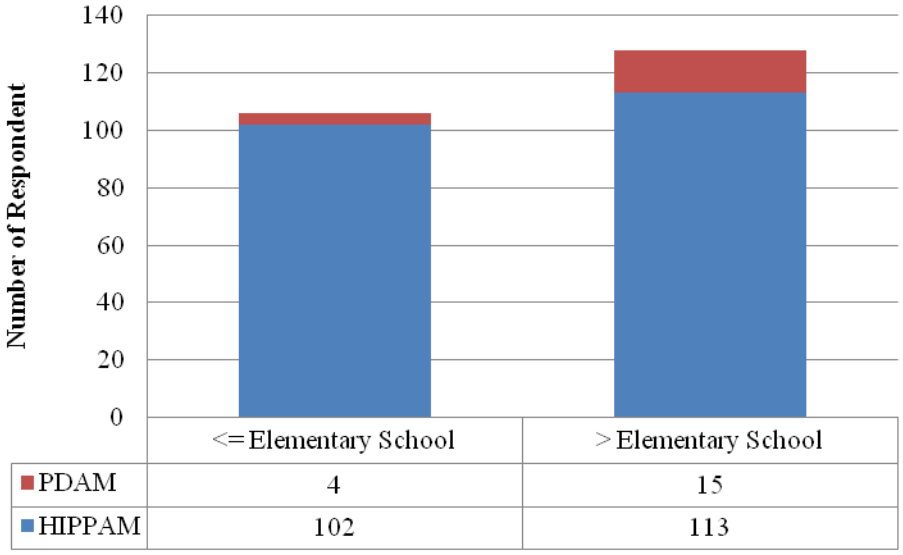


Figure 6.11 Education Level of HIPPAM members and PDAM customers

In the questionnaire survey, we asked respondent to reveal their working place within 6 options as follows: (i) At home, (ii) Within the community, (iii) Inside the Village, (iv) Outside the Village, inside district, (v) Outside district, inside regency, and (vi) Another regency or city.

There are two main usual working places for respondents. First are 60 respondents who work at home (26%), and second are 40 respondents who work within the community (19%). There is an interesting result of chi-square from the working place of the head of the household. First, the critical value of chi-square at $p < 0.05$ with $df = 1$ is 3.84, working place of respondents categorized as working at home = 1, and 0 otherwise, shows $\chi^2(df = 1, N = 234) = 11.28$ at $p < 0.001$. Second, the derive value of - working place of respondents categorized as working at home and within hamlet = 1, and 0 otherwise - $\chi^2(df = 1, N = 234) = 4.81$ at $p < 0.03$ does exceed the tabled critical value of chi-square. It indicates that working place and choice to join or not join HIPPAM are dependent. Hence, we may argue that households which the head of family working outside home or outside the community, they have higher tendency to join HIPPAM than the respondents who work at home or inside the community or hamlet. Figure 6.12 and 6.13 describe the two of working place condition.

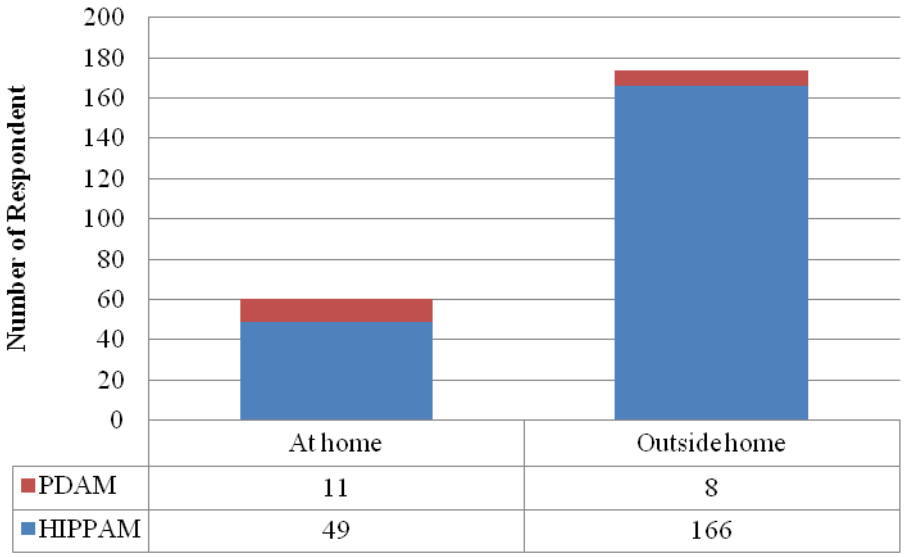


Figure 6.12 Working Place of HPPAM members and PDAM Customers (A)

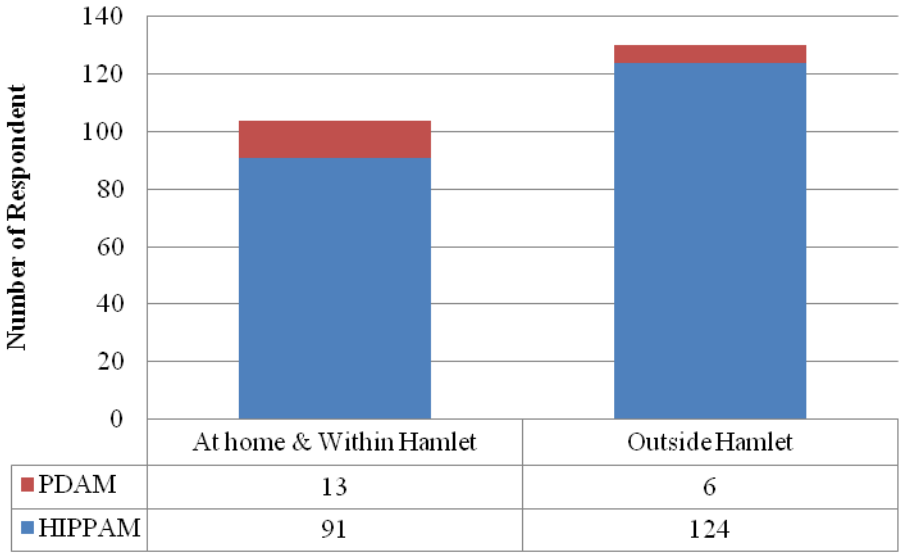


Figure 6.13 Working Place of HIPPAM members and PDAM customers (B)

6.3.5 The Weight Matrix

A critical part of spatial econometric models specification concerns the construction of W. The elements of the weight matrix W reflect the potential dependence between units of analysis. Furthermore, Leenders (2002) underlined that the entire approach of network autoregressive model hinges upon the specification of an appropriate weight matrix W wherein the model will be useless if there is no appropriate specification of weight matrix W. In our case, we reasoned that households with better community ties have ability to organize community based water supply system. Therefore, we define a spatial weight matrix using the data related to community network. There are 3 data as candidates for weight matrix consist of (i) geographic distance data, (ii) multiple memberships in community groups, and (iii) attributes demographic. In these sense, we may assume these three types of weight matrix reflect social relation effect in term of (i) physical, (ii) emotional, and (iii) attribute/nature.

Influence of significant others have different weight to household and it presents 'nearness' among them, referring to the extent to which alters' opinions and beliefs are imitate by ego (Leenders, 2002). Moreover, Leenders (2002) revealed that theoretically social influence is driven by either communication or comparison. When '*actors use actors with whom they are directly tied as their frame*' we may define that social influence is driven by communication, whereas when '*actors use actors they feel similar to as their frame of reference*' means that social influence is driven by comparison. Next, dealing with the difficulties to distinguish between communication and comparison (particularly in empirically) he suggested direct tie and no direct tie as the alternative approach to social influence. Firstly, direct tie refers to '*contagion*

among directly tied actors picks up both direct and indirect communication and comparison effects'. And secondly, indirect tie refers to '*contagion among actors who are not directly tied summarizes direct and indirect comparison and indirect communication effects*'. Hence, in this research we propose three type data in order to have appropriate significant weight matrix W in the model choice. The first and second weight matrix W covering data of geographic distance and multiple memberships in community groups that reflects physical and emotional nearness may show contagion among directly tied respondents wherein social influence processes occur through direct and indirect communication and comparison effects. Here, we may argue that nearest neighbors display respondents who reside very close to one another geographically so that among households might have direct tie. And, for the respondents who affiliate in the same community groups they might also display contagion among directly tied respondents through their frequent meeting in the community group. The third data – attribute weight matrix W displays contagion among respondents who are not directly tied since their nearness is presented by the same demographic attribute group among households. In this sense, their social influence may occur through direct and indirect comparison and indirect communication effects.

Furthermore, we may define 'nearness' among households by developing weight matrix based on the size of respondent for each hamlet with assumption that there is a social influence effect among households within hamlet. The first factor is that geographic distance to main pipeline may give significant consideration towards household's water choice. Secondly, affiliation network among residences through multiple memberships in community groups may show specific structure of social relationship for each hamlet. Thirdly, neighbors whom reside within the same hamlet are the most general closest people for the respondent where they communicate through face to face contact in their daily meeting. Hence, we may compose our weight matrix W as it is illustrated by the following formula (6.6).

$$\mathrm{W} = \begin{bmatrix} \mathrm{H}_1 & 0 & 0 \\ 0 & \mathrm{H}_2 & 0 \\ 0 & 0 & \mathrm{H}_3 \end{bmatrix} \tag{6.6}$$

Whereby H_1 consists of $n = 100$ for Sumberawan hamlet, H_2 consists of $n = 64$ for Ngujung hamlet, and H_3 consists of $n = 70$ for RW 6.

Since main purpose of composing weight matrix W is to scrutinize whether there is social interaction effect of the influential actors on the actors related to choice of access community based water supply system, means our research deals with received influence an actor from the other alter(s). In other words, we focus upon the influence exerted on an actor by the other

actor(s). Therefore, the entire weight matrix W is operationalized by row normalization of adjacency matrix A by which each row sums to one denoted as $\sum_{j=1}^{n} w_{ij} = 1$ in the following expression: (Leenders, 2002)

$$w_{ij} = \frac{a_{ij}}{ai.} \tag{6.7}$$

Here $a_{ij} = 1$ means that j influences i, meanwhile $a_{i.} = \sum_j a_{ij}$ indicates the number of households to whom i has a tie. The 'symmetric' weight matrix W after row normalization might become asymmetric since $\sum_j w_{ij} \neq \sum_i w_{ji}$ in which w_{ij} represents the j's influence on i.

Additionally, we set the diagonal cell $w_{ii} = 0$ which means that the effect an actor has on his own position is not taken into consideration in the influence structure in a network of weight matrix *W*.

1) Geographic Distance

From the observation survey, we develop the map that describes the geographic position for each respondent's residence on the longitude and latitude information. Then following Yang and Allenby (2003), we measure geographic distance between respondent's houses i and j to compose a square matrix of the geographic distance for each pairs of respondent's houses as follows:

$$d(i,j) = \sqrt{(d_i^1 - d_j^1)^2 + (d_i^2 - d_j^2)^2} \tag{6.8}$$

Figure 6.14 to 6.16 attached in Appendix D show a position of each respondent's residence for each hamlet – Sumberawan, Ngujung and RW 6.

In this research, we develop two types' weight matrices. First, referring to LeSage et.al (2010), we may assume that geographic influence is determined by nearest neighbors. Considering influence of any kind of one respondent on another, it will decrease through increasing the distance between them and until a certain distance there will be no more impact on one's decision. Relate to the purpose of study, we further assume three scales of the nearest 5, 10, and 15 households as neighbors who potentially exert an impact on one's decision. In these sense, we compose three weight matrices based on the nearest neighbors. Firstly, we define distance of the nearest 5, 10, and 15 households among total 234 households from each observed household i. Then secondly, we may denote $d_{ij} = 1$ if distance of household j to the observed household i within the distance of the 5, 10, or 15 nearest neighbors, and 0 otherwise.

$$w_{ij}^{g_1} = \begin{cases} 1 \text{ if } d_{ij} \leq \text{the } 5, 10, \text{or } 15 \text{ nearest neighbors} \\ 0 \text{ otherwise} \end{cases} \quad (6.9)$$

Here we label the first type of 'physical' weight matrix as W11.

Second, referring to Leenders (2002) we may assume that geographic influence may decrease due to increasing the distance between neighbors. Therefore, we may define geographic influence as an inverse of the geographic distance, denoted as:

$$w_{ij}^{g_2} = \frac{1}{d(i,j)} \quad (6.10)$$

The second type of 'physical' weight matrix is labeling as W12.

2) Community group

In the questionnaire survey, we asked respondents to mention in which community groups they participate. Based on the preliminary field survey, there are 15 options of the community groups. It encompasses (1) religious, (2) cultural/social, (3) PDAM, (4) HIPPAM, (5) HIPPA – community based on irrigation water supply system, (6) ethnic based, (7) community organization, (8) finance, (9) production, (10) union (labor/trade), (11) political party, (12) professional association, (13) business association, (14) social movement, and (15) others.

In order to get suitable description of respondent memberships in community groups, we may focus upon the four popular community groups consist of (i) religious, (ii) cultural/social, (iii) community organization and (iv) finance. Moreover, in case of HIPPAM and PDAM group we may not able to put it in the weight matrix since our purpose is to investigate the choice of people upon piped 'community based' water supply system (provided by HIPPAM) over the conventional piped drinking water supply system (provided by PDAM). The following Table 6.5 illustrates number of respondent in each community group for every hamlet based on their current choice of piped clean water supply system.

Table 6.5 Memberships in Community Groups

	Religious	Cultural/Social	Community Org.	Finance
Sumberawan				
HIPPAM	86	12	11	11
Ngujung				
HIPPAM	42	13	4	3
PDAM	16	2	1	1
RW 6				
HIPPAM	45	7	7	5
PDAM	1	0	0	0

We define weight matrix of the respondents on joint participation in community groups into two ways. Firstly, we measure their memberships in collectivities through Cosine similarity in which it is a measure of similarity between two vectors of attributes, v_i and v_j, as labeled in

formula (6.11).

$$\text{sim(i, j)} = \frac{v_i \cdot v_j}{|v_i||v_j|} \qquad [0 \leq \text{sim(i, j)} \leq 1] \tag{6.11}$$

where v_i is an attributes vector of household i and on the other hand v_j is an attributes vector of household j. Its data is assumed as binary relation whereby attendance in a certain community group is equal to 1, otherwise equals zero. Since the term frequencies cannot be negative, the cosine similarity is in the range from 0 to 1. The first type of 'emotional' weight matrix is labeling as W21. In this sense, we may assume that a pair of respondents who shared membership in community groups may have more frequent social interaction that might influence each other, so that they may adapt the preference of others.

Secondly, we compose weight matrix based on geodesic distance through their sharing memberships in community groups in the form of actor co-membership matrix. This is the binary relation actor co-membership matrix, that we may assume an acquaintance network by constructing a 1-mode matrix such that $a_{ij} = 1$ indicates the presence of a network of ties between respondent n_i and respondent n_j through their joint participation in at least one similar event, and $a_{ij} = 0$ indicates the different membership that then it does not create a network of ties between them. The diagonal cell are set to zero, because it refers to ties from a respondent n_i to himself (loops) in which $a_{ii} = 0$. Hence, we measure geodesic distance between two respondents in a graph as the number of links in the shortest path among pairs of respondents. Following argumentation of Wasserman and Faust (1994), the geodesic distance between respondent n_i and respondent n_j is denoted as $\text{d}(i, j)$; whereby $\text{d}(i, j) = \text{d}(j, i)$ and it will form symmetric matrix. Hence, considering influence or communication of any kind of one respondent on another, it will decline through increasing the distance between them. Thus, we may assume that geodesic influence is an inverse of the geodesic distance.

$$w_{ij}^{\text{gd}} = \frac{1}{d(i,j)} = \frac{1}{d(j,i)} \tag{6.12}$$

The second type of 'emotional' weight matrix is labeling as W22.

3) Attributes

Referring to Yang and Allenby (2003), we apply attributes neighbors in terms of people who shares similar demographic characteristics. Then, we define weight matrix of attributes neighbors based on Cosine similarity as denoted in formula (6.11). In this case, we also assume that input data of the matrix for each element of attribute is dichotomizing with 0 or 1 dummy variables.

Here we might see significant result of chi-square test among the eight demographic data as important embedded character on individual households relate to their decision to join community based water supply system. Hence, in composing attribute weigh matrix W, we employ four attributes of the households which show significant result consist of education, working place, income level and occupation. The first two attributes as explained in subsection 6.3.3 indicate that

(i) Households with education background at lower than or equal to elementary school have higher tendency to join HIPPAM than households with education background higher than elementary school. The critical value of level of education of the respondents show $\chi^2(df = 1, N = 234) = 4.91$ at $p < 0.03$.

(ii) Households with working place outside home have higher tendency to join HIPPAM than households with working place at home. The critical value of chi-square at $p < 0.05$ with $df = 1$ is 3.84, working place of respondents categorized as working at home = 1, and 0 otherwise, shows $\chi^2(df = 1, N = 234) = 11.28$ at $p < 0.001$.

In addition, we continue chi-square test for the entire sample of member of HIPPAM member and customer of PDAM (N = 236) wherein we indicate another two attribute which show significant result as follows.

(i) Households with income level less than or equal to IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000) have higher tendency to join HIPPAM than households with income level higher than IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000). The critical value of income level of the respondents show $\chi^2(df = 1, N = 326) = 14.11$ at $p < 0.0002$.

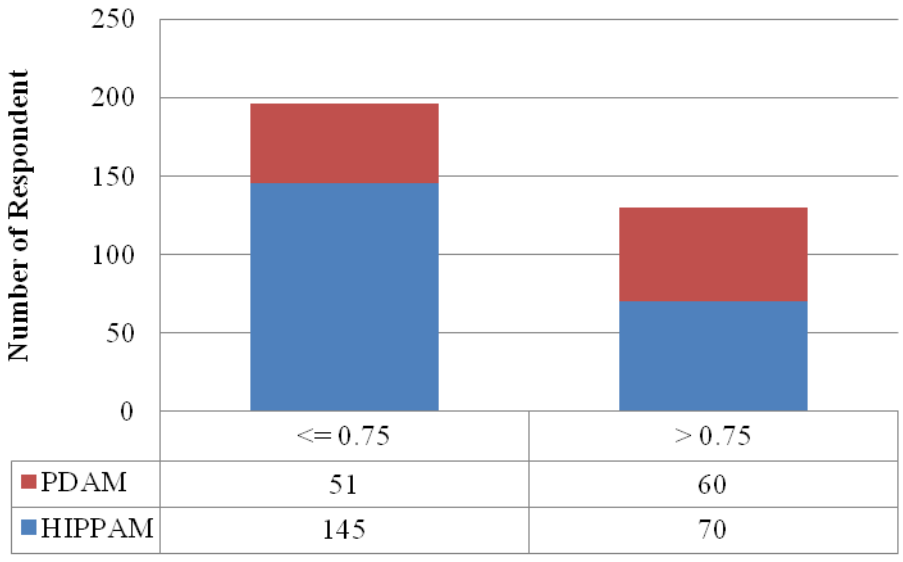
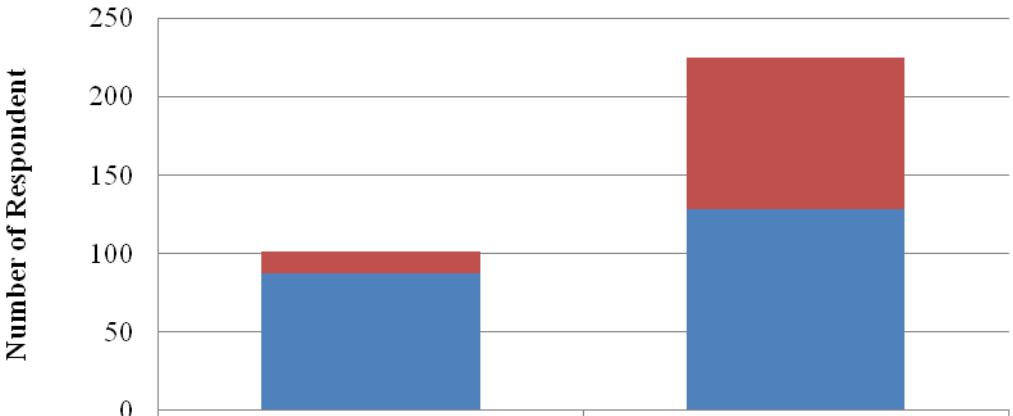


Figure 6.14 Income Level of HIPPAM Members & PDAM Customers (N = 326)

(ii) Households with occupation classified as agriculture and manufacturing have higher tendency to Join HIPPAM than households with occupation in services sector. The critical value of occupation of the respondents show $\chi^2(df = 1, N = 326) = \infty$ (infinite) at $p < 2.56E - 0$.



	Agriculture & Manufacturing	Services
PDAM	14	97
HIPPAM	87	128

Figure 6.15 Occupation of the Respondents of HIPPAM & PDAM (N = 326)

Hence, for attribute weight matrix W we have four attributes which show significant relation between respondent attributes and choice to community based water supply system. First, educational level in which set of dummy variable is equals to 1 if respondent has background of education lower than or equal to elementary school, and 0 otherwise. Second, working place in which set of dummy variables is equals to 1 if working place of the respondent is at home, and 0 otherwise. Third, household income in which set of dummy variable is equals to 1 if the household income level is less than or equal to the median at IDR 0.75 million, and 0 if the household income level is higher than IDR 0.75 million. Fourth, type of occupation in which set of dummy variables is equals to 1 if the respondent works in agriculture and manufacturing sector, and 0 if the respondent working in services sector. Based on the answer of respondent's occupation, we may categorize their type of occupation into two sectors. The first sector is agriculture and manufacturing covering thirty percent respondents. Type of their livelihood is such as food peddler, owner and worker in the small scale sandal industry, farmer, breeder and field hand. On the other hand, the second sector is services which covering majority respondents. In this case, their occupation could be categorized into 9 types of livelihood consist of private company, labor industry, merchant, driver, teacher, official, military/police, retiree, housewife, and even 4% respondent in unemployment status.

For the last two attributes we may argue that it is necessity to consider household income and occupation in order to draw more holistic picture of exogenous interdependent manner between individual households in particular purpose of choice to access community based water supply system.

Finally, we employ the four demographic data of respondents – education level, working place, household income and occupation for composing attribute weight matrix W. In a sense, we may assume that share similarity in demographic attributes among respondents may give similar preference on choice to access piped clean water supply system. The third type of 'attributes' weight matrix W is labeled as W3.

6.3.6 Estimation Result

In this study we assume the individuals choice to join community based water supply system are affected by his/her closest neighbors that is possibly reflected by social interaction effect among them due to their 'nearness' on physical, emotional, and attribute. Hence, we introduce a spatial autoregressive (SAR) probit model of interdependent preferences in an individual choice context that captures the social interaction between an individual's preference and others' preference in the same network. The model may suitable for a complex network with multiple exogenous explanatory variables consist of education background and working place of the head of household. In addition, this research focuses upon the dependent variable reflecting choice behavior to access water within hamlet where dependence is spatially related.

Figure 6.16 summaries diagram of the weight matrix W that estimated in the model covering geographic distance, multiple memberships in community groups and household attribute. Data for geographic distance is derived from geographical distance between respondent' houses wherein the distance is clustered by hamlet area consist of 100 respondent's houses for Sumberawan hamlet, 64 respondent's houses for Ngujung hamlet, and 70 respondent's houses for RW 6. Figure 6.17, 6.18 and 6.19 attached in Appendix D depict position of each respondent's residence in the hamlet.

Firstly, we estimate the geographic distance with method of the nearest neighbors (LeSage et.al, 2010) which we assume geographic influence occurs within and across nearest neighbors. Distance of the 5 nearest neighbors in Sumberawan hamlet is varying from 22.45 to 103.72 meters, meanwhile in Ngujung and RW 6 hamlet are from 27.26 to 715.68 meters and from 16.27 to 579.55 meters, respectively. Here, we denotes geographic distance between respondent's house i and j is 1 if the distance is less than or equal to distance of the 5 nearest neighbors, and 0 otherwise. Thus, we might form the spatial weight matrix W of the 5 nearest neighbors. Next, we repeat that algorithm to compose spatial weight matrix W for the 10 and

15 nearest neighbors. The 10 nearest neighbors in Sumberawan hamlet is vary from 36.18 to 144 meters, and in case of Ngujung and RW 6 hamlet are from 38.54 to 763.08 meters and from 22.82 to 628.28 meters, respectively. The 15 nearest neighbors in Sumberawan hamlet is vary from 49.53 to 226.56 meters, and in case of Ngujung and RW 6 hamlet are from 60.50 to 787.97 meters and from 30.94 to 643.59 meters, respectively. Herewith, we label the first type of 'physical' weight matrix W as W11 covering W11 (5) represents estimation result for the 5 nearest neighbors, and followed by W11 (10) and W11 (15) for the 10 and 15 nearest neighbors, respectively. Secondly, employing the same data of geographic distance between respondent's houses and referring to Leenders (2002) we may assume that geographic influence may decrease due to increasing the distance between neighbors. Thus, the geographic influence is an inverse of the geographic distance, labeled as W12.

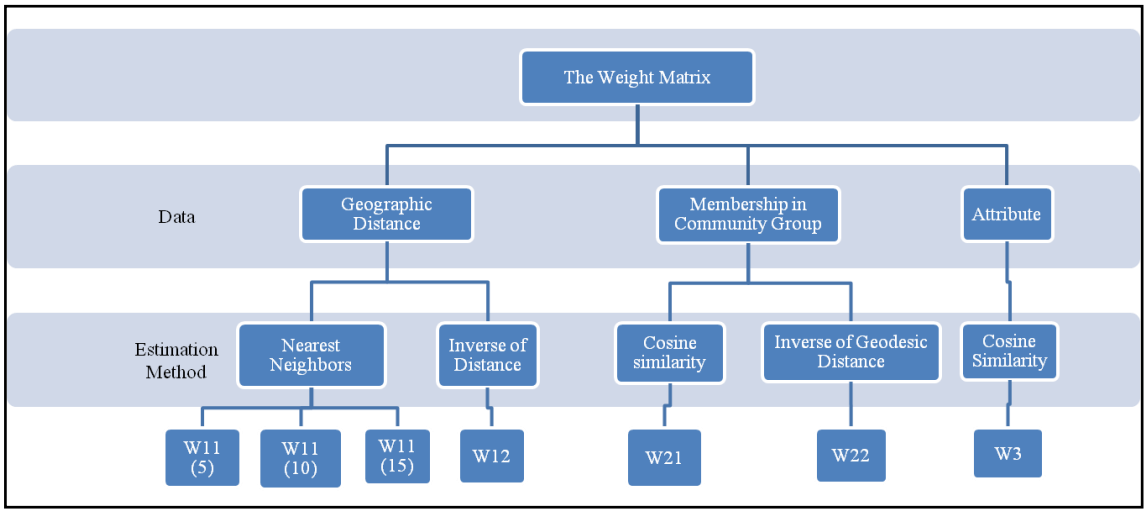


Figure 6.16 Diagram of the Weight Matrix

Secondly is weight matrix W which is constructed from respondent's multiple memberships in community groups consist of religious, cultural/social, community organization and finance group. In the first part, we measure their memberships in collectivities through Cosine similarity, labeled as W21. In this sense, we may assume that their share memberships in community groups may give them more frequent interaction with each other, that simultaneously it forms their interdependent preferences. In the second part, we consider their multiple memberships in community groups as actor co-membership matrix derived from affiliation network to depict the number of multiple memberships shared by each pair of respondents. Here, we compose an adjacency matrix which is a simple binary matrix measuring distance between a pair of respondents through their shortest path. Here, considering influence of one respondent on another, it will decline through increasing the distance between them. Thus, we may assume that

geodesic influence is an inverse of the geodesic distance and labeled as W22.

The third weight matrix W is labeled as W3 estimates the social interaction effect between individual choices through their share similarity on four demographic attributes consist of education level, working place, income level and occupation. In this sense we may assume that households who have similar attributes may behave in the similar way, wherein households' mimic significant others' behavior.

Referring to significant result of chi-square test of the 234 respondents, we determine two explanatory variables for model estimation consist of education level and working place of the head of household. Thus, in this research, we attempt to estimate parameter β of education level and working place as the intrinsic effects. We determined the two demographic attributes mainly based on significant result of the Chi-square test. However, there are many possibilities approach on choosing the most appropriate attributes for the explanatory variables, so that this remains a subject for future research.

Here we involved an individual household level model of choice to access community based water supply system where $y = 1$ for the 215 member of HIPPAM and $y = 0$ for the customer of PDAM. Explanatory variables used were a constant term, a binary vector of 0 and 1 values with 1 for 106 individual households characterized by education level lower than or equal to elementary school and 0 for 128 individual households with who have education level higher than elementary school, with 1 for 60 individual households with working place at home and 0 for 174 individual households who work outside home. Then, for the simulation, we iterate MCMC algorithm and sample 2500 parameters respectively and set 500 samples as burn-in. The chain was considered to have practically converged after 500 iterations based on a diagnostic proposed by Geweke (1992). The last 2000 draws were used to calculate the posterior mean and standard deviation of the parameters. The following Table 6.6 shows the estimation results of each weight matrix and Figure 6.19 to 6.53 in Appendix E show weight matrices, sample paths and posterior probabilities for the parameters.

Table 6.6 Estimation Result

Parameter	Spatial Autoregressive (SAR) Probit Model			
	Geographic Distance			
	W11 (Nearest Neighbors)			W12 (Inverse of Distance)
	5 neighbors	10 neighbors	15 neighbors	
Constant	0.42* [0.04, 0.87]	0.20 [-0.27, 0.66]	0.26 [-0.17, 0.73]	0.21 [-0.25, 0.70]
Education	0.94* [0.24, 1.77]	1.09* [0.26, 2.13]	0.97* [0.24, 1.81]	0.76* [0.08, 1.56]
Work Place	-0.80* [-1.50, -0.13]	-0.88* [-1.54, -0.25]	-0.85* [-1.50, -0.20]	-0.68* [-1.37, -0.07]
Rho	0.76* [0.63, 0.86]	0.81* [0.69, 0.91]	0.79* [0.67, 0.90]	0.83* [0.69, 0.93]

Parameter	Spatial Autoregressive Probit Model			Standard Probit Model
	Community Group		Attribute	
	W21	W22	W3	
Constant	0.83* [0.41, 1.30]	0.86* [0.41, 1.32]	0.49* [0.01, 0.95]	1.49* [1.14, 1.87]
Education	0.69* [0.10, 1.30]	0.71* [0.11, 1.37]	0.58 [-0.06, 1.25]	0.67* [0.18, 1.19]
Work Place	-0.97* [-1.54, -0.44]	-0.95* [-1.58, -0.37]	-0.74* [-1.32, -0.22]	-0.81* [-1.34, -0.30]
Rho	0.60* [0.35, 0.79]	0.56* [0.32, 0.78]	0.74* [0.53, 0.89]	-

Note: 95% credible interval in brackets. * indicates 95% credible interval does not contain zero

Statistically, the entire weight matrix W yield positive and significant estimated parameter ρ. Here, we may argue that there is existence of the social interaction effect among households on choice to community based water supply system. In other words, the estimated parameter ρ provides verification of spatial interdependence among households on choice to community based water supply system. Next, the entire estimated parameter working place statistically is negative and significant, whereas estimated parameter education is positive and significant for the six weight matrices W – geographic distance and community group, except the attribute weight matrix W which is statistically positive but insignificant. In this sense, we may argue that households' behavior is also determined by their own local effect with respect to the six weight matrices W – geographic distance (W11 and W12) and community membership (W21 and W22). Thus, through spatial autoregressive (SAR) probit model we might provide evident that individual households' behavior is determined by social interaction effect of the significant others on individual households as well as by their own local effect of the individual households that is represented by nearness of physical and emotional.

Furthermore, statistically positive and significant estimated parameter EDUCATION for the

six weight matrices W may indicate that households with background of education at lower than or equal to elementary school have higher tendency to join HIPPAM than households with background of education at higher than elementary school. Through chi-square test $\chi^2(df = 1, N = 326)$, empirical data display that 96% households with education background lower than or equal to elementary school have tendency to join HIPPAM, whereas households with education background higher than elementary school have tendency to join HIPPAM at 88%. Hence, we argue that HIPPAM group may consist of more member which characterized by quite low human capital with respect to their education background.

In addition, the estimated parameter *WORKING PLACE* is negative and significant for the whole types of weight matrices W. Referring to data 15 nearest neighbors of the geographic distance as a approach to define the furthest distance of 'neighbors' in the research area, we find that the maximum distance of neighbors who live in close proximity to each other are at distance 787.97 meters. In other words, we may describe that neighbors of an observer individual are all the observed individuals who reside in the geographic distance at maximum 787.97 meters from the observer individual's residence. In this sense, the nearest geographic distance may give us better understanding on why residence of intimates by relationship tends to have face to face communication in their daily life due to their nearness residence. Next, the result of chi-square test displays those respondents who work at home or within hamlet have lower tendency to join HIPPAM than respondents who work outside home or outside hamlet. Moreover, dummy variable of working at home yields higher significant relation than dummy variable of working at home and within hamlet at $\chi^2(df = 1, N = 234)$ = 11.28 and 4.81 respectively. In one hand, we may see it as the narrower their scope of working space, the respondents could easily form a closed network due their less communication with otherness outside their boundary. Since concept of community water supply system such as HIPPAM is a relative 'new' alternative from the conventional water supply system – piped clean water connection provided by PDAM as well as their habit to fetch water from wells and river, it might make them have less preference to join HIPPAM. In the other hand, it seems that having contact with 'otherness' outside the community may give broader perspective to the respondents that derive them to have more preference to join HIPPAM than the respondents who work at home or within the community. As a consequence, the estimated parameter WORKING PLACE may indicate that the respondents with working place at home or inside the community have lower tendency to join HIPPAM than the respondents who work outside the community or the hamlet. In other words, respondents with working place at home or within the community may have less communication with 'otherness' that lead them to have less preference to join

HIPPAM than respondents with working place outside their own community.

The entire estimated parameter ρ shows high degree of spatial dependence across households within each hamlet, particularly for weight matrix W geographic distance. Next, among the four weight matrices W geographic distance, estimated parameter ρ inverse of geographic distance yields the highest degree of spatial dependence across households within each hamlet at 0.83. It may indicate that social interaction effect through physical nearness might occurs among households within the boundary of hamlet as it is indicated by respondents' consideration to join either PDAM or HIPPAM relate to proximity of their residence to the main pipeline of PDAM or HIPPAM. Then, their multiple memberships in the community groups – religious, cultural/social, community organization and finance households may have linkage to one another through their weekly or monthly meeting of the community group. Between the two weight matrices W – cosine similarity and geodesic distance it also yields a quite similar positive and significant degree of spatial dependence. In these sense, the two nearness of physical and emotional might point to social interaction effect among directly tied households. Last, the attribute weight matrix W also yields a high positive and significant degree of spatial dependence among households whom characterized by the same demographic group. Since attribute is personally embedded in each individual respondent the occurrence of social interaction effect may happen among indirectly tied households.

Next, physical proximity represented by nearest neighbors and inverse of distance of the geographic distance have estimated parameter ρ close to 1. Then, the emotional distance indicated by cosine similarity and inverse of geodesic distance of multiple memberships in community groups – religious, cultural/social, community organization and finance have estimated parameter ρ away from zero. Last, the weight matrices of attribute characterized by cosine similarity of four exogenous explanatory variables – education, working place, household income, and occupation also have estimated parameter ρ close to 1. Referring to Yang and Allenby (2003) in which interdependent preference may lead to either conformity or individual in preferences, here we get a hint that choice to community based water supply system is a product of collective action driven by power relation rather than individual action driven by equivalence relation, especially with respect to the estimated parameter ρ of the geographic distance.

The following Table 6.7 displays goodness to fit wherein we test the predicted result towards the observed data. Here y = 1 labels the household who joint participation in HIPPAM group, meanwhile y = 0 labels the household who belongs to PDAM. In general, we may see that for both Spatial Autoregressive (SAR) Probit Model and Standard Probit Model yield high

significant appropriateness between predicted result and observed data. Moreover, the weight matrix of geographic distance shows very high preciseness at above 93%. Nevertheless, the whole goodness to fit illustrates very low predicted (y = 0) except W11 10 nearest neighbors of the weight matrix geographic distance. In this sense, it will be one of the important notes for the future research that a hint of collective decision derived by the leader in the community may play a significant role is need to be investigated in greater depth.

Table 6.7 Goodness to Fit

	Spatial Autoregressive Probit Model							
	Geographic Distance							
	W11 (Nearest Neighbors)						W12 (Inverse of Distance)	
	5 neighbors		10 neighbors		15 neighbors			
	Predicted (y=1)	Predicted (y=0)	Predicted (y=1)	Predicted (y=0)	Predicted (y=1)	Predicted (y=0)	Predicted (y=1)	Predicted (y=0)
Observed (y=1)	215	0	212	3	214	1	215	0
Observed (y=0)	15	4	11	8	15	4	19	0
Total	230	4	223	11	229	5	234	0
	0.9359		0.9402		0.9316		0.9188	

	Spatial Autoregressive Probit Model						Standard Probit Model	
	Community Group				Attribute			
	W21 (Cosine Similarity)		W22 (Inverse of Geodesic Distance)		W3 (Cosine Similarity)			
	Predicted (y=1)	Predicted (y=0)	Predicted (y=1)	Predicted (y=0)	Predicted (y=1)	Predicted (y=0)	Predicted (y=1)	Predicted (y=0)
Observed (y=1)	213	2	213	2	215	0	215	0
Observed (y=0)	19	0	19	0	19	0	19	0
Total	232	2	232	2	234	0	234	0
	0.9103		0.9103		0.9188		0.9188	

6.4 Conclusion

Referring to theory of social influence stated by Leenders (2002) we reasoned that the source of influence is that individual respondents mimic significant other's behavior, so that in this research we propose spatial autoregressive (SAR) probit model. The main objective is to investigate interdependence preference choice of individual households to participate in community based water supply system that is assumed determined by the influential others' interaction effect as well as the individual's intrinsic effect. We describe the posterior distribution from the Bayes theorem and express the MCMC sampling method in which the approach applies to the empirical analysis of the empirical data from a field survey in Indonesia.

In order to have appropriate specification of weight matrix W dealing with difficulties to

distinguish between communication and comparison as the drivers of social influence in the empirical case, we estimate three types of data covering (i) geographic distance between each pairs of respondent's houses, (ii) multiple memberships in community groups, and (iii) household attributes. Herein, we form three types of weight matrix W represent nearness of (i) physical distance covering 5, 10 and 15 nearest neighbors, and inverse of distance, (ii) emotional distance covering cosine similarity and geodesic distance of multiple memberships in community groups, and (iii) household attributes through cosine similarity of four demographic data – education level, working place, household income, and occupation. The first and second data reflect contagion among directly tied respondents wherein social influence processes occur through direct and indirect communication and comparison effects. Meanwhile, the third data reveal contagion among respondents who are not directly tied in which their social influence may occurs through direct and indirect comparison and indirect communication effects. Then, we apply row normalization that lessens the influence each significant others have on respondent with each additional significant other.

The entire three type weight matrices W – nearness of physical, emotional and attribute, the estimated parameters ρ show positive and significant result which might us to conclude that households' choice to community based water supply system is interdependent – display social interaction effects of significant respondents on individual households. Next, the entire estimated parameter working place is statistically negative and significant, whereas estimated parameter education is positive and significant for the six weight matrices W – geographic distance and community group, except the attribute weight matrix W which is statistically positive but insignificant. In this sense, we may argue that households' behavior is also determined by their own local effect with respect to the six weight matrices W – geographic distance (W11 and W12) and community membership (W21 and W22). Thus, through spatial autoregressive (SAR) probit model we might provide evident that individual households' behavior is determined by social interaction effect of the significant others on individual households as well as by their own local effect of the individual households that is represented by nearness of physical and emotional.

Next, in this research we get a proof our hypothesis that community with stronger ties might have ability to manage their community based water supply system. Directly tied among households is reflected by their social interaction effect of significant others on individual households through their nearness of residence's geographic distance and multiple memberships in community groups. Consequently, in order to sustain the existence of HIPPAM as a 'self-help' voluntary association on providing clean water it is necessity to understand which

social interaction effect as the driver of social influence for a particular community. Our current model so far could explain that in case of the entire research area the social interaction effect is driven by geographic distance as well as community group. However, we still could not able to explain which one is the most appropriate weight matrix that might describe social interaction effect among households. Therefore, it is necessity to continue the analysis to compare which weight matrix give the most significant social interaction effect among households in a particular community.

Then, it is also important to consider which explanatory variable which might give higher impact on individuals' behavior. In our research we propose two types of explanatory variables – education background and working place mainly based on the significant result of chi-square test. However, there are many possibilities to determine explanatory variable to enrich the estimation parameter of local effect. Hence, referring to LeSage and Pace (2009) we might operatinalize the current model to conduct marginal effect analysis to determine how likely individual households who have been a member of HIPPAM (the direct impact) and their neighbors (the indirect impact) are to joint participation HIPPAM.

Last, this is individual base empirical research of the spatial autoregressive (SAR) probit model, which we get a hint of collective action on choice to participate in community based water supply system. The entire estimated parameter rho interpreted as the degree of spatial dependence across households yields positive value close to 1 means influence from significant others play an important role on individual households' decision. In the other words, we might argue that individual behavior mimic alters' behavior. Then, empirically contagion among directly tied nearest neighbors who reside in the nearest geographic distance and shared membership in community groups might become the main drivers of social influence in this research through their face to face contact in their daily activity. Next, the further question is whether this is true a collective action driven by the 'central' leader through power relation mechanism or this is an individual action driven by the voice of people through equivalence relation mechanism. Therefore, it is necessity to scrutinize into more detail the relation between social capital and power relation which we may assume that there is a significant influence from the prominence actor on choice to access community based water supply system. This remains a subject matter for the future research.

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Chapter 7
Conclusion

7.1 Summary and Recommendation

Main objective of this dissertation is to investigate participatory approach to community based water supply system through social network analysis and spatial autoregressive (SAR) probit model with respect to empirical research on community based water supply system in Toyomarto and Candi Renggo village, Singosari district, Malang regency, Indonesia. Next, we assume that community based water supply system is one of strong alternatives to existing water supply system by the public sector. Then, we formulate a hypothesis that households with better community tie have ability to organize "community based" water supply system. Last, in this research we might argue that we able to provide a significant hint to answer the 'incomplete' knowledge between the linkage of collective action theory and the social capital approach that is searched by social capital scholars up to now as mentioned by Ostrom and Ahn (2003).

The whole dissertation consists of 7 chapters in which the following paragraph explains each chapter into more detail.

Chapter 1 describes a basic idea of the research about participatory approach to community water supply system, rationale and objective of the research, as well as methodology and contribution of the research to the body of knowledge. Inception of this research is driven by the belief that community based water supply system is one strong alternatives to existing water services by the public sector with respect to Indonesian rural case study. This research attempts to develop theory as well as analytical model of household's social interaction as an essence in participatory approach. Thus, the research presented in this dissertation may enrich research theory and model in vary disciplines covering engineering and social science, as well as empirical research whereby the result will bring possibility for development better policy in water governance, particularly in case of developing countries.

Chapter 2 investigates literature review about social capital in collaborative action and voluntary association serve as a grand knowledge of the research. In social capital there are ties that relate between actors or agents embedded in that in a result it may bring their movement to pursue their common goal. In a sense of collective action, existence of social capital might reflected by density and cohesion of social ties throughout the community who engage in that it will be an important requirement whether they can achieve their common goal or not. Referring to the fact of low access to water in the research area whereby their area is blessed by abundant water resources, we may assume that one of the reasons is because the community has high

bonding social capital, yet it combined with low bridging social capital.

There is no universal solution to deal with the problem of voluntary association due to their diverse characteristics, as well as legitimacy which it's local and individual contexts. There is a basic requirement of existence active participation on trust relationship between association members in order to mobilize their common resources on pursuing the goal. Based on the characteristic of voluntary associations as self motivated and self active participation, we focus our research upon individual choice on access to clean water to investigate their collaborative action. In this sense, it assumes that participatory approach is an effective and sustainable water management system in the view points of human security and well-being, and its important role in promoting water availability and accessibility.

Chapter 3 portrays chronological and institution of community water supply system with respect to research area. In the inception development of water supply system, there was a mechanism that inhabitants who live near the water resource could not develop the water resource with their value and even more for several decades they were excluded from the piped clean water system that is constructed exclusively for certain community in a particular territory. Hence, through participatory approach that growth within the community may bring them to a better circumstance of access to clean water through collective action in water supply system.

Indonesian Constitution 1945 section 33 gives the basis for the state right to control water. In this sense, PDAM as local drinking water company has duty to provide piping clean water of household connection to the residents. In fact, in the research area, total number of inhabitants with access to piped drinking water is only 28% of the population whereby PDAM serves 24% inhabitants and HIPPAM serves another 4% of it. It indicates that majority residents acquire fresh water from individual wells, communal wells, public tap as well as river without piping connection to individual house.

In general, resident in the research area get acquainted with piped clean water system in four different forms. First, the residents were introduced to piped clean water system with special purpose to supply clean water exclusively for a particular territory. The development of piped clean water network done by Indonesian military – Indonesian Air Force in 1950s and Inodnesian Army in 1961s was the example for this case. Even more, the service has gone across the district when Indonesian Air Force constructed their pipeline network from Ken Dedes Pond and transmitted to Pakis district – neighbor district in the east of Singosari district. Second, the community was introduced to water piping system of household connection by PDAM unit branch Singosari district in 1984. The piped clean water system that open for public who wish to join. Third, the community was introduced to public hydrant whereby the piped

clean water was developed to transmit water into certain point of public water reservoir. Through this public facility, the residents for the first time acquainted with public tap where they fecth clean water freely. This public facility was introduced to the community through a kind of community service program. It did by the student of Brawijaya University in 1986 thorugh community service activity, and by the Indonesian Army in 1991/1992 through social responsibility program. Fourth, the community get acquainted with piping system of household connection through community based water association. Impact from the construction of public hydrant by Indonesian Army, residents in Ngujung hamlet were stimulated to establish community based water association which provide water piping system of household connection. Next, this idea spread to their nearest neighbor – the residents in Sumberawan hamlet. They constructed their water piping system of household connection which driven by their formal as well as informal leader of the hamlet. The notion of establishment community based water association in RW 6 was strengthened by sharing of water usage from Indonesian Air force who holds water right to maintain Ken Dedes Pond.

There are five HIPPAM groups who serve the residents in Sumberawan hamlet through piping clean water system of household connection. Meanwhile, there is only one HIPPAM group in Ngujung hamlet as well as in RW 6. In general they have similar structural organization consist of the chairman, the secretary, the treasurer and the technician. Moreover, each hamlet creates their own rule and norm, eventhough not all of them give sanction to the violator. Unfortunately, it indicates that HIPPAM Air Minum Bersaudara in Ngujung hamlet has quite serious problem whereby few members have willingness to pay their dues due to lack of communication between the committee and the members. HIPPAM in RW 6 is no longer just a voluntary drinking water association as other HIPPAMs in Sumberawan and Ngujung hamlet, since the cooperative Primer Koperasi Tirta Perwita has become an incorporated institution. They build stronger rule towards members than general HIPPAM groups in Toyomarto village. In addition, some HIPPAM groups also provide public tap for non-member to fecth clean water freely in a certain strategic place such as inside the local mosque, or in front of one resident who has quite wide front yard and his or her house faces the village road. In case of the group does not provide a kind of public tap, they let the non-member to fetch fresh water from the faucet in front of the house's member. It may argue that there is a mechanism of bridging social capital developed by HIPPAM's member for the non-member.

Chapter 4 displays the result of household questionnaire survey that is developed referring to the Instruments of the Social Capital Assessment Tools developed by World Bank (2004) and based on the preliminary observation survey, covering demographic character of the households,

issue of water supply system, and community network. Face to face questionnaire interview survey method was conducted in two periods on December 2008 and February 2010 in which 500 selected respondents for the study are the husband, the wife or the head of family are chosen so as they represent typical precious inhabitants. The selected respondents live in six hamlets covering three hamlets in Toyomarto village - Sumberawan (104 respondents), Ngujung (64 respondents) and Glatik (81 respondents), and another three hamlets in Candi Renggo village - RW 6 (74 respondents), RW 8 (75 respondents) and RW 12 (100 respondents).

The demographic characteristic of respondents consists of 8 attributes - sex identity, age, education background, income, occupation, working place, length of stay of the head of household and family member within the same house.

There are most male respondents as compared to the females in the study area covering 70% households in the two villages. Majority households comprise of 4 family members who live in the same house (56% from total households). Average age of the respondents is 47 years, in the mean time the youngest respondent is 22 years meanwhile the oldest one is 90 years.

The number of respondents with education background equal to or higher than junior school is slightly higher than the number of respondents with education background equal to or lower than elementary school at 56% and 44%, respectively. Majority respondents who get access to piped clean water supply system from HIPPAM or PDAM have average education level higher than elementary school. In contrary, respondents with access to fresh water from individual wells, public hydrant and other source such as river, majority of them have education background at lower or equal to elementary school. In a sense, we might assume that majority respondents who get access to piped clean water supply system have average education level higher than elementary school.

Majority occupation of the respondents can be categorized as working in the service sector (70%). In every hamlet, it shows that the numbers of respondents who work in the services sector are always higher than the number of respondents who work in the agriculture and manufacturing sector, except the respondents in Ngujung hamlet who have slightly higher number of respondents who work in the agriculture and manufacturing sector. Among total respondents, there are 23% of respondents who work at home and it is the highest number of respondents based on the six categorization of working place.

In general villagers live with household monthly income at equal to or less than standard monthly minimum wage in Malang regency (the standard in 2009 is IDR 945,500 or JPY 9,455). Except customers of PDAM whereby 54% of them have monthly income higher than IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000), 67% members of HIPPAM, 70% users of private

wells, and 79% users of public hydrant have monthly income equal to or lower than IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000). Most respondents work at home, therefore time to reach work place is zero minute and reached by foot. In general, the average travel time is 30 minutes. Motor bike is the most favorite vehicle used by respondent to reach work place, comparing to public transportation such as small public bus.

Based on Chi-square test with the tabled critical value $\chi^2 = 3.84$ at $p < 0.05$ $with\ df = 1$, amongst $N = 326$ respondents, there are 5 significant attributes to choice of community based water supply system consist of sex identity, age, education, occupation and income level. In this sense, we may argue that the relation between demographic attributes and choice to HIPPAM are as follows:

6. It indicates that male respondents tend to join HIPPAM group than female respondents;
7. It indicates that respondents with average age equal to or younger than 47 years tends to join HIPPAM group;
8. The respondents with education level equal to or lower than elementary school tends to join HIPPAM group;
9. Majority respondents with occupation in agriculture and manufacturing sector tend to join HIPPAM group than the respondents with occupation in services sector (57%);
10. It indicates that household with income level equal to or less than IDR 500,000 – 1,000,000 (JPY 5,000 – 10,000) tend to join HIPPAM group.

Meanwhile, through Chi-square test we may argue that working place and choice to join HIPPAM are slightly independent.

Except for members of HIPPAM, there is no specific rule on water usage for customer of PDAM, owner of private wells, as well as households who fetch fresh water from public hydrant and river. In principal, every household has 24 hours access to fresh water without any limitation of amount of water. In particular for customer of PDAM, the more water they use the more expensive their monthly charge of water usage since the price per cubic meter will increase once their water usage exceeds 10 cubic meters. In the other hand, regardless amount of water usage HIPPAM groups set up a fixed price for their members through maximum two faucets for each member with the appeal to utilize water efficiently particularly in the dry season.

In general, physical condition of public hydrant - communal well shared by private wells' owner or public tap supplied by HIPPAM group – are not good. It might cause by the absence of norms on how to utilize the source amongst users. Except, the public taps that is located inside the mosque whereby the mosque care taker will maintain it for all users. Moreover, some

public facility located in and nearby the river, the physical condition is even worse than the pubic hydrant. In this sense, there is no specific difference between different purposes such as bathing and washing at the same place. Even more, there is no distinction between spaces of river for human beings, vehicles or animals.

Commonly respondents have high level of satisfaction towards their current access to water supply. In detail, the following description illustrates the respondents' water satisfaction through five categories covering taste, quantity, quality, price and availability:

6. Related to 'taste' of water, HIPPAM's members show higher level of satisfaction than PDAM customers.
7. PDAM customer has the lowest level of water 'quantity' satisfaction compare to other types of water source.
8. The whole households feel satisfied toward quality of water from springs as well as some households who acquire water directly from rivers.
9. Customer of PDAM has the lowest level of water 'price' satisfaction than the others. In this sense, we may argue that 'price' of water is an important consideration for the households.
10. Again, PDAM customers have the lowest satisfaction of water 'availability' compare to other water users.

It is interesting that, HIPPAM members and PDAM customers in the same village have similar response on option to solve water problem, but they have different pattern between distinct villages. HIPPAM members in Sumberawan and Ngujung hamlet tend to contact the water management body rather than directly fix it by them self or even ask neighbor to fix it together. Meanwhile, HIPPAM members in RW 6 tend to fix by them self as the first choice, and then it followed by contact to the water management body and asks their neighbor to fix it together. It may indicate that relation between the board committee and the members of HIPPAM groups in Toyomarto village is closer than the relation of HIPPAM group in Candi Renggo village. Furthermore, it might caused by the different institution of HIPPAM between the two villages. In the meantime, PDAM customers in Toyomarto village have similar response with HIPPAM member in the same village, as well as similar pattern of option to solve water problem between PDAM customer and HIPPAM member in Candi Renggo. In this sense, we may argue that the respondents in Toyomarto village may have tendency to act in collective action than individual action, and in contrary the respondents in Candi Renggo village may have tendency to act in individual action rather than to collective action.

When we continue the previous question by asking their reason of the choice, HIPPAM

members and PDAM customers have a slightly different reason. In general, HIPPAM members reveal three main important reasons consist of safety, cost and effort on solving the water problem. Meanwhile, PDAM members put more attention towards cost, effort, and quality on their choice to the problem solving.

Related to opinion to improve or solve the problem related to the current water supply system, a few respondents think that there is no water problem, except the needs of maintenance actions to maintain the current good conditions. Meanwhile, other majority respondents suggest improving water supply system through enhancing water services, fare betterment, improvement the performance of water officer and management of the water body.

There are four popular community groups amongst respondents Toyomarto village consist of religious group (84% of the respondents), cultural/social group (13% of the respondents), community organization and finance group at 10% from the total respondents of each group. Amongst respondents in Toyomarto village, respondents in Sumberawan hamlet joint participate in the most variety community groups consist of 12 types. Then, it followed by respondents in Ngujung hamlet with 9 community groups and respondents in Glatik hamlet with 8 community groups. Respondents in Candi Renggo village also have similar four popular community groups to respondents in Toyomarto village. The forth of them in order are religious group (70% of the respondents), community organization (25% of the respondents), cultural/social group (19% of the respondents) and finance group (9% of the respondents). In addition, all respondents in the three hamlets joint participate in 9 community groups. Furthermore, religious group is one of community group which has high regular meeting (4 times in a month) with a very important meaning and a very high benefit towards community.

In general, we may conclude that a trust on lending and borrowing among households in the research area is very high. Average percentage of respondents who answer yes is 87%. Among the six hamlets, respondents in RW 12 occupy the lowest rate at 81%, and respondents in RW 8 occupy the highest 91%. Then, when we asked them to examine their level of trust within the last three years, except respondents in Ngujung hamlet who express that their level of trust has improved, majority respondents in other five hamlets reveal that their level of trust has remained the same in the last three years. Thus, we may argue that, in general, households in the research area have high stable mutual trust to each other.

Regarding concern to community welfare as a whole respondent in the research area has quite high whereby members of HIPPAM have higher concern than customers of PDAM. Referring to each hamlet, respondents in Sumberawan have higher concern than the other two hamlets – RW 6 and Ngujung.

In general, villagers in Toyomarto and Candi Renggo village think that their community and living environment have very high meaning or value for them. Moreover, we may argue that villagers love their area and their community, as well as they want to make it better through cooperate with each other.

In the last part of questionnaire, we asked respondent to list up six people outside his or her household that he or she feel closest to. It indicates that neighbor as a whole is the closest person outside household at every level of closeness relationship (strength of relationship 1 to 6). In this sense, we may argue that position of the neighbor occupy very important role for the respondents. Even more, the closeness of relationship of neighbor to respondent is higher than the closeness of all kin to respondent, except in the first closest level with only very slight different (212 : 213).

Most type of relationships to respondent, except intimacy with friend and other unrelated person, shows that distance has a significant burden towards closeness of relationship. Therefore, the closer distance of residence on intimate person to respondent, the more intimate their relationship. Closeness relationship towards neighbor is the highest ranked among other intimates by relationship; even more the gap is very high. It seems that distance of residence plays very important role towards intimate relationship. In addition, respondent still has intimate relationship when residence of intimates in East Java Province.

The most intimate by relationship to respondent is the person who lives in the same community with them. The number of closeness relationship decrease sharply when the person lives in difference community, in the same sub village. Furthermore this very close distance of residence of intimate relationship (residence in the same community to respondent) in this district could be more understandable since most respondent use face to face communication (96%) than telephone (3.5%) and letter (0.5%). Additionally, most of them make daily contact with frequency more than 5 times in a week. Finally, we may conclude that position neighbor who live in the same community occupy very important role towards respondents in the research area.

In Chapter 5, we investigate social network in the community level focus upon pairs of respondents' memberships in community groups employing social network analysis. We define sample of respondent in two premises consist of (i) the respondent is currently HIPPAM member or PDAM customer on getting access to piped clean water supply system, and (ii) the respondent lives in the hamlet where currently water services from HIPPAM and PDAM is available as it represented by geographic distance of each respondent's house to main pipeline of HIPPAM and PDAM.

Finally we may conclude that there are three types of community in the research area. First, structure of social network of the residents in Sumberawan hamlet may described as a combination between (i) one central actor that occupies as a formal and informal influential leader which might have high ability to influence villagers through minimum steps when relating to all others, (ii) very low or almost no one places an intermediary position for a pair of residents, (iii) middle and high level of closeness to each other, and (iv) every respondent has tie to each other through their membership in at least one community group. Hence, we may develop assumption that single choice of piped clean water supply system from HIPPAM is a result of their a collective action driven by central leader since in general every respondent may has high equal influence to each other within the community.

Second, structure of social network of the residents in Ngujung hamlet may illustrated as a combination of (i) less power relation due to two different informal leaders with different choices of piped clean water supply system, (ii) no one in position of mediator since (iii) every respondent is adjacent to every other respondents within internal community, and (iv) every respondent has tie to each other through their membership in at least one community group. This situation may bring their current collective action on managing water supply system may difficult to sustain in the long term.

Third, social structure of the residents in RW 6 are a combination between (i) one informal leader who has equal distance of influence as the others, (ii) very low betweenness – but it is slightly higher than respondents in Sumberawan, (iii) middle and high level of closeness to each other, and (iv) moderate cohesion between respondents since some of them do not participate in a kind of community group. Then, we may assume that their choices upon piped clean water supply system is a result of an individual action, whereby among residents they might have quite high connectedness and equal ability to influence each other, but there is no major power relation that able derived them to the similar option. In other words, there is a social interaction that may influence their decision but in the same time there is no central influential actor that able to encourage them to behave homogenously. Another important thing, in this community they able to 'formalize' their community based water supply system. In this sense, their social tie might bring them to have ability to maintain their community based water supply system in different way than the first community.

Thus, by investigating respondents multiple memberships in community groups, we may provide evidence that choice to join community based water supply system may reflect their collective action as well as individual action. But, in a sense of collective action, we may argue that the stimulation is derived by the power relation initiated by a central respondent.

In Chapter 6, we show the spatial autoregressive (SAR) probit model with using Bayesian estimation method in order to investigate the choice of individuals to piped clean water supply system that is determined by the influential others' interaction effect as well as the individual's intrinsic effect. We describe the posterior distribution from the Bayes theorem and express the MCMC sampling method. Then, our approach applies to the empirical analysis of the data from a field survey in Indonesia.

In order to have appropriate specification of weight matrix W dealing with difficulties to distinguish between communication and comparison as the drivers of social influence in the empirical case, we estimate three types of data covering (i) geographic distance between each pairs of respondent's houses, (ii) multiple memberships in community groups, and (iii) household attributes. Herein, we form three types of weight matrix W represent nearness of (i) physical distance covering 5, 10 and 15 nearest neighbors, and inverse of distance, (ii) emotional distance covering cosine similarity and geodesic distance of multiple memberships in community groups, and (iii) household attributes through cosine similarity of four demographic data – education level, working place, household income, and occupation. The first and second data reflect contagion among directly tied respondents wherein social influence processes occur through direct and indirect communication and comparison effects. Meanwhile, the third data reveal contagion among respondents who are not directly tied in which their social influence may occurs through direct and indirect comparison and indirect communication effects. Then, we apply row normalization that lessens the influence each significant others have on respondent with each additional significant other.

The entire three type weight matrices W – nearness of physical, emotional and attribute, the estimated parameters ρ show positive and significant result which might us to conclude that households' choice to community based water supply system is interdependent – display social interaction effects of significant respondents on individual households. Next, the entire estimated parameter working place is statistically negative and significant, whereas estimated parameter education is positive and significant for the six weight matrices W – geographic distance and community group, except the attribute weight matrix W which is statistically positive but insignificant. In this sense, we may argue that households' behavior is also determined by their own local effect with respect to the six weight matrices W – geographic distance (W11 and W12) and community membership (W21 and W22). Thus, through spatial autoregressive (SAR) probit model we might provide evident that individual households' behavior is determined by social interaction effect of the significant others on individual households as well as by their own local effect of the individual households that is represented

by nearness of physical and emotional.

7.2 Future Research

This research focuses upon social tie among respondents through memberships in community groups and did not take up the institution of community based water supply system. Needless to say, however, it is necessity to investigate the institution identity of community based water supply system as a part of proposing appropriate water governance in order to establish a more sustained collective action.

In this research we able to proof our hypothesis that community with stronger ties might have ability to manage their community based water supply system. Directly tied among households is reflected by their social interaction effect of significant others on individual households through their nearness of residence's geographic distance and multiple memberships in community groups. Moreover, water services provided by HIPPAM groups reflect diverse needs for their engaged civic members. Consequently, in order to sustain the existence of HIPPAM as a 'self-help' voluntary association on providing clean water it is necessity to understand which social interaction effect as the driver of social influence for a particular community. Our current model so far could explain that in case of the entire research area the social interaction effect is driven by geographic distance as well as community group.

This is an individual base empirical research of the spatial autoregressive (SAR) probit model, which we get a hint of collective action on choice to participate in community based water supply system. The entire estimated parameter rho interpreted as the degree of spatial dependence across households yields positive value close to 1 means influence from significant others play an important role on individual households' decision. In the other words, we might argue that individual behavior mimic alters' behavior. Then, empirically contagion among directly tied nearest neighbors who reside in the nearest geographic distance and shared membership in community groups might become the main drivers of social influence in this research through their face to face contact in their daily activity. Next, the further question is whether this is true a collective action driven by the 'central' leader through power relation mechanism or this is an individual action driven by the voice of people through equivalence relation mechanism. Therefore, it is necessity to scrutinize into more detail the relation between social capital and power relation which we may assume that there is a significant influence from the prominence actor on choice to access community based water supply system. This remains a subject matter for the future research.

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Appendix A
Two-Mode Degree Centrality

Sumberawan hamlet

No Resp.	Raw Degree	$C_D(x)$
I-18	1	0.25
I-19	2	0.5
I-20	2	0.5
I-21	2	0.5
I-22	2	0.5
I-23	0	0
I-24	0	0
I-25	1	0.25
I-26	1	0.25
I-27	0	0
I-28	1	0.25
I-29	2	0.5
I-30	1	0.25
I-31	1	0.25
I-32	1	0.25
I-33	1	0.25
I-34	1	0.25
I-35	1	0.25
I-36	1	0.25
I-37	0	0
I-38	2	0.5
I-39	1	0.25
I-40	1	0.25
I-41	2	0.5
I-42	1	0.25
I-43	0	0
I-44	1	0.25
I-45	1	0.25
I-46	1	0.25
I-47	1	0.25
I-48	1	0.25
I-49	1	0.25
I-50	1	0.25
I-51	1	0.25
I-52	1	0.25
I-53	0	0

I-54	0	0
I-55	1	0.25
I-57	2	0.5
I-58	1	0.25
I-59	2	0.5
I-60	3	0.75
I-61	1	0.25
I-62	1	0.25
I-65	1	0.25
I-66	1	0.25
I-67	2	0.5
I-68	2	0.5
I-69	2	0.5
I-70	2	0.5
I-71	2	0.5
I-72	2	0.5
I-73	2	0.5
I-74	1	0.25
I-75	2	0.5
I-76	1	0.25
I-77	1	0.25
I-78	1	0.25
I-79	1	0.25
I-80	1	0.25
I-81	1	0.25
I-82	0	0
I-83	1	0.25
I-84	3	0.75
I-85	1	0.25
I-86	1	0.25
I-87	1	0.25
I-88	2	0.5
I-89	2	0.5
I-91	2	0.5
I-92	1	0.25
I-93	1	0.25
I-94	0	0
I-96	1	0.25
I-98	1	0.25
I-214	1	0.25
I-215	1	0.25
I-216	1	0.25

I-217	1	0.25	
I-218	1	0.25	
I-219	0	0	
I-220	1	0.25	
I-221	2	0.5	
I-222	1	0.25	
I-223	1	0.25	
I-224	1	0.25	
I-225	1	0.25	
I-226	2	0.5	
I-227	2	0.5	
I-228	1	0.25	
I-229	2	0.5	
I-230	1	0.25	
I-231	1	0.25	
I-232	1	0.25	
I-233	2	0.5	
I-234	0	0	
I-235	1	0.25	
I-236	2	0.5	
I-237	2	0.5	
I-238	1	0.25	
Community Group	Raw Degree	$C_D\ (y)^1$	$C_D\ (y)^2$
Religious	82	0.82	0.92
Cultural/Social	12	0.12	0.13
Community Organization	11	0.11	0.12
Finance	11	0.11	0.12

Ngujung hamlet

No Resp.	Raw Degree	$C_D\ (x)$	
I-64	1	0.25	
I-99	2	0.5	
I-100	2	0.5	
I-101	2	0.5	
I-102	0	0	
I-103	2	0.5	
I-104	2	0.5	
I-105	2	0.5	
I-106	2	0.5	
I-107	2	0.5	
I-108	2	0.5	

I-109	2	0.5
I-110	2	0.5
I-111	2	0.5
I-112	1	0.25
I-113	1	0.25
I-114	1	0.25
I-115	2	0.5
I-116	0	0
I-117	2	0.5
I-118	2	0.5
I-120	1	0.25
I-121	1	0.25
I-122	1	0.25
I-123	1	0.25
I-124	1	0.25
I-125	1	0.25
I-126	1	0.25
I-127	0	0
I-128	1	0.25
I-129	1	0.25
I-130	0	0
I-131	1	0.25
I-132	1	0.25
I-133	3	0.75
I-134	2	0.5
I-135	1	0.25
I-136	1	0.25
I-137	1	0.25
I-138	1	0.25
I-139	1	0.25
I-140	1	0.25
I-141	1	0.25
I-142	2	0.5
I-143	1	0.25
I-144	2	0.5
I-01	2	0.5
I-02	1	0.25
I-03	1	0.25
I-04	0	0
I-05	1	0.25
I-06	1	0.25
I-07	1	0.25

I-08	1	0.25	
I-09	1	0.25	
I-10	1	0.25	
I-11	3	0.75	
I-12	1	0.25	
I-13	0	0	
I-14	2	0.5	
I-15	1	0.25	
I-16	1	0.25	
I-17	1	0.25	
I-119	1	0.25	
Community Group	Raw Degree	$C_D(y)^1$	$C_D(y)^2$
Religious	58	0.91	1.00
Cultural/Social	15	0.23	0.26
Community Organization	5	0.08	0.09
Finance	4	0.06	0.07

RW 6 hamlet

No Resp.	Raw Degree	$C_D(x)$	
II-87	0	0	
II-90	0	0	
II-91	1	0.25	
II-92	1	0.25	
II-93	0	0	
II-94	0	0	
II-95	1	0.25	
II-96	3	0.75	
II-97	2	0.5	
II-98	0	0	
II-99	0	0	
II-100	1	0.25	
II-101	0	0	
II-102	0	0	
II-103	1	0.25	
II-104	2	0.5	
II-105	1	0.25	
II-106	2	0.5	
II-107	1	0.25	
II-108	1	0.25	
II-109	1	0.25	
II-110	1	0.25	

II-111	1	0.25
II-112	1	0.25
II-113	2	0.5
II-114	1	0.25
II-115	1	0.25
II-116	2	0.5
II-117	1	0.25
II-118	1	0.25
II-119	1	0.25
II-120	0	0
II-121	1	0.25
II-122	2	0.5
II-123	1	0.25
II-124	0	0
II-125	2	0.5
II-126	1	0.25
II-127	1	0.25
II-128	1	0.25
II-129	1	0.25
II-130	0	0
II-131	1	0.25
II-132	1	0.25
II-133	1	0.25
II-134	0	0
II-135	2	0.5
II-136	1	0.25
II-137	1	0.25
II-138	2	0.5
II-139	0	0
II-140	2	0.5
II-141	1	0.25
II-142	1	0.25
II-143	1	0.25
II-144	1	0.25
II-161	1	0.25
II-214	1	0.25
II-215	1	0.25
II-216	1	0.25
II-217	1	0.25
II-218	1	0.25
II-219	1	0.25
II-220	0	0

II-221	0	0	
II-222	0	0	
II-223	2	0.5	
II-224	0	0	
II-225	0	0	
II-86	1	0.25	
Community Group	Raw Degree	$C_D\ (y)^1$	$C_D\ (y)^2$
Religious	46	0.66	0.88
Cultural/Social	7	0.10	0.13
Community Organization	7	0.10	0.13
Finance	5	0.07	0.10

Legend:
$C_D\ (x)$: Two-mode actor co-membership degree centrality
$C_D\ (y)^1$: Two-mode events overlap degree centrality with all respondents
$C_D\ (y)^2$: Two-mode events overlap degree centrality without isolated respondents

Appendix B
One-Mode Actor Co-Membership Centrality

Sumberawan hamlet

No. Resp.	C_D	C_B	C'_D	C'_B	C'_C
I-18	0.859	0	0.966	0	0.9670
I-19	0.859	0	0.966	0	0.9670
I-20	0.859	0	0.966	0	0.9670
I-21	0.869	0.0016	0.977	0.0020	0.9778
I-22	0.869	0.0016	0.977	0.0020	0.9778
I-23	0	0	-	-	-
I-24	0	0	-	-	-
I-25	0.859	0	0.966	0	0.9670
I-26	0.859	0	0.966	0	0.9670
I-27	0	0	-	-	-
I-28	0.859	0	0.966	0	0.9670
I-29	0.859	0	0.966	0	0.9670
I-30	0.859	0	0.966	0	0.9670
I-31	0.859	0	0.966	0	0.9670
I-32	0.859	0	0.966	0	0.9670
I-33	0.859	0	0.966	0	0.9670
I-34	0.859	0	0.966	0	0.9670
I-35	0.859	0	0.966	0	0.9670
I-36	0.859	0	0.966	0	0.9670
I-37	0	0	-	-	-
I-38	0.879	0.0031	0.989	0.0040	0.9888
I-39	0.859	0	0.966	0	0.9670
I-40	0.859	0	0.966	0	0.9670
I-41	0.869	0.0016	0.977	0.0020	0.9778
I-42	0.859	0	0.966	0	0.9670
I-43	0	0	-	-	-
I-44	0.111	0	0.125	0	0.5333
I-45	0.859	0	0.966	0	0.9670
I-46	0.859	0	0.966	0	0.9670
I-47	0.859	0	0.966	0	0.9670
I-48	0.859	0	0.966	0	0.9670
I-49	0.859	0	0.966	0	0.9670
I-50	0.111	0	0.125	0	0.5333
I-51	0.859	0	0.966	0	0.9670
I-52	0.859	0	0.966	0	0.9670
I-53	0	0	-	-	-

I-54	0	0	-	-	-
I-55	0.859	0	0.966	0	0.9670
I-57	0.879	0.0031	0.989	0.0040	0.9888
I-58	0.859	0	0.966	0	0.9670
I-59	0.869	0.0016	0.977	0.0020	0.9778
I-60	0.869	0.0016	0.977	0.0020	0.9778
I-61	0.859	0	0.966	0	0.9670
I-62	0.859	0	0.966	0	0.9670
I-65	0.859	0	0.966	0	0.9670
I-66	0.859	0	0.966	0	0.9670
I-67	0.879	0.0031	0.989	0.0040	0.9888
I-68	0.879	0.0031	0.989	0.0040	0.9888
I-69	0.859	0	0.966	0	0.9670
I-70	0.859	0	0.966	0	0.9670
I-71	0.859	0	0.966	0	0.9670
I-72	0.859	0	0.966	0	0.9670
I-73	0.879	0.0031	0.989	0.0040	0.9888
I-74	0.859	0	0.966	0	0.9670
I-75	0.879	0.0031	0.989	0.0040	0.9888
I-76	0.859	0	0.966	0	0.9670
I-77	0.859	0	0.966	0	0.9670
I-78	0.859	0	0.966	0	0.9670
I-79	0.859	0	0.966	0	0.9670
I-80	0.859	0	0.966	0	0.9670
I-81	0.859	0	0.966	0	0.9670
I-82	0	0	-	-	-
I-83	0.859	0	0.966	0	0.9670
I-84	0.889	0.0051	1	0.0065	1
I-85	0.859	0	0.966	0	0.9670
I-86	0.859	0	0.966	0	0.9670
I-87	0.859	0	0.966	0	0.9670
I-88	0.859	0	0.966	0	0.9670
I-89	0.869	0.0016	0.977	0.0020	0.9778
I-91	0.869	0.0016	0.977	0.0020	0.9778
I-92	0.859	0	0.966	0	0.9670
I-93	0.859	0	0.966	0	0.9670
I-94	0	0	-	-	-
I-96	0.859	0	0.966	0	0.9670
I-98	0.859	0	0.966	0	0.9670
I-214	0.859	0	0.966	0	0.9670
I-215	0.859	0	0.966	0	0.9670
I-216	0.859	0	0.966	0	0.9670

I-217	0.859	0	0.966	0	0.9670
I-218	0.859	0	0.966	0	0.9670
I-219	0	0	-	-	-
I-220	0.859	0	0.966	0	0.9670
I-221	0.869	0.0016	0.977	0.0020	0.9778
I-222	0.859	0	0.966	0	0.9670
I-223	0.859	0	0.966	0	0.9670
I-224	0.859	0	0.966	0	0.9670
I-225	0.859	0	0.966	0	0.9670
I-226	0.859	0	0.966	0	0.9670
I-227	0.869	0.0016	0.977	0.0020	0.9778
I-228	0.859	0	0.966	0	0.9670
I-229	0.859	0	0.966	0	0.9670
I-230	0.859	0	0.966	0	0.9670
I-231	0.859	0	0.966	0	0.9670
I-232	0.859	0	0.966	0	0.9670
I-233	0.879	0.0031	0.989	0.0040	0.9888
I-234	0	0	-	-	-
I-235	0.859	0	0.966	0	0.9670
I-236	0.879	0.0031	0.989	0.0040	0.9888
I-237	0.879	0.0031	0.989	0.0040	0.9888
I-238	0.101	0	0.114	0	0.5301

Ngujung hamlet

No. Resp.	C_D	C_B	C'_D	C'_B	C'_C
I-01	0.905	0	1	0	1
I-02	0.905	0	1	0	1
I-03	0.905	0	1	0	1
I-04	0	0	-	-	-
I-05	0.905	0	1	0	1
I-06	0.905	0	1	0	1
I-07	0.905	0	1	0	1
I-08	0.905	0	1	0	1
I-09	0.905	0	1	0	1
I-10	0.905	0	1	0	1
I-11	0.905	0	1	0	1
I-12	0.905	0	1	0	1
I-13	0	0	-	-	-
I-14	0.905	0	1	0	1
I-15	0.905	0	1	0	1
I-16	0.905	0	1	0	1
I-17	0.905	0	1	0	1

I-64	0.905	0	1	0	1
I-99	0.905	0	1	0	1
I-100	0.905	0	1	0	1
I-101	0.905	0	1	0	1
I-102	0	0	-	-	-
I-103	0.905	0	1	0	1
I-104	0.905	0	1	0	1
I-105	0.905	0	1	0	1
I-106	0.905	0	1	0	1
I-107	0.905	0	1	0	1
I-108	0.905	0	1	0	1
I-109	0.905	0	1	0	1
I-110	0.905	0	1	0	1
I-111	0.905	0	1	0	1
I-112	0.905	0	1	0	1
I-113	0.905	0	1	0	1
I-114	0.905	0	1	0	1
I-115	0.905	0	1	0	1
I-116	0	0	-	-	-
I-117	0.905	0	1	0	1
I-118	0.905	0	1	0	1
I-119	0.905	0	1	0	1
I-120	0.905	0	1	0	1
I-121	0.905	0	1	0	1
I-122	0.905	0	1	0	1
I-123	0.905	0	1	0	1
I-124	0.905	0	1	0	1
I-125	0.905	0	1	0	1
I-126	0.905	0	1	-	1
I-127	0	0	-	-	-
I-128	0.905	0	1	0	1
I-129	0.905	0	1	0	1
I-130	0	0	-	-	-
I-131	0.905	0	1	0	1
I-132	0.905	0	1	0	1
I-133	0.905	0	1	0	1
I-134	0.905	0	1	0	1
I-135	0.905	0	1	0	1
I-136	0.905	0	1	0	1
I-137	0.905	0	1	0	1
I-138	0.905	0	1	0	1
I-139	0.905	0	1	0	1

I-140	0.905	0	1	0	1
I-141	0.905	0	1	0	1
I-142	0.905	0	1	0	1
I-143	0.905	0	1	0	1
I-144	0.905	0	1	0	1

RW 6 hamlet

No. Resp.	C_D	C_B	C'_D	C'_B	C'_C
II-86	0.652	0	0.882	0	0.8947
II-87	0	0	-	-	-
II-90	0	0	-	-	-
II-91	0.638	0	0.863	0	0.8947
II-92	0.058	0	0.078	0	0.5152
II-93	0	0	-	-	-
II-94	0	0	-	-	-
II-95	0.638	0	0.863	0	0.8947
II-96	0.710	0.0385	0.961	0.0708	0.9808
II-97	0.681	0.0288	0.922	0.0529	0.9444
II-98	0	0	-	-	-
II-99	0	0	-	-	-
II-100	0.087	0	0.118	0	0.5258
II-101	0	0	-	-	-
II-102	0	0	-	-	-
II-103	0.638	0	0.863	0	0.8947
II-104	0.652	0.0032	0.882	0.0059	0.9107
II-105	0.638	0	0.863	0	0.8947
II-106	0.667	0.0072	0.902	0.0132	0.9273
II-107	0.638	0	0.863	0	0.8947
II-108	0.638	0	0.863	0	0.8947
II-109	0.638	0	0.863	0	0.8947
II-110	0.638	0	0.863	0	0.8947
II-111	0.638	0	0.863	0	0.8947
II-112	0.087	0	0.118	0	0.5258
II-113	0.667	0.0072	0.902	0.0132	0.9273
II-114	0.058	0	0.078	0	0.5152
II-115	0.638	0	0.863	0	0.8947
II-116	0.652	0.0032	0.882	0.0059	0.9107
II-117	0.638	0	0.863	0	0.8947
II-118	0.638	0	0.863	0	0.8947
II-119	0.638	0	0.863	0	0.8947
II-120	0	0	-	-	-
II-121	0.638	0	0.863	0	0.8947
II-122	0.667	0.0072	0.902	0.0132	0.9273
II-123	0.638	0	0.863	0	0.8947
II-124	0	0	-	-	-
II-125	0.652	0.0032	0.882	0.0059	0.9107
II-126	0.638	0	0.863	0	0.8947
II-127	0.638	0	0.863	0	0.8947

II-128	0.638	0	0.863	0	0.8947
II-129	0.638	0	0.863	0	0.8947
II-130	0	0	-	-	-
II-131	0.638	0	0.863	0	0.8947
II-132	0.638	0	0.863	0	0.8947
II-133	0.638	0	0.863	0	0.8947
II-134	0	0	-	-	-
II-135	0.667	0.0072	0.902	0.0132	0.9273
II-136	0.638	0	0.863	0	0.8947
II-137	0.638	0	0.863	0	0.8947
II-138	0.652	0.0032	0.882	0.0059	0.9107
II-139	0	0	-	-	-
II-140	0.652	0.0032	0.882	0.0059	0.9107
II-141	0.058	0	0.078	0	0.5152
II-142	0.638	0	0.863	0	0.8947
II-143	0.638	0	0.863	0	0.8947
II-144	0.638	0	0.863	0	0.8947
II-161	0.638	0	0.863	0	0.8947
II-214	0.638	0	0.863	0	0.8947
II-215	0.638	0	0.863	0	0.8947
II-216	0.087	0	0.118	0	0.5050
II-217	0.638	0	0.863	0	0.8947
II-218	0.638	0	0.863	0	0.8947
II-219	0.638	0	0.863	0	0.8947
II-220	0	0	-	-	-
II-221	0	0	-	-	-
II-222	0	0	-	-	-
II-223	0.652	0.0032	0.882	0.0059	0.9107
II-224	0	0	-	-	-
II-225	0	0	-	-	-

Legend:
C_D : One-mode actor co-membership degree centrality with isolated respondent
C_B: One-mode actor co-membership betweenness centrality with isolated respondent
C'_D: One-mode actor co-membership degree centrality without isolated respondent
C'_B: One-mode actor co-membership betweenness centrality without isolated respondent
C'_C: One-mode actor co-membership closeness centrality without isolated respondent

Appendix C
The Estimation Method

C.1 Bayesian Inference

We estimate above spatial probit model by using Markov Chain Monte Carlo (MCMC) method. Gibbs sampler was a first MCMC algorithm and was used in statistics and econometrics popularly, which arrives at the target distribution of unknown parameters by sequentially sampling from a set of conditional distributions of parameters. This is very useful since usually it is difficult to find an analytical result for posterior densities. The MCMC method provides a sample from the posterior density and we can use this sample to draw inferences about the parameters of interest. Under mild regularity conditions satisfied in this application, these samples converge to sample from the posterior distribution.

Most of the parameters can be sampled by using Gibbs sampler, however, sampling the spatial parameter ρ is solely difficult since the conditional posterior distribution is not reducible to a standard distribution. Therefore, we apply a Metropolis-Hastings (MH) sampling method.

To derive the conditional posterior distributions, we use the Bayes theorem.

$$p(\beta, \rho, z|y) \propto L(y|\beta, \rho, z) \cdot \pi(\beta, \rho, z) \tag{C.1}$$

where $p(\cdot)$ represents posterior densities. The prior distributions of each parameter β, ρ are assumed independent; therefore, the posterior joint density $p(\beta, \rho, z|y)$ is given up to a constant of proportionality by

$$p(\beta, \rho, z|y) \propto L(y|z) \cdot \pi(z|\beta, \rho) \cdot \pi(\beta) \cdot \pi(\rho) \tag{C.2}$$

Using this relation, we obtain the appropriate conditional posterior distributions for each parameter in the model and examine MCMC sampling methods in the following section. Before we examine the Bayesian estimation we set each parameter's prior distributions as follows:

$$\begin{aligned} &L(y|z) \sim \prod_{i=1}^{n} \{\delta(y_i = 1)\delta(z_i > 0) + \delta(y_i = 0)\delta(z_i \leq 0)\} \\ &\pi(z|\beta, \rho) \sim N_n\left[S(\rho)X\beta, S(\rho)S(\rho)'\right] = N_n(\mu, \Omega) \\ &\pi(\beta) \sim N_K(c, T) \\ &\pi(\rho) \sim U\left(\lambda_{min}^{-1}, \lambda_{max}^{-1}\right) \end{aligned} \tag{C.3}$$

where β has normal conjugate prior distribution with means set to zero and covariance matrix set to $100I_K$. We employ a uniform prior distribution on ρ over a specified range. The parameter ρ must lie in the interval $\left[\lambda_{min}^{-1}, \lambda_{max}^{-1}\right]$, where λ_{min} and λ_{max} denote the

minimum and maximum eigenvalues of W, for the matrix $S(\rho) = I_n - \rho W$ to be invertible (Sun, Tsukawa and Speckman 1999). Introducing each prior distribution (2) into equation (3), we can derive the conditional posterior distributions for each parameter. In the next section, we examine the MCMC sampling method with using these conditional posterior distributions.

C.2 The Markov Chain Monte Carlo (MCMC) sampler

The MCMC estimation scheme involves starting with arbitrary initial values for the parameters which we denote β^0, ρ^0 and the latent variable z^0. We then sample sequentially from the following set of conditional distributions for the parameters in our model.

a) Calculate $p(\beta|\rho^0, z^0, y)$ using each initial parameter. We carry out a multivariate random draw to determine β^1.

$$\beta|(\rho, z, y) \sim N_K(A^{-1}b, A^{-1}) \quad \text{(C.4)}$$

where

$$A = X'X + T^{-1}, b = X'\mathrm{S}(\rho)\mathrm{z} + T^{-1}c.$$

b) Calculate ρ using z^0 and β^1 from previous steps. We represent the posterior distribution of ρ as follows,

$$p(\rho|\beta^1, z^0, y) \propto |I_n - \rho W| \cdot exp\left\{-\frac{1}{2}[S(\rho)z - X\beta]'[S(\rho)z - X\beta]\right\} \quad \text{(C.5)}$$

It is difficult to sample a draw from this distribution. Therefore, we use the Metropolis-Hastings algorithm with a random walk chain to generate draws (see Chib and Greenberg 1995). Let ρ^{old} denote the previous draw, and then the next draw ρ^{new} is given by:

$$\rho^{new} = \rho^{old} + c^*\phi \qquad \phi \sim N(0,1 \quad \text{(C.6)}$$

where c^* is called tuning parameter. The spatial term ρ is restricted $\lambda_{min}^{-1}, \lambda_{max}^{-1}$. Next, we evaluate the acceptance probability as follows,

$$\Psi\left(\rho^{old}, \rho^{new}\right) = min\left(1, \frac{p(\rho^{new}|\beta^1, z^0, y)}{p(\rho^{old}|\beta^1, z^0, y)}\right) \quad \text{(C.7)}$$

Finally, we set $\rho = \rho^{new}$ with probability $\Psi(\rho^{old}, \rho^{new})$, otherwise $\rho = \rho^{old}$.

c) We sample z^1 draws from a truncated normal distribution using β^1 and ρ^1 as follows,

$$z_i|(\beta,\rho,z_{-i},y) \sim \begin{cases} TN_{(0,\infty)}[S(\rho)_i x_i'\beta - V_{ii}^{-1}V_{i-i}(z_{-i} - X_{-i}\beta), V_{ii}^{-1}] & if \quad y_i = 1 \\ TN_{(-\infty,0]}[S(\rho)_i x_i'\beta - V_{ii}^{-1}V_{i-i}(z_{-i} - X_{-i}\beta), V_{ii}^{-1}] & if \quad y_i = 0 \end{cases} \tag{C.8}$$

where $z_{-i} = (z_1, \cdots, z_{i-1}, z_{i+1}, \cdots, z_n)$; $V = \Omega^{-1}$; V_{ii} denotes the scalar appearing in the i^{th} row and column of V; V_{i-i} denotes the (n-1)-dimensional row vector obtained by deleting the i^{th} column from the i^{th} row of V.

We now return to step 1 employing the updated parameter values in place of the initial values β^1, ρ^1 and z^1. On each pass through the sequence we collect the parameter draws which are used to construct a posterior distribution for the parameters in our model.

Appendix D
Map of Main Pipelines and Location of Respondent's House

D1.

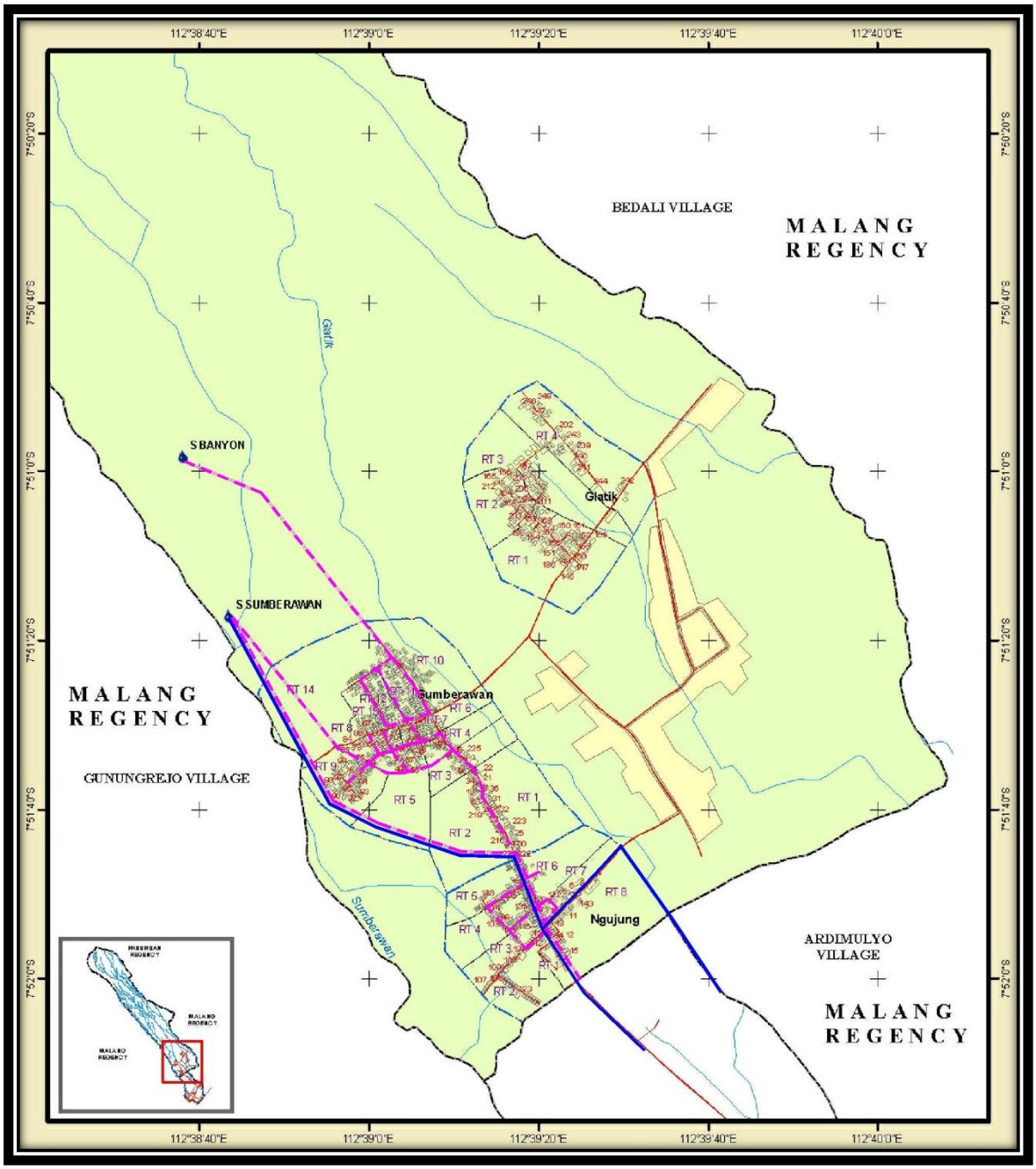

Figure 6.4 Main Pipelines of HIPPAM and PDAM in Toyomarto Village

Legend:

Blue solid line is main pipelines of PDAM
Magenta dash line is main pipelines of HIPPAM

D2.

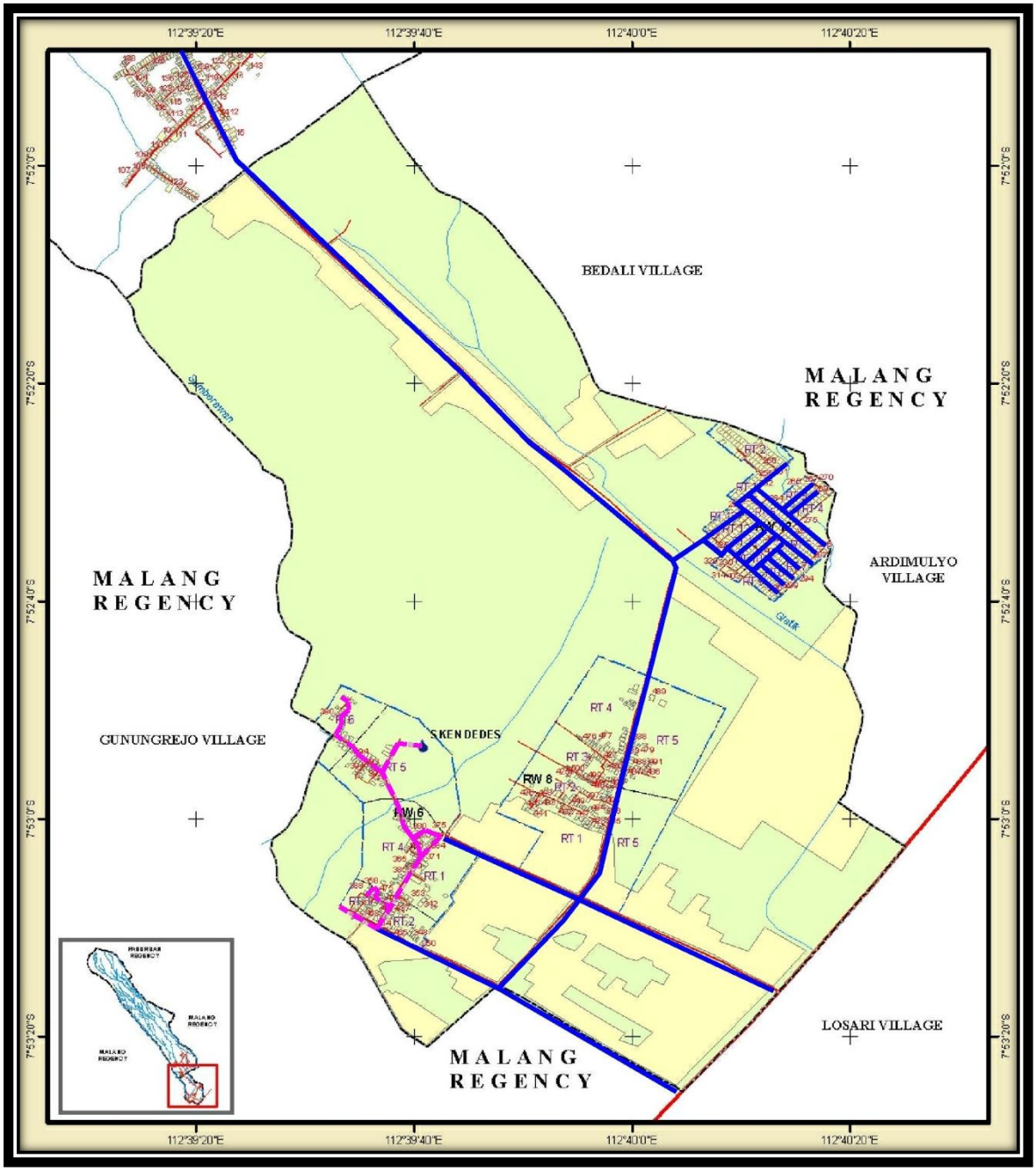

Figure 6.5 Main Pipelines of HIPPAM and PDAM in Candi Renggo Village

Legend:

Blue solid line is main pipelines of PDAM
Magenta dash line is main pipelines of HIPPAM

D3.

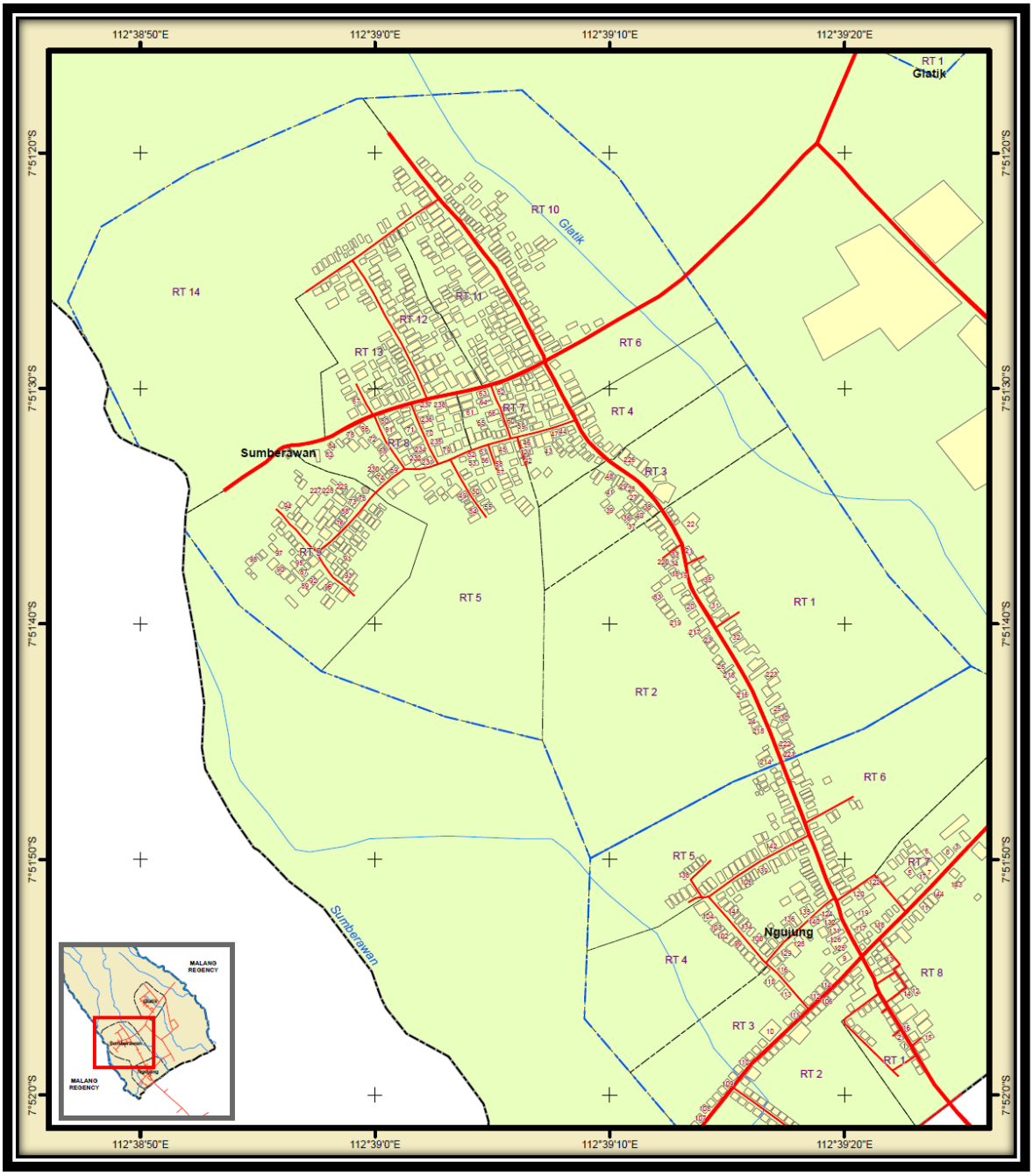

Figure 6.17 Respondent's House in Sumberawan Hamlet, Toyomarto Village

Legend:

Red solid line is local road in the hamlet
Blue dash line is administrative boundary for each hamlet

D4.

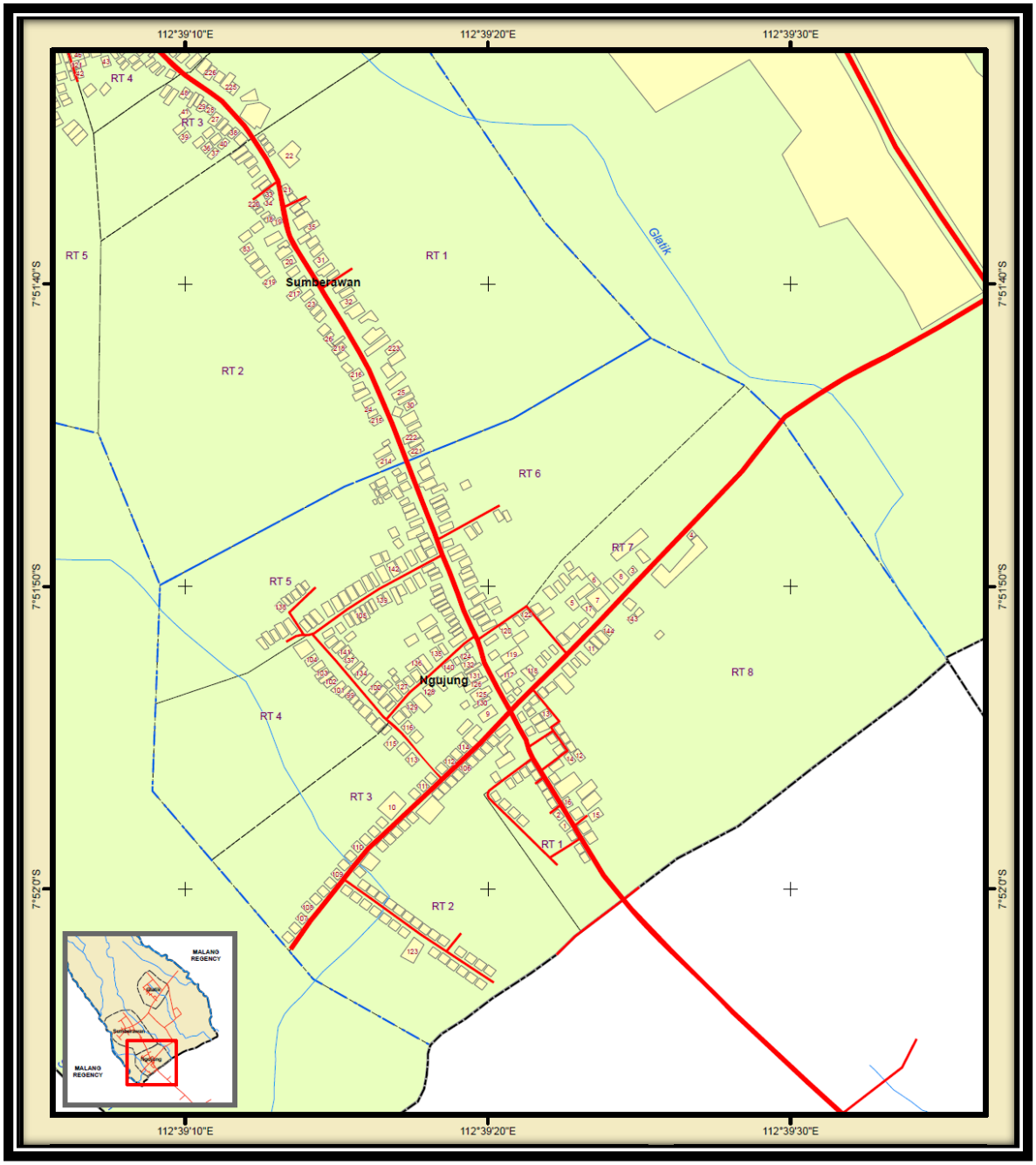

Figure 6.18 Respondent's House in Ngujung Hamlet, Toyomarto Village

Legend:

Red solid line is local road in the hamlet
Blue dash line is administrative boundary for each hamlet

D5.

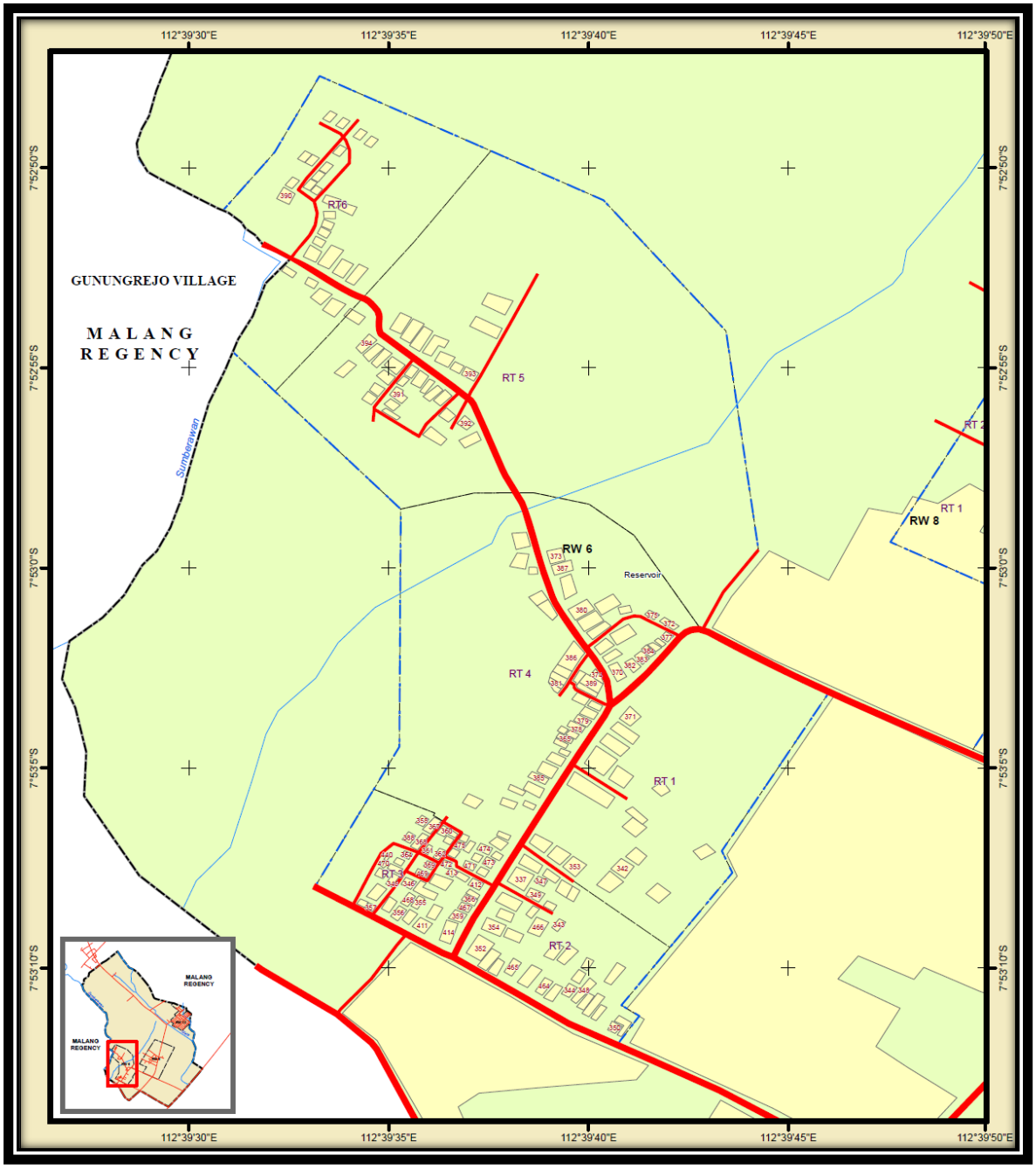

Figure 6.19 Respondent's House in RW 6 Hamlet, Candi Renggo Village

Legend:

Red solid line is local road in the hamlet
Blue dash line is administrative boundary for each hamlet

Appendix E
Estimation Result of Spatial Autoregressive (SAR) Probit Model

E1. W11 - 5 Nearest Neighbors of Geographic Distance

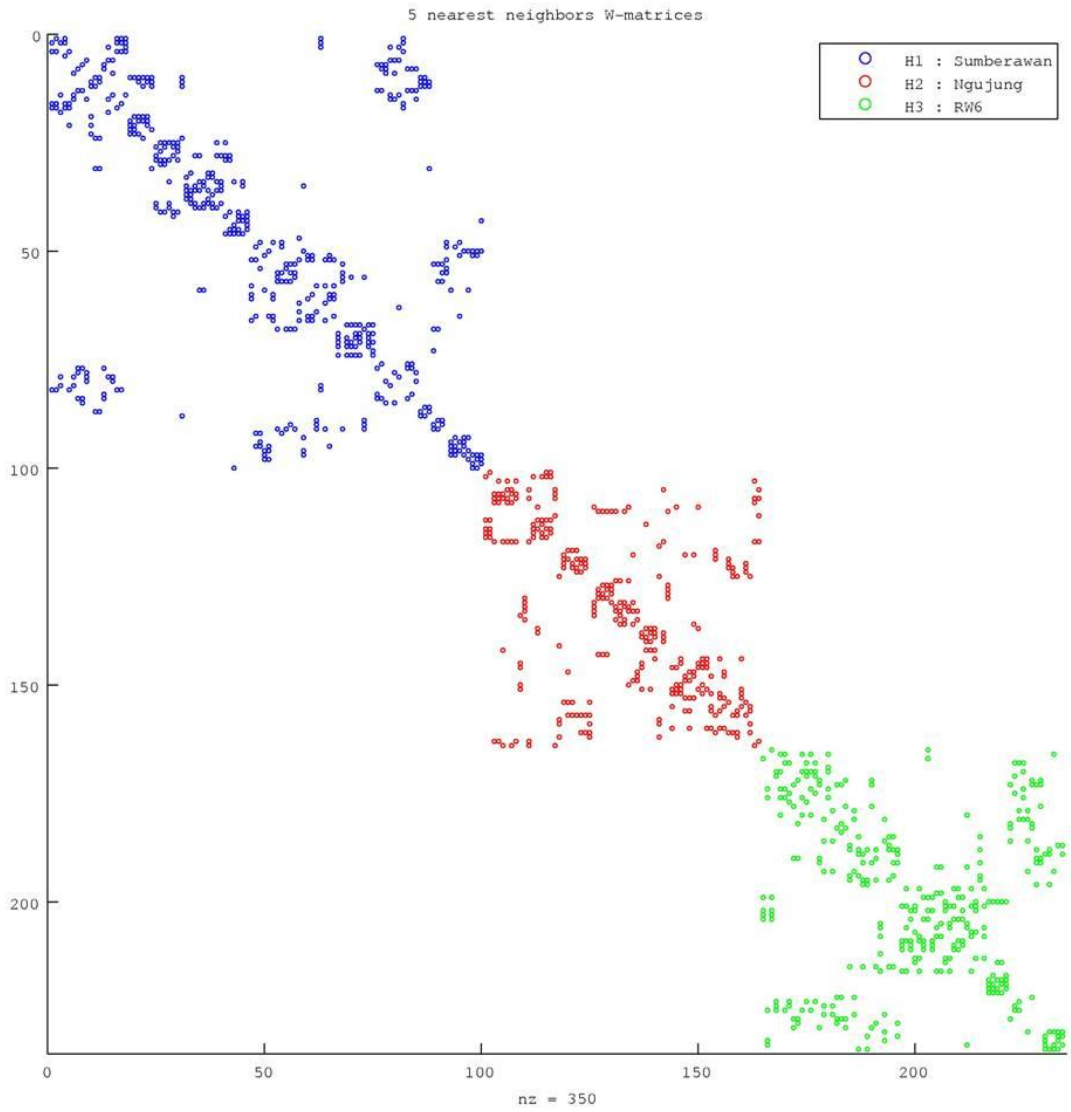

Figure 6.20 Weight Matrix of the 5 Nearest Neighbors

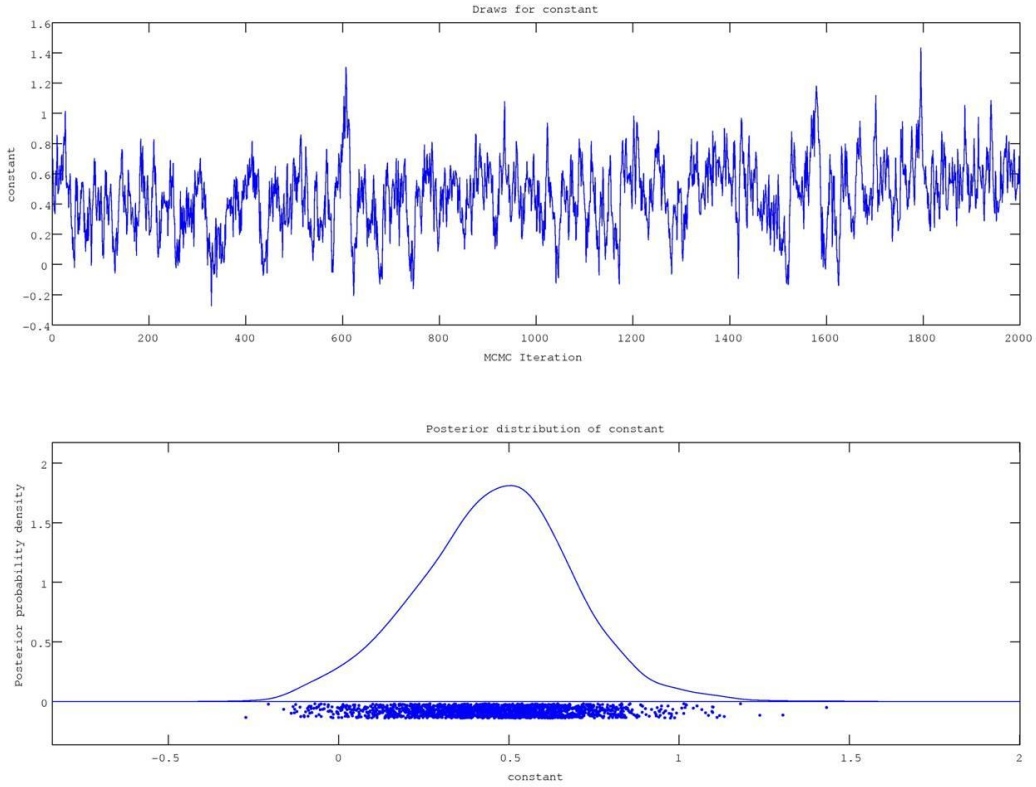

Figure 6.21 Sample Paths and Posterior Probabilities for the Parameter Constant

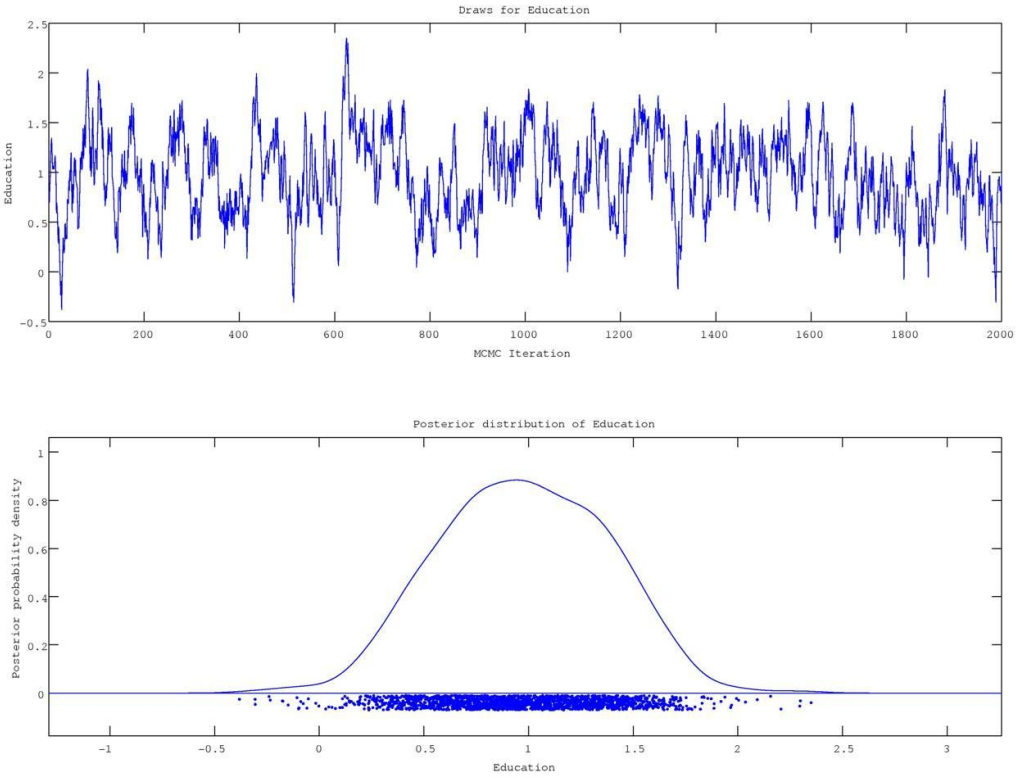

Figure 6.22 Sample Paths and Posterior Probabilities for the Parameter Education

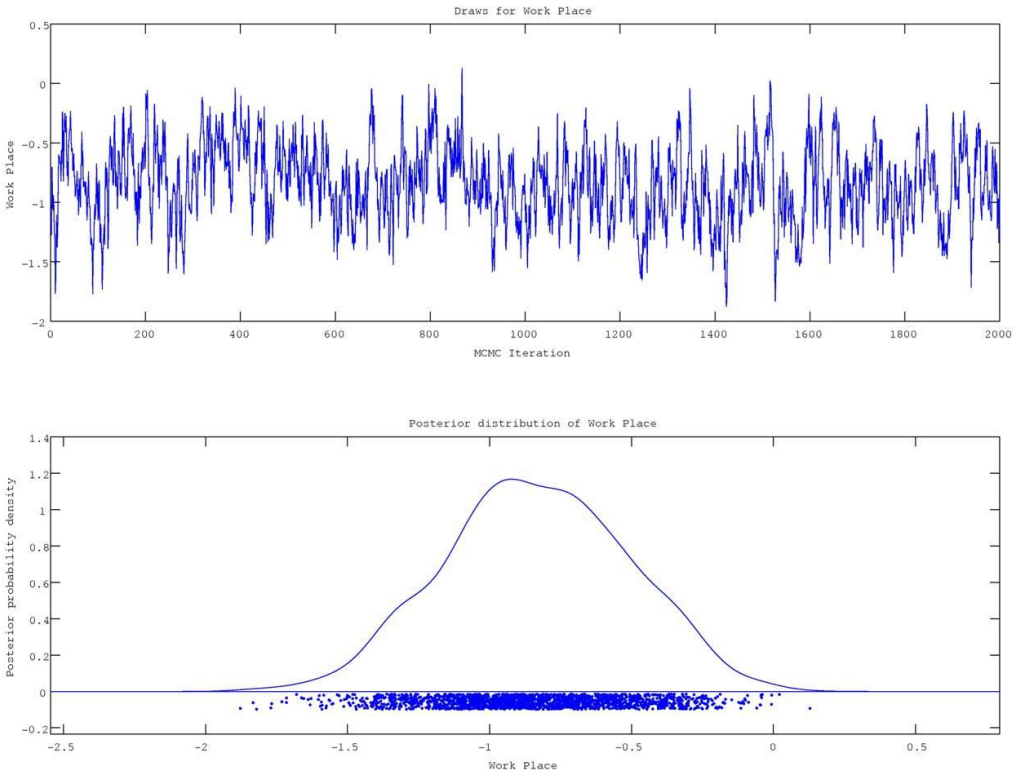

Figure 6.23 Sample Paths and Posterior Probabilities for the Parameter Working Place

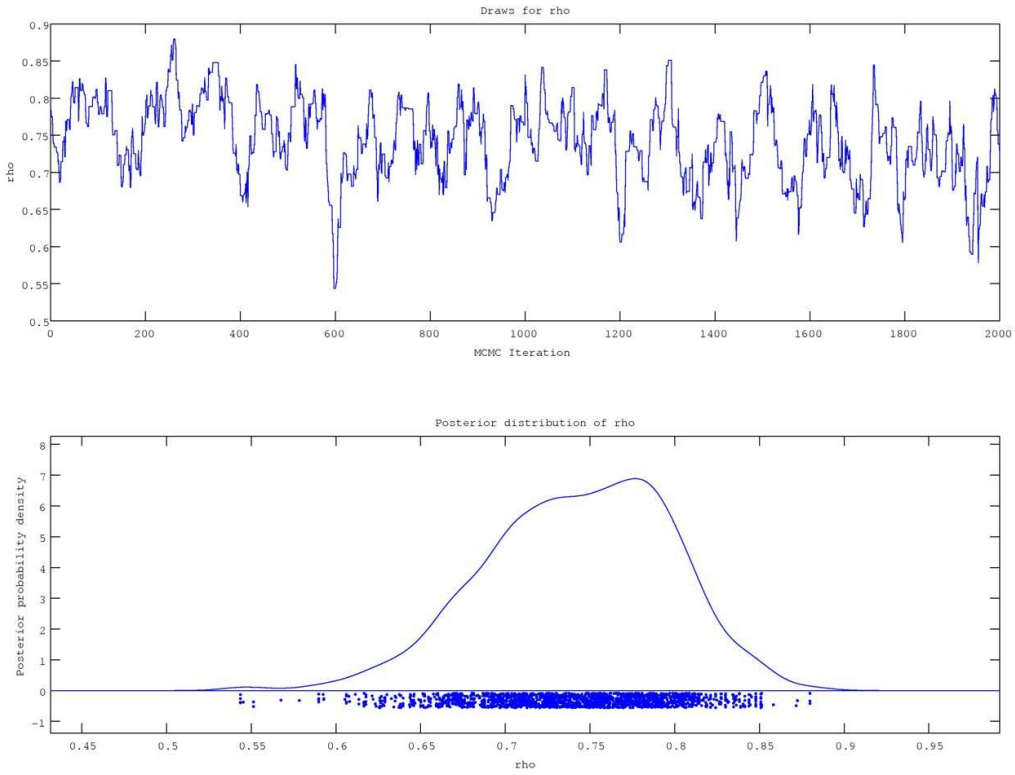

Figure 6.24 Sample Paths and Posterior Probabilities for the Parameter Rho

E2. W11 - 10 Nearest Neighbors of Geographic Distance

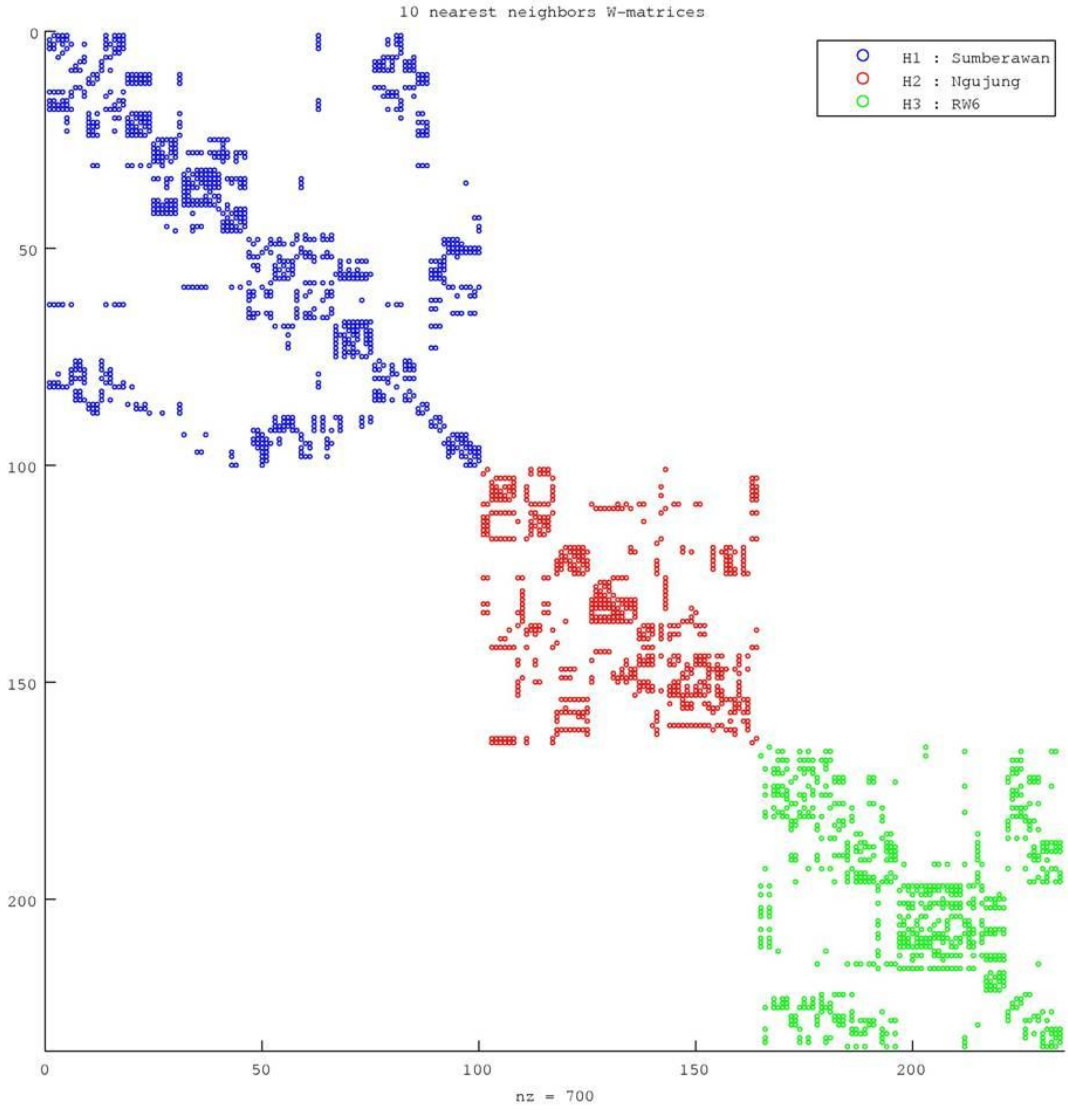

Figure 6.25 Weight Matrix of the 10 Nearest Neighbors

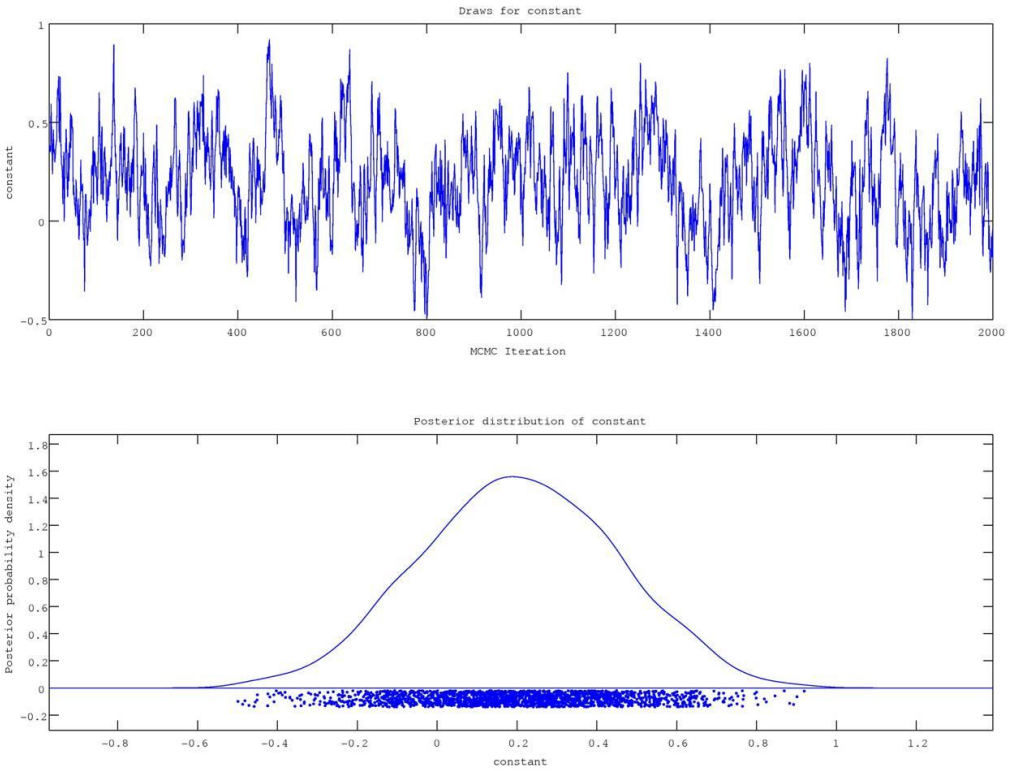

Figure 6.26 Sample Paths and Posterior Probabilities for the Parameter Constant

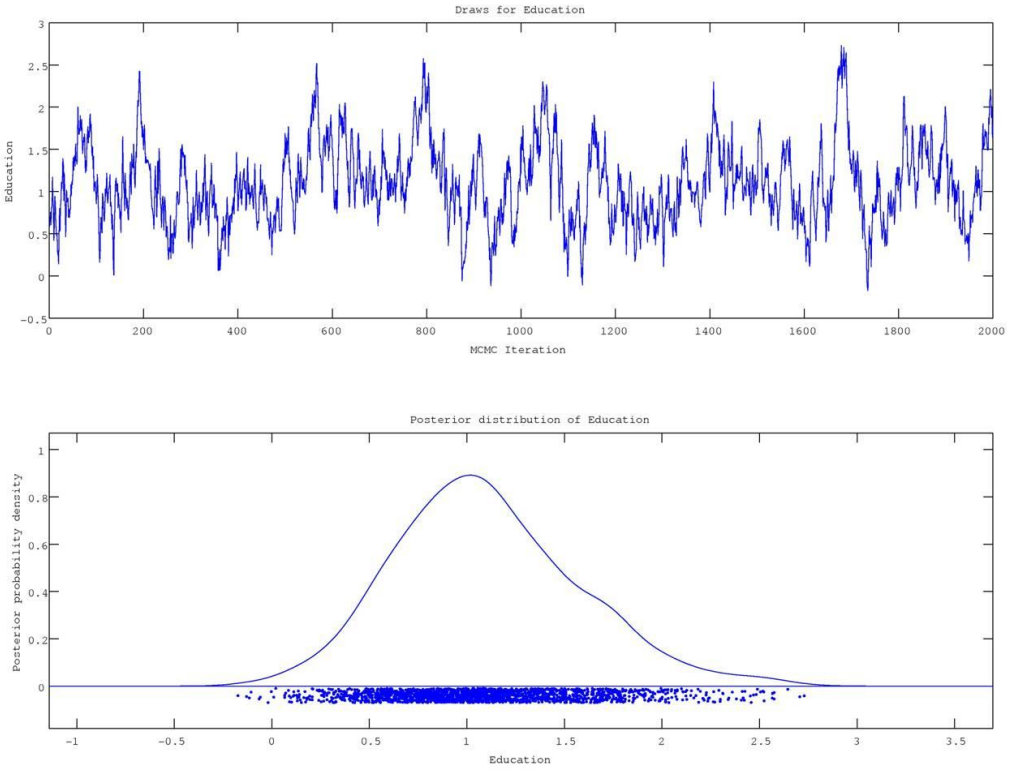

Figure 6.27 Sample Paths and Posterior Probabilities for the Parameter Education

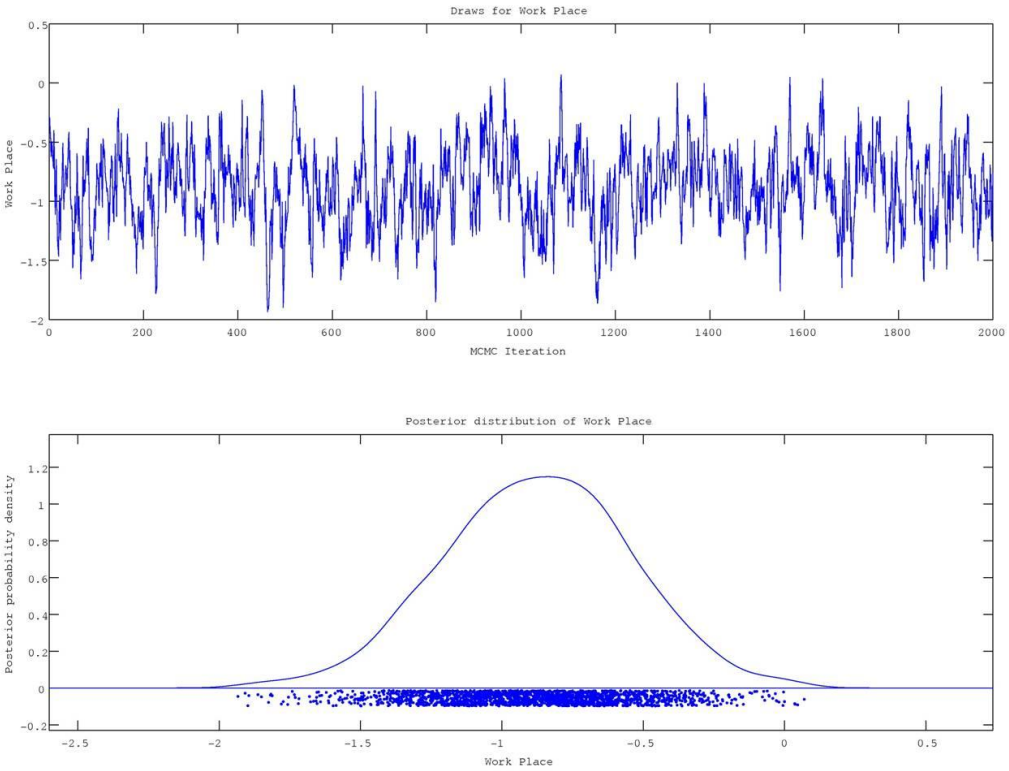

Figure 6.28 Sample Paths and Posterior Probabilities for the Parameter Working Place

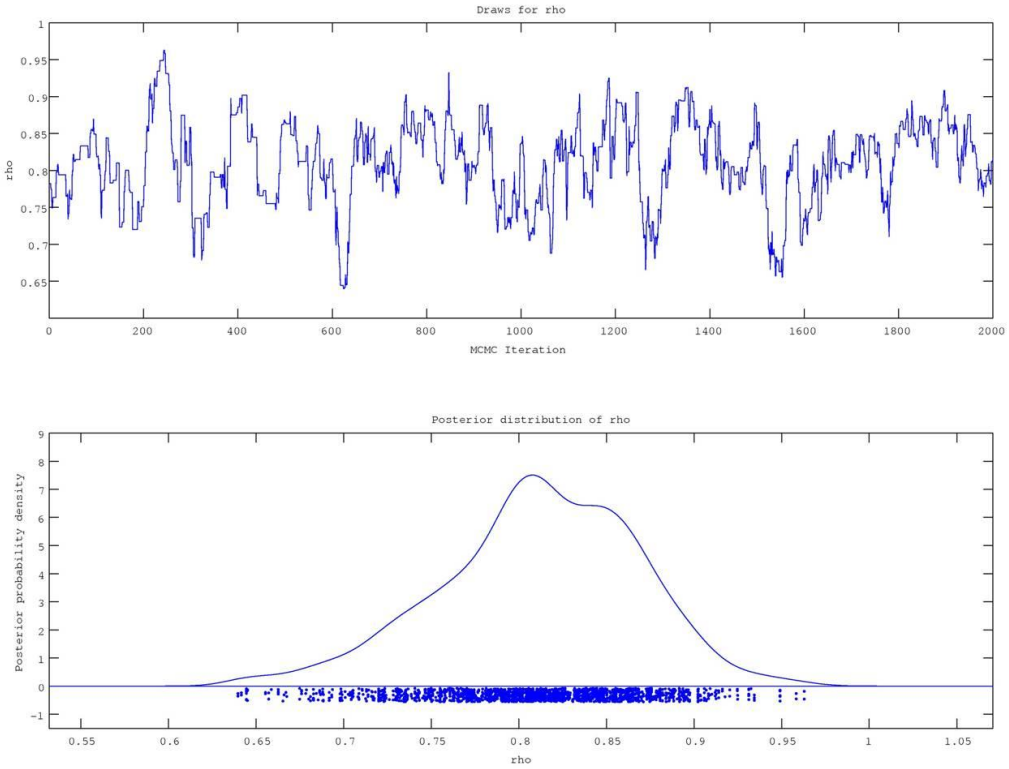

Figure 6.29 Sample Paths and Posterior Probabilities for the Parameter Rho

E3. W11 - 15 Nearest Neighbors of Geographic Distance

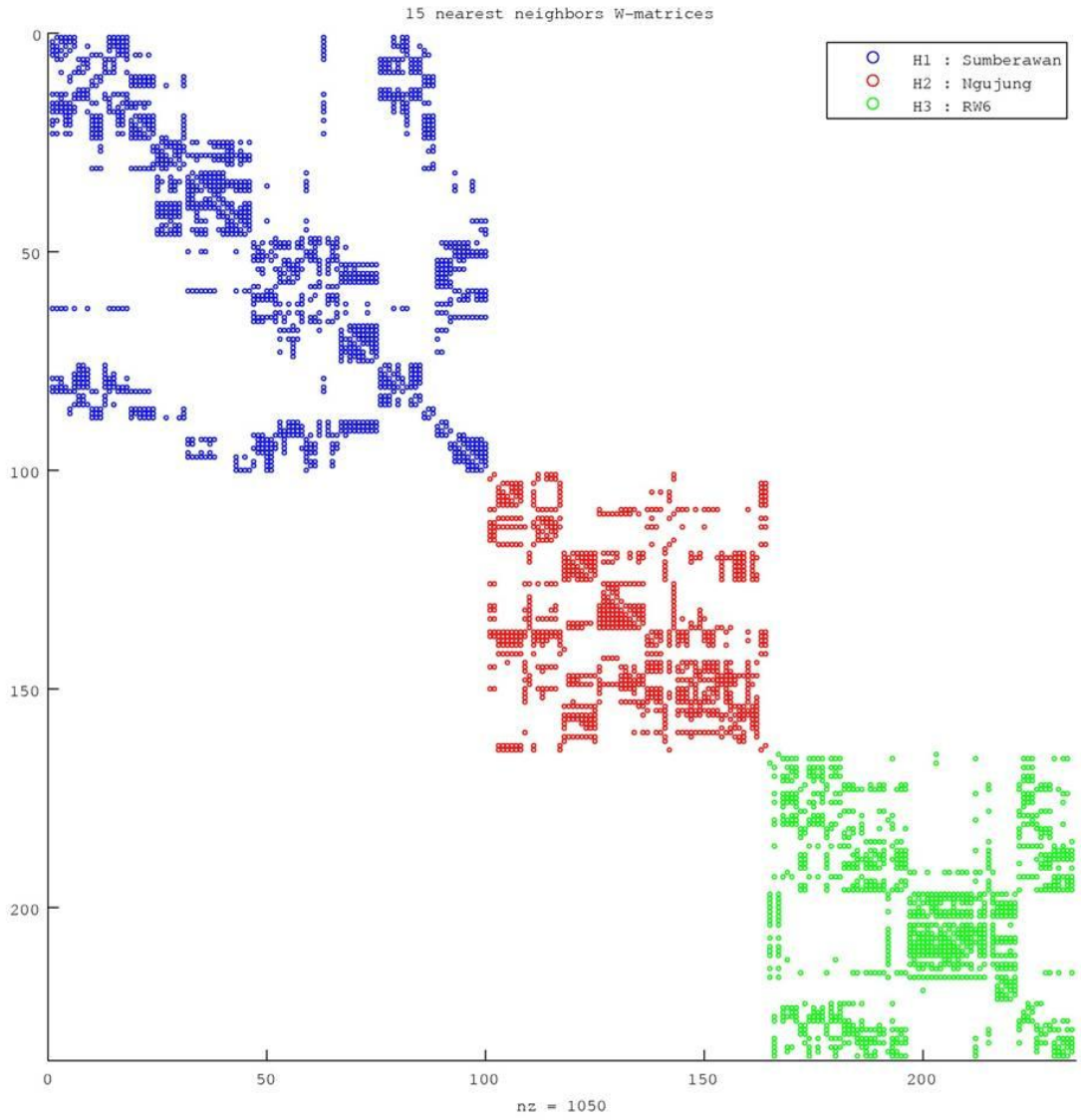

Figure 6.30 Weight Matrix of the 15 Nearest Neighbors

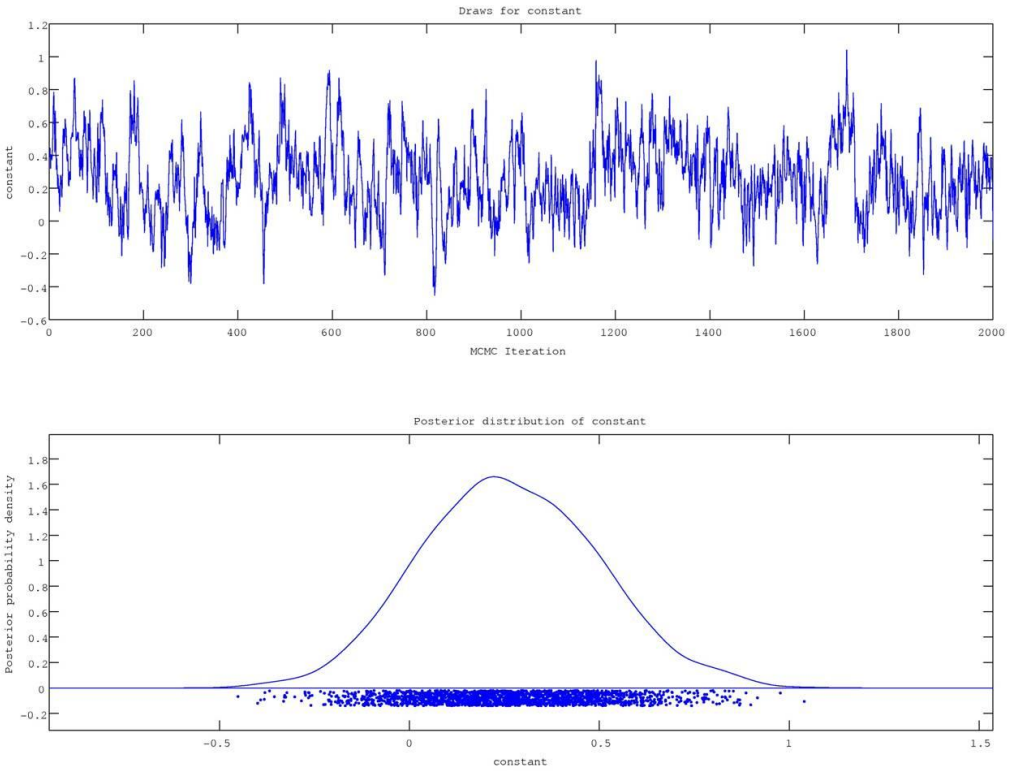

Figure 6.31 Sample Paths and Posterior Probabilities for the Parameter Constant

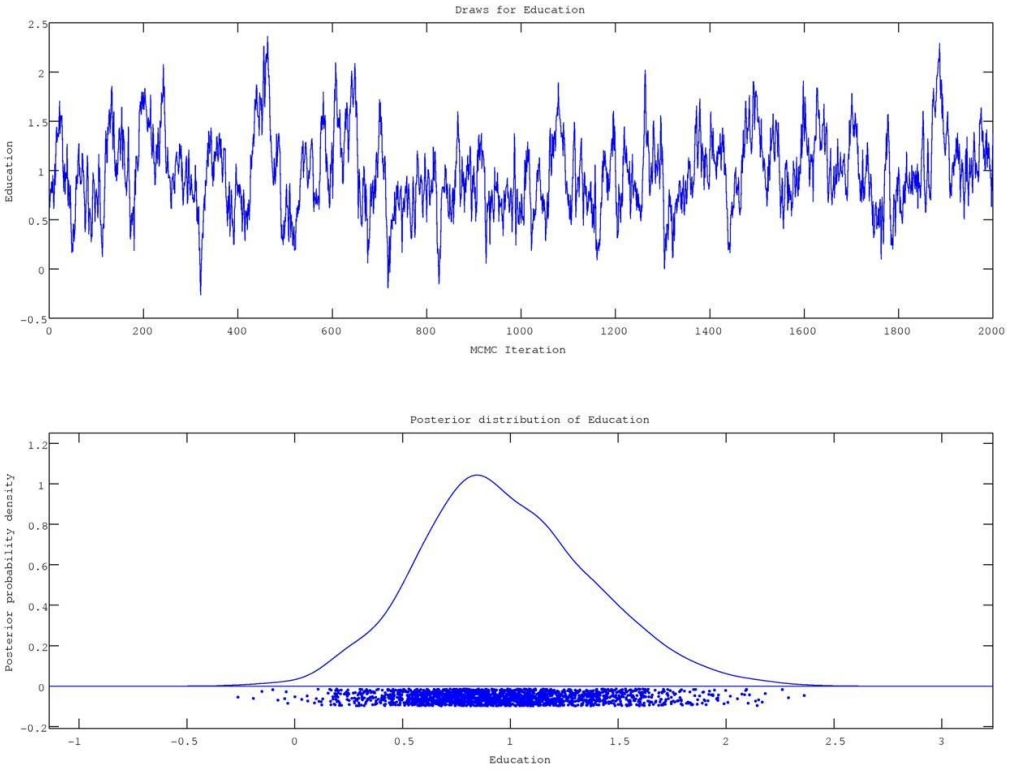

Figure 6.32 Sample Paths and Posterior Probabilities for the Parameter Education

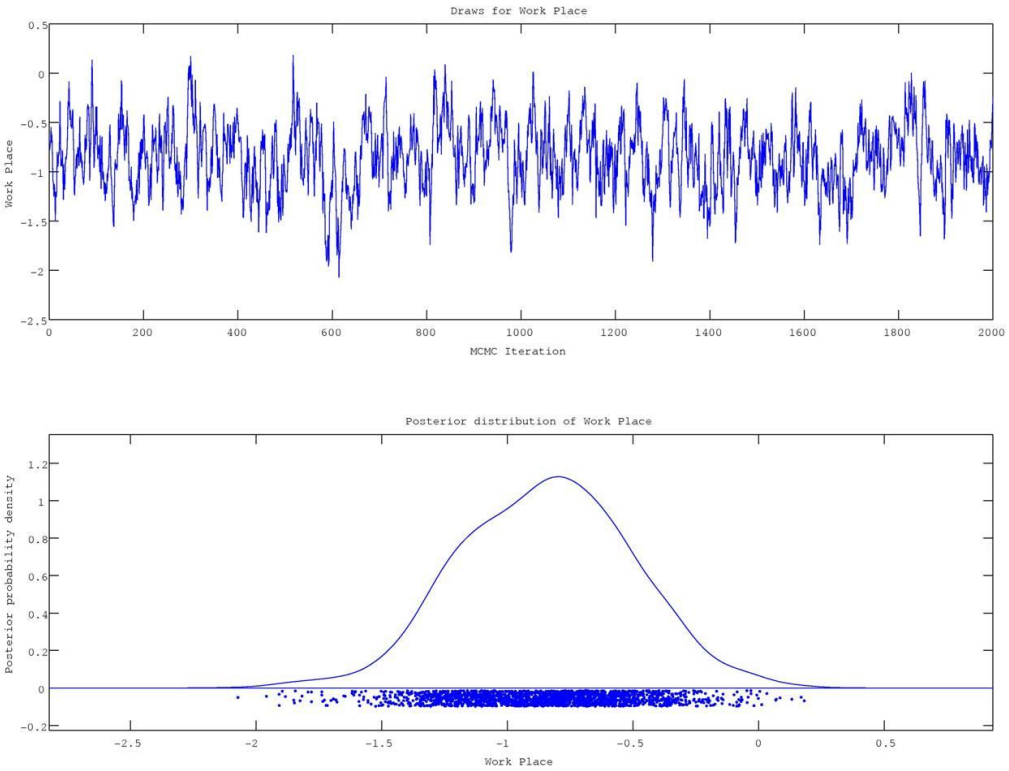

Figure 6.33 Sample Paths and Posterior Probabilities for the Parameter Working Place

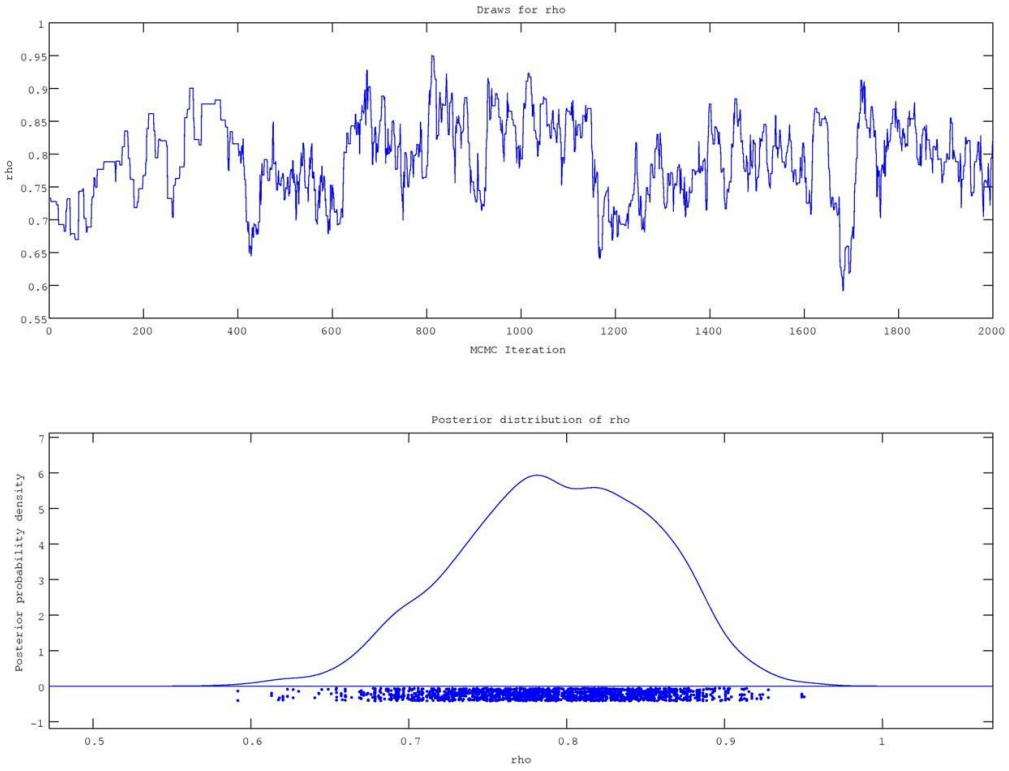

Figure 6.34 Sample Paths and Posterior Probabilities for the Parameter Rho

E4. W12 - Inverse of Geographic Distance

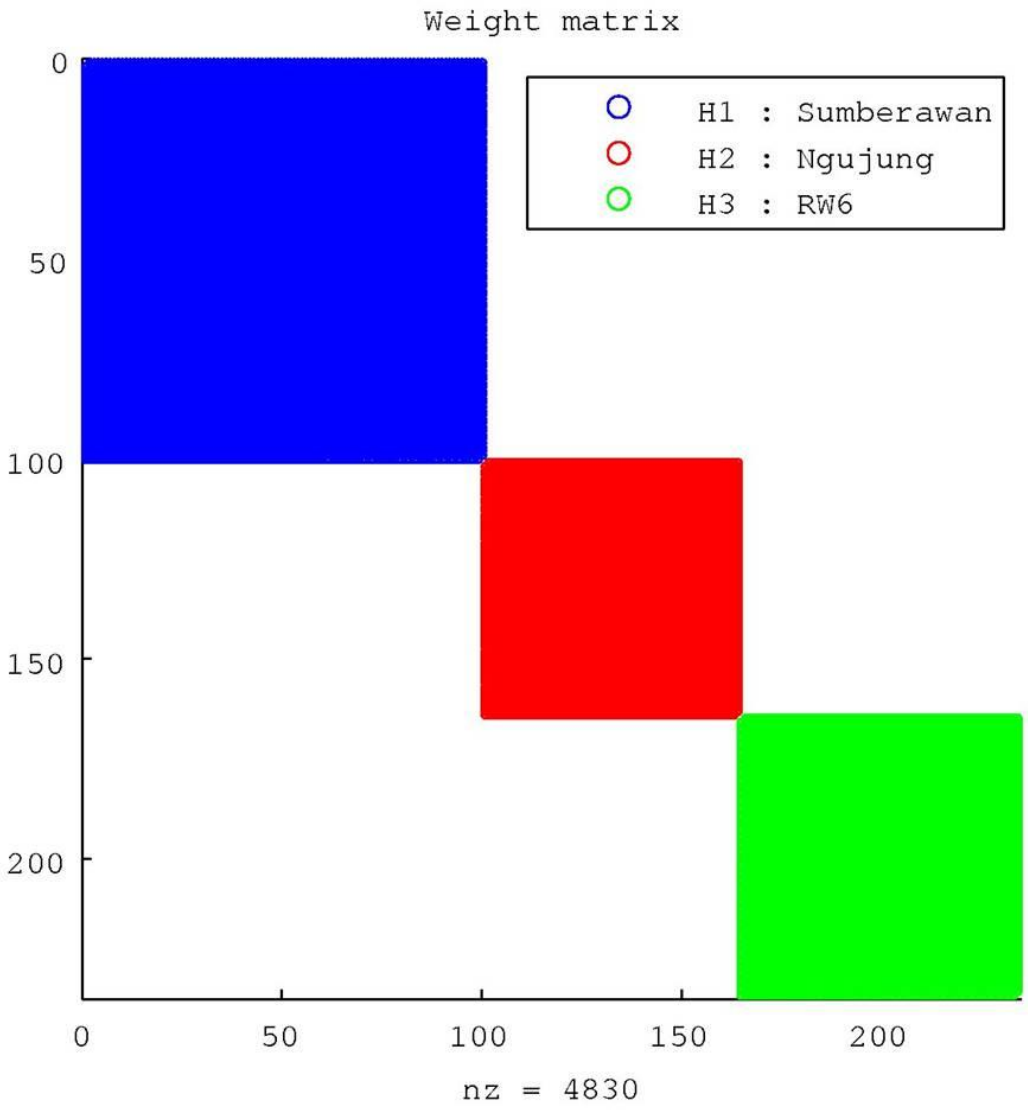

Figure 6.35 Weight Matrix of the Inverse of Geographic Distance

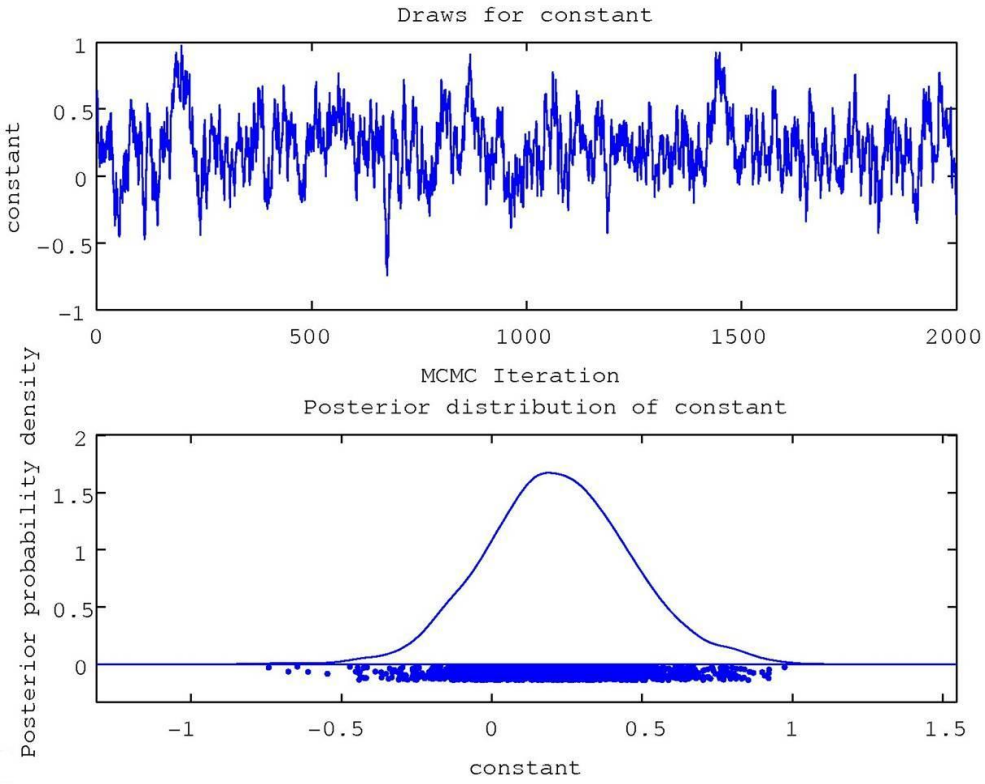

Figure 6.36 Sample Paths and Posterior Probabilities for the Parameter Constant

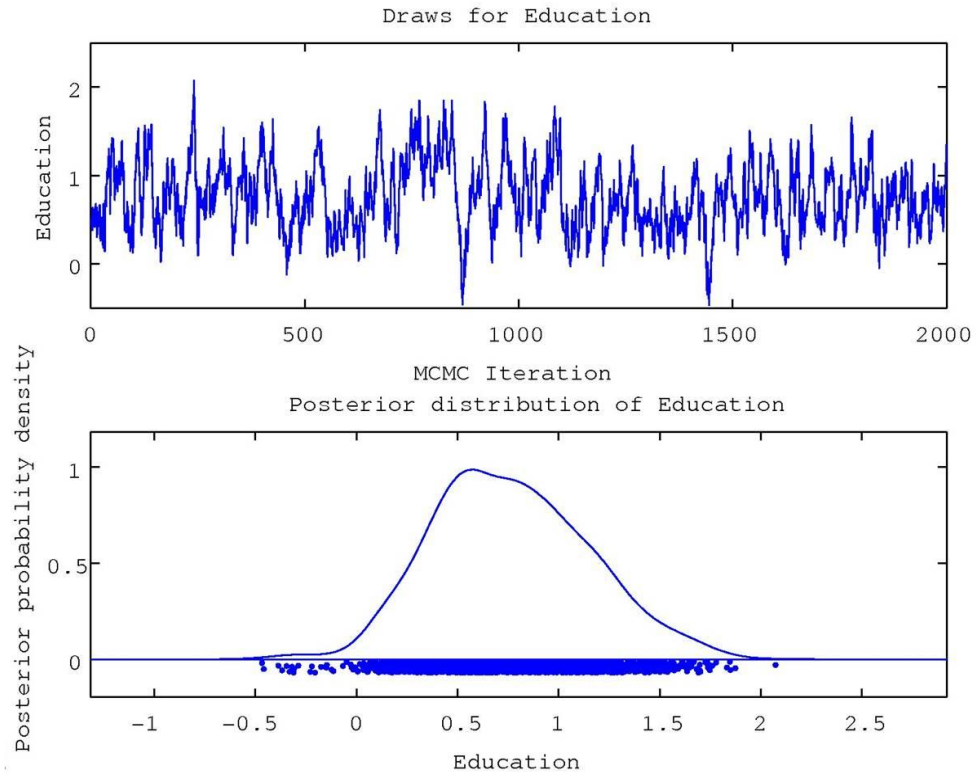

Figure 6.37 Sample Paths and Posterior Probabilities for the Parameter Education

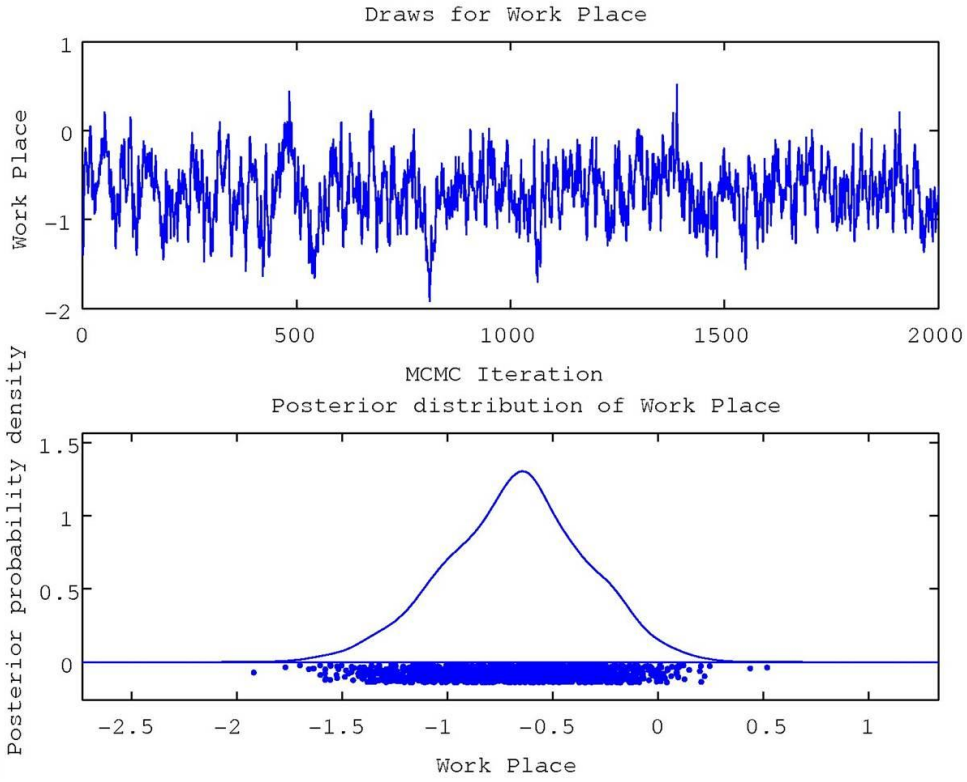

Figure 6.38 Sample Paths and Posterior Probabilities for the Parameter Working Place

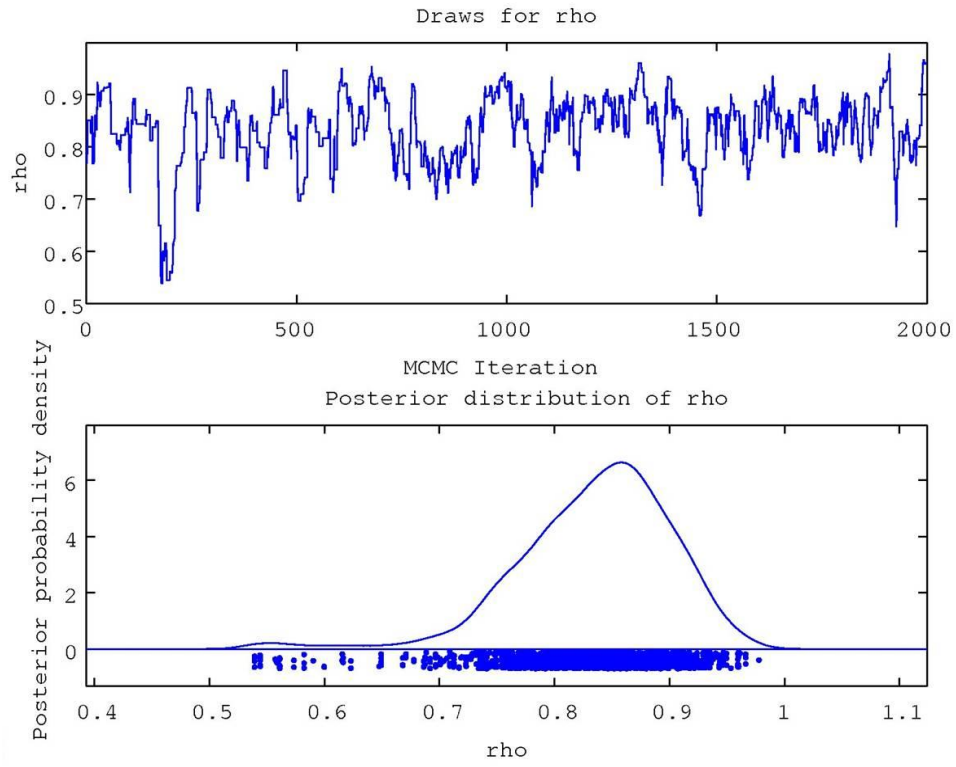

Figure 6.39 Sample Paths and Posterior Probabilities for the Parameter Rho

E5. W21 - Cosine Similarity of Membership in Community Group

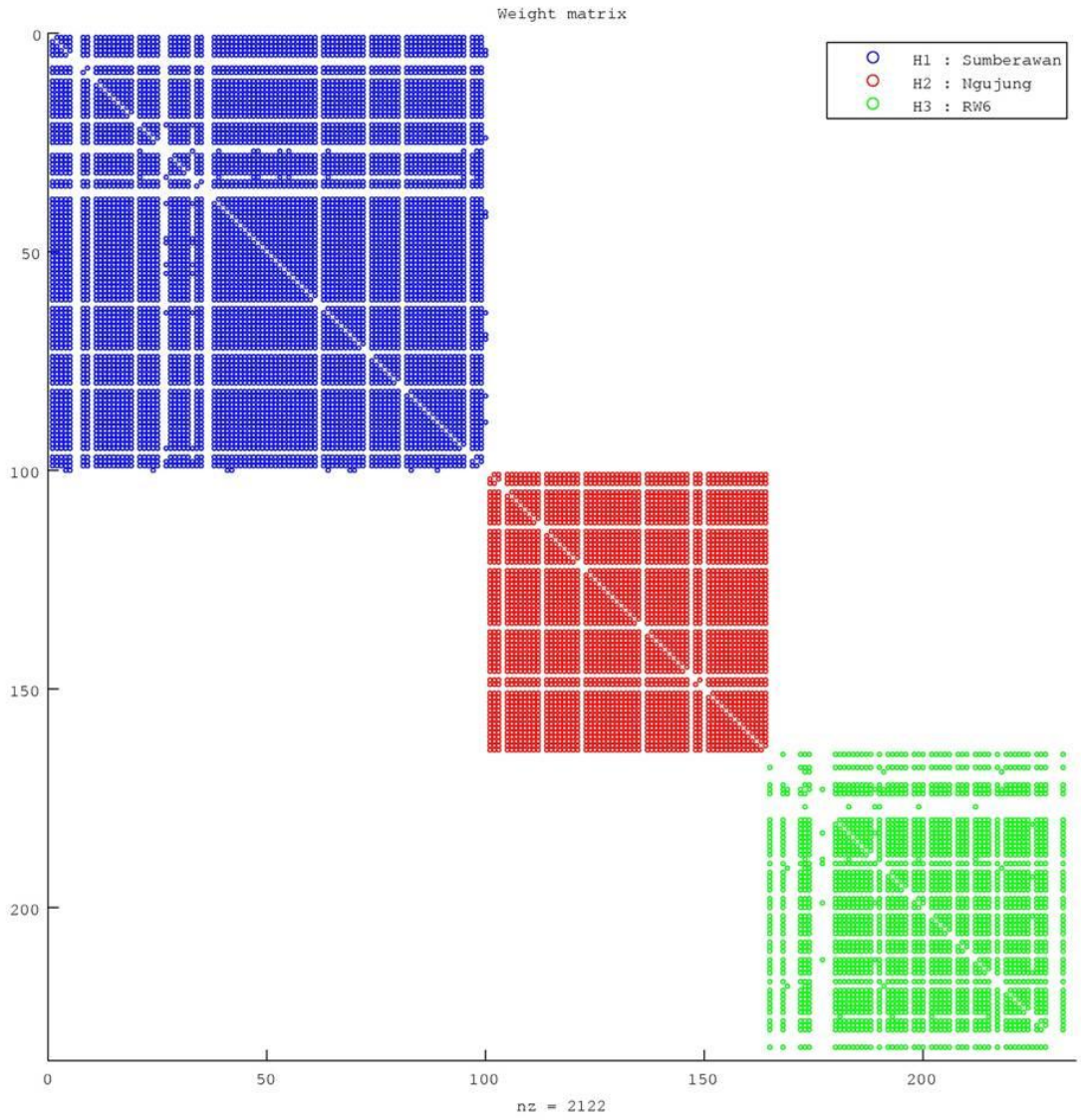

Figure 6.40 Weight Matrix of the Cosine Similarity in Community Group

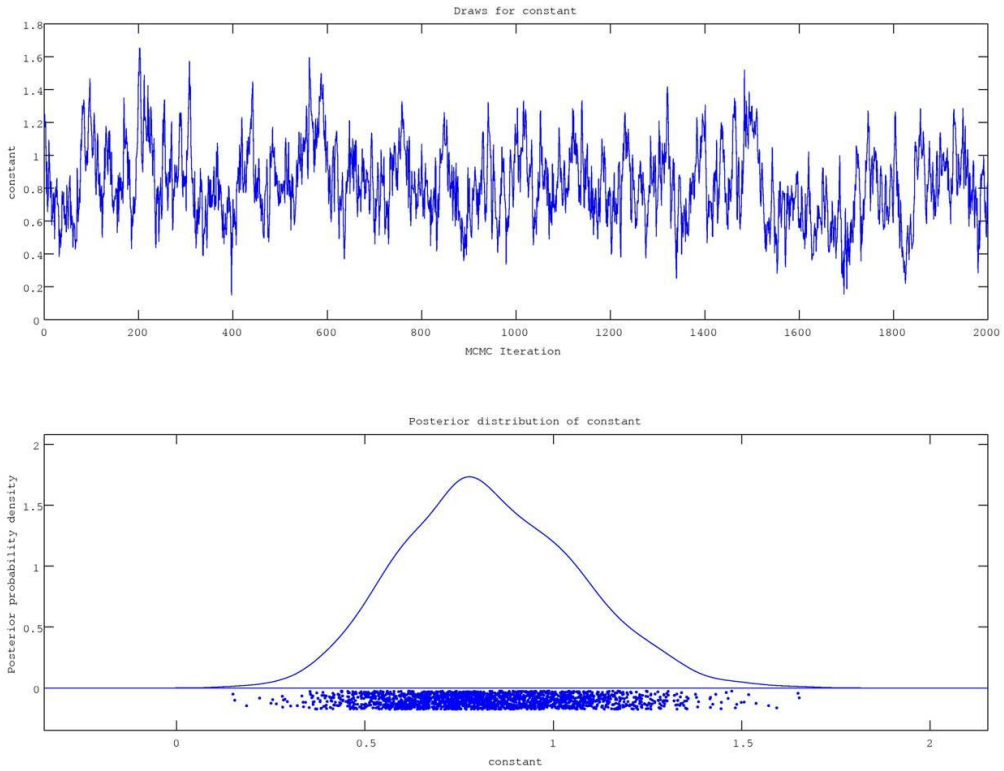

Figure 6.41 Sample Paths and Posterior Probabilities for the Parameter Constant

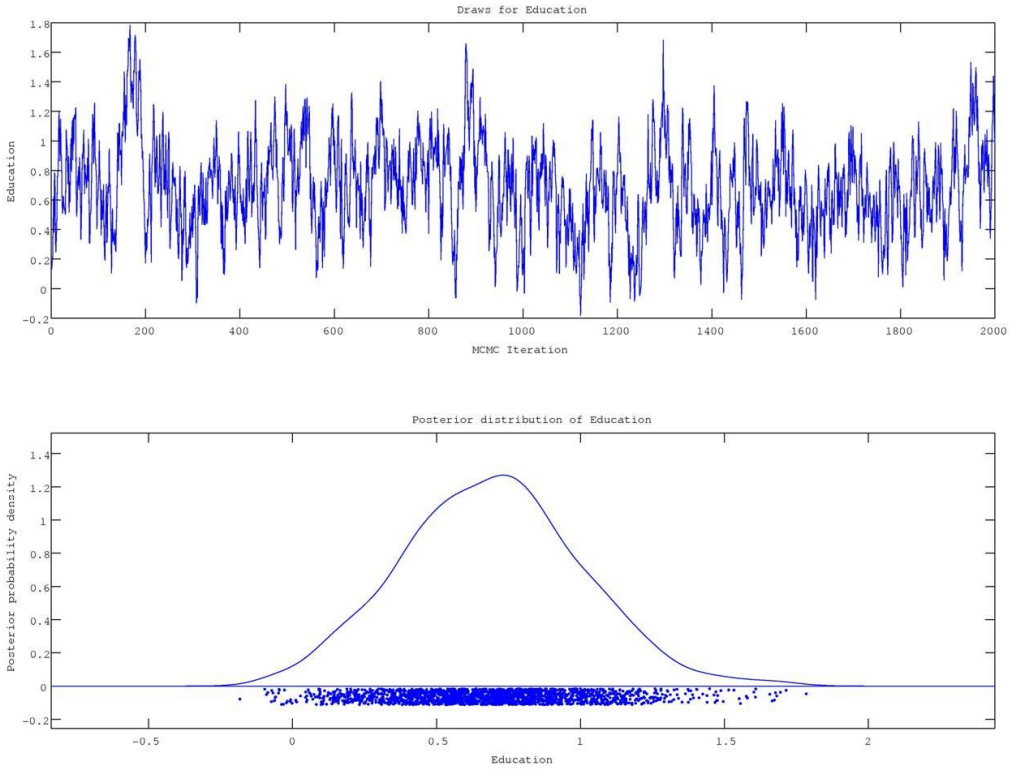

Figure 6.42 Sample Paths and Posterior Probabilities for the Parameter Education

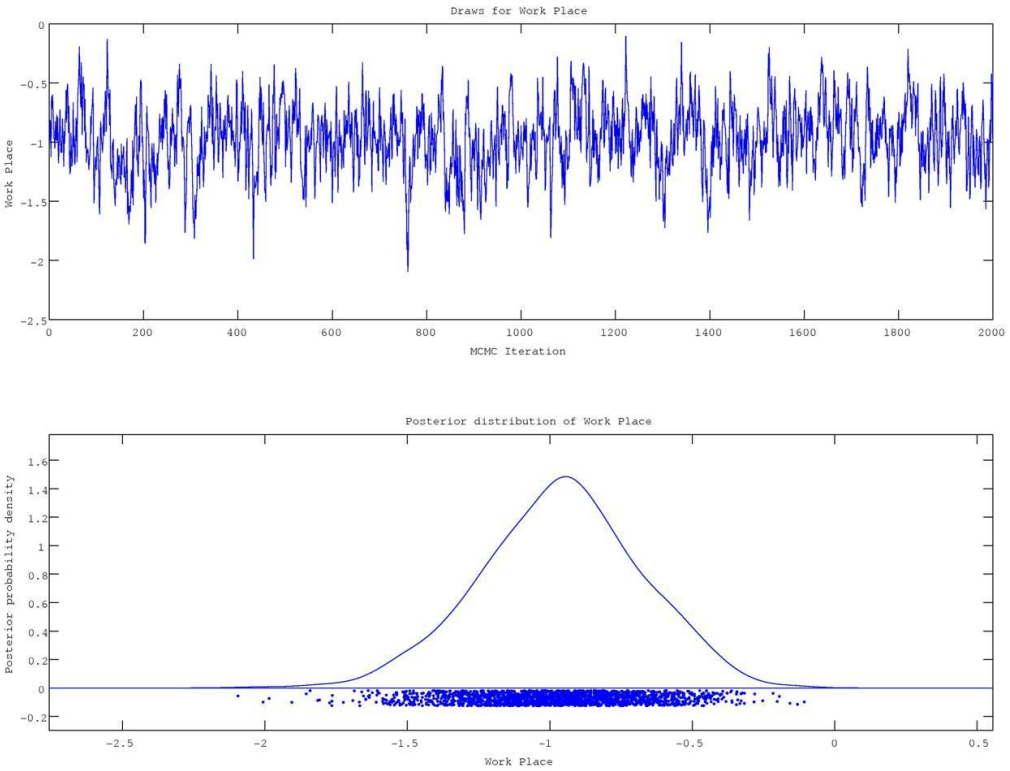

Figure 6.43 Sample Paths and Posterior Probabilities for the Parameter Working Place

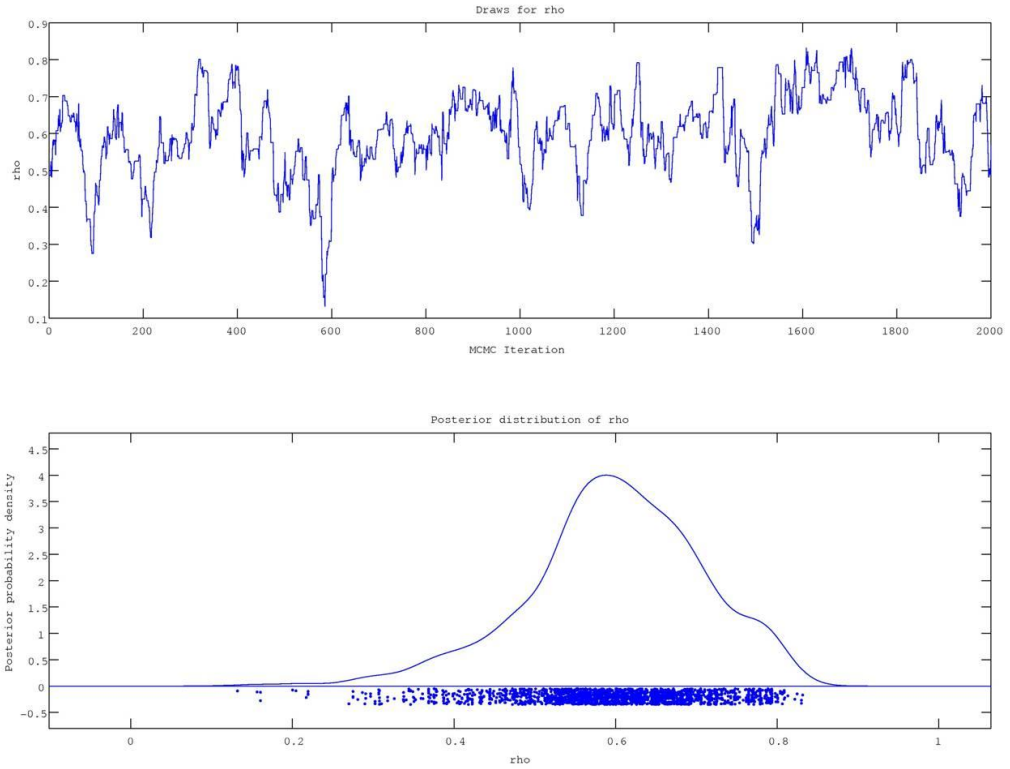

Figure 6.44 Sample Paths and Posterior Probabilities for the Parameter Rho

E6. W22 - Inverse of Geodesic Distance Membership in Community G.

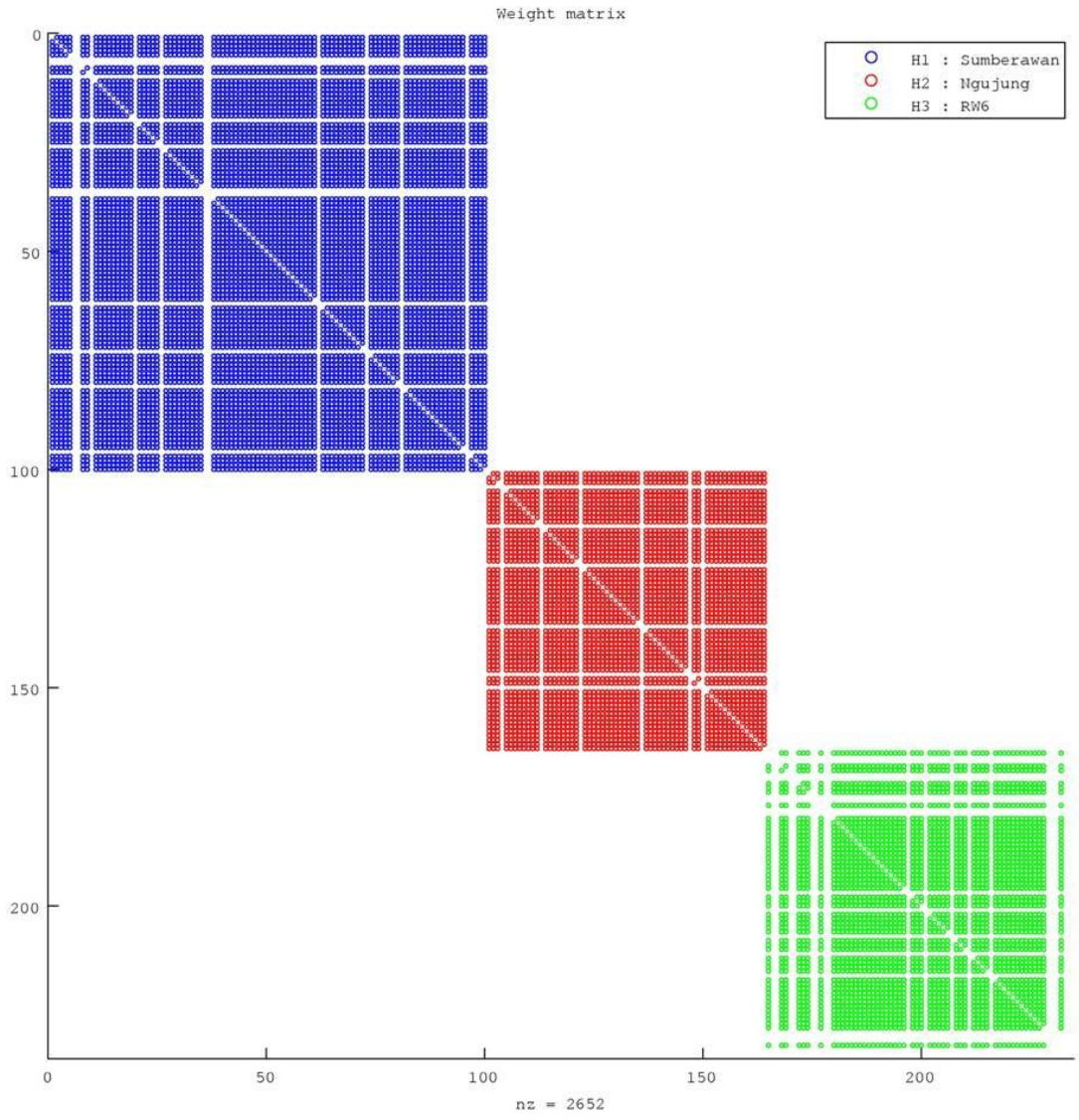

Figure 6.45 Weight Matrix of the Inverse Geodesic Distance

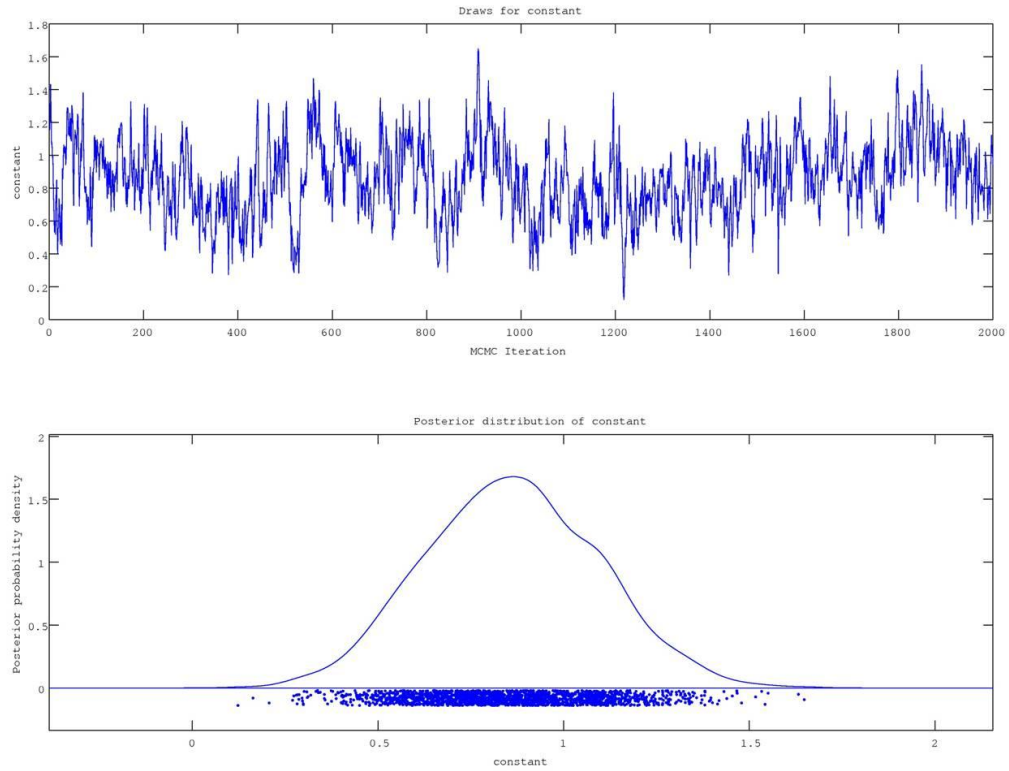

Figure 6.46 Sample Paths and Posterior Probabilities for the Parameter Constant

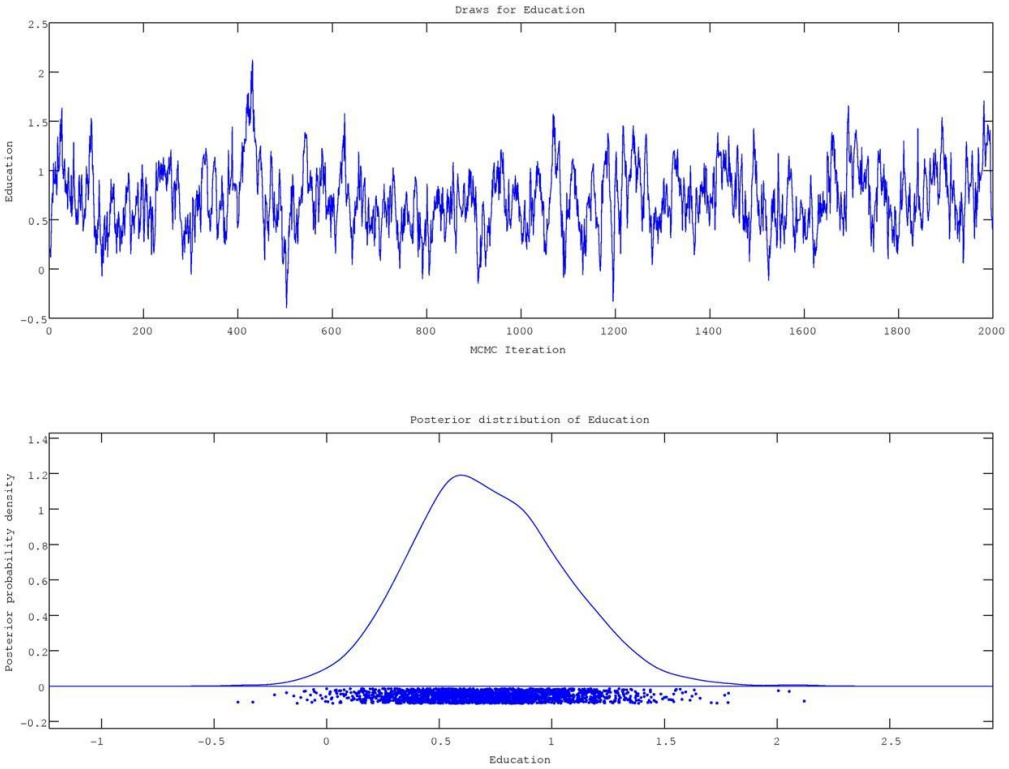

Figure 6.47 Sample Paths and Posterior Probabilities for the Parameter Education

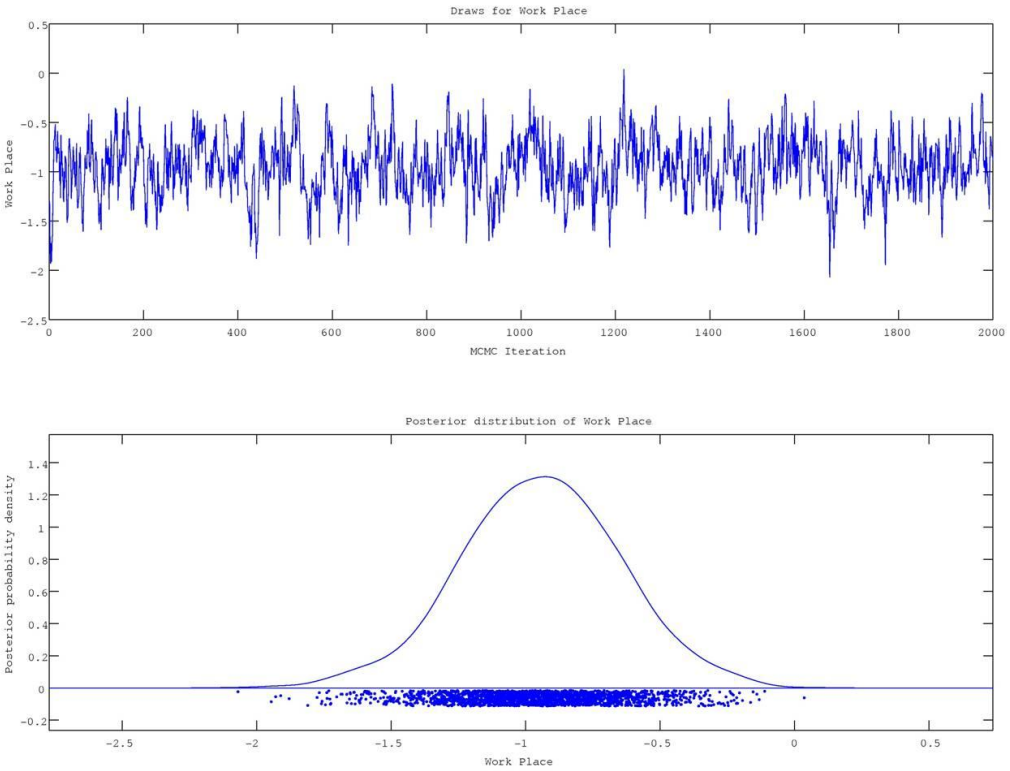

Figure 6.48 Sample Paths and Posterior Probabilities for the Parameter Working Place

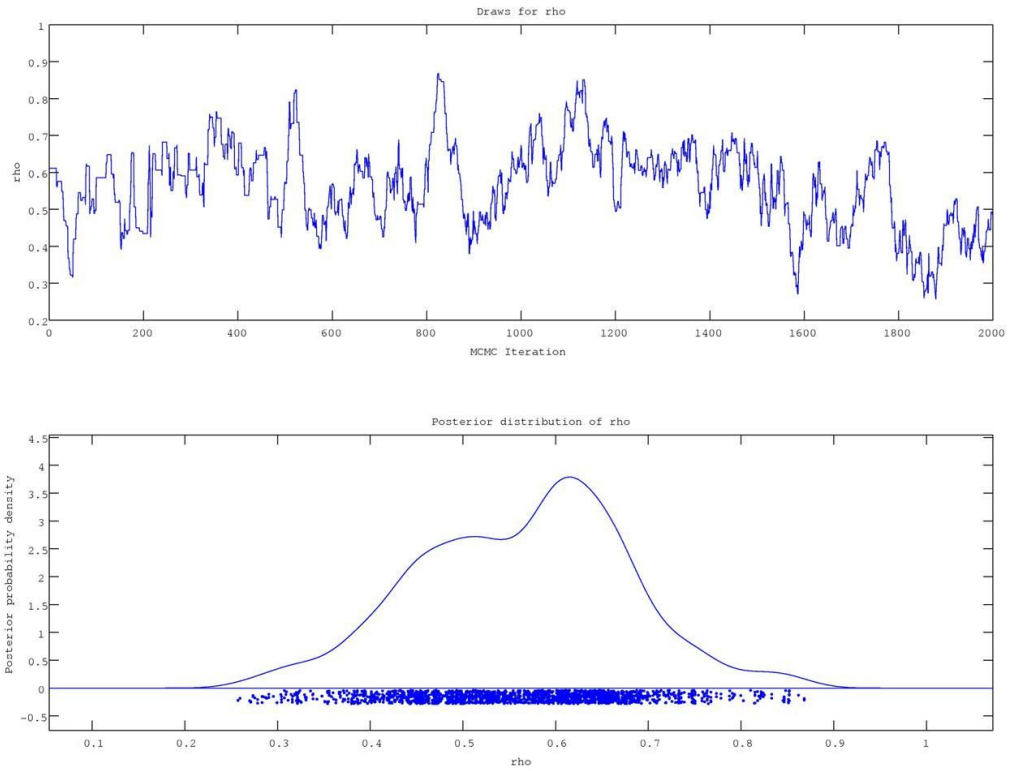

Figure 6.49 Sample Paths and Posterior Probabilities for the Parameter Rho

E7. W3 - Cosine Similarity of Demographic Attributes

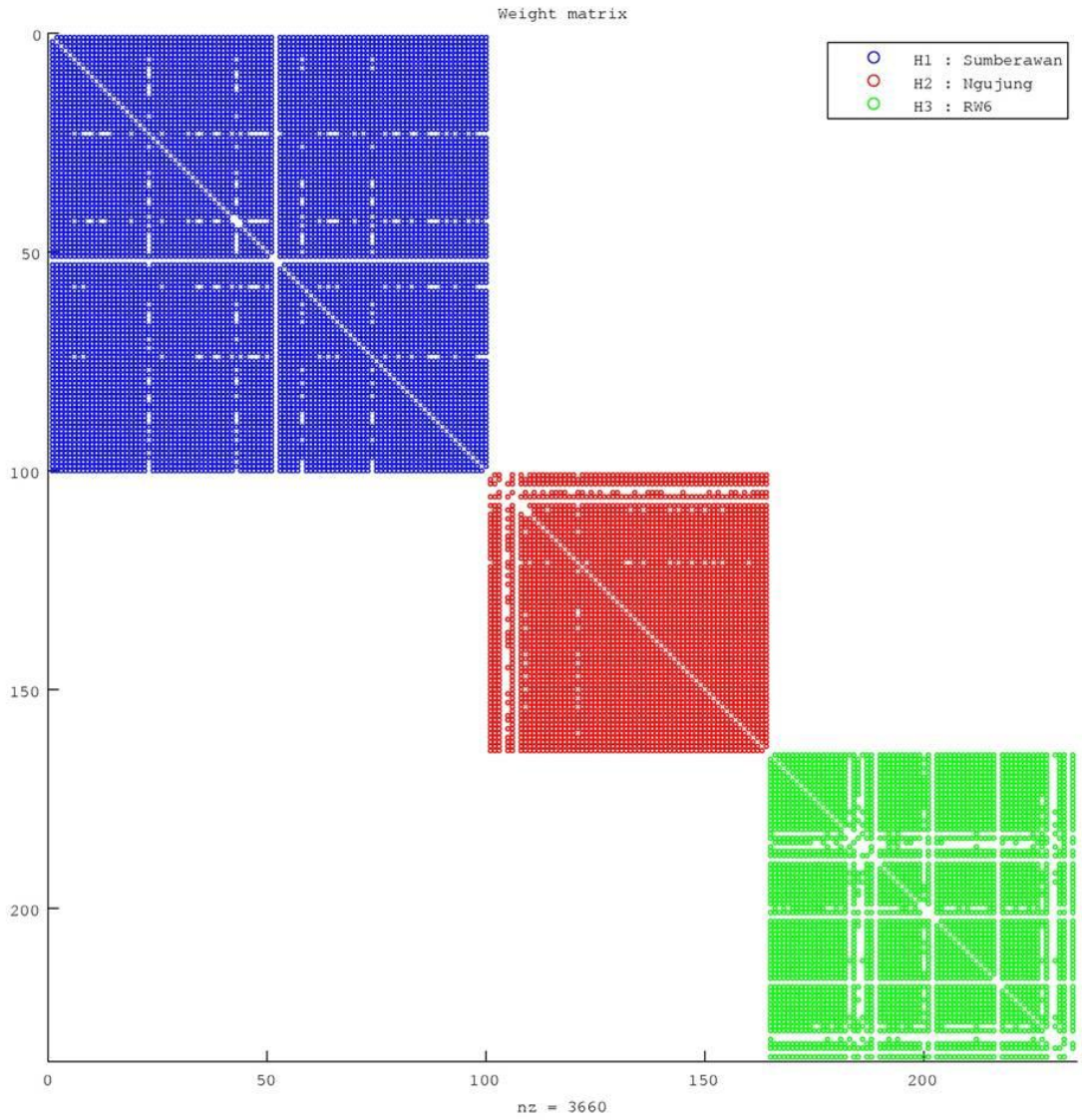

Figure 6.50 Weight Matrix of the Cosine Similarity of Attribute

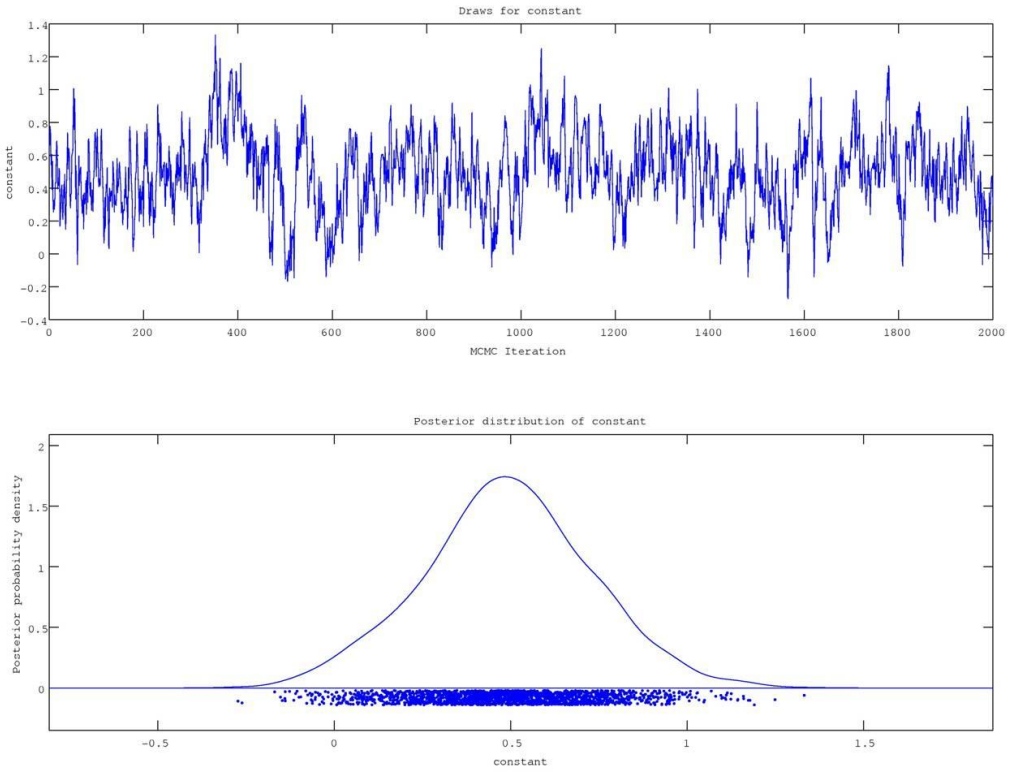

Figure 6.51 Sample Paths and Posterior Probabilities for the Parameter Constant

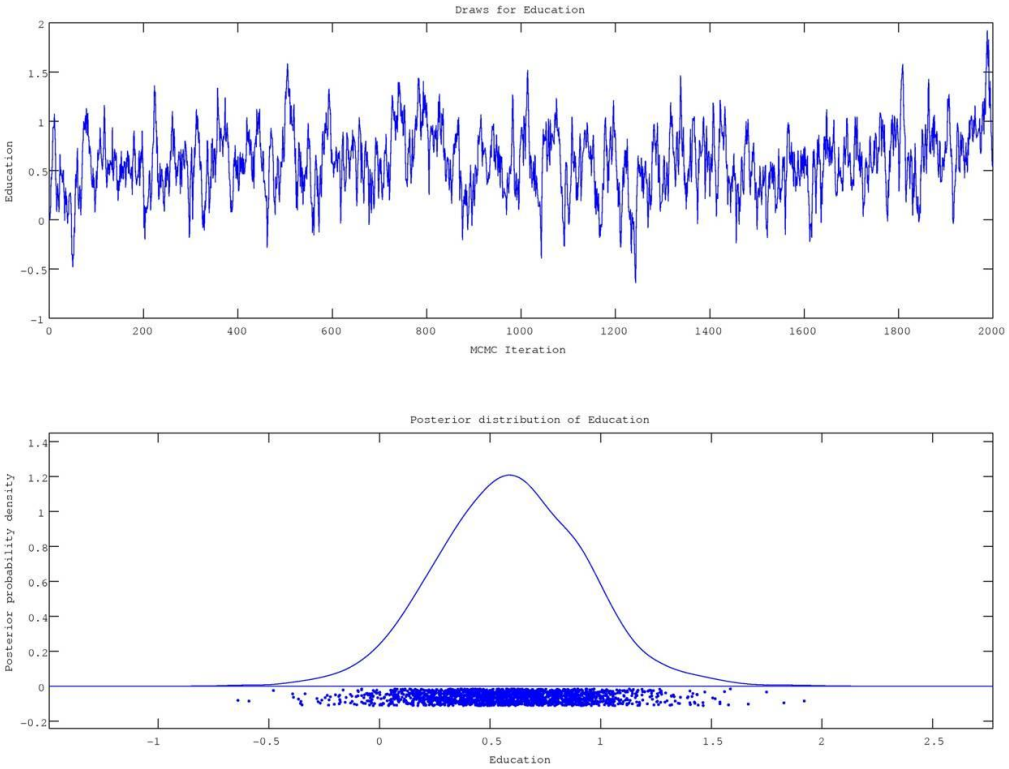

Figure 6.52 Sample Paths and Posterior Probabilities for the Parameter Education

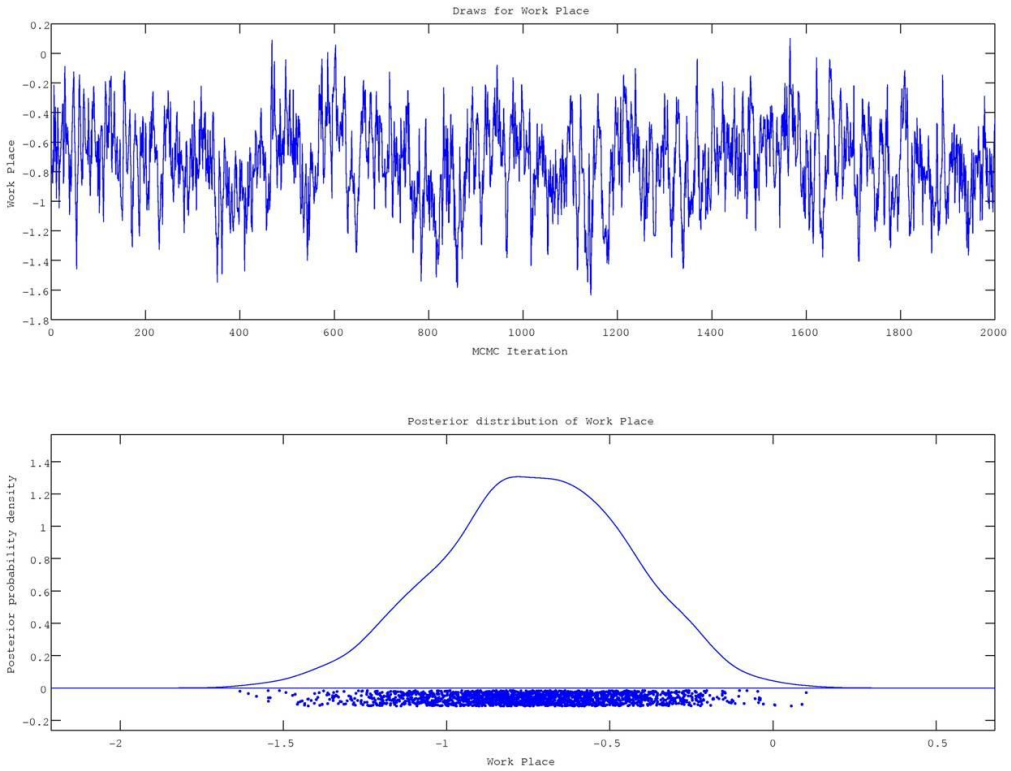

Figure 6.53 Sample Paths and Posterior Probabilities for the Parameter Working Place

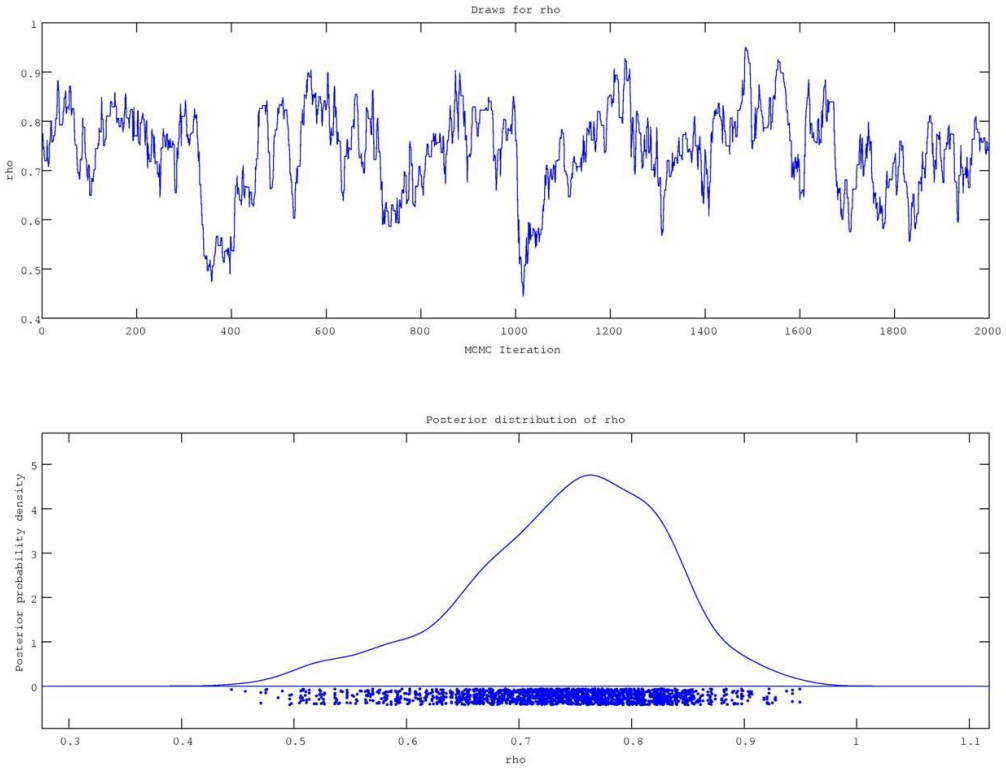

Figure 6.54 Sample Paths and Posterior Probabilities for the Parameter Rho

Appendix F
Household Questionnaire Survey

Household Questionnaire Survey 2008

1 General Information

1.1 Respondent's Name: _____

1.2 Respondent's Address : _____

1.3 Sex of Respondent : 1 Male 2 Female

1.4 Members of the household

	Father	Mother	Children 1	Children 2		
Age						
Sex						
Education						
Occupation						

1.5 Location of the work place:

At home	[ ] 1
Within the community, inside Sub village	[ ] 2
Outside community, inside Sub village	[ ] 3
Outside Sub village, inside the Village	[ ] 4
Outside the Village, inside District	[ ] 5
Outside District, inside Regency	[ ] 6
Another Regency/City	[ ] 7

1.6 The time and means to reach work place from home: _____ hr./min. by_____

1.7 The range of household income per month: (in Rupiah)

Less than 500.000	[ ] 1
500.000 – 1.000.000	[ ] 2
1.000.000 – 1.500.000	[ ] 3
1.500.000 – 2.000.000	[ ] 4
2.000.000 – 2.500.000	[ ] 5
2.500.000 – 3.000.000	[ ] 6
More than 3.000.000	[ ] 7

1.8 The length of respondent has been lived in this area/community: _____ Years

1.9 Description of one day activity of Respondent during 24 hours:
(e.g. of activities: working, cooking, shopping, voluntary, fishing)

Time	Activity	Time	Activity

2 Water Supply Management System

2.1 Please give me a description of drinking water usage in domestic needs based on your daily use, both during rainy season and dry season.

Water supply in Rainy Season					
	Source	**Liters/day**	**Price/day**	**Means**	**Time/day**
Individual Well					
Communal Well					
HIPAM					
PDAM					
Private Vendor					
River					
Other (specify)					
Water supply in Dry Season					
	Source	**Liters/day**	**Price/day**	**Means**	**Time/day**
Individual Well					
Communal Well					
HIPAM					
PDAM					
Private Vendor					
River					
Other (specify)					

2.2 Please give me a description of rule on drinking water usage, both during rainy season and dry season

Water supply in Rainy Season				
	Liters/day	**Price/day**	**Means**	**Time/day**
Individual Well				
Communal Well				
HIPAM				
PDAM				
Private Vendor				
River				
Other (specify)				
Water supply in Dry Season				
	Liters/day	**Price/day**	**Means**	**Time/day**
Individual Well				
Communal Well				
HIPAM				
PDAM				
Private Vendor				
River				
Other (specify)				

2.3 Do you satisfied in current drinking water condition? What is your needs and expectation?

Water	**Satisfaction**			**Needs and Expectation**
	good	**average**	**bad**	
Taste				
Quantity				
Quality (sanitation)				
Price				
Availability				

2.4 If there is any problem with water such as a water pipe broke, how do you do?
(a) Fix it by myself
(b) Ask neighbor any help to fix it together
(c) Contact to water management body (PDAM, HIPAM) for asking to fix it
(d) No idea and leave it
(e) Else, specify…(_____)

2.5 Regarding to your answer in 2.7, what is the main reason to choose the answer?
(a) Cost
(b) Time
(c) Effort
(d) Quality
(e) Safety

2.6 What is your opinion to improve or solve the problem related to the current water management system?
(a) _____
(b) _____

3 Community Network

3.1 What is the meaning of the group that you belong to? Use this 5 point scale where 1 means the group has no meaning/benefit and 5 means the group has very important/benefit to the community.

Type of Groups	Check for Joint	How many groups	Meeting/ month	Order of importance	Order of benefit
Religious					
Cultural/Social					
Basic Services					
- PDAM					
- HIPAM					
Ethnic based					
Community organization					
Finance					
Production					
Union (labor, trade)					
Political party					
Professional association					
Business Ass.					
Social Movement					
Any other? specify					

3.2 Do people in the community generally trust one another in matters of lending and borrowing?

Yes [ ] 1
No [ ] 2

3.3 In the last three years, has the level of trust improved, worsened, or stayed the same?

Improved [ ] 1
Worsened [ ] 2
Remained the same [ ] 3

3.4 Do you agree or disagree with the following statement: People here look out mainly for the welfare of their own families and they are not much concerned with community welfare.

Strongly agree [ ] 1
Agree [ ] 2
Disagree [ ] 3
Strongly disagree [ ] 4

3.5 Will you list here, please, the initials of the people outside your household that you feel closest to. These could be friends, neighbors or relatives. Start with the one you feel closest to, then next closest and so on.

(a) _____
(b) _____
(c) _____
(d) _____
(e) _____
(f) _____

3.6 Regarding to your answer in 3.5, will you please fill the table below, the detail relationship among of you.

Relationship to respondent	Sex		What is his/her occupation? (If not working get record occupation of household & mark alongside *	Where does he/ she live?	How often do you see him/her?	By what are you in touch with him/her? (phone/ letter/face to face)	How long you communicate with him/her?
	M	F					
(a)	1	2					
(b)	1	2					
(c)	1	2					
(d)	1	2					
(e)	1	2					
(f)	1	2					

3.7 Regarding to your previous answer, please tell me which of the people whose initials are on your sheet of paper are close to one another.

Which of these people are close to Person (…) ?					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
	(a)	(a)	(a)	(a)	(a)
(b)		(b)	(b)	(b)	(b)
(c)	(c)		(c)	(c)	(c)
(d)	(d)	(d)		(d)	(d)
(e)	(e)	(e)	(e)		(e)
(f)	(f)	(f)	(f)	(f)	
none	none	none	none	none	none

3.8 Please marked one answer only for each question related to occupation of the head of household, or the head of his/her household.

Which of these people do you now work with at your place of employment?	Which of these do you get together with informally?	Which of these do you rely on for help in everyday matters?	Which of these do you rely on for help in an emergency?	Which of the people rely on you for help in an emergency?	Which one of these people have you turned to most for help in an emergency?
(a)	1	1	1	1	1
(b)	2	2	2	2	2
(c)	3	3	3	3	3
(d)	4	4	4	4	4
(e)	5	5	5	5	5
(f)	6	6	6	6	6
None	7 None	7 None	7 None	7 None	7 None

Household Questionnaire Survey 2010

1 General Information

1.1 Respondent's Name : _____

1.2 Respondent's Address : _____

1.3 Sex of Respondent : 1 Male 2 Female

1.4 Members of the household

	Father	Mother	Children 1	Children 2		
Age						
Sex						
Education						
Occupation						

1.5 Number of household that they are your relative who live in the same community

Family 1	**Father**	**Mother**	**Children 1**	**Children 2**		
Age						
Education						
Occupation						
Family 2	**Father**	**Mother**	**Children 1**	**Children 2**		
Age						
Education						
Occupation						
Family 3	**Father**	**Mother**	**Children 1**	**Children 2**		
Age						
Education						
Occupation						
Family 4	**Father**	**Mother**	**Children 1**	**Children 2**		
Age						
Education						
Occupation						
Family 5	**Father**	**Mother**	**Children 1**	**Children 2**		
Age						
Education						
Occupation						

2 Water Supply Management System

2.1 Please describe detail information your group of HIPPAM if your answer of 2.1 is HIPPAM

HIPPAM		
Name of group		
Management	Leader	Name: Address:
	Treasurer	Name: Address:
	Technical	Name 1: Address 2: Name 2: Address 2:
Number of member		
Location		
Rule in water usage	price	
	meeting	
	others	

2.5 These are six options to improve water management system. Use this 3 point scale where 1 means less important, 2 means important and 3 means very important to improve current water management.

A: Management Improvement (organization system)	1	2	3
B: Official/Staff Performance	1	2	3
C: Physical Network Improvement	1	2	3
D: Fare Betterment	1	2	3
E: Landscape Preservation	1	2	3
F: Community Participation	1	2	3

2.6 How the representative of community may change in order to keep the community facility well-organized?

Yes No

2.7 Do you want to change your water resources? Circle one among two options: Yes or No. If your answer is Yes, to which water service provider you prefer? What is your reason? (For both answer Yes and No)

Yes / No

Reason _____

_____

_____

3 Community Network

3.1 Please check one column in this table to describe your opinion about your living environment using 5 scales where 5 means very much until 1 means least meaning.

Opinion	**1**	**2**	**3**	**4**	**5**
I feel proud of this area/community					
I think nature and scenery in this area/community are great					
I think availability of foods in this area/community are great					
It is important to participate in the local event					
It is important to collaborate with to make this area/community better					
It is important to join in educational activities for the growth of local children					
It is important to listen other's problem					
It is important to keep having a daily relationship with neighbors					
It is important to take care of a single or elderly person					
It is important to maintain regional grave yard					
It is important to manage relationship with your relatives in the area/community					
People in this area/community are important for me					
I want to continue living in this area/community					

Achievements

I	International Conference	Role
1	Ari Ismu Rini Dwi, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Hayeong JEONG: Water Supply System in Singosari District Malang Regency, Case Study: Toyomarto & Candi Renggo Village, The 1st International Workshop on Water Supply Management System and Social Capital, Bandung Institute of Technology, March 20, 2009	Present a paper
2	Ismu Rini Dwi Ari, Access to Water and Community Network, A case of Singosari district, Malang regency, Indonesia, The 6th Workshop on Social Capital and Development Trends in the Japanese and Sweden Countryside, Ishigaki Island, Japan, July 1-2, 2009	Present a paper
3	Ismu Rini Dwi Ari, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Hayeong JEONG: Access to Water And Community Network Participatory Approach To Community Managed Water Supply System, The 40 Conference of Japan Society Civil Engineering (JSCE), Kanazawa University, November 21 - 23, 2009	Present a paper
4	Ismu Rini Dwi Ari, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Hayeong JEONG, Kenshiro OGI: Investigating on Community Based Water Management: Club Goods and Community Network, The 2nd International Workshop on Water Supply Management System and Social Capital, ITS Surabaya, Indonesia, March 15-16, 2010	Present a paper
5	Kenshiro OGI, Ismu Rini Dwi Ari, Hayeong JEONG, Kakuya MATSUSHIMA, Kiyoshi KOBAYASHI: Participatory Approach to Community Based Water Supply System, The 2nd International Workshop on Water Supply Management System and Social Capital, Sepuluh Nopember Institute of Technology, March 15-16, 2010	Co-author
6	Kenshiro OGI, Ismu Rini Dwi Ari, Hayeong JEONG, Kakuya MATSUSHIMA, Kiyoshi KOBAYASHI: Participatory Approach to Community Based Water Supply System, The 50 ERSA Conference, Jonkoping, Sweden, August 19-23, 2010	Co-author (not attend)
7	Ismu Rini Dwi Ari, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Kenshiro OGI: Community Network, Social Capital and Access to Drinking Water, The 42nd Conference of Japan Society Civil Engineering (JSCE), Yamanashi University, November 21-23, 2010	Present a paper
8	Ismu Rini Dwi Ari, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Hayeong JEONG, Kenshiro OGI: An Empirical Research on Community Network, Social Capital and Access to Water, International Conference SUSTAIN2010, Kyoto University, December 11-12, 2010	Present a paper

9	Ismu Rini Dwi Ari, Kenshiro OGI , Kakuya MATSUSHIMA and Kiyoshi KOBAYASHI: Structure of Social Network: Centrality and Cohesion, A Case of Access to Clean Water, The 3rd International Conference on Water Supply Management System and Social Capital, Brawijaya University, Malang, Indonesia, February 21-22, 2011	Present a paper
II	**Publication**	**Role**
1	Ari Ismu Rini Dwi, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Hayeong JEONG: Water Supply System in Singosari District Malang Regency, Case Study: Toyomarto & Candi Renggo Village, Kyoto University HSE Technical Report Series 026, The 1st International Workshop on Water Supply Management System and Social Capital, 2009	1st Author
2	Hayeong JEONG, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Ari Ismu Rini Dwi: A Study on Poverty Problem by Resource Scarcity- A Literature Review on Responsibility and Welfare, Kyoto University HSE Technical Report Series 026, The 1st International Workshop on Water Supply Management System and Social Capital, 2009	Co-author
3	Ismu Rini Dwi Ari, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Hayeong JEONG: Access to Water And Community Network Participatory Approach To Community Managed Water Supply System, The 40 Proceedings of Infrastructure Planning and Management, JSCE, 2009	1st Author
4	Ismu Rini Dwi Ari, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Hayeong JEONG: An Empirical Research on Access to Water: Water Issues and Public Opinions, Chapter 5, pp.65-80, in K. Kobayashi and I. Syabri (eds.) Water Supply Management System and Social Capital Volume 1, Institut Teknologi Bandung Press, 2010, ISBN: 978-602-96625-0-4	1st Author
5	H. Jeong, K. Kobayashi, K. Matsushima, A.R.D.Ismu: A Study on Poverty Problem by Resource Scarcity - A Literature Review on Responsibility and Welfare, Chapter 4, pp.50-64, in K. Kobayashi and I. Syabri (eds.) Water Supply Management System and Social Capital Volume 1, Institut Teknologi Bandung Press, 2010, ISBN: 978-602-96625-0-4	Co-author
6	Ismu Rini Dwi Ari, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Kenshiro OGI: Community Network, Social Capital and Access to Drinking Water, The 42 Proceedings of Infrastructure Planning and Management, JSCE, 2010	1st Author

7	Ismu Rini Dwi Ari, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Hayeong JEONG, Kenshiro OGI: An Empirical Research on Community Network, Social Capital and Access to Water, The Proceedings of International Conference SUSTAIN2010, 2010	1st Author
8	Ismu Rini Dwi Ari, Kiyoshi KOBAYASHI, Kakuya MATSUSHIMA, Hayeong JEONG and Kenshiro OGI: Investigating on Community Based Water Management: Club Goods and Community Network, Chapter 5, pp.57-71, in K. Kobayashi and J. Permana (eds.) Water Supply Management System and Social Capital Volume 2, Institut Teknologi Sepuluh Nopember (ITS) Press, 2011, ISBN: 978-602-95595-3-8	1st Author
9	Kenshiro OGI, Ismu Rini Dwi Ari, Hayeong JEONG, Kakuya MATSUSHIMA and Kiyoshi KOBAYASHI: Participatory Approach to Community Based Water Supply System, Chapter 7, pp.79-92, in K. Kobayashi and J. Permana (eds.) Water Supply Management System and Social Capital Volume 2, Institut Teknologi Sepuluh Nopember (ITS) Press, 2011, ISBN: 978-602-95595-3-8	Co-author
10	Ismu Rini Dwi Ari : Access to Water and Community Network – A Case of Singosari District, Malang Regency, Indonesia, Chapter 9, pp. 113-127, in K.Kobayashi, H. Westlund and H. Jeong (eds.) Social Capital and Development Trends in Rural Areas, Marginal Areas Research Group (MARG) Kyoto University, 2011, ISBN: 978-4-907830-07-6	Author