Management of local irrigation systems and stakeholder perceptions in southern Tamil Nadu, India

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Preface

This Master’s thesis is Maria Nehlin’s degree project in Environmental Management and Physical Planning at the Department of Physical Geography, Stockholm University. The Master’s thesis comprises 30 credits (one term of full-time studies).

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Abstract

The irrigation tanks in Tamil Nadu are part of an irrigation system which has developed over centuries, they are man-made reservoirs of varying sizes and they are important sources of irrigation water but also provide services such as flood control, silt capture, and ground water recharge. The tanks are now deteriorating, they are used less than before and their capacity is lower because of poor maintenance. Other studies have found many possible explanations to the deterioration of tanks, for example overuse of water, not enough de-silting of the tanks, or increasing population pressure. The purpose of this study is to investigate how stakeholders perceive the situation and the issues with the irrigation system, and to assess and compare how efficient the management of a state-owned tank and a private-owned tank is. Two cases of irrigation tanks in southern Tamil Nadu were part of the study and interviews were conducted with both farmers using the irrigation water in the tanks and with people who are involved in the management of the tanks. The study shows that the stakeholders perceive that there has been a reduction in the water availability and that there are problems with poor or inadequate maintenance, especially de-silting and maintenance of sluices in the tanks. The stakeholders interviewed also perceived funding of the management to be an issue. The study also showed that overall the management of the tanks was not functioning well, although in the private-owned tank a local user organization was involved and the management of that tank seemed to function somewhat better than in the other tank because of it. Furthermore, in both irrigation tanks there were groups which seemed to have unequal influence over the tank’s management, and the engagement in management among tank users was low.

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1. Introduction

The irrigation tanks in Tamil Nadu are numerous, varied in size, and has existed for centuries. Irrigation tanks is a type of small-scale reservoir that were developed to store unevenly distributed rainfall to be used for irrigation primarily (Sakthivadivel et al., 2004). They are a valuable source of irrigation water, especially for small-scale farmers (Balasubramanian & Selvaraj, 2003), but also provide services such as flood control, silt capture and ground water recharge (Bassi et al., 2014). Furthermore, the irrigation tanks are of ecological importance. Many bird species, both resident and migratory, reside in the irrigation tanks according to Abhisheka et al (2013) who surveyed tanks in Tuticorin and Tirunelveli district. However, there seems to be a widespread understanding within literature on the subject that tanks in southern India are deteriorating: the area irrigated by tanks is decreasing while other alternatives for irrigation are increasing in importance (Asian development bank, 2006; Palanisami et al., 2010), the capacity of tanks has decreased (Reddy & Behera, 2009), and, some tanks are in a bad condition and do not function properly (Sakthivadivel et al., 2004; Balasubramanian & Selvaraj, 2003). The tanks as an irrigation source and the many values associated with them is thus at risk. A starting point for this thesis were the ecological values of irrigation tanks as habitat for birds, the field work was done with the help of ATREE which is the organization that conducted the survey of birds in irrigation tanks mentioned above and ATREE also introduced the topic to me. The study then developed into focusing on how stakeholders perceive the threats facing irrigation tanks and how the tanks are managed.

In previous research, large-scale trends such as population pressure and urbanization have been found to be driving forces of the decline in tank irrigation (Narain & Vij, 2016). There are also examples of activities that directly impact tanks negatively such as poorly maintained structures, siltation and encroachments (Palanisami et al., 2010), and regulations not being enforced and overuse of water (Anbumozhi et al., 2001), amongst many other examples. Intrinsic to the topic of deteriorating irrigation tanks are discussions on their management, the irrigation system which the tanks in this study is part of has developed over time and is a very dispersed system, the tanks are local resources and their management can vary between different tanks. Many different actors are involved in tank management, and some authors argue that a shift away from traditional management, or local informal management, is part of the explanation of their decline (Anbumozhi et al., 2001; Jegadeesan & Fujita, 2011). There are interview studies on both use and management of tanks, and causes of their degradation. However, many of those use survey methods and focus on measureable factors such as, for example, revenue from tanks and funding of maintenance (Palanisami et al., 2011), measures of collective action and number of private wells (Kajisa et al., 2007), or participation in local users associations (Arun et al., 2012). The focus is usually not on perceptions of stakeholders, and most studies have taken a quantitative approach. Reyes-Garcia et al (2011), for example, investigated the relative importance of issues with irrigation tanks according to water users by looking at how respondents ranked issues. It is therefore interesting to seek more descriptive, or in-depth, information from tank users and others involved in the tank irrigation system, it could give insights into whether stakeholders perceive that irrigation tanks are deteriorating and if so what the reasons could be according to them. The purpose with this study is to obtain more qualitative knowledge on how stakeholders perceive the issues with irrigation tanks, and on how well functioning the management is in tanks with different ownerships. Two tanks are investigated in a dual case study, Arumugamangalam and Thoodhukuzhy tank, where the tanks are compared to each other as well as findings in previous studies.
1.1 Aim with the study and research questions

The aim of this study is to contribute to the understanding of why tank irrigation is deteriorating in India by investigating stakeholders’ perceptions of the situation and investigating the tank management. This will be done by studying two cases of irrigation tanks, the village-owned Arumugamangalam tank and the government-owned Thoodhukuzhy tank. One part of the study focus on stakeholders’ perceptions on issues with tank irrigation and possible causes and solutions. The other part of the study focus on management of the tanks in aspects of rules and practices and also different actors and their responsibilities. The focus is on investigating how well-functioning the management is and comparing the management in two tanks that differ in their management, and in order to do so, the management in these particular tanks needs to be investigated and described.

Research questions:
1. How are issues with tank irrigation perceived by stakeholders?
2. How efficient the management in a state-owned tank compared to a private-owned tank?
2. Background

2.1 The Tamirabarani irrigation system

Irrigation tanks have for a long time been a main source of irrigation in parts of India, and in South India there are especially many tanks since the rainfall pattern in this region creates a need for storing water (Asian development bank, 2006). Irrigation tanks are man-made reservoirs for storing water that looks like ponds or lakes depending on their size, their size can vary between tanks that are so small that only one farm use them and tanks that are several square kilometers in area. Tanks can be rain fed or system tanks, the system tanks receive water from canals and are situated in chains, or cascades, where water flows from one tank to the next. Water for irrigation is taken both from tanks and directly from canals. The irrigation tanks that are the focus of this study are system tanks and lies in the Tamirabarani river basin that runs through Tirunelveli and Thoothukudi district in Tamil Nadu. Tirunelveli and Thoothukudi districts are semi-arid areas that receive most of its rainfall from the north-east monsoon, but the Tamirabarani river running from the Western Ghats mountains to the Gulf of Mannar captures water from the north-east monsoon as well as the south-west monsoon in its drainage basin (Ganesh et al., 2014). The irrigation system started with the construction of anicuts, which are dams that diverts water into canals, in the Tamirabarani river. Seven of the anicuts are very old, the latest was built in the 13th century, and the eight anicut was constructed during the British period (Gomathinayagam, 2012). The irrigation system has developed over centuries, villages constructed tanks and different parts have over time amalgamated into one irrigation system (Brewer et al., 1997). Today there are more than 3000 irrigation tanks in the two districts (Ganesh et al., 2014). The tanks are, except for irrigation, used for activities such as bathing and fishing, and the water is also used for industrial purposes (Gomathinayagam, 2012). The demand for water for different uses has increased, according to Brewer et al. (1997) the share of water used for industrial and municipal uses has increased, and the demand for irrigation water has increased since the irrigated area is larger and because the cultivating season has become longer.

Arumugamangalam and Thoodhukuzhy tanks are located in Thoothukudi district. Arumugamangalam receives water from the Srivaikuntam anicut through the North main canal which feeds 6 tanks in total, and Thoodhukuzhy from Marudur anicut through Marudur melakkal canal feeding 16 tanks. The location of the two canals and the tanks in those canals are shown in figure 1 (page 12). The two anicuts constitutes the tail end reach of the Tamirabarani and together they stand for 52 % of the irrigated area in the Tamirabarani irrigation system (Gomathinayagam, 2012). In the Tamirabarani basin, rice is cultivated in two seasons corresponding with the two monsoons, and in the tail end, rice is sometimes cultivated in a third season in April to June. Banana has increased in the Tamirabarani basin, and especially in the tail end. Bananas are not cultivated in a particular season, but are cultivated continuously and needs water throughout the year (Brewer et al., 1997).

2.2 Management of the irrigation system

The Tamirabarani irrigation system as a whole is the responsibility of the Public Works Department (PWD), and the Tamil Nadu Electricity Board controls reservoirs in the system. The responsibility for management of individual irrigation tanks, was decided in the 1880s to be either on the PWD, the local government, or land tenants, based on the size of the tank (Asian development bank, 2006). Within the PWD there is an executive engineer responsible for operation and maintenance, and there are several other PWD officers involved in the management, for example gate openers that controls the channel sluices (Brewer et al., 1997). Rules on water allocation for irrigation is based on some common principles: water
requirements for rice cultivation and the recognized crop seasons, irrigation purposes have priority over power generation, and, within channels, direct irrigation from the channel is prioritized over tank irrigation (Gomathinayagam, 2012). There are schedules for when water will be released from reservoirs, to the channels in the system, and within the channels. The PWD assess the water available and decides how much water will be allocated to different parts of the irrigation system, and it is then distributed according to the schedules (Brewer et al., 1997). The rules specifying the schedules within the channels has been in place for a long time, the original schedule was made in the 19th century and it was last changed in 1935 (Gomathinayagam, 2012). The irrigation tanks in the system are also managed by local user organizations. They are mostly based on villages and they are engaged in management, maintenance, and sometimes in lobbying for water to their tanks (Brewer et al., 1997). Many of these organizations were formed by farmers and have existed for a long time (Asian development bank, 2006). There are many different forms of local users organizations in tank management, but there is a distinction between informal organizations and formal organizations. There is a large variation in the informal organizations that are described in literature on irrigation tanks, both who is member of the organizations and their tasks, and what they are called. In this study, the informal local organizations found consisted of farmers and is therefore called farmers’ associations (FA). The formal local organizations in tank management, on the other hand, are called water users’ associations (WUA) and have been established by the government and thus have rules for how they should be established and what their tasks are.
3. Methodology and methods

3.1 Research approach

The research approach guides how a study is designed: the questions asked, the choice of methods, and the research process. Creswell (2014) writes that the research approach includes philosophical ideas that affect how the research is designed and he describes three often distinguished research approaches: qualitative, quantitative, and mixed methods. This study has a qualitative research approach. The planning and design of this study, including what methods were chosen and what research questions to ask, was directed by the available information when starting the study. Tracy (2013) describes the process of developing a topic and research questions in qualitative research, the research begins with an interest in a phenomenon and with basic, wide questions to get a general understanding, and during the research the focus is narrowed down. The issue, or phenomenon, of degrading irrigation tanks was presented by ATREE and a general idea of the topic could be formed from literature, however, it became clear that there is a large variability in different aspects of this issue, and that there was not much information available on specific irrigation tanks. An exploratory approach was therefore selected for the study. The focus of the study and the research questions has then been narrowed down and refined during the study, Tracy (2013) describes a so-called iterative research approach, and describes a process where a general topic is narrowed down during the study by both existing literature and theories and by collected data.

Another important aspect of the study, which affects its design, is that the field work was conducted in Tamil Nadu in India with help of an interpreter. Some argue that much information is lost when interviews are translated. Kapborg and Berterö (2002) writes about how there can be a loss of meaning when translating between languages, and how not only the two spoken languages, Tamil and English in this case, but also my native language Swedish can affect the transfer of meaning over languages since I am thinking in my native language. They further argue that negative effects of translated interviews can be mitigated by, for example, the researcher staying in the culture a longer time period, interpreter and researcher having the same native language, and the interpreter being trained in the research field (Kapborg & Berterö, 2002). However, it was not possible to follow all of these advices, and also, in my opinion useful information can be obtained even if some information is lost in translation and there probably are some misunderstandings. Another perspective on the impact of translation and conducting research in a foreign culture is offered by Temple and Young (2004) who argues that if the researcher is believed to be objective potential bias can be or at least strived after being eliminated, while researchers with other perspectives does not believe bias because of translation can be eliminated. My opinion is that the translation and my role as a foreigner have affected the interview situations, and that even though it cannot be eliminated discussing this impact and bringing it into attention can at least increase the transparency of the study. Furthermore, Temple and Young (2004) argues using an interpreter can give other benefits than the translation itself if the interpreter is involved in study, such as having a cultural brokering role and as a key informant. The interpreter that held most of the interviews in this study was both familiar to the irrigation tanks and the environment they are in, and experienced in conducting interviews. My opinion is that the interpreter was an important asset in many ways for this study.

3.2 Method

The field work for this study was conducted in Thoothukudi district in Tamil Nadu in India during February to April 2016. Three irrigation tanks were initially chosen as cases for the
study: Thirupani chetty kulam, Arumugamangalam, and Thoodhukuzhy. These tanks were chosen because of their different ownership, Thirupani chetty kulam being private-owned by an individual, Arumugamangalam private-owned by a village, and Thoodhukuzhy government-owned. Based on literature studies before coming to India, I had found that different ownership of irrigation tanks might affect management and could be an interesting starting point for the study. ATREE who has knowledge on irrigation tanks in the area helped select three tanks that had different ownership and thus could represent different types of tanks. First three interviews were done, one in each of the tanks, with representatives for local organizations involved in management of the tanks. The purpose of these interviews were to gain practical information on the irrigation tanks since very little information was available, and to gain information that could further develop the focus of the study. Thirupani chetty kulam was found to be different from the other two tanks in terms of size, use, actors in management, and issues, which made it difficult to compare with the other two tanks. Gerring (2007) describes different strategies for selecting cases for a study, they can be selected because they are typical cases of a phenomenon, or because they represent the variance of a phenomenon, for example. Arumugamangalam and Thoodhukuzhy tanks were selected because of their similarities and because these characteristics seemed typical for a type of tank, system tanks that are used for irrigation primarily. The two tanks were thus selected because they were considered typical cases of a type of tank and issues related to that type of tank. The tanks also differ on an important aspect, their ownership, which then can be compared. However, when comparing the three tanks, Thoodhukuzhy and Arumugamangalam had some similarities, while the third tank Thirupani chetty kulam stood out because it was different in the aspects mentioned above. Thirupani chetty kulam was therefore excluded after the first three interviews and I decided to focus on two cases in the main part of the study. This will be further explained in the result section of the report.

After selecting the two tanks, the rest of the field work was conducted in two different phases. First three more individual interviews were held with people involved in management of the two tanks. A ground level PWD officer were interviewed in both tanks, and a higher level PWD officer involved in management of one of the tanks, Arumugamangalam, was interviewed. Then, group interviews (mostly) were held with people in villages around the tanks. Three interviews were held with farmers in Thoodhukuzhy and six interviews with farmers were held in the other tank Arumugamangalam and one interview with a management actor. All interviews were conducted using an interview guide. The interview guide was prepared following some advice of Tracy (2013) on what type of questions to ask, and how to order the questions. The interview guide for different interviews during the study was focused on mainly the same topics but some changes were done because of the focus of the study being narrowed down or refined, and because of experience on how questions were received in earlier interviews. The number of interviews and the respondents were selected to get a representative sample where those involved in the management of the tanks and those using the tanks are represented, but also because some saturation was achieved. Creswell (2014) means that the interview sample and how it is decided will depend on the research design, and describes the idea of saturation as one way of deciding when there is enough interviews, a theme is saturated when new data does not reveal new insights. The topic of this study is broad and irrigation tanks are very diverse and new ideas was brought up in most interviews, yet in both parts of the field work, the interviews with management actors and the village interviews, much was repeated in later interviews. The themes were thus perceived to be somewhat saturated.

A precondition for this study that has had much impact is that there was very little information about particular tanks, different government bodies might have more information
about specific irrigation tanks, but if so that information was not available. Therefore, information that could be used for describing the study sites was gathered throughout the fieldwork. The respondents were asked about information such as the use of the tank and about other water sources, but also about the location of villages and shutters in the tanks that could be used for creating maps of the study sites. Some GPS-points were also collected with the purpose of creating maps of the study sites. Based on the information from the interviews, the GPS-points and base-maps in ArcMap 10.2.2 maps of the study sites were created. However, the information was sometimes unreliable or contradictory and there are probably errors in the maps, they should therefore only been seen as giving an idea of how the study sites look.

Before, during, and after the fieldwork literature on the topic has been reviewed. Creswell (2014) discuss different ways a literature review is used in qualitative research, it can vary much but most studies at least use literature for giving a background and framing the issue, the literature review is besides this used as either a theoretical background guiding how the study is designed or as literature to compare the result with to aid the interpretation. In this study, the literature review is primarily used for interpreting the result of the fieldwork, but previous literature has been reviewed during the fieldwork and affected the focus of the study according to the iterative approach by Tracy (2013) which was described in the previous section. Furthermore, a log has been kept continuously during the study in order to be able to overlook the research process.

3.3 Interviews

In total 16 interviews were conducted, see table 1 (page 10). The interviews were semi-structured and followed an interview guide. Unstructured interviews are flexible and encourage discussion and they give the respondent more control (Tracy, 2013), while structured interviews have a standardized situation and questions and the possible answers for the respondent is decided beforehand (Bengtsson et al., 1998). Bengtsson et al (1998) describes two aspects of interviews that determine how structured they are, standardization and structuration. Standardization is the degree to which the interview situation is the same, and structuration can either mean how fixed possible answers are or to what degree the interview is kept on subjects or themes decided by the researcher. The standardization of the interviews in this study was low, the place of the interviews and people present were adapted to what was practical and the interview guide was altered between interviews. In the other aspect, structuration, the interviews followed interview guides and did not stray so much from the interview questions, the questions were mostly open-ended without fixed options for the answers.

The interviews were conducted by the interpreter following the interview guide and, in most cases, translated during the interview. In a few cases the interviews were translated afterwards because direct translation would have obstructed the interview, it was for example when the respondent was impatient or when there was a group of respondents and the interpreter struggled to both listen to respondents and translate. Both methods had benefits, translation during the interview allowed me to ask follow up questions while there was less interruption in the interviews that were translated afterwards which gave more room for the respondents to talk. This added a difference in how interviews were conducted making them less standardized and maybe less comparable, however the flexibility was necessary to get good information from different respondents. All interviews were recorded and transcribed afterwards, either by me or by the interpreter. If questions appeared after the interviews I had the possibility to ask the interpreter that conducted most of the interviews, both if something was unclear and questions on how to interpret the respondents’ answers. Since the interpreter was experienced in conducting interviews and was from this area, I was confident in the translation and the input.
Irrigation tank | Phase 1: Management actors | Phase 2: Farmers + WUA | Total interviews | Total respondents
---|---|---|---|---
Thirupani chetty kulam | 1 | 0 | 1 | 1
Thoodhukuzhy | 2 | 3 | 5 | 9
Arumugamangalam | 3 | 7 | 10 | 20

Table 1. Number of interviews and respondents for each of the tanks.

3.3.1 Individual interviews with management actors

The first part of the field work consisted of six individual interviews with actors involved in management of the tanks. First three interviews with a representative of a local organization in each of the tanks were held, one of the interviews were about the third tank, Thirupani chetty kulam, which after these interviews were excluded from the study. Then interviews were held with ground level government officials in the two remaining tanks, and one interview with a higher level government official involved in management of one of the two tanks. Only one higher level government official was interviewed because that respondent mostly gave general responses about tank management and did not seem to be so involved in specific tanks, interviewing the corresponding officer for the other tank seemed like it would not give much new information.

The interviews were arranged beforehand and held at the respondent’s workplace, home or other places decided by the respondent. The interviews were held by an interpreter following an interview guide, the first two interviews with one interpreter and the rest with another. Sometimes other people were present during the interview. The interview guide focused on use of the tank, management and maintenance, and issues with the tank, and there were also questions about factual information such as tank size or villages benefitting from the tank. The respondents were asked about the role of their organization as well as the role of other actors. They were asked about issues with the tank first as an open-ended question and then about specific issues that had been found in literature to be common issues in irrigation tanks. Some changes were made to the interview guide between interviews, questions that did not seem to work well were removed or changed, and questions about issues that came up in interviews were added.

3.3.2 Group or individual interviews in villages

The second part of the field work consisted of ten interviews, three interviews in Thoodhukuzhy and seven interviews in Arumugamangalam, of which six was with farmers and one with the WUA representative. The strategy for finding and selecting respondents were more of a convenience or opportunistic sample which is where respondents are selected because they are convenient to access (Tracy, 2013) than in the first part of the field work, we drove around the tanks and in the villages searching for farmers. But the sample was also decided by trying to get a representative sample of the villages using the tank. The smaller number of interviews in Thoodhukuzhy is because the tank and its irrigated area is smaller, two villages use the tank compared to about 12 villages in Arumugamangalam. In Arumugamangalam there are a larger number of villages using the tank, but some of them where located very close to each other (some were distinguished as separate villages by some respondents and as one village by others) and similar in other aspects and therefore I decided interviewing people from some of the villages would be enough for getting a representative sample.
During the interviews with farmers around Arumugamangalam tank I was informed that there was a WUA present in Arumugamangalam, which I had not been aware of during the first part of field work where management actors were interviewed. A possible explanation for this is that the WUA was not very active, most of the farmers were not aware of that the WUA existed. One of the interview groups with farmers facilitated the contact with the president of that WUA and an interview was held that focused on the WUAs role in management according to the WUA president. The WUA president in Arumugamangalam is a management actor, but the interview material is presented together with the material from interviews with farmers. The reason for this is that the interview situation and interview guide was more similar to the interviews with farmers, and because this interview was conducted in conjunction with one of the group interviews with farmers. My opinion is that the interview with the president of the WUA in Arumugamangalam was more similar to the interviews with farmers than with the management actors, and that this could have impacted the respondents’ answers, and because of that it should be presented together with the interviews with farmers.

The interviews were held outside around the tanks or in villages. The plan was to do individual interviews or in small groups of 2–4 people, small groups or individual interviews would make it easier for the interpreter to translate during the interview and would be suitable for a convenience sample strategy. Small groups were preferred since that might make the respondents more comfortable. Most of the interviews were individual or in small groups, but there was often other people present and in one interview the group became larger because other people joined the interview.

As with the interviews in the first part of the field work these interviews were held by an interpreter following an interview guide, they were translated during the interview or afterwards, and the interviews were recorded and transcribed. The topics of the interview guide was the same but the focus was less on different actors involvement in management of the tanks, and the respondents were not asked about any specific issues or problems as in previous interviews but questions about causes and solutions for issues they had brought up were included in the interview guide.

3.3.3 Processing and analysis of the interview material

A lot of information is produced from interviews and analyzing that information means narrowing it down. Creswell (2014) writes that qualitative research use information that is thick and descriptive and that the information is analyzed by focusing on parts of it and disregarding other parts. This is often done by coding where the information is sorted into categories. Tracy (2013) describes this as a process with two cycles of coding, first the information is coded with descriptive labels, and in the second cycle of coding the information is organized and arranged in different structures. Tracy’s way of coding is similar to approaches based on grounded theory where themes or theories are developed from the collected data, but in Tracy’s approach existing theories are used as well. Methods for analyzing data based on grounded theory, or a version of it, is what is usually used in qualitative research according to Tracy (2013). Guest et al (2012) on the other hand describe several approaches that are used in qualitative research, and several strategies for coding qualitative information. They advocate for a more open approach to how the analysis is done, depending on what the purpose of the study is, although it is important that the analysis is done in a systematic and planned way. I agree with this approach and have followed advice from Guest et al when analyzing the interview material. In this study the analysis started with reading interview transcriptions following tips described by Guest et al (2012) on how to find themes, such as for example ideas that are repeated, or topics that are similar or different when compared. The themes and what was included was decided based on
this search for themes in the interview material and from topics found to be important in existing literature on irrigation tanks, the themes were then defined, and this list of definitions, or codebook, was changed continuously during the field work. The interview transcriptions were coded following the definitions in the codebook and the interview material was then organized after themes where material from different respondents and from the two tanks was compared and summarized. The summary is presented in the results section of the report. Then the interview material is further analyzed by comparing the two tanks and comparing the results from the field work with findings in previous studies. The discussion of the result and previous literature attempts at answering the research questions, and the information is therefore structured according to the research questions in the discussion section instead of according to the themes as in the section were results of the field work is presented.

3.4 Study area

In this section the study sites Arumugamangalam and Thoodhukuzhy tank will be presented briefly, the information is mainly from interviews. The respondents have sometimes given information that does not correspond with each other, in that case both are presented, or the information perceived as most reliable. Below is a map showing the Tamirabarani river, the canals leading to Thoodhukuzhy and Arumugamangalam tank, and other tanks in the same canal system (figure 1).

![Figure 1. Map of tail end of Tamirabarani river basin and two of the canals.](image-url)
The Arumugamangalam tank’s water spread area is about 3.2 km² (based on measurements in ArcMap) and it irrigates an area of about 8-10 km². The tank receives water from Srivaikuntam anicut and through the North main canal, there are 6 tanks in the canal, Arumugamangalam is the second (see figure 1). There are 6 shutters in the tank, shutters are sluices through which water is diverted from the tank to the farmlands. Around twelve villages use the irrigation tank (some are close to each other and it is difficult to determine if it is two separate villages or one), these are: Arumugamangalam, Puthu Nagar, Karadiyur, Sampadi, Kulathu Pucheri, Aladi Pucheri, Thalavaipuram, Maramangalam, Theepachi, Idayarkadu, Kaavalkadu, and Agaram. Figure 2 shows a map of the tank and some of the surrounding villages (the exact location of Kulathu Pucheri and Aladi Pucheri was unclear, but they are located along the tank bund), the map is made with the help of GPS-points, information from interviews and base-maps in ArcMap, the map is very simplified but should give an impression of the study site. Of those twelve villages, the first seven belongs to a FA involved in management of the tank. Arumugamangalam village is the owner of the tank. The primary use of the tank is water for irrigation, for cultivation of paddy and banana and coconut, moringa and black gram by some. The tank also is used for fishing, collection of lotus flower, and sometimes duck rearing. Nearby villages also wash clothes and bath in the tank. Most respondents agree that the tank holds water for about nine months, but the range in the answers is between 6-7 months and 9 months. Water used to be taken from Arumugamangalam tank to Thoothukudi city by pipeline, the tank was then kept with water throughout the year, however, the pipeline was moved to Srivaikuntam anicut a few years ago.

![Figure 2. Map of Arumugamangalam tank and surrounding villages](image)

The water spread area of Thoodhukuzhy tank is about 0.8km² (based on measurement in ArcMap) and the irrigated area is about 5 km². The tank receives water from Marudur anicut
and Melakkal canal, there are 16 tanks in total and Thoodhukuzhy is the 5th tank (see figure 1). There are 5 or 6 shutters in the tank. Two villages benefit from the tank, a larger village called Karungulam and the smaller village Thoodhukuzhy. Figure 3 shows a map of Thoodhukuzhy tank and the two villages, it is mainly made based on information from interviews and base-maps in ArcMap, the location of the shutters are uncertain. The tank is used for irrigation of paddy, banana and flowers, it is also used for fishing, and for bathing and washing of clothes. Cucumber is cultivated inside the tank during the time the tank is dry. The tank holds water for about 6-8 months. There is a WUA involved in management, and Thoodhukuzhy tank is owned by the PWD.

Figure 3 Map of Thoodhukuzhy tank and surrounding villages
4. Literature review

In this section previous literature with topics related to this study is reviewed to give an impression of the discussion on deteriorating tank irrigation. The review will also be used for interpreting the results of this study. It has been divided into two parts: first what the problem is and causes of it are discussed; and then focus is on tank management in general and issues with the management according to the literature and also the idea of the declining traditional management. The literature review has been divided into these two parts to make the reading easier, although the topics are related and sometimes overlap.

4.1 The problem with deteriorating tank irrigation

In this first part of the literature review an account of the problem situation from relevant literature is attempted, starting with what is described as the problem and why. There is an agreement in the reviewed literature on irrigation tanks in Tamil Nadu that they are in decline, some specify this as a decline in the performance of tanks (Palanisami et al., 2010), and some as a decline in water use efficiency (Anbumozhi et al., 2001). Possibly it is a decline in both aspects, either way it results in a decrease in the area that is irrigated by tanks. This is a problem because of the benefits provided by irrigation tanks such as groundwater recharge, flood control, fish and habitats for wildlife, and moreover, they have been found to be especially important for small and marginal farmers (Balasubramanian & Selvaraj, 2003). Through a larger perspective the irrigation tanks are important because of water scarcities. According to Anbumozhi et al (2001) Tamil Nadu has developed most potential irrigation sources in the state and needs to focus on maintaining and improving current resources. It is especially important to investigate how they can be improved because of climate change which will increase the rainfall variability and need for water storage and flood control in the future (Palanisami et al., 2010). The primary use of the tanks is for irrigation for farmers, and they are of course important for that reason and for the other benefits they provide the communities, but according to the literature they are also important at the larger scale because of a water scarcity in the state, and because of services provided by the tanks.

Many possible causes for the deterioration of irrigation tanks are offered in the literature. Some examples are poor maintenance which leads to leaking shutters and silted tanks and channels and overuse of water (Anbumozhi et al., 2001), or conversion of land in catchments and encroachment (Palanisami et al., 2010). Changes in the catchment, encroachments, and overuse of water are issues that are common in inland fresh water wetlands in India in general, according to Bassi et al (2014). Another example of an activity affecting the state of tanks is pressure from different groups to deliver more water to them, for instance in order to cultivate bananas (Gomathinayagam, 2012). These are examples of factors that directly affect tanks negatively and can be possible causes for the deterioration of tanks, and the examples are often related to an inadequate management.

Except from these directly impacting factors, some articles describe developments or driving forces that indirectly impact the state of tanks or their management negatively. In the articles reviewed here, two driving forces that indirectly affect tanks have been found to be common topics. The first of those topics is an increase in the use of private wells for irrigation that supposedly has affected the management of tanks. Wells can be used as a supplement to tank irrigation and some own their own well while others can by water from well owners. Private wells became cheaper to install in the 1990s which could be the reason for the increase (Kajisa et al., 2007), although some argue that it was caused by the decreasing capacity of tanks (Reddy & Behera, 2009) or unreliability of irrigation tanks (Balasubramanian & Selvaraj, 2003). Kajisa et al (2007) recognizes that the deterioration of tanks might have been driving the
increase in private wells, yet concludes that private wells, at the same time, have affected irrigation tanks negatively since it has reduced the collective management in tanks, which in turn leads to lower yields, and, lower income and more inequalities for those who still use tank irrigation. These findings are supported by Balasubramanian and Selvaraj (2003). So while private wells could be a coping strategy when tank irrigation is failing, people who own wells are less willing to contribute to the management of the common irrigation source, which then would affect irrigation tanks in a negative feedback, and increase inequalities in communities. Also, except from the supposed social impacts and reduced commitment in tank management, wells also affect irrigation tanks because they withdraw water from the groundwater which is recharged by irrigation tanks. Balasubramanian and Selvaraj (2003, p.27) writes that wells could be seen as a “mechanism to ‘privatize’ common pool tank water” since they rely on recharge from tanks. Establishment of private wells would thus be a driving force of impacts both on management and the tanks themselves.

The second topic regarding driving forces of tank deterioration that is brought up in articles on irrigation tanks and their management is the collection of revenues and fees from tanks and the lack of funds for maintenance. Palanisami et al (2011) claims that the revenue collected from irrigation tanks has fallen even though the overall value produced by the tanks has not, and that even though less revenue is collected it is still more than what is spent on the tanks by the government. According to that, it seems like the issue lies in the collection of revenues and government spending on tanks. Collection of revenue from tanks is not straightforward, revenue from irrigation and non-irrigation uses of the tanks are collected by a number of actors such as different government departments, panchayats and village organizations, it is not used directly for tank maintenance but tank maintenance is instead done with government funds (Palanisami et al., 2010). A reason for why there is a lack of funds even though revenue is collected from the tanks could therefore be that revenue collected from a particular tank is not invested back into that tank but goes through the government, and that several government bodies are involved in this in different tanks making it less clear. But not only the government is part of the problem, there is supposedly a low collection of fees from members by WUAs (Chun, 2014). The lack of funds would be a driving force of inadequate management, and furthermore, Karthikeyan et al (2009) argues that this is an important issue not only because revenues collected from tanks would provide funds for management, but also because collecting revenue could reduce overuse of water and increase a sense of ownership over tanks. According to the literature on tank irrigation there is an issue with lack of funds and low collection of both non-irrigation uses, which could be from fishing auctions for instance, and from irrigation uses, probably through fees. This would then be a cause of inadequate maintenance which in its turn affects the state of tanks negatively, and it could possibly have other negative effects on the tanks.

Except from an increase in private wells and a lack of fund affecting tanks through inadequate management, some articles discuss large-scale driving forces as part of the problem with deteriorating irrigation tanks. Narain and Vij (2016) has studied common property resources in India, irrigation tanks are included since they are managed by communities to some extent today and more so earlier. They find that common property resources in India has been declining for a long time, and that there are some large-scale driving forces responsible for this in different time periods: In the 1950s and 1960s population pressure and invasion of modern technology was driving the decline; next was a period where shifts in ownership and management was the driving force; and today urbanization is causing the decline. Urbanization is threatening common property resources through conversion of land, and through resource need for urban areas and industry (Narain & Vij, 2016). These are large-scale trends affecting common property resources in general, but similar explanations can be seen in other articles.
about irrigation tanks. Gomathinayagam (2012) who has conducted a thorough study of the development of the entire Tamirabarani irrigation system describes how pressures from different uses and between users in different parts of the basin have increased. Gomathinayagam writes that management policies and subversion of rules by powerful users is worsening the conflicts, and concludes that “the uneven distribution of water among users always leads to conflicts” and that all stakeholders needs to be involved, especially farmers. An example of a development that supposedly has increased pressures is the increase of banana cultivation since about the 1960s-1070s, banana cultivators tries to exert pressure to receive more water (Gomathinayagam, 2012). Finally, a driving force that has been identified in the literature on irrigation tanks is a change in management institutions. It is suggested that a weakening or disintegration of village institutions are one of the causes for the poor maintenance of irrigation tanks (Palanisami et al., 2010), or because of the disappearance of traditional maintenance (Anbumozhi et al., 2001). Reddy and Behera (2009) writes about traditional community organizations that has declined because of changes in policy, during the British period towards medium and large irrigation systems, and from management focused on protecting the resource towards focus on producing revenue. Jegadeesan and Fujita (2011), who has studied reasons for the decline of a traditional and informal management system, instead argues that the decline is caused by developments such as urbanization and a shift to non-agricultural incomes, and development of private wells. This driving force for the deterioration of irrigation tanks will be further discussed in next section of the literature review, which focuses on management of the tanks.

Except from discussions on the issues and causes, some of the articles on irrigation tanks in Tamil Nadu also make suggestions on how to improve the situation. Tank rehabilitation, restoration, or modernization is proposed by several authors (Palanisami et al., 2010; Reddy & Behera, 2009; Anbumozhi et al., 2001; Sakthivadivel et al., 2004), and implies actions such as partial de-silting, lining of canals, or modernization of sluices. These are practical suggestions for how to restore the tanks’s capacity. According to Sakthivadivel et al (2004) previous efforts to improve tank irrigation has emphasized improved tank structures while they argue that it is equally important with programs to ensure maintenance by focusing on institutions and a shared responsibility of governments and farmers. Balasubramanian and Selvaraj (2003) agrees that more responsibility and control should be given to local communities, and that local institutions should be strengthened or introduced if not present. Furthermore, they suggest property rights should be developed to give a broader stakeholder base for collective action in tank management (Balasubramanian & Selvaraj, 2003). Reddy and Behera (2009) agrees that more people should be included in tank management, landless farmers should be included too. So while suggestions on how to restore tanks after the inadequate maintenance which has reduced their capacity, some authors also argues that efforts needs to be put on developing institutions and involving tank users to ensure maintenance in the future. Something else that was considered a problem for tank irrigation in some articles was low collection of revenues or fees and lack of funding for management, yet there are not so many suggestions on how to solve this issue. What is suggested is to develop legal support (Palanisami et al., 2010), to enforce collection of fees from users (Reddy & Behera, 2009)and charging fees for electricity used in wells (Kajisa et al., 2007). Besides, Karthikeyan et al (2009) showed that farmers are willing to pay more for tank management than what they currently do. Negative effects from well irrigation are also an issue that is repeated in the literature, and Balasubramanian and Selvaraj (2003) suggest development of wells can be prevented by stricter regulations and community wells. Finally, a suggested activity to reduce pressure on irrigation tanks is crop diversification away from water demanding rice (Balasubramanian & Selvaraj, 2003; Palanisami et al., 2010).
In this part I have attempted to give an overview of the problem situation as it is described in the literature reviewed. Some different reasons are given for why the irrigation tanks should be preserved, and some different suggestions on how the situation could be improved, the suggestions are mostly about modernizing or restoring tanks but also on how to increase participation of users. Regarding driving forces of the problem, there are many suggestions, but there are some that are brought up more than others, such as the development of private wells, lack of funds, and change in management institutions. These driving forces affect tanks directly or through inadequate management, management is part of the problem with deteriorating tanks and will be further discussed in the following section.

4.2 Management of the irrigation tank

This part of the literature review focus on how tanks are managed and how well management is functioning according to previous literature. First trends in policy regarding irrigation tanks is discussed, then the role of different actors in tank management and how well they are fulfilling that role, and finally a change in management institutions away from traditional management that often is brought up in articles. The irrigation tanks in Tamil Nadu are subject to policies on both state and national level, and these policies are affected by theories and trends in water management. One such trend in water management is to advocate for small-scale de-centralized management. Reyes-Garcia et al (2011) finds that this has been trend for about two decades within water management in general and in irrigation projects. And there is also an increased focus on sociocultural factors to achieve efficient water management, shifting away from a focus on mainly technical factors (Reyes-Garcia et al., 2011). Many of the irrigation systems in south and southeast Asia has moved from local management to large-scale projects managed by government agency in a rapid development during the 1960s and 1970s, and later, into a phase where participation by water users and small-scale irrigation systems are promoted (Asian Productivity Organization, 2002). This later phase might be seen in India today, Arun et al (2012) describes a program promoted by the Government of India in policy documents called Participatory Irrigation Management (PIM) where farmers are supposed to be involved in planning, operation and maintenance of irrigation systems, and in which WUAs are formed. The PIM program is also promoted in policy documents from the state government in Tamil Nadu (Panneerselvam, 2015; Public Works Department, 2015). However, in the case of irrigation tanks in Tamil Nadu, users have been involved in management for a long time because they own the tank or through local organizations, promotion of user participation is thus maybe not because of a trend. Mosse (1999) claims that the colonial government too promoted a de-centralized management and participation of users since it is necessary for the tank irrigation system which is very dispersed. However, regardless of whether the government policies are part of a trend in management theories or not, user participation is important in tank management and the recent policies has entailed changes in practice such as the establishments of WUAs in tank irrigation systems.

An argument for a participatory approach is that it is supposed to give a more efficient management by transferring costs to users and by giving users a sense of ownership over the resources (Asian Productivity Organization, 2002). Previously, much money has been invested in rehabilitating irrigation systems in Asia without investing in maintenance afterwards (Chun, 2014). This has been the case for irrigation tanks in Tamil Nadu as well, Sakthivadivel (2004, p.3521) describes this as the tanks has fell into a cycle of “rehabilitation-poor maintenance-deterioration-rehabilitation”. WUAs are then an attempt to handle this type of problem, a way of ensuring maintenance so investment in rehabilitating the irrigation systems are not lost (Chun, 2014). Reddy and Behera (2009) agrees with the idea of user participation being necessary in
water management, but also say participation approaches to water management often stay at the policy level without really being implemented. However, in their study Arun et al (2012) found WUAs canal irrigation systems in Tamil Nadu has increased the reliability of the irrigation system, which in its turn creates other benefits. Although the success of the WUAs was found to be dependent on participation of farmers which was sometimes lacking (Arun et al., 2012), the policies has had an impact and not just stayed on the policy level. A participatory approach is an important element of the policies related to irrigation management, which also have an impact on tank management on the local scale since WUAs have been established.

There are both formal and informal actors involved in tank management, and the actors involved and their responsibilities seems to vary between different tanks. According to Balasubramanian and Selvaraj (2003) there is a large variation in institutions in management of irrigation tanks in Tamil Nadu, there are both formal and informal institutions and the strength varies both in relation to each other and on different aspects of management. Perhaps the most important formal actor is the PWD. The PWD has ownership of the larger tanks and has overall responsibility over the Tamirabarani irrigation system and therefore involved in management of other tanks as well in some way. An issue with the PWD’s involvement in management in irrigation tanks seems to be lack of funds. Kajisa et al (2007) writes that the PWD does not do the maintenance it is responsible for because of lack of funds. And further, Ananda et al (2006) states that corruption and a constant lack of funds are problems in state level institutions involved in irrigation management in general in India. The PWD has an overarching responsibility of the irrigation systems as well as being involved in management at tank level. The WUAs are local institutions that have been established by the government to increase participation in irrigation management, which was brought up earlier, some issues with the WUAs have been found in previous studies. The implementation of the WUAs has supposedly been slow because of lack of policy or legal support, lack of funds, lack of authority, and more (Asian Productivity Organization, 2002). Furthermore, Ananda et al (2006), who found the success of WUAs and participation by farmers in them to be mixed, assessed WUAs in canal irrigation systems through a framework for assessing institutions and find them to be lacking on several criteria, for example having too many objectives which makes them unclear, and their success to be dependent on how strongly they can assert their role in management. Other issues found with the WUAs are lack of maintenance and low collection of fees (Chun, 2014). There seem to be some issues with the WUAs, some of the issues mentioned above are related to the design of the WUAs and some to their implementation. Low participation is also brought forward, and what affects participation in WUAs has been given attention in some articles. For example, Arun et al (2012) suggests better awareness of benefits from WUAs is needed to encourage participation of farmers. Chun (2014) has studied participation in collective action and in WUAs, and found factors that might affect participation in collective action, for example, clarity of the rules and presence of strong leadership, or abundance or scarcity of water in different parts of an irrigation system which affect the expected pay offs. Additionally, an important factor that could affect participation is ethnic or class heterogeneity of the participants (Chun, 2014). Low participation could give a lower performance of the WUAs, and moreover it has been found that WUAs and tank management might be controlled by groups within communities. Reyes-Garcia et al (2011) found that the WUAs in their study was inefficient after being established and management of the irrigation tanks was more influenced by wealthy people in the villages. They also found that other resources from the irrigation tanks, such as fish, were out of control of most people in the village, fishing right auctions were held by the PWD to the village heads, who in their turn afterwards held an informal auction of the fishing rights (Reyes-Garcia et al., 2011). However, this might be an issue whether a WUA or some
other institution is involved in the management of a particular tank. Gomathinayagam (2012) has investigated conflicts in the Tamirabarani irrigation system and finds influence of powerful users to be a problem in general. So while WUAs have been established and found to have success in some cases, many of the authors find there to be problems with the WUAs as an organization and with the participation in WUAs by tank users for different reasons.

Except from WUAs there are also informal local institutions involved in tank management, some of which has been in place for a long time. And supposedly, local institutions that traditionally managed irrigation systems are declining in India (Asian Productivity Organization, 2002). Yet informal management and actors at the local level are still found to be important by many authors. Balasubramanian and Selvaraj (2003) claims Tamil Nadu farmers contribute to the management of irrigation tanks with labor and money even though the government has the responsibility, and that farmers have informal meetings where maintenance of the tanks are planned. And Sakthivadivel et al (2004) found, in their study of local tank institutions in Tamil Nadu, informal rules for water acquisition and participation in maintenance or compensation otherwise to be important. These informal institutions are sometimes referred to as traditional tank institutions, in a study where traditional tank institutions were compared to government established WUAs, they were found to better designed in several aspects and more successful (Ananda et al., 2006). However, there is some confusion in the literature when describing local informal organizations involved in tank management, among many different names they are sometimes called water users organizations, farmers associations, or traditional institutions. A reason for this could be that there probably is some variation in the organizations present in different tanks. Sakthivadivel et al (2004) studied local informal organizations and included the categories traditional institutions, WUAs, fishermen cooperatives, and informal institutions amongst other categories of informal local institutions, and moreover, they found that the tank institutions in their study had existed from just four years back up to over hundred years back.

Many possible reasons for the deterioration of tank irrigation are discussed in the literature, however, one phenomenon that often is brought up as an explanation is a decline of the traditional management system or traditional institutions. Palanisami et al (2010) describe a changing management system: in the traditional system tanks were owned by the rulers and farmers were responsible for maintenance of supply canals as well as landlords (Zamindars in their words), the British brought tanks under the control of the PWD and local bodies in 1886, and since the local bodies did not have the skills necessary and because the responsibilities of water users was not defined clearly, the traditional system declined over time. Another example where a change in tank management is brought up is in an article by Anbumozhi et al (2001), they describe how the current management systems has no institutional framework for handling water allocation between interconnected tanks and how a smaller share of production value from tanks is spent on management compared to in the traditional management system. This traditional management system has deteriorated during the past three centuries, according to Anbumozhi et al, and they state that during this time: “farmers lost their awareness that tank and irrigation facilities are their common property” (Anbumozhi et al., 2001, p.300). In these two examples, and in other texts, the deterioration of traditional management is not the focus of the study but it is brought up. How much emphasis the deterioration of traditional management is given varies, yet it is often at least mentioned. Reddy and Behera (2009) discuss several possible drivers or trends causing tank degradation, but mean that it originates in a change from small-scale traditional management to government controlled management. Ananda et al (2006) mentions causes for the decline in tank irrigation by referring to other studies, and among the causes is a decline in traditional community management. Mosse (1999) critiques the idea a
decline of traditional management as a cause for deterioration of irrigation tanks, arguing it is an ideological phenomenon rather than a historical phenomenon. Mosse discuss difficulties in determining when the traditional system existed and how the irrigation system throughout times has been described as in decline, stating: “Tank systems have, in fact, been interpreted as being in a state of decline, neglect and disrepair wherever they have been described” (Mosse, 1999, p.307). In literature on irrigation tanks, it seems to be a bit careless use of the word “traditional”, the traditional management is often not described and sometimes seems to stand for different things in different articles, and sometimes this change from traditional management as a cause for the deterioration in irrigation tanks is just repeated without going into it further. However, some common features of this traditional management can be found in the literature, management is controlled by informal local organizations that sometimes have existed for a long time and collective action by tank users is important. Some also describe functionaries at different levels, for example common irrigators that control shutters (Balasubramanian & Selvaraj, 2003; Jegadeesan & Fujita, 2011). The way the traditional management and its decline is described might make it seem like a more uniform development that it probably is, but a change in tank management over time can still have occurred.

In this part of the report tank management has been described based on previous literature. A participatory approach to management of the tanks is promoted through policies today, and even though local institutions has been present in tank management in Tamil Nadu for a long time this has led to the establishment of WUAs. However, there seems to be many issues with the WUAs such as a low participation for example. Many articles discuss the role of the different actors in tank management, especially the local institutions, and its impact on the development of irrigation tanks. Many articles also claim that there has been a change in tank management away from traditional organizations that used to be present at the local scale, and that this is part of the explanation why tanks are deteriorating, however, the description of the traditional management and this change might be somewhat simplified.
5. Results

5.1 Interviews with PWD, FA and WUA

5.1.1 The initial interviews

Initially three irrigation tanks were included in the study. In this section result is presented from the three first interviews that showed some differences between Thirupani chetty kulam and the other two tanks: the type of tank, use of the tank, actors involved in its management, and water availability. Other information from the interviews in Arumugamangalam and Thoodhukuzhy is presented in the next section.

Arumugamangalam and Thoodhukuzhy are system tanks receiving water from canals and the primary use of the tanks are for irrigation water. Thirupani chetty kulam, on the other hand, is rain fed, the primary use is fishing and there is no, or almost no, irrigation. In Thirupani chetty kulam the panchayat alone is involved in management and it has been so for a long time. The president of the panchayat seems to have a prominent role in management, at least according to the president himself, when asked about how the tank is managed he answered it is managed by him and describes maintenance work he has done. In both Arumugamangalam and Thoodhukuzhy there is instead a local user organization involved in management, in Arumugamangalam a FA and a WUA. Also, the PWD is involved in management, the PWD allocates water to Arumugamangalam and is supposed to do some management according to the FA president, and the PWD owns Thoodhukuzhy tank. Furthermore, in both Arumugamangalam and Thoodhukuzhy tank the respondents say that there is an issue with water availability because of, amongst else, silt accumulation. The president of the panchayat in Thirupani chetty kulam, in contrast, claimed that even though Thirupani chetty tank does not hold water throughout the year, the panchayat president is of the opinion that there is more than enough water, saying, according to the translation, that water is overflowing and going to waste.

5.1.2 Interviews with actors responsible for management of the two tanks

Interviews with people involved in the management of the two tanks are presented in this part of the report. The result is presented according to four themes. The first theme is actors involved in management and their activities, the second water allocation at different levels, the third maintenance with focus on funding and statements about poor maintenance, and the fourth is issues with the tanks according to respondents.

Actors

The PWD is an important actor in management of both tanks and one of their main tasks is to allocate water to the tanks according to the three PWD officers interviewed. Ground level officers are responsible for the sluices leading to the tanks, while higher level officers are responsible for the anicuts which leads water to the canals and instructing water distribution at tank level in case of water scarcity. And, according to the ground level officer in Arumugamangalam, he can be involved in water distribution from the tank to farmlands in water scarcity times. All respondents agreed that the PWD also has a role in maintenance of the tank. In the interviews in Thoodhukuzhy the PWD was said to be responsible for overall maintenance, and in Arumugamangalam it was periodic maintenance or responsibility for works such as shutter maintenance. According to the two ground level PWD officers a task of the PWD is also communication with farmers around the tanks, they visit the tank every day and can then take requests from farmers and forward them to the PWD. The president of the WUA in Thoodhukuzhy also describes communication between farmers and the PWD, meetings are supposed to be held every week where the WUA, an officer from the district collectorate, and
an officer from the PWD participates. Furthermore, in the two interviews from Thoodhukuzhy, the PWD is also said to have responsibility over the fish auctions, however, one respondent say 50 % of the money from the fishing auction goes to the WUA to use for maintenance.

In both tanks an organization for the farmers is also a main actor in management, in Thoodhukuzhy there is a WUA. The WUA was initiated by the government in 2004 and consists of elected representatives and members. Both Thoodhukuzhy respondents tell how this type of WUA is supposed to exist in all tanks receiving water from the canal, and that there is a canal committee as well. The WUA does not seem to have any responsibility over water allocation, except communicating to the PWD if there is a water scarcity. The WUAs role in maintenance of Thoodhukuzhy tank is according to the president to forward requests from farmers to the PWD, they meet with the farmers often. According to the PWD officer the WUA too is supposed to do tank maintenance. That maintenance work is to be funded by half of the money from fish auctions, and money collected from the members, however, till now they have not collected that money according to the PWD officer.

In Arumugamangalam a FA is involved in management of the tank. The president of the FA in Arumugamangalam told how it has existed for 50 years, and how seven villages are members and the FA consists of representatives of those villages. The FA in Arumugamangalam is involved in water distribution from the tank to the fields, and in maintenance work such as maintaining the shutters. Although, one respondent said nearby farmers control the shutters. The FA in Arumugamangalam receives money for maintenance from auctioning of fishing rights, duck rearing, and lotus collection according to the FA president. One respondent in Thoodhukuzhy told how there used to be a FA in place there too that was involved in, for example, shutter maintenance.

The main actors in management of the two tanks are the PWD and the WUA or the FA, however, some other actors are mentioned in the interviews. The farmers themselves are a few times said to be involved in water allocation or maintenance, although it is unclear if by that the FA or WUA is actually what the respondents refers to. A temporary actor is brought up by respondents in both Arumugamangalam and Thoodhukuzhy, in Arumugamangalam a company made a donation for removing some silt, in Thoodhukuzhy a government body supposedly removed silt to be used for construction of a new railway track. Figures showing the constellation of different actors in the two tanks is shown on page 26 (figure 4 and 5), it is my interpretation of the constellation of actors based on both the interviews with management actors and the interviews in villages.

Water allocation

Most of the information on water allocation from these interviews was regarding water allocation to tanks, however, the higher level PWD officer explained some of the rules for water allocation between tanks and canals in the Tamirabarani basin. The water allocated is enough for cultivation of paddy which is the approved crop, in the basin are so-called a-group areas that will be prioritized first, except a percentage of the water that is allocated for power generation. The rules for which areas are in the a-group are very old. The PWD officer also said Arumugamangalam has a large share of the a-group land in the Tamirabarani basin within its irrigated area.

Thoodhukuzhy tank receives water from Marudur anicut and Melakkal canal, and Arumugamangalam from Srivaikuntam and North main canal, the PWD controls water distribution to the tanks in those canals. Thoodhukuzhy is the 5th tank in its system of 16 tanks and Arumugamangalam is the second tank in that system, however, Arumugamangalam is within the a-group and is therefore prioritized. There is one person within the PWD responsible for releasing water to the tanks, when there is enough water this ground level PWD officer will
control the water distribution, when there is a water scarcity he will consult with a higher PWD officer. Water is released to certain villages based on the water level in the dams, and on the rules about a-group lands where some areas are prioritized. The president of the WUA in Thoodhukuzhy further describes how there can be some pressure on the PWD officer responsible for water distribution during times with water scarcity since some villages gives him money in order to persuade him to release more water to them. The higher PWD officer in Arumugamangalam describe something similar, although it is not clear if this is the case in Arumugamangalam or in management of system tanks in general. Another practice in case of water scarcity is described by the Thoodhukuzhy PWD officer, water is diverted directly to villages instead of filling up the tank since that takes time.

Water distribution from the tanks was not explained in any detail, but the respondents said either the WUA, FA or farmers nearby the tank control water distribution from the tank to the farmlands, and the ground level PWD officer in Arumugamangalam also said he will control water distribution from the tank in case there is a water scarcity.

**Maintenance**

How maintenance is funded or supposed to be funded was described in interviews, otherwise when maintenance was brought up respondents usually talked about maintenance not being done. Therefore funding is first brought up under this theme, and then poor maintenance.

The maintenance of Thoodhukuzhy tank is mainly funded by the government according to the PWD officer, although there is also a program for tank maintenance funded by the World Bank. The WUA is also supposed to collect money from its members but this might not have happened. However, the PWD officer said that if there is a water scarcity the farmers will fund maintenance themselves. The WUA president in Thoodhukuzhy describes how the PWD now controls fishing auctions and therefore receives the money from this, and how the WUA are requesting the PWD to use that money for maintenance but that has not been the case so far. In Arumugamangalam the president of the FA say the FA controls money from auctions that is used for maintenance, and the higher level PWD officer say that full tank maintenance such as de-silting is done with government funds when they have some special funds.

An issue brought up several times in the interviews was maintenance not being done or being poor, often maintenance in general without going into it further. In two interviews in Thoodhukuzhy and one in Arumugamangalam the respondents complain about maintenance not being done, and in interviews in both Thoodhukuzhy and Arumugamangalam shutter maintenance is mentioned. In Thoodhukuzhy tank one of the respondents claimed that no maintenance has happened since 2000.

**Issues**

This theme is about information brought up as issues regarding the tanks and their management. The respondents were asked directly about some issues, but many times issues were brought up by the respondents under other parts of the interview too.

An issue brought up many times by the management actors was water availability, and this was perhaps the issue that was explained or described most. One respondent in Thoodhukuzhy tell how farmers used to cultivate two crops a year earlier, and even three crops before that, compared to one crop today, and how the water is enough for one cultivation of paddy but not for banana which requires water year round. The other respondent in Thoodhukuzhy also said two crops used to be cultivated, and that the tank today holds water for 5-6 months compared to 8 months before. The same respondent, when asked about the future of the tank, said there will be a water shortage and if it will go on like it is today there will be a big problem. In Arumugamangalam, one respondent explained how there used to be water in the tank year round when water was taken to Thoothukudi but since the tank is dry for two months, and the
water is thus not sufficient. The higher level PWD officer describes water availability in tanks in general, and say that water is allocated for cultivating paddy and is generally sufficient for that, but that some people cultivate banana which requires water for a longer time period. Several explanations for this issue are offered. In Thoodhukuzhy it is explained with a change in government policy where drinking water is decided to be first priority, to little water released from the anicut, de-silting not being done which reduces water holding capacity, and shutters not being maintained causing leakage. In Arumugamangalam, the explanations for water not being sufficient has already been mentioned, the move of the Thoothukudi pipeline and cultivation of banana requiring water for a longer time.

One issue that was repeated by many respondents was silt accumulation, silt accumulation is mentioned together with a reduced water availability but also as an issue in itself. The three respondents in Arumugamangalam and one respondent in Thoodhukuzhy thought it was an issue. Arumugamangalam tank is said to be so filled with silt that only two or three feet out of 12 feet holds water today. Some explanations for the issue of silt accumulation was brought up, the WUA president in Thoodhukuzhy said that a government policy enforced 20 years ago allowed only the government to de-silt tanks, which according to the respondent had not been done since then. In Arumugamangalam a different situation was described by one of the PWD officers, supposedly farmers in Arumugamangalam are allowed to take out silt and when companies have been approved for larger de-silting the farmers have opposed this since they think they should use the silt. Another explanation brought up in one of the Arumugamangalam interviews is that the tank used to be filled throughout the year why there was no time for de-silting.

Except silt accumulation and water availability, several other issues were brought up. Vegetation cover is said to be an issue in Arumugamangalam by all three respondents, and in one interview in Thoodhukuzhy. One of the respondents in Arumugamangalam said water hyacinths has increased in the tank because of inflow of polluted water to the tank. Otherwise, vegetation cover was mentioned but not further explained. When asked about encroachment, the WUA in Thoodhukuzhy and the FA in Arumugamangalam said there have been issues with encroachment in the tank, although it was not described in any detail. In Thoodhukuzhy, cucumber cultivation in the tank was said to be a big problem by the president of the WUA, who explained that the cultivators opens shutters to let out water from the tank in order to cultivate inside. The PWD confirms that this is an issue and has been for the last 15 years or so, but also said that the cultivation is good since they clear the vegetation in the tank, thus maintaining the tank yearly. Another issue in both tanks seems to be the fishing auctions, it is only mentioned by a respondent in Arumugamangalam, and explained by a respondent in Thoodhukuzhy. In Thoodhukuzhy the fishing auctions are held by the PWD, the respondent claim that this auction is not held in public and that afterwards a second auction is held with a higher price, and that the money is not used for maintenance which it is supposed to. Other issues mentioned are pollution and the introduction of African catfish in tanks.

When talking about issues with the tanks and their management, people’s responses to issues were sometimes described. A response to issues of water availability that has already been mentioned is that fewer crop seasons are cultivated than before according to the respondents. In Thoodhukuzhy one respondent say people use bore wells in order to water bananas, and people who do not have their own well buy from others, however, since the price of water has been increasing more people dig their own well. Farmers around Thoodhukuzhy have also used things such as paddy straw and sandbags to stop water flow from shutters in bad condition. Another Thoodhukuzhy respondent also said farmers will use their own money for maintenance, in case of drought years. Sometimes suggestions for how the issues could be
solved was mentioned, one respondent saying only the government can do anything about the issues, and two respondents saying that there already are plans or at least that it is proposed that Arumugamangalam will be de-silted under a government program called IAMWARM. A ground level PWD officer also told how the PWD arranges a training program for them about future water shortages where it is suggested that a certain amount of water will be allocated and if people request more they will have to pay for that.

Figure 4. Actors involved in management of Arumugamangalam tank

Figure 5. Actors involved in management of Thoodhukuzhy tank
5.2 Village interviews

**Actors**

In both tanks all farmers new about the FA. In Arumugamangalam, many respondents repeated that there is an active FA in Arumugamangalam that has been there for a long time, 50-70 years. In Thoodhukuzhy, all farmers interviewed new about the FA but said it was no longer functioning. In two of the interviews the FA in Thoodhukuzhy tank was described: it was a private organization of farmers that existed before the WUA that is in place today, it used to control fishing auctions, and it used to collect money from farmers using the tank water to be used for small maintenance works in the tank according to one interview group. Another group described how, even before the FA, tank maintenance was the responsibility of the gram sabha (a village government body) that received money from the government to use for maintenance. Interviews in Arumugamangalam also provided descriptions of the FA and its activities, one interview group said the president of the FA is rotated between different villages, on the other hand, the president of the WUA said the posts of president, secretary and treasurer is always given to members from certain villages. This FA controls fishing auctions, and duck rearing auctions and collects money from farmers using the tank, the money from auctions and farmers is used for small maintenance, and for digging temporary channels according to one group. However, according to some of the respondents the farmers have not paid the fees in recent years, and according to another interview group money collected by the FA should be distributed to their village, but that this was not the case since the money was used by some individuals. In this FA, seven of the villages around Arumugamangalam are included, but interview groups from other villages told about another FA that used to be in place in Arumugamangalam tank. That FA is no longer functioning, which according to two of the groups is because farmers stopped paying fees to that FA when they did not receive enough water for two crops. Which of the villages were included in this other FA was somewhat unclear from the interviews.

A WUA is established in both tanks, and in Arumugamangalam four of the six interview groups were aware of the WUA, although three of those group does not know about any activities of the WUA. One interview group explained that the WUA was formed by the government some ten years ago but that no one in their village are member and that there are no elections of representatives, instead there is the FA. A respondent in another interview group said he knew about the WUA in Arumugamangalam and its president and that the organization had been allotted money for maintenance from the government, the third group said they knew about the WUA but that there are no members in their village. All farmers in Thoodhukuzhy knew of the WUA, although one group thought it was the FA that used to be in place in Thoodhukuzhy. In two of the interviews in Thoodhukuzhy, the farmers said that the WUA had been formed by the government recently, or about ten years ago, the farmers in the third interview called it the FA. All land-owning farmers are eligible for voting in the WUA in Thoodhukuzhy according to two interviews, out of the three farmers in those interviews none had voting rights in the WUA. One of them were leasing land, for one of them, even though he was 49 years old, his father held the ownership document and thus the voting right, and for the third farmer his older brother inherited the ownership document. This document needs to be transferred, it is common that this is not done according to one respondent. In the third interview it was said that some are members in the WUA. The farmers without voting right in the WUA said they do not pay any membership fee, one man said that nobody pays any fee. The farmers with voting rights did not mention this. Activities of the Thoodhukuzhy WUA are holding fishing auctions, and one group said the president forwards maintenance requests to the government. As already mentioned, most of the farmers in Arumugamangalam did not know of
the activities of the WUA. However, the fourth group that was aware of the WUA also said the WUA did some channel maintenance and maintenance through excavator, and that the WUA controls auctions and maintains the tank jointly with the FA. This interview group were the farmers who facilitated the contact with the president of the WUA. The president of the WUA in Arumugamangalam further explained the organization, here described from the translation: It has been present for a while but elections have not been happening until five years back. Whoever owns land (whoever owns a patta or ownership document) are eligible for voting and the WUA has more than 1000 members. The WUA and the FA together control auctions and does maintenance such as clearing vegetation and an amount of silt was removed by AD mines (a government department) through their influence. According to the WUA president, farmers do not pay any fees to the WUA and money from auctions goes to the FA, maintenance such as the clearance of vegetation was funded by a donation by a company.

In Arumugamangalam the FA is described to have the main role in management of the tank by many of the respondents, both compared to the WUA and to the PWD. But in addition Arumugamangalam village seems to have a role in management, three of the interview groups mentions how Arumugamangalam village owns the tank as an explanation for the role of the FA and farmers. In one of the interviews the answer when asked about who is doing maintenance was, after translation, that it is all with the Arumugamangalam village. One interview group and the president of the WUA also told us about an event where the government had tried to take control of the tank, whereas the farmers had filed a case, which they won since Arumugamangalam village had a document (a patta) saying the tank is owned by that village. Thoodhukuzhy tank, on the other hand, is owned by the PWD and there is no FA present. The role of the farmers in management of Thoodhukuzhy tank seems to be reporting to the president of the WUA what maintenance works are needed. According to one respondent, the farmers also clear the feeder channel of weeds once a year and use banana leaf to close shutters that are in poor condition during the summer season when there is water shortage. The PWD is present in management of Arumugamangalam tank but the role of the PWD is not described by the groups of farmers, except one group saying a PWD officer is controlling the shutters from the tank. And, the president of the WUA told us about communication with the PWD, he participates in meetings with the district collectorate, and if there is any problem with the tank the farmers will contact the PWD. In the interviews in Arumugamangalam, some other actors were also mentioned to be involved in management of the tank: the farmers in some villages doing channel maintenance through the government scheme MGNREGA, AD mines government department removing some silt, a donation from a company, and, one of the interview groups told that they make the decision on whether or not to cultivate a second crop based on the district collectorate’s assessment of the water availability.

Water allocation

According to what farmers in both Arumugamangalam and Thoodhukuzhy said, there seems to be no rules for water distribution between farmers if there is enough water. Farmers in Thoodhukuzhy said so directly, while farmers in Arumugamangalam did not mention any rules for water distribution in times with enough water, except that farmers distribute water themselves and, two interview groups saying, that Arumugamangalam village is prioritized since that village owns the tank. In Thoodhukuzhy, the respondents in two of the interviews claimed there is never any rules for water distribution, while one interview group claimed there is a system for distribution in times of water scarcity. The response of the first interview was rendered as: if there is water they cultivate if there is no water they do not cultivate. The respondent in the second interview said there was no rules for water distribution because when they only cultivate one crop water is enough. In the third interview, the farmers said there used
to be a system for water distribution when there is less water, fields in the top most part of the tank will receive water first and then it will go from top to bottom, and the second time it will go from bottom to top instead. However, this system was no longer in practice. In the Arumugamangalam interviews, some different practices for distributing water during times with less water was brought up. Three of the interview groups tell how temporary channels are dug from the main channel directly to the fields instead of filling up the tank. One group describes the situation if there is a water scarcity, translated like this: there is enough water for the first crop but only people who have farmlands close to the tank will have enough water for a second crop, and that since they are the only village receiving water from a certain shutter there will not be a conflict. Another group say that during times with less water, there will be some politics between people.

In one interview in Thoodhukuzhy water allocation at the canal level was brought up, supposedly the water level in the dam needs to be higher in order for Thoodhukuzhy to be allocated water today compared to earlier because drinking water is prioritized nowadays.

**Maintenance**

Regarding funding of maintenance, all interview groups with farmers in Arumugamangalam and the president of the WUA said an activity of the FA is to collect money from users of the tank water to be used for maintenance. However, except from in two interviews, the respondents told us fees were no longer collected, since three, five or ten years back. Three of the four groups that said fees were no longer collected are not part of the current FA and were talking about a FA that used to be in place but are no longer functioning. In three interviews reasons for the farmers to have stopped paying the fees were brought up, one group said it was because of more corruption in the FA, and the other two groups because the farmers did not receive enough water for two crops any longer. Two of the interview groups in Arumugamangalam also say the FA will use money from auctions for maintenance, while one group and the WUA president said the FA and the WUA together control the auctions. The president of the Arumugamangalam WUA did, however, say money from auctions went to the FA. In Thoodhukuzhy, none of the farmers say they are paying fees to any organization such as the WUA or FA. In two of the interviews, money from fishing auctions are said to have been used for maintenance by the farmers during the FA’s involvement in tank management. It is suggested that today, that money is collected by the government in one case, and in the other case the farmers say that the WUA in Thoodhukuzhy does not do anything.

Another source of maintenance funds in Arumugamangalam is, according to three interview groups and the WUA president, the MGNREGA government scheme through which farmers from the villages perform maintenance work. One of the groups, that also said the FA for their village had not been functioning the last ten years, said that this scheme had funded maintenance since then and complained that other villages did not contribute as much as them to tank maintenance.

As in the interviews with management actors, an often repeated issue in the Thoodhukuzhy interviews is maintenance being poor or not being done. General maintenance not being done is mentioned in all three interviews. The maintenance work that was described as not being done was in two interviews de-silting, one 49 year old respondent said, what was translated to, that from his childhood days, he has never seen de-silting. Another example of poor maintenance work is maintenance of the shutters, in one interview the farmers said two shutters cannot be closed and one shutter cannot be opened, shutters possibly being abandoned was mentioned in another interview as well. The explanations told for the lacking maintenance was that even though the need for maintenance is reported to the government it is not done, and lack of funds since money from fishing auctions no longer is collected by the FA. In Arumugamangalam, two
of the interview groups talked directly about maintenance being poor or not being done, one group told how shutters are in poor condition causing the tank to hold less water, and the other group said maintenance is not done in the tank where de-silting is needed or in the channels which needs to be cleared from vegetation. The respondents in Arumugamangalam did not bring up poor maintenance as many times as in Thoodhukuzhy, however, as will be further developed below, many of the respondents in Arumugamangalam complained specifically on de-silting not being done.

Issues

All interview groups thought water availability was an issue. In the three interviews in Thoodhukuzhy, the respondents tell how they used to be able to cultivate two crops in a year, but today only one crop in a year is possible. The water available has thus decreased, according the respondents, and while there is enough water for one crop the farmers still think water scarcity is an issue, especially for bananas and during the summer season according to one respondent’s answers, and there was a concern for the future because of a decreasing water availability. The respondents in one interview when asked about the future of Thoodhukuzhy tank gave a response, reworded and translated to, that if the same development continues with less water available, the fields will in the future be converted to a housing area. The Arumugamangalam farmers too described the issue of less water available. Three of the groups say they used to cultivate two crops in a year some time back (answers ranged from 5 to 20 years back) compared to one crop today, and a 75 year old man in one of those group said they cultivated three crops before that. One of the groups describes the issue of water availability as while there is enough water for one crop today, they will not be able to cultivate this one crop in the future if the current development continues. Another group told how they cultivated a second crop last year but did not receive enough water. Farmers in both tanks explain how water holding capacity of the tanks has been reduced because of silt accumulation, leading to less water available. Several other explanations for the development with reducing water availability were offered as well. In Thoodhukuzhy the respondents gave these explanations: changed water allocation rules because of prioritization of drinking water, cucumber cultivation where water is let out from the tank, poor maintenance in general, water running through the tank because shutters cannot be closed, and a government policy dis-allowing farmers from taking out silt for farmlands. Reasons mentioned by the Arumugamangalam farmers were: shutters being in poor condition, and how the government that used to take water for industry purposes from Arumugamangalam by pipeline to Thoothukudi, ensuring supply of water, started taking water from the anicut instead.

Silt accumulation or lack of de-silting is brought up as an issue in all interviews with farmers in both tanks. The issue of silt accumulation is closely linked to water availability and maintenance and is often brought up together with other issues, it might therefore seem unnecessary to describe silt accumulation as a separate issue. However, in some cases the farmers very clearly talk about silt accumulation as an issue in itself and this was the reason for making it a separate issue. In Thoodhukuzhy tank, silt accumulation is said to be an issue in all three interviews together with other issues such as poor maintenance of shutters or in general. In Arumugamangalam all six groups claim silt accumulation is the main problem and it is sometimes brought up more than once, although some bring up other issues as well. The silt accumulation leads to the tank having less water holding capacity, and one group in Arumugamangalam gave two reasons for this, according to the translation: farmers no longer being allowed to take out silt to the fields and because the tank used to hold water throughout the year there was no time for removing silt.
Other than a reduced water availability (and other than poor maintenance), some other issues with the tank were brought up. One interview group in Thoodhukuzhy described both the FA that was in place before the WUA, and, as understood from the translation, how the tank management was functioning well when the gram sabha (village government body) before that was responsible for management of the tank, and argued that problems were caused by the WUA not doing anything. Another issue according to two interviews in Thoodhukuzhy was cucumber cultivation. In Arumugamangalam, three groups said vegetation cover is the main issue together with silt accumulation, and two of them that vegetation in channels too is a problem. One of the groups told us, after translation, that Arumugamangalam tank used to look like the ocean. Another group explained how a channel for excess water was so full of vegetation that water would not drain from fields, making them not suitable for any crops. Encroachment is also said to be an issue in two of the Arumugamangalam interviews, supposedly coconut is cultivated and tank water is also taken for this purpose. Pollution was mentioned by one group.

In all interviews with farmers, they were asked about how they thought the future of the tank would be. In Arumugamangalam, four of the interview groups answered that, what was translated to, if the tank is de-silted there will be scope for agriculture, the fifth group said if the tank is well maintained there will be scope for agriculture, and the sixth that if the current development continues they will not be able to cultivate in the future. One group said that agriculture land had been abandoned because of lack of water, while another group said that if the tank gets de-silted there will be good conditions for agriculture, they will not even need water from the channel but rainwater will be enough. In the three Thoodhukuzhy interviews, the farmers said there might be less scope for agriculture in Thoodhukuzhy, and there will be less water available, at least if the current development continues. One group explained how silt accumulates because the government does not allow farmers to take silt from the tank, and that this is causing a reduced water holding capacity. Another farmer said there will be less farming in Thoodhukuzhy, and that a reason for that also is that the younger generation does not want to work in agriculture because of low incomes.

When asked about how they thought issues brought up in the interviews could be solved, most respondents in both tanks answered that only the government could do something about the problems. The Thoodhukuzhy farmers also said that what they could do was to report maintenance that is needed to the government through the WUA. In Thoodhukuzhy cucumber cultivation was said to be an issue in two interviews, those farmers thought that they could not influence this since the cucumber cultivation is done by higher caste people that would not listen to their complaints. Cucumber cultivation was not brought up in the third interview in Thoodhukuzhy, this group belonged to a higher caste and might have been engaged in the cucumber cultivation according to the interpreter conducting the interview. In Arumugamangalam, the issue in mind was many times silt accumulation when they said only the government could do anything about the issues, and one farmer explained that since the tank is so big a huge budget is required for de-silting which the farmers cannot manage themselves. Another group told how the panchayat had attempted to clear the vegetation in a channel through the MGNREGA scheme but failed since an excavator was needed. Except these statements on how to solve issues, a respondent in Arumugamangalam suggested that a peace committee should be established by the government, all villages would be members and the committee would to tank maintenance.

In the interviews, some responses of the farmers to issues with the tank were mentioned as well, the most common response mentioned in both tanks were that less crops are cultivated in a year. In Thoodhukuzhy some of the farmers said the crops cultivated had changed too, two of
the interview groups said banana cultivation increased because of the tank holding less water and paddy requires more water than banana. However, banana needs water for a longer period, for that reason bore wells are used. Apparently, bore wells were also used in one part of the tank’s irrigated area because one of the shutters was in such a bad condition that water was not let through. Some of the farmers in Thoodhukuzhy have their own bore wells, and others buy water from other farmers for 150 rupees per hour according to a respondent. The use of bore wells was mentioned in two interviews in Arumugamangalam, it was told that some people in Arumugamangalam use wells, but they also said that place is not suitable for bore wells, one group saying the wells are not deep and the other group saying the water is salty. In Thoodhukuzhy, one farmer also described how farmers themselves try to stop leakage from shutters to save water in the tank longer, as a response to issues with shutters in poor condition.
6. Discussion

6.1 Stakeholders’ perception of issues in tank irrigation

In this section the first research question will be discussed: how are issues with tank irrigation in Arumugamangalam and Thoodhukuzhy perceived by stakeholders? A lot of different issues with the tank irrigation were brought up in the interviews, out of this I have found there to be some main issues in the interviews from both tanks that are brought often and described more than other issues and also expressed as important issues. How these main issues, or topics, are perceived by the stakeholders will be discussed and related to the problem situation described in the literature with deteriorating irrigation tanks.

Water availability was one of the main issues discussed in the interviews. In both tanks water availability was considered an issue by the stakeholders, although it seemed to be perceived as a more urgent in Thoodhukuzhy by how respondents described the issue, for instance, they thought there would be problems in the future with agriculture because there will be more of a water scarcity. The respondents in both tanks described how the water availability has decreased over time causing farmers to grow fewer crops in a year, which suggests that the respondents in Thoodhukuzhy and Arumugamangalam perceives that there has been a change in the irrigation over time. But this does not have to mean that the development is because of a deterioration of tanks. Respondents explain the reduced water availability with changes in government policy where drinking water is prioritized, that not enough water is allowed from the anicut, an increased cultivation of banana which requires water for a longer time period, and cucumber cultivation in Thoodhukuzhy where water is let out from the tank. In Arumugamangalam, a reason for why there is less water available given by some respondents was that the pipeline supplying water to Thoothukudi city was moved, when water was taken from the tank it needed to hold water year round. Some of these reasons are about competing uses for the water, or arable land in the case with cucumber cultivation. This corresponds with the development Gomathinayagam (2012) found in the Tamirabarani river basin, that pressure from different uses and conflicting interests has increased. It is also interesting that in the third tank that was included in this study in the beginning, Thirupani chetty kulam, there did not seem to be an issue with not enough water available and the tank was almost only used for fishing and farmers in the area got irrigation water from other tanks, therefore there might not be so much pressure from different uses. So the reduced water availability over time in Thoodhukuzhy and Arumugamangalam is explained by changes in the use of the tank water. However, poor maintenance too was said to be a reason for the reduced available water in the two tanks. Desilting not being done is a problem in both tanks and poor maintenance in general, in Thoodhukuzhy shutters in poor conditions causing leakage was mentioned several times.

Karthikeyan et al (2009) asked tank users in their study for reasons for why there was insufficient water and more than half thought poor maintenance was a reason, when asked for suggestions on how to improve the tanks about fifty percent answered that regular maintenance such as desilting and cleaning of canals. The respondents in that study thought other reasons were important as well, such as failure of the monsoon, inequitable water distribution, and increased wells, but poor maintenance was the second most common answer after failure of the monsoon (Karthikeyan et al., 2009, p.8). So while other explanations are offered, it seems to be a common perception among tank users, and other stakeholders in the case of Arumugamangalam and Thoodhukuzhy, that poor maintenance is a reason for insufficient water availability. The stakeholders’ perception of water availability as an issue and poor maintenance being one of the main reasons for this seems to correspond with the problem situation in irrigation tanks in general which is described in previous literature.
The next topic which I found to be a main issue in the interviews in both tanks was poor maintenance, it was brought up as an explanation for a reduced water availability but also as an issue in itself. Respondents often just complained about poor maintenance in general, but when examples were given it was usually de-silting and maintenance of shutters. Silt accumulation was an important issue in both tanks, but it seemed to be especially important in Arumugamangalam because it was described as the main issue there, while in Thoodhukuzhy shutters in poor condition too was important and respondents described how shutters are leaking constantly and how agricultural land has been abandoned because shutters are not working. It is not possible to assess how severe these issues are in each tank, but when comparing the interviews in the two tanks both silt accumulation and shutter conditions seems to be important issues in Thoodhukuzhy while stakeholders in Arumugamangalam put more emphasis on silt accumulation. An explanation offered for the siltation in Arumugamangalam is that the tank could not be de-silted during the time period when water was led by pipeline to Thoothukudi since the tank was filled with water all the time. An explanation to the siltation of both tanks was the enforcement of a policy some time ago that did not allow farmers to take silt themselves. Supposedly Arumugamangalam is an exception from this policy, but farmers did not seem to be aware of this. Additionally, some farmers explained that Arumugamangalam tank is too big for the farmers to de-silt. Palanisami et al (2010) discuss difficulties with de-silting tanks, even though the silt can be used as fertilizer it is costly, their recommendation was partial de-silting. According to some interviews partial de-silting has been done in Arumugamangalam and Thoodhukuzhy because of temporary opportunities, a donation from a company and a railway project, but silt accumulation is still a problem.

Poor maintenance in general and of shutters was often not explained, but one of the explanations given in the interviews was lack of funds. Lack of funds and inadequate collection of revenues was brought up as an issue many times, and is in my opinion a third main topic in the interview material about issues with the tanks. Respondents often describe how it is supposed to work but in practice does not. The management actors interviewed describe how maintenance will be funded by the PWD when there is some special fund available, such as a program, there is no regular funded maintenance. Palanisami et al (2010) agrees that one of the challenges facing tanks is a lack of funding for operation and maintenance of tanks, and say that while government funds is the main source of funds it only covers part of the costs they estimate is necessary in tank management. Their suggestion is to develop the revenue collected from both irrigation and non-irrigation activities such as the fish auctions (Palanisami et al., 2010). Fish auctions are held in both tanks, however, in Thoodhukuzhy one respondent claim that the money from fish auctions are collected by the PWD but then not used for management of the tank. Regarding revenues from irrigation, membership fees are supposed to be collected by the WUAs and the FA. Karthikeyan et al (2009) asked farmers in tanks in Tamil Nadu if they were willing to pay for operation and maintenance costs and got positive answers, and they conclude that farmers were willing to pay more than is enough for operation and maintenance. This suggests that revenue sources from tanks can be developed, that the obstacle for sufficient funding is not because of farmers’ willingness to pay. But in Thoodhukuzhy and Arumugamangalam most of the respondents were not members or did not know about the WUAs and therefore did not pay any fee, and in Arumugamangalam many of the farmers said they did not pay any fee to the FA either, some of them because they were not member of any FA anymore, and some because they had stopped paying the fees because of dissatisfactions with the FA. Ananda et al (2006) found that the collection of fees was low in WUAs in canals because the members did not know how the money was to be used and mistrusted the WUA. Maybe this could be a factor impacting both the WUAs and the FA in Arumugamangalam, the
awareness about the WUAs and their activities was very low in both tanks, and regarding the FA some of the respondents said they had stopped paying fees because they were not satisfied with the FA. The respondents accounts of the collection of tank revenues and government funding taken together show that the funding of management is problematic in both tanks.

These were three topics of issues with the tanks that I thought was prominent in the interview material, but many other issues were brought up and repeated in the interviews. Vegetation cover in the tank mainly but also in canals was mentioned to be an issue, especially in Arumugamangalam where it sometimes was described as one of the main issues, although it was not described much in most cases and only one explanation was offered, that the inflow of pollutions had increased. Encroachments were also mentioned, in Arumugamangalam a coconut plantation has supposedly been started. Another issue that should be mentioned is the cucumber cultivation in Thoodhukuzhy since some of the respondents perceived this to be a very important issue. An interesting part of this issue was that other respondents did not see this as a problem or did not mention it, and that those that said it was a problem also said that part of the problem was that an influential group of farmers were doing the cultivations.

Many of the issues that were brought up by respondents and discussed here was also found to be important issues in the literature. As already mentioned, Karthikeyan et al (2009), although it was not the focus of the study, asked tank users in Tamil Nadu in a questionnaire about reasons for water being insufficient: the most common answer was failure of the monsoon, and more than half answered poor maintenance, and other common answers were inequitable water distribution and an increased number of wells leading to poor water storage in the tanks. Although respondents in Thoodhukuzhy and Arumugamangalam study sometimes talked about times when there was less water, failure of the monsoon was not discussed much in the interviews in this study, possibly because of what questions were asked. Poor maintenance was discussed a lot, and inequitable water distribution to some extent. However, the forth answer that the respondents in the study of Karthikeyan et al (2009) gave, that an increase in wells affected tank storage negatively, was not brought up in the interviews in this study. This issue is discussed in other articles as well, the increase in wells was on the one hand a consequence of the deteriorating tank irrigation, and on the other hand a driving force because it leads to less participation in tank management, and a driving force of increased inequalities (Balasubramanian & Selvaraj, 2003; Kajisa et al., 2007). Use of private wells was mentioned in both tanks, but in Arumugamangalam the ground was supposedly not suitable and wells was not used as much. In Thoodhukuzhy it was said that some farmers are using wells and some pay for the water from others’ wells, and that since it is expensive to buy water from wells installation of wells is increasing. It is possible that the wells have an impact on the communities and management of the tanks, however, the respondents do not describe the wells as an issue but instead as a response to water scarcity, for instance wells are used for banana cultivation when the tanks is dry. Another possibility discussed in the literature is that large scale economic development and societal changes with urbanization causes a change, according to Narain and Vij (2016) urbanization is a driver of decline in commons in India in general today, and Jegadeesan and Fujita (2011) has found this development to cause less interest in agriculture and in tank irrigation and to be a major cause for the deterioration of tanks. One of the farmers in Thoodhukuzhy reflect on this, saying that young people does not want to work with agriculture because of low income. Otherwise urbanization or other large-scale drivers were not described in any detail.

In summary, the stakeholders in Arumugamangalam and Thoodhukuzhy, consisting of both tank users and people involved in management, gave many different perspectives on issues in the two tanks. Among these accounts some larger topics, or main issues, were found that
seemed to be perceived as important by stakeholders in both tanks. The water availability was insufficient and had also been reduced over time, it was explained by both changes in the use of the water and by poor maintenance affecting the performance of the tanks. Thus the perception of stakeholders seemed to correspond with the development described in literature on irrigation tanks. Poor maintenance was perceived as an issue by many respondents, the most common examples of maintenance that was needed but not done was de-silting and shutter maintenance, in Arumugamangalam de-silting seemed to be more important. The third topic identified in the interviews were funding of management and collection of tank revenues, where many different aspects were brought up by the respondents. What was perceived as issues by stakeholders in Thoodhukuzhy and Arumugamangalam was in large found in previous literature as well. However, in previous studies private wells and large-scale trends such as urbanization is argued to affect irrigation tanks negatively which was not described as issues by the respondents in this study.

6.2 Assessment of the tank management

This section of the discussion will focus on the second research question: how efficient the management in a state-owned tank compared to a private-owned tank? The management of the two tanks is in this part related to the management described in the literature review to assess how well management is functioning and the tanks are compared to each other.

Water allocation is managed at different levels, there are rules for the entire river basin and there are rules for canals and tanks. There is a division in the responsibility over water allocation between the water leading to the tank and water leading from the tank to fields. In the interviews the rules and practices for allocating water from canal to tanks seems to be less confusing than the water allocation from tanks to fields, and the rules and practices for water allocation from canal to tank are similar for both Thoodhukuzhy and Arumugamangalam. The water allocation is based on rules and the PWD will make decisions on water allocation based on the water available that year. One respondent describe rules that are common for the Tamirabarani irrigation system, how water allocations are based on the amount of rice that is grown, and that land is divided into groups that will be prioritized differently. The same respondent does however complaint that there are problems with people trying to influence PWD officers to release more water to their villages or fields. This was mentioned by other respondents as well, and other studies have discussed this issue as well (Gomathinayagam, 2012). It is difficult to assess to what extent the rules on water allocation are followed in the case of Arumugamangalam and Thoodhukuzhy based on the information from the interviews since they focused on management of these particular tanks and because the respondents were mostly users or involved in management at ground level, and this might also be the reason why water allocation at the higher level seems clearer than other parts of the tank management.

Water allocation from tank to farmland is more confused, and it differs between the tanks. In Thoodhukuzhy there does not seem to be any system for how water is distributed, most respondents say that the farmers manage it themselves, although one group of farmers said there used to be rules for in which order shutters should be opened which are no longer in practice. Furthermore, since some of the shutters supposedly are in such poor condition that they cannot be closed or have been abandoned, controlling the water distribution might be difficult. In Arumugamangalam there is some regulation for how water is distributed between farmers, there are rules for how villages are prioritized. There is also a practice where temporary canals are dug directly from the canal to villages during times with less water, which is described in some interviews. Sakthivadivel et al (2004) found in their study of local tank institutions that in many tanks there are rules for distributing water between farmers in times were there is a water
scarcity that will ensure that all farmers receive water. The rules described by one group of farmers in Thoodhukuzhy, as mentioned above, seemed to be something similar, although those rules were no longer in practice. In Arumugamangalam they have a rule for distributing water during water scarcities, however, it is not explained if this is to ensure equitable water distribution but instead some villages are prioritized. Either way, the water allocation below tank level seems to be more regulated in Arumugamangalam than in Thoodhukuzhy, and also, the FA in Arumugamangalam is said to have responsibility over the water allocation in some way. However, what the FA does is not described in any detail. In some articles about tank management a common irrigator was described that is associated with a more traditional tank management (Balasubramanian & Selvaraj, 2003; Jegadeesan & Fujita, 2011). The FA in Arumugamangalam has been in place for a long time and it is involved in water allocation in some way, however any common irrigator or something similar is not mentioned. Although the water allocation at the below tank level seems to be more regulated in Arumugamangalam than in Thoodhukuzhy where there seems to be almost no regulation, neither of the tanks have common irrigators or rules as described in articles, or at least it is not brought up in the interviews. The description of water allocation from tanks to fields were not described in very much detail in the interviews, and my perception is that the interview material does not give the whole picture, at least not in Arumugamangalam which is a big tank with many users and different villages.

Maintenance of the two tanks is more difficult to describe than the water allocation since it seems to be more haphazard, maintenance is done when there is some government funding available or a donation or when farmers do it themselves, and since the respondents mostly talk about maintenance that is not done. There does not seem to be any plans or regulations for when certain maintenance is supposed to be done, or any formal division of the responsibilities in either tank. The PWD and WUAs have some responsibility over maintenance, and the FA in Arumugamangalam, and the farmers themselves are involved in maintenance of both tanks. However, that maintenance would be unregulated might have been expected since most articles regarding maintenance of irrigation tanks does not describe a systematic maintenance. For example, Reddy and Behera (2009, p.133) who has investigated ways of restoring tank capacity and also how to sustain the restored tanks, and they find that maintenance is not done regularly but rather on an ad hoc basis.

When comparing Thoodhukuzhy and Arumugamangalam one can see some differences in their management, first of all the fact that the constellation of actors in management differs between the two tanks. Ananda et al (2006) say tanks differ in their ownership and in actors involved in management, but that they can be classified into three categories: government owned and managed where a WUA usually is present, village owned and managed, and panchayat managed. This was one of the factors that were taken into consideration when the tanks were chosen for this study and it seems that there are some differences related to the ownership. In Arumugamangalam the FA and the PWD share responsibilities over management, while the PWD is the main actor in Thoodhukuzhy and the FA is no longer active. The WUAs does not seem to be very active in either of the two tanks, they are only known to some of the farmers and they do not seem to carry out activities on their own. The PWD have a larger role in management of Thoodhukuzhy tank than in management of Arumugamangalam, in Thoodhukuzhy the PWD is said to be responsible for maintenance, communication between the PWD , the WUA and the farmers is described in interviews, and the PWD holds fish auctions. In Arumugamangalam, on the other hand, the FA is described to have a main role, and is involved in water allocation and maintenance and collects money from auctions and used to collect fees from members. The FA in Arumugamangalam thus has responsibility over some of
the tasks that the PWD or WUA has in Thoodhukuzhy. The larger role of the PWD in Thoodhukuzhy might be because the PWD owns that tank, whereas Arumugamangalam is owned by a village which is part of the FA. Additionally, the third tank Thirupani chetty kulam is mainly the responsibility of the panchayat, and in this tank neither the PWD nor a FA or WUA seemed have a large role, although it should be mentioned that only the panchayat president was interviewed. So there are some clear differences in the constellation of actors in Arumugamangalam and Thoodhukuzhy, and a reason for this could possibly be the different ownership of the tanks that has allowed different actors to take large roles in management of the tanks.

According to Ananda et al. (2006), tanks that are owned and managed by the government have often been rehabilitated and a WUA is dominant. However, in both Thoodhukuzhy and Arumugamangalam a WUA has at least been established. WUAs have been a strategy for increasing participation and local control in irrigation, part of the Participatory Irrigation Management (PIM) policy. The WUAs have been found to give benefits in some cases (Arun et al., 2012), but some authors also argue that WUA has not had the intended impact, and discuss both their organization and implementation as reasons for why they have not been fully successful. Ananda et al. (2006) find that WUAs are sometimes lacking in how they have been designed, for example objectives are not clear enough and they are not adaptive, but argues that the variable irrigation system and changing environment is also important and that it is difficult to see if it is the internal or external factors that determines the WUAs success. Aubriot and Prabhakar (2011) criticize the implementation of the WUAs, saying that in their case studies the PWD has not shared the responsibilities in tank management with WUAs but mostly does decision-making and implementation of work themselves. There is a WUA present in both Thoodhukuzhy and Arumugamangalam but they do not seem to have influential roles in the management of either tank. In Thoodhukuzhy the responsibility of the WUA according to its president seems to mainly be communication and requesting maintenance, while the PWD claims the WUA is also supposed to collect fees and do maintenance work. In Arumugamangalam the WUA mainly seem to work together with the FA. Farmers in both tanks did not have much awareness of the WUAs activities. According to the rules on how WUAs in Tamil Nadu should be established and organized (RULES TO THE TAMIL NADU FARMERS’ MANAGEMENT OF IRRIGATION, 2000) the WUAs should collect fees, participate in water allocation and plan and perform maintenance activities. However, this was not activities of the WUAs that were described in the interviews, even though presidents of the two WUAs were interviewed, and some respondents were not even aware of the WUAs activities. This could indicate some confusion on the objectives with the WUAs, unclear objectives were one of the critiques of the design of WUAs in canal irrigation by Ananda et al. (2006). But perhaps it is more likely that the difference between what WUAs are supposed to do according to the rules and what respondents say the WUAs do, and the fact that people are not aware of what the WUAs do, is because WUAs have difficulties enforcing their role and performing the activities they are supposed to. Ananda et al (2006) claim that there is a problem in WUAs in canal system that members were not aware of how money is spent and because members mistrust the WUAs, and that this was an important cause for why the collection of fees by these WUAs were low. This could be an issue in Thoodhukuzhy and Arumugamangalam too, the awareness of the WUA and the collection of fees seem low in both tanks and this would make it more difficult for the WUAs to perform their tasks. Except for these possible explanations of the WUAs inactive roles, some authors discuss what affects participation in WUAs which is an important factor for the WUAs success. Arun et al (2012) found that one of the major constraints for farmers to participate in WUAs was lack of unity and cohesiveness.
among farmers. In Thoodhukuzhy there seemed to be some caste differences within the communities where some were members of the WUA and others not, and some of the farmers described a group that was more influential in management of the tank. In Arumugamangalam seven of the villages are part of the FA that is active, one of them Arumugamangalam village which seems to have a special status since the village own the tank. Thus there are different groups of users in both tanks, which could then be an obstacle for the farmers to participate and cooperate in the WUA. Furthermore, in Thoodhukuzhy some of the farmers were not members in the WUA because document of ownership of land was required and some other family member had it. This would be another obstacle for participation in the WUAs, and of inclusion of different groups such as landless farmers.

The other users’ organization in this study is the FA in Arumugamangalam. This is an informal organization run by the farmers in some of the villages around the tank that has existed for a long time. The FA is involved in water allocation, for example by digging temporary channels when there is less water, and in maintenance of the tank, it is more actively involved in management than the WUAs. The FA is different from the WUAs in its establishment, organization, and activities, even though its organization is not described in detail in the interviews. In the literature, the deterioration in irrigation tanks is sometimes attributed to a decline in traditional organizations or local informal organizations. In Thoodhukuzhy this is supported by one group of farmers, they claimed issues with the tank was caused by the WUA being inactive and that management had been functioning well with the FA that existed earlier, and the local government body before that. In Arumugamangalam, there is one FA today but there also used to be another FA that is no longer active. The reason for why the second FA in Arumugamangalam stopped functioning was according to some of the farmers that they stopped paying fees since they did not receive sufficient with water. Ananda et al (2006) has assessed the institutional design of both traditional irrigation institutions and WUAs and found that traditional institutions are good on several criteria. However, since these institutions and tanks are still on decline, the traditional institutions are still not able to maintain the tank irrigation (Ananda et al., 2006). The decline in informal institutions might thus both be because of deterioration in the irrigation tanks, and it might be contributing to the deterioration. For example, a reason for why the FA in Arumugamangalam is still active could be that Arumugamangalam is a prioritized tank, it receives more water than other areas, which could mean that there is not as much conflict between different interests. Some years back Arumugamangalam was even filled with water throughout the year because of the pipeline, and it is in recent years that the second FA in Arumugamangalam stopped functioning, according to some respondents they stopped paying fees when they did not receive enough water. This issue would need to be investigated further to draw any conclusions, but the presence of the FA which does some maintenance work might be because there have been less issues, as well as the other way around. Furthermore, even though the FA in Arumugamangalam is functioning today why the local management in Arumugamangalam seems to be somewhat better than in Thoodhukuzhy only some of the villages are included in this FA. And also, some other villages around Arumugamangalam were involved in maintenance of the tank through the government program MNREGA. So even though Arumugamangalam has an active FA, there seem to be some groups in the tank users, and some of them might be more influential in the management of the tank than others, there might be an unequal influence over management.

Some common points can be seen in Arumugamangalam and Thoodhukuzhy regarding participation by tank users, whether it is through a WUA or FA, or something else such as the MNREGA program. There are groups that seem to have different influence over management. In Arumugamangalam there is the FA where only some villages that are included and among
them Arumugamangalam village, and in Thoodhukuzhy there is a group of farmers that are of a higher caste. Aubriot and Prabhakar (2011) studied the implementation of WUAs in four case studies and found that the WUAs became affected by social systems and hierarchies that existed in the villages, WUAs were dominated by some groups and marginalized people were not included. Perhaps this could have an impact on the tank management in Thoodhukuzhy and Arumugamangalam as well, although maybe not through WUAs. Something else that I find is evident in both Arumugamangalam and Thoodhukuzhy is that while farmers are involved in management in different ways, through local organizations or communication with the PWD or through their own initiatives to do maintenance for example, much of the responsibility to solve issues of poor maintenance in the tank is put on the PWD. Balasubramanian and Selvaraj (2003, p.12) in their study of communities using tank irrigation and collective action, found there to be: “an overwhelming feeling among rural communities that tank maintenance is the state’s duty since the state took over the responsibility of managing tanks decades back”. In Arumugamangalam and Thoodhukuzhy a common answer to questions on how problems could be solved was that only the government could do something. This attitude might also affect stakeholders’ participation in management.

In summary, the rules and practices for water allocation at above the tank level was similar in Thoodhukuzhy and Arumugamangalam, there are rules for the irrigation system in general and the PWD makes assessments, although there might be some pressures from some villages as well. Below tank level there were some differences between the tanks, in Arumugamangalam the FA is involved in water allocation and there are some prioritized villages and some practices for distributing water during scarcities. However, more information was needed about water allocation and this might be a simplified image. Maintenance was not planned or performed regularly in the two tanks, which seems to be the case in tank management in general. A clear difference between Arumugamangalam and Thoodhukuzhy which affect their management is the constellation of actors involved in the management. In Thoodhukuzhy the PWD has a main role, while the PWD and the FA share some of the responsibilities in Arumugamangalam, these difference might be because Thoodhukuzhy is owned by the PWD while Arumugamangalam is owned by a village. The WUAs seems to be rather inactive in both tanks, and several of the factors found in literature to affect WUAs could be of importance in the two tanks, for example lack of awareness of trust in the WUAs causing farmers to not contribute financially or unequal influence over tank management between different groups of users. The FA in Arumugamangalam is still active in tank management whereas the management at the local scale seems more efficient in Arumugamangalam, although the active FA might also be because of better pre-conditions for tank irrigation in Arumugamangalam. Common for the management in both tanks is that there seems to be different groups within the tank users, and that they might have different influence on management. Another similarity between the tanks, which had also been found in another study, is that the government or PWD has a main responsibility over management.
7. Conclusions

This study has attempted to answer two questions, how stakeholders perceive issues in Thoodhukuzhy and Arumugamangalam tank, and how efficient management of the two tanks is. First, the investigation of stakeholders’ perceptions showed that in both tanks stakeholders had the understanding that the water availability was insufficient and this was in part because of poor maintenance which has reduced the performance of the tanks, but also because of competing uses. This corresponds to a development described in literature on irrigation tanks. Except from the water availability, poor maintenance was perceived as an issue in both tanks, lack of de-silting and shutter maintenance was of importance in Thoodhukuzhy and mainly lack of de-silting in Arumugamangalam. Furthermore, different issues regarding the financing of tank management and revenue from the tanks was described by tank stakeholders in both Thoodhukuzhy and Arumugamangalam, such as inadequate government funding and low collection of fees among tank users. There was a large variation in the answers in different interviews, and many different issues were brought up, the topics brought up here is those that I interpret as main topics in the interview material. The main issues in the stakeholders’ statements are related to a poor management of irrigation tanks, although this could also be because except from issues with tank irrigation, the interviewed stakeholders were asked about management of the tanks. However, the other focus of the study was to investigate how efficient management is in Arumugamangalam and Thoodhukuzhy, and to compare their management. It was found that the constellation of actors differed between the tanks, in Thoodhukuzhy the PWD is a main actor in management but also a WUA, while in Arumugamangalam a FA had a major role although the PWD and a WUA also was involved in management of the tank. The FA in Arumugamangalam, and also other groups of farmers in Arumugamangalam such as those engaged in management through a government scheme, supposedly performed some management activities, which did not seem to be happening in Thoodhukuzhy. This might indicate that the ownership of the tanks have an influence on the efficiency of their management, however, the more efficient management in Arumugamangalam might also be because of better preconditions. Furthermore, in both tanks there seemed to be different groups within tank users with different influence over management, and despite differences in management between the tanks the tank users seemed to think the PWD had a main responsibility to maintain tanks and solve issues since this was the answer many respondents gave on the question of how to solve problems. These two aspects could make management of both tanks less efficient.
References


Appendix
These are the interview questions used for interviews with farmers in villages around the tanks.

Use of the tank
How do you use the tank?

Agriculture around the tank:
- Where is your village located? Which other villages use the tank?
- Which crops are cultivated? And in what seasons?
- For how long does the tank hold water? Do you get water from other sources than the tank?
- How many shutters are there? Where are they?

How is the tank used other than for irrigation?
Which parts of the tank are used for this?

Management and maintenance
How is water distributed between farmers and villages?
What happens in years with less water?
How is the tank maintained?
How can you influence water allocation and maintenance?
What does the water users’ association/farmers’ association do?
- For how long has there been a WUA/FA?
- Who are the members of the WUA/FA?
- Do members pay any fee to the WUA/FA?
How are fishing auctions done?

Problems and causes
If any, what problems or difficulties do you experience with the tank irrigation?

- Which of these problems are most important in your opinion?

- What do you think is the cause?

- How do you think the problems could be solved?

How is the state of the tank today, compared to when you started as a farmer?
How do you think it should be in the future?