

*Proceedings of International Conference : Issues, Management And Engineering In The Sustainable Development On Delta Areas
Semarang, Indonesia – February 20th, 2015
Paper No. XXX (The number assigned by the OpenConf System)*

The Social Aspects in Water Management of Semarang's Drainage System (Case Study of Banger Polder and Water Board BPP Sima)

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Abstract-The climate is changing, rainfall will increase, the sea level is rising and the river discharges will change more. Delta areas are faced with the increasing risk of flooding. A traditional solution against flooding is the Dutch polder system. These polder areas in the Netherlands are for many years managed and maintained by water boards. The Dutch water board model has not been used much in other countries. At this moment it is not known what the social aspects of water management are, which are important in the implementation of a polder system and institute in another cultural context outside the Netherlands. For this research, the Banger Polder pilot Project in Semarang is used as a case study, where a polder is constructed and the first public organization for water management in Indonesia has been established. The new water board named BPP SIMA, is similar to the Dutch water board model and is responsible for creating and maintain of dry feet in the area. The water board should work with the stakeholders to know what the important aspects of the social side in water management are.

This research looked at the available knowledge by the selected stakeholders, the acceptance of the water fee and the main interest of the selected stakeholders in the Banger polder . The method that is developed in this research gives insights of the social aspects in water management. The focus of this research is on the social dimension of water management. The developed method is the existing three layer model of water governance in combination with a 360 degrees evaluation. The three layer model is a method to analyze the risks and opportunities within the water management. The three layer model consist of three layers, content layer, institutional layer and relational layer. This requires different information which are collected by existing literature, field visits, discussions, surveys and interviews.

In the survey results appears that not all local stakeholders are familiar with the project and BPP SIMA. This is because the communication with the existing hierarchical structure between RW/RT and inhabitants about the knowledge transfer of the project is lacking. According to existing literature in this research, it is important that inhabitants feel involved and feel ownership of the project to increase the acceptance of the water fee. They are the most important stakeholders and must feel involved with the water management. Inhabitants need knowledge about water problems to accept the policy and measures are implemented more efficient.

Keywords: *social aspects, water management*

1. Introduction

According to the government of the Netherlands, a polder is an area which is protected from water by a barrier. The water levels are controlled by a pump. The inlet of water to the polder, like rainfall and seepage, can be consumed or stored; however, if this doesn't happen then it will be pumped out of the area (Rijkswaterstaat, 2011). A polder is a hydraulic engineering unit, because the area is connected with the outside water by an engineering structure (Venster op de vecht, 2014).

In the future, the floods will increase due to the expected climate change. The functioning of a polder system will therefore be more important in counteracting climate change. Polder areas in the Netherlands are for many years managed and maintained by water boards. At the legal level, water is a public good which is managed by a government authority. A water board is a local government in a democratic environment and takes into account the needs of the most important stakeholder, inhabitants. For managing and maintaining the area, a financial system is needed, water fee. The water fee is paid by the inhabitants. To understand the needs and interest of inhabitants, elements such as communication and collaboration are of high importance. It is therefore important that the inhabitants are first aware of water safety so they understand the water issues and the water fee. To achieve a water fee, the social conditions of the stakeholders must be fulfilled to realize the government authority. Hereby, the payer must have awareness about paying the water fee.

2. Fundamental Theory

2.1 Polder System

A polder system is a traditional solution against flooding in the Netherlands. The concept of a polder system is carried out in different countries, in multiple ways. A polder system is applied to regulate the water management in the area. The design of a polder system must take a few aspects into account. An aspect which should be taken into account is that there is climate change that has the potential to cause more heavy rainfall and a rise in sea level. In the polder, the rainfall flows easily from paved areas and unpaved areas into several small canals. A negative effect of this type of rainfall can be the high water levels which result in exceptionally high groundwater levels, resulting in flooding in the area (Overloop, 2006).

The polder system is also affected by land subsidence. A result of sea level rise and changes in rainfall patterns, is that the river discharges increase and the regional water system gets more pressure. For example, climate change leads to risks such as increasing the water levels, the changes in local rainfall, increases in dry peaks and damages because of salinity of irrigation water, urban water and drinking water. These risks are increased by the future land subsidence that leads to the increasing of seepage and costs of maintenance and management of the pump stations. Also, the economical and demographical development plays a roll, because these developments determine the damage caused by flooding. According to the Delta commission, in delta areas, population increase, consequently leads to an increase of damage when there is a flood (Kok, Jonkman, Kanning, Rijcken, & Stijnen, 2008).

2.2 Water Board

A water board, according to the Government of the Netherlands, is a governmental organization comparable to provinces and municipalities. The administrative and juridical

boundaries of waterboards and municipalities overlap, hence their tasks and responsibilities in water management are different. Water boards are responsible for the water management in a certain area (Rijksoverheid, 2014). There are different tasks for a water board in order to manage the water system in the area, like water quantity, flood defences, water quality and urban wastewater treatment (Rijksoverheid, 2014). These tasks differ per project because each water board has its own management area.

In the Netherlands the water boards have an important role of the water management of the country. With good water management there are dry feet, clean water and there is not too much water, but also not too little water (Unie van Waterschappen, 2014). It is also important to build a sustainable relationship with stakeholders which is why it is chosen to approach the stakeholders personally in the Netherlands (Waterschap Brabantse Delta, 2013). Inhabitants are one of the most important groups of stakeholders, because they must feel more involved with the water management. Inhabitants experience the direct effects of inadequate water management or of projects in their direct living environment. In general, more information about water management in the direct environment leads to more interest of inhabitants (Waterschap Noorderzijlvest, 2006).

Besides that, the water board must be transparent and must recognize its mistakes. Participation from the inhabitants is also important, as their input and signals can be used to make solutions which fit in the practice of the water board. When the community has more knowledge about the current water problems, it is expected that they will accept the policy and measures before these are implemented (Waterschap Brabantse Delta, 2013).

2.3 Social Component of Water Management

The social component of water management is a component of water management which relates to the human community (Philippa, 2003-2009). A water board is a functional or interest group democracy, currently governed by representatives of house owners, agriculture and terrain managers, companies and inhabitants of the area. During water board elections in the Netherlands different categories of water users are represented in the water board. Residents can vote in the resident category for a person that represents a specific water board party. It is a party system, each party having their own program. There is a law for the attendance at the elections of the water board because these elections hardly spark the interest of the public (de Jong & Meijerink, 2006).

The Netherlands is still changing the relationship between the governments and the communities with regards to dealing with water issues (de Jong & Meijerink, 2006). The water issues are linked to social issues, so the social component in combination with the technical component of water management (de Graaff, Gerrits, & Edelenbos, 2009). Resulting from long developments of the '*Wet modernisering waterschapsbestel*' in 2009 the role and position of the water board in the community have changed. The leading principles are simplified, increasing the transparency and strengthening the democratic legitimation (van den Berg, 2009).

For the solutions of water problems, collaboration with inhabitants is desirable. It is important that people have awareness for water safety, to understand the severity of water problems. When stakeholders are more intimately involved with the design and implementation of the water policy, professionals can learn about the interests of the people in terms of their residential and living environment. When professionals understand the interests of the people, the policy can better fit the interests of the stakeholders. Therefore,

interactive processes between experts and inhabitants improve the policy. Finally it is desirable that inhabitants have the possibility to exert influence on the policy, policy implementation and management of water management structures in different ways. It is about proceedings for the general interest wherefore people must pay more in the future, due to climate change and prescribed water quality requirements of Europe (de Jong & Meijerink, 2006). The water board's communication with the inhabitants can be achieved through annual accounts and reports, media, advertisements, regional weekly newspapers, education, website, events, leaflets, brochures and other promotional materials (Hoogheemraadschap van Schieland en de Krimpenerwaard, 2009).

3. Research Methodology

This research is a qualitative study because the problem definition and subsidiary questions are qualitative questions. For the research the qualitative results will be collected. To answer the problem definition and subsidiary questions the research carried out different activities.

This research consists largely of a literature study. Some required information could not be found in the existing literature for the improvement of the water management in Indonesia. That is why additional research methods such as field visits, organized discussions, surveys and interviews are performed.

The interviews were recorded with permission of the interviewees and also a pictures are made of the interviewees. On basis of the recordings and notes, consultation reports have been made. The results of the research have been discussed with UNISSULA University, Rotterdam University of Applied Sciences, BPP SIMA and HHSK. For every discussion session, appropriate reports have been made.

To analyse the problems and opportunities for water management, the three layer model is used. The three layer model is a method for water governance organisations like a water board. The elements from the three layer model are partly merged and linked to five new aspects: technical, institutional, legal, financial and social. In this paragraph, the three layer model is connected to the five aspects based on the analysis report, through the use of existing information. This means that the five aspects are taken account into by the three layer model. The five aspects test the elements of the three layer model. Per layer of the three layer model the mainlines of the elements are described.

- The content layer is connected with the technical aspect. This layer is about the elements knowledge and experiences. The mainlines are establishing a polder system and climate change. In the conceptual model of the research the technical aspect is only used in the preliminary research.
- The institutional layer is connected with the institutional aspect, legal aspect and financial aspect. This layer is about the elements organisation and financing in water management.
- The legal aspect is a part of the institutional layer because the organisation and finance systems are based on the regulations. In the conceptual model of the research, the legal aspect is only used in the preliminary research. The research is focused on the institutional and financial aspect within the institutional layer. The mainlines are about the structure of the organisation, water fee and the relationships with stakeholders.
- The relational layer is connected with the social aspect. This layer is about the elements cooperation, communication and participation. The mainlines within this

layer are the involvement of the stakeholders, interests of the stakeholders and communication about the project.

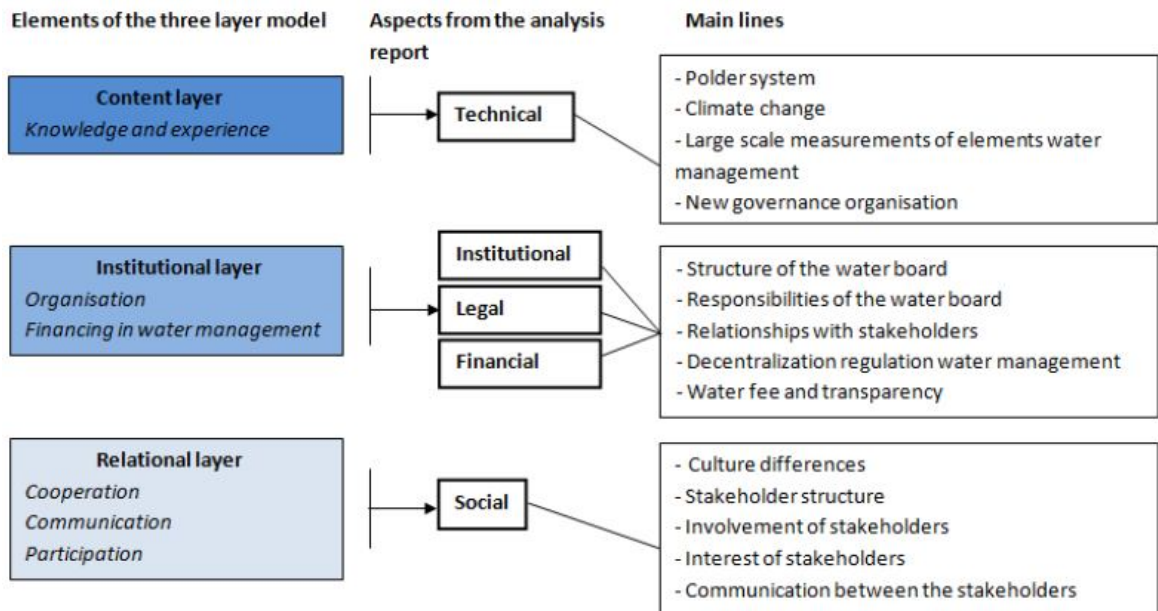


Figure 1 - Schematic overview of the elements of the three layer model, the aspects and main lines

4. Results and Discussion

Indonesia and the Netherlands are challenged with the presence and threat of (coastal) floodings . However, both countries cope with this challenge in very distinctive ways. The aim of the Banger Polder Pilot project is test if a polder system is feasible to address the flooding in Semarang and the Northern coast of Java. Does the polder system also work in a complete different cultural context. The Banger Polder Pilot project in Semarang, Indonesia is a result of the agreement between the Dutch Ministries of Transport and Public Works, the Dutch Ministries of Economic Affairs and the Indonesian Ministry for Public Works. The partners for the project program sponsor for the Dutch engineering agency is Witteveen + Bos who made the technical designs for the polder.

4.1 Analysis Area

The Banger area is located in Semarang, Indonesia. The city Semarang has seventeen districts and one of the districts is Semarang Timur, also called the Banger area. The Banger area covers 527 hectares ground with 84.000 legal inhabitants (Peters, 2012). There are 415 hectares of housing, 20 hectares of water and 92 hectares of other land (Witteveen+Bos, 2008). The district Semarang Timur consists of ten sub-districts; Kemijen, Rejomulyo, Mlatibaru, Mlatiharjo, Kebon Agung, Bugangan, Sarirejo, Rejosari, Karungturi and Karangtempel. Please refer to figure 2 for the location of the Banger area.

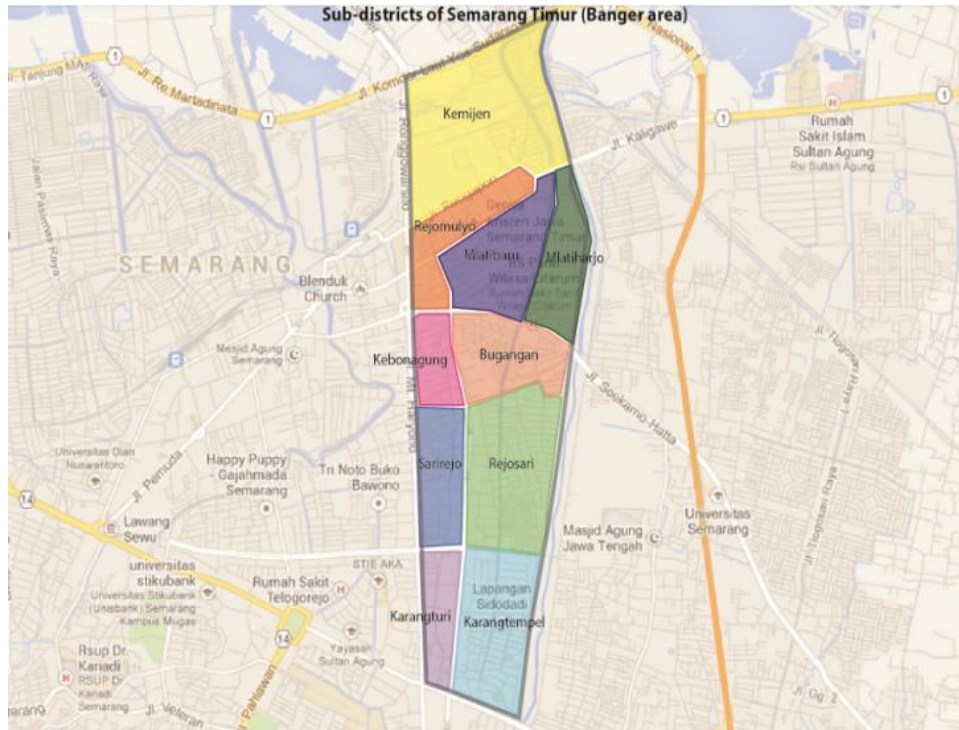


Figure 2. The location of the Banger area in Semarang

The northern part of the Banger Polder area has a lower surface level of -1.0 m till 1.0 m above sea level and the southern part of the Banger Polder area from 0.0 m till 4.0 m above sea level (Witteveen+Bos Indonesia, 2007). The northern part of the Banger Polder area is the lowest part of the area and is most severely affected by flooding. Of the poorest inhabitants, almost half (48%), live in the northern part of the area (IRPdelft, 2011) (Irawati, 2012). As mentioned before, the northern part of the Banger Polder area is the most frequently affected by flooding. These inhabitants also have the lowest income of the Banger Polder area, which makes it difficult for these people to invest in property protection.

The Banger Polder area has several important buildings. The area has four churches, one mosque, three hotels, two government organisations and two gas stations. Besides that, the area has nine schools, two parks and three hospitals (Google Maps, 2014). Those three hospitals are located in the sub-districts Bugangan, Karangturi and Mlaltiharjo. The three hospitals are minimally affected by flooding due to the higher locations and the additional pumps in the hospitals.

4.2 The Social Side

The Dutch water board Hoogheemraadschap van Schieland en de Krimpenerwaard (HHSK) has set up a Polder Pilot Project in Semarang, Indonesia. The area is called the Banger area, which covers 550 ha and consists of 84,000 inhabitants (IRPdelft, 2011). The problem at this moment in the area is that the area is affected by flooding on a daily basis. The water level is determined by the sea with inflow during the high tide and outflow during

low tide. In the future, the water problems will increase due to climate change (Center for River Basin Organization and Management, 2010). The technical phases of the Polder project are almost complete. To perform the management and maintenance in the future, HHSK funded the first public organization for water management in Indonesia, Badan Pengelola Polder SIMA (BPP SIMA), which is similar to the Dutch water board organisation. After the completion of the technical phases, BPP SIMA will take on the responsibility of managing and maintaining the future hydraulic engineering works (Hoogheemraadschap van Schieland en de Krimpenerwaard, 2010). To manage and maintain the polder system, the Indonesian municipality of Semarang provides a financial support towards BPP SIMA for the first ten years.

The Dutch and Indonesian involved organisations

At this moment some Dutch organisations are directly involved in the Banger Polder Pilot project. The involvement of the engineering company Witteveen+Bos (Netherlands and Jakarta) is to research if the technical elements of the polder system are sufficient to allow the polder to work accordingly (Kops A., 2014). HHSK is involved with the project for the institutional aspect. Their main objective for in the future is to create integral water management and maintenance for the polder system (HHSK, 2009).

The Indonesian governmental organisations

The hierarchical structure level in Semarang is: national level Indonesia, province level Central Java, municipality level Semarang, district level Semarang Timur and sub-district level. On the municipality level there is the mayor of Semarang, PU, BAPPEDA and PSDA. On the district level there is the Camat. Each of the ten sub-districts have a Lurah and consists of 5 different community organisations (LPMK, PKK, BKM, Karangtaruna and KIM).

Inhabitants

In the hierarchic system the Camat communicate with the Lurah. The Lurah communicate to the inhabitants through the Rukun Tetangga (RT) and Rukun Warga (RW). The RT consists of a maximum of 30 neighborhood families. Several neighbouring RT's will form a RW. The RT and RW are elected among the family's representatives. They organize different activities together for the family members in daily life (Ginting D. M., 2012).

4.3 Findings

Survey

Per sub-district there are 30 respondents which were randomly selected including one RW or RT. The surveys were distributed to a sample of 300 respondents, filled in by the inhabitants including 10 RW or RT, in the period 08-04-2014 until 15-05-2014. The survey consists of two closed questions, namely "do you know the Banger Polder pilot project?" and "do you know BPP SIMA?". The assumption for the results per sub-district is that the results are valid for all the inhabitants of the sub-district. Also the results give an indication about the knowledge about the project and BPP SIMA by inhabitants.

The Banger area is divided in a low- and high risk area of flooding. The high risk area consists of the sub-districts Kemijen, Rejomulyo, Bugangan, Mlatibaru, Mlatiharjo and

Kebon Agung. The low risk area consists of the sub-districts Karangturi, Karangtempel, Sarirejo and Rejosari.

Results of The Survey

The respondents who know about the Banger Polder project differ from 13.3% until 83.3%. The respondents who know about BPP SIMA differ from 0.0% until 20.0%. The respondents who have knowledge about BPP SIMA have also knowledge about the project. The respondents in the high risk area have more knowledge about the Banger Polder project than the respondents in the low risk area. The knowledge about the Banger Polder project in the high risk area is not lower than 30.0%. The highest score in the high risk area is 83.3% in Kemijen. Please refer to graph 1 for the results of the surveys about the project. Based on the literature study and analyses, Kemijen has the highest score because of the most low-lying area, the new pumping station and the area still suffers the most flooding of the whole Banger area. The low risk area is aware of the Banger Polder project which is less than 28.0%. Kemijen has the most risk of flooding so the project will have the highest impact on this sub-district, which is probably why most people in this area know about the Banger Polder project.

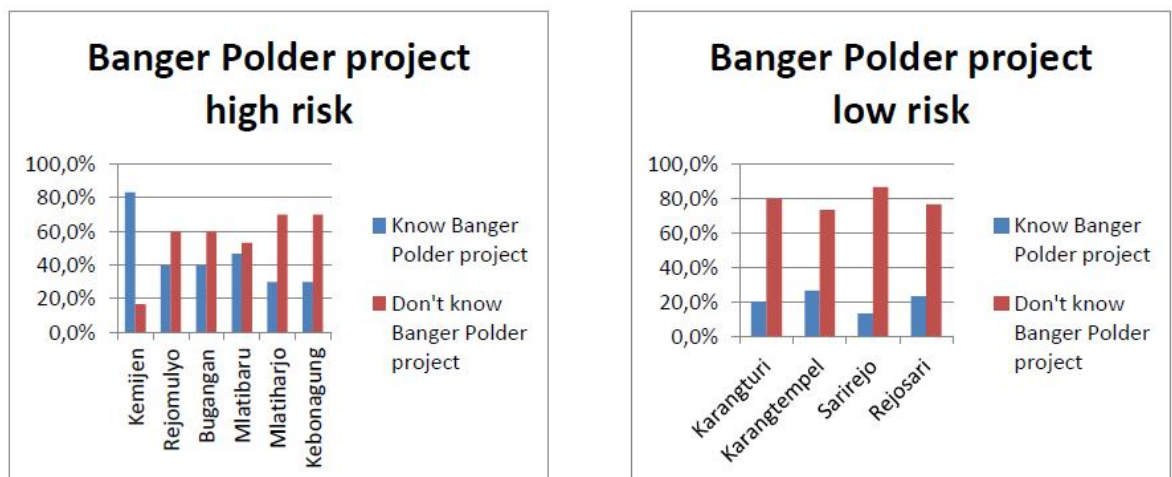


Figure 3. Graphs depicting the familiarity of the Banger Polder project among inhabitants (N=30 per subdistrict)

Most of the respondents don't know about BPP SIMA. In the area Rejomulyo and the area Karangturi, where none of the respondents know about BPP SIMA. In the high risk area 10.0% or more of the respondents of Mlatiharjo, Mlatibaru and Bugangan know about BPP SIMA. The low risk area is only Karangtempel. Mlatibaru in the high risk area has the most respondents 20.0% that know about BPP SIMA. Please refer to Figure 4 for the results of the surveys about BPP SIMA. For these results, no conclusions can be drawn because the results of both risks do not greatly differ.

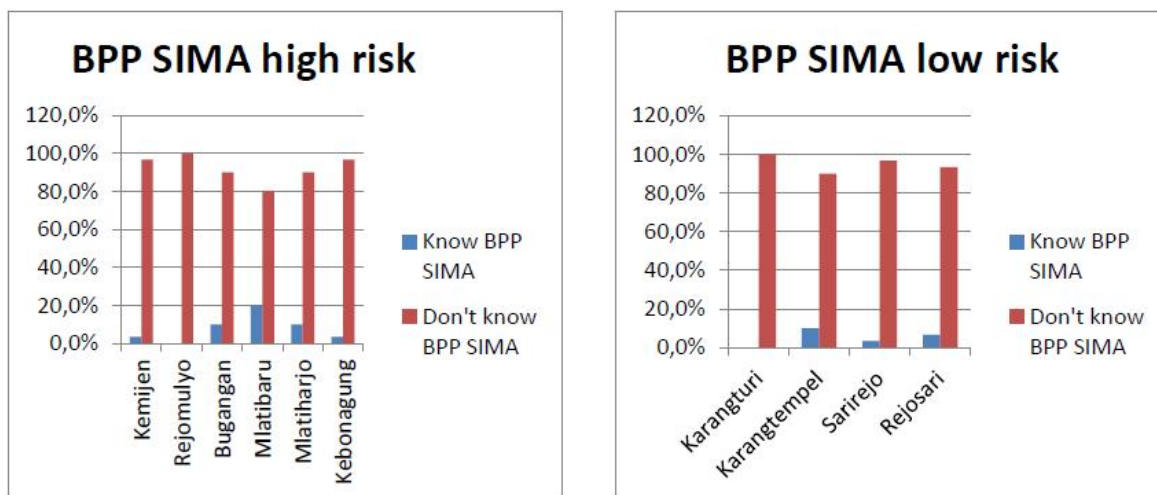


Figure 4. Graphs depicting the familiarity of BPP SIMA Poldee board among inhabitants (N=30 per subdistric)

Based on the findings the respondents knows about the Banger Polder project from different sources. The respondents knows it from the RW or RT, the political party “*Genchia Policity Party*”, relatives, the newspaper “*Suara Merdeka*”, electronic media, meetings by the Lurah and a meeting from the sub-district office. Some of the respondents recognize the name of the project but do not know the content of the project. There were also respondents who pointed at the Kemijen because of the pump station, but they don’t know the function of the pump station. The respondents who know about BPP SIMA, know about it from the local newspaper, socialisation organised by Mr. Sumono BPP SIMA member, socialisation by the Lurah, meetings of BPP SIMA and the residence office. Remarkable is that some respondents think the project is from the government.

Three Layer Model Content layer

In the content layer the project is known by all the selected stakeholders. The governments share their knowledge witch each other and contribute it over to the camat, lurahs and RW/RT. At this moment, there is no knowledge positioned between RW/RT and inhabitants. However, the RW/RT can all learn from the knowledge exchange between them, camat and lurahs. The governments has sufficient knowledge and confidence in the project so they can support the RW/RT. When there are knowledge exchanges at all levels, this provides opportunities such as creating better dissemination of knowledge, dry feet in the area, and development of a new economy.

Institutional layer

Within the institutional layer it’s not clear who of the selected stakeholders is responsible for the area, now and in the future. According to the camat and lurahs BPP SIMA is responsible for the area, while the RW/RT says that the government is responsible for the area. At this moment the roles and tasks of BPP SIMA are unclear. The selected stakeholders know their own responsibilities. BPP SIMA has not elaborated its responsibilities, which

creates confusions between RW/RT and inhabitants about the responsibilities. The various local stakeholders indicate that they want to help with the activities of BPP SIMA. In this way the responsibility and role of BPP SIMA can be increased.

BPP SIMA, in the future, will be responsible for the financial system of the water fee, which is not functioning at this moment. The government is aware of the agreement that inhabitants don't have to pay the water fee if the project is not functioning. There are uncertainties about the willingness to pay the water fee. According to the mayor the inhabitants are willing to pay, but the rest of the governments say that it depends on the behaviour of inhabitants. According to the local stakeholders there is willingness by inhabitants to pay to RW/RT after socialisation of BPP SIMA, when the benefits are visible to the inhabitants. The inhabitants are willing to pay, but it depends on their financial situation. The government can help by paying a part of the costs, and the government itself indicates that they can help financing the project for the first 10 years. The solutions that inhabitants indicate by themselves are paying together with other inhabitants or help BPP SIMA with work. When inhabitants help BPP SIMA, it is difficult for the administration of BPP SIMA. All lurahs and RW/RT wants to have insights in the financial reports of their own financial administration.

Relational layer – Cooperation

The relational layer indicates that all the selected stakeholders that communicate with BPP SIMA are important, but it is unclear about what and how they must communicate. The local stakeholders indicate that the communication of BPP SIMA can go through the existing communication hierarchy. This way the mayor can assume a coordinating role for the governments and the Camat for the local stakeholders. In addition, to communicate, BPP SIMA must make a name by showing their face in the area. Because the selected stakeholders all have private interests in the future maintenance and management of BPP SIMA, but the subjects about which to communicate are unclear. The governments indicate that the inhabitants and BPP SIMA are responsible for the maintenance and management in the area. The inhabitants are not yet aware of this, but their will is there to go to the meetings of BPP SIMA. BPP SIMA should therefore focus on multiple activities to achieve the interest of the selected stakeholders. An important interest for the selected stakeholders is the water fee. The governments see opportunities for the socialization of inhabitants to pay the water fee. The socialization should focus on the inhabitants to raise their awareness. The problem is that more than half doesn't have the knowledge about the project through socialisation. However, more than the half of the lurahs indicate their willingness to work with BPP SIMA on socialisation about the project. For the water fee BPP SIMA should first discuss with the RW/RT on the content and the way before the inhabitants are going to pay.

5. Conclusion

In this research the main building blocks of the three layer model are analysed for the social side of water management, namely the content layer, the institutional layer and the relational layer. The three layer model is tested on the case study Banger Polder project in Semarang, Indonesia. This section describes the main conclusions for the social aspects within the water management, which are needed during the implementation of a polder system and a water board for the Semarang context.

The management and maintenance of the Banger Polder project is only successful if the selected stakeholders are familiar with the project and water board. Inhabitants do only support the financial contribution for the management and maintenance of the polder if they have knowledge about the project. The community in Semarang is characterized by the hierarchical structure, which can be used to communicate and to transfer knowledge. Within this hierarchical structure BPP SIMA is new. The study made it clear that the public stakeholders are involved since the start of the project and during the set up of the water board, whereby they have knowledge about the Banger Polder project and BPP SIMA.

Besides the knowledge about the project and water board the selected stakeholders have to be familiar with the water fee payment of BPP SIMA. Knowledge about the water fee payment is needed to enlarge the acceptance of the financial system. When inhabitants are aware of water safety and when they will no longer experience flooding, they will be willing to pay water fee to BPP SIMA.

Based on the three layer model, the *selected stakeholders* are tested on different aspects which are important for a *successful water management*. The most important aspects for the social aspect within the content layer is that all stakeholders are *familiar* with the project. The second layer in the model prescribes that the public stakeholders must *transfer knowledge* to the local stakeholders.. If the knowledge exists at all *hierarchical* levels, then the *opportunities* for the project can be exploited and the risks can be avoided. The study shows that the public stakeholders do share the available knowledge to all levels.. The study shows that the familiarity of the Banger Polder project and the BPP SIMA water board among inhabitants is (too) low, which is a risk for the support of the introduction of a future water fee. This means that water board BPP SIMA must take their chances to develop a strategy to *involve inhabitants* in the project .

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