

Impacts of Saline Water Intrusion on the Daily Lives in the Mekong Delta Viet Nam

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Abstract

We conducted a field study in the coastal province of Ben Tre, Viet Nam. Saline intrusion is a reality for people living in this province and one objective of our study was to ask for views and consequences of this phenomenon. The study was conducted by making qualitative interviews with farmers and various authorities in the province during the spring of 2011. Water samples were collected and the total electrical conductivity was measured in order to get an understanding of the range of saline levels in the region. The study was done in cooperation with Can Tho University, Viet Nam and the Swedish University of Agricultural Sciences, Sweden.

The majority of the interviewees regarded saltwater intrusion to be a problem and a challenge. Problematic features observed in the study were for instance that the levels of salinity had increased during the last several years and that saltwater had intruded further into the province during that time. Farmers expressed their concern that there was little they could do to change their situation. Answers received from our interviews differed between farmers and local authorities with respect to their way of communication. This calls for a development and strengthening of the cooperation and communication between local authorities, researchers and farmers. Adaptations and measures that have been taken into account during the past several years include the building of dams and installing of gates. Switches of cropping systems have been frequent in the area with a significant rate of change from rice cultivation to integration of shrimp and prawn cultivation by using rice varieties with a short rotation period. In order to obtain a lasting improvement we believe that a holistic and long-term approach is necessary to minimize the negative impacts of saline intrusion.

Key words: saline intrusion, cropping systems, rice-shrimp, farmers, local authorities, communication, adaptation.

TÓM LƯỢC (Vietnamese abstract)

Xâm nhập mặn đã và đang gây nhiều trở ngại cho đời sống, sinh hoạt và sản xuất nông nghiệp ở các huyện ven biển của tỉnh Bến Tre, Việt Nam. Trong khuôn khổ hợp tác giữa trường Đại học Cần Thơ và trường Đại học Nông Nghiệp Thủy Điền, chúng tôi đã thực hiện nghiên cứu đánh giá hậu quả gây ra bởi xâm nhập mặn và nhận định của người dân về hiện tượng này tại huyện Thạnh Phú, một trong những địa phương chịu ảnh hưởng bởi xâm nhập mặn của tỉnh. Nghiên cứu đã thực hiện phỏng vấn chi tiết nhiều hộ nông dân và các cấp chính quyền địa phương, cũng như phân tích hàm lượng muối trong các mẫu nước (phân tích EC - Electrical Conductivity) suốt mùa xuân năm 2011 để hiểu rõ về mức độ nhiễm mặn của khu vực.

Đa số những người được phỏng vấn đều cho rằng xâm nhập mặn hiện đang là yếu tố gây trở ngại và khó khăn. Trong những năm gần đây, nghiên cứu cho thấy hàm lượng muối trong nước ngày càng gia tăng và nước nhiễm mặn xâm nhập sâu hơn vào nội đồng. Tuy vậy, khả năng thay đổi của nông dân để thích ứng với hiện trạng này rất thấp. Mức độ nhận được thông tin và chia sẻ thông tin về tình hình nhiễm mặn giữa người dân và với các cấp chính quyền cũng khác nhau. Do đó, cần tăng cường sự hợp tác và chia sẻ thông tin về tình hình nhiễm mặn và các biện pháp ứng phó giữa các cấp chính quyền địa phương, nhà nghiên cứu và nông dân. Để hạn chế tác hại của xâm nhập mặn, các đập ngăn mặn đã được xây dựng tại địa phương trong những năm gần đây. Bên cạnh đó, thay đổi mô hình canh tác cũng là biện pháp thích ứng với sự xâm nhập mặn. Trong những năm gần đây, mô hình độc canh lúa đã được chuyển đổi nhanh chóng sang mô hình lúa-tôm sử dụng giống lúa ngắn ngày luân canh với tôm sú nước mặn. Để đạt được hiệu quả phát triển bền vững cho vùng nghiên cứu, chúng tôi tin rằng cần thiết phải xây dựng những giải pháp dài hạn và phù hợp để giảm thiểu những ảnh hưởng bất lợi của xâm nhập mặn tại địa phương nghiên cứu.

Từ khóa: xâm nhập mặn, mô hình canh tác, lúa-tôm, nông dân, các cấp chính quyền địa phương, thông tin, sự thích ứng.

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1. Preface

The writing of this report was carried out both individually and by cooperation as follows:

Anna Bergqvist was main editor of following sections:

- 3. Introduction
- 6. Method
- 6.2 Water samples and analysis
- 7. Background
- 7.3 State management and organization
- 8. Findings and discussion
- 8.2 Awareness of salinity intrusion, water samples and analysis
- 8.3 Measures and Adaptations

Katrin Eitrem Holmgren was main editor of following sections:

- 6. Method
- 6.3 Literature study
- 6.4 Personal communication
- 7. Background
- 7.2 Living standards in the Mekong Delta
- 7.4 Study site
- 8. Findings and discussion
- 8.1 Problem or opportunity
- 8.5 Mastering your own situation

Pehr Rylander was main editor of following sections:

- 4. Purpose
- 5. Scope and limitations of the study
- 6. Method
- 6.1 Interviews
- 7. Background
- 7.1 Saltwater intrusion
- 8. Findings and discussion
- 8.2.2. Present status of salinity
 - Crops and salinity
- 8.4 Communication

2. Table of explanations

Abbreviations

CTU	Can Tho University
DARD	Department of Agriculture and Rural Development
DONRE	Department of Natural Resources and Environment
DOSTE	Department of Science and Technology
FA	Farmers' Association
MARD	Ministry of Agriculture and Rural Development
MONRE	Ministry of Natural Resources and Environment
SLU	Swedish University of Agricultural Sciences

Vietnamese words

TÔM CÀNG XANH	Fresh water prawn <i>(Macrobrachium rosenbergii)</i>
TÔM SÚ	Tiger shrimp <i>(Penaeus monodon)</i>
XÃ	Commune
ẤP	Village

3. Introduction

Viet Nam is one of the fast developing economies in Southeast Asia with a human population of 88 million people in 2009 according to the World Health Organization. Of those 88 million approximately 17 million live in the southernmost part of the country, or more specifically - in the Mekong Delta.

The delta is also the most important agricultural region in Viet Nam and covers 4 million hectares. About 81 % of the land is used for agriculture (Tuan, 2007) and many of the farmers in the delta are highly dependent on the Mekong River as a source of water for crop irrigation (Lenton, 2009). The farmers in the delta produce about 90 % of all the rice exported from Viet Nam, which is presently the second largest rice exporter worldwide (Oxfam, 2008). These facts confirm the statement by Miller (2003) that the Mekong delta plays a crucial role for both national food security and economic development.

The Mekong Delta has a tropical monsoon climate and the year is divided into two distinct seasons, dry and wet season. The dry season usually occurs between December and April and is followed by the wet season that often starts in May with heavy rainfall and ends in November (De, 2005). During the wet season flooding is common whereas phenomena such as saltwater intrusion are more common during the dry season (Ojendal, 2000). This is mostly due to the flat land (Wassman, 2004), tidal fluctuations and low water flows which make it possible for saline water to intrude to the rivers and canals with brackish water as a result (White, 2002). Intrusion of salt water is regarded as a major constraint for agricultural production (Sakamoto, 2008) and the brackish water is unsuitable for rice growth though it enables aquaculture such as shrimp farming (White, 2002).

One of the provinces in the delta that is affected by salinity intrusion is the coastal province Ben Tre. This province has also been suggested as one of the most vulnerable provinces in Viet Nam to climate change and increasing sea levels (Carew-Reid, 2008). Almost the whole province has an elevation above the average sea level that is less than 1.5 meters. Even if the majority of inhabitants in the province are no longer officially defined as poor, Ben Tre still has the highest number of poor people of all the provinces in the delta and many of these are farmers (Oxfam, 2008).

What will happen to the farmers if the sea level rises and saline water intrudes further into the coastal areas as was predicted by the Inter-Governmental Panel on Climate Change (IPCC) in 2007. The Mekong Delta contains already about 1.7 million hectare of salinized land (Wassmann, 2004).

These questions show the importance of studies about salinity intrusion. In this report we will try to investigate how a few farmers and local authorities in Ben Tre province are affected by saltwater intrusion. Our aim has also been to understand how farmers have tried to adapt to saline conditions and what they think will be needed in the future.

4. Purpose

The main objective of this project was to study which impacts saltwater intrusion may have on the daily life of some selected villagers in the southern Mekong Delta. The study was made to examine the following:

- Is saltwater intrusion regarded as a problem or an opportunity? What are the consequences for the farmers?
- The farmers' awareness of the salt issue.
- The adaptations and measures used to cope with saltwater intrusion.
- The communication between farmers and authorities.
- If the farmers and local authorities feel that they have had the power to affect their situation, and if so, how much they could affect it.

By examining these aspects we wanted to assess if there is a need for a change in order to improve the farmers' livelihood, and if so, outline some important aspects to consider for facilitating such a change.

The selected villagers were farmers who live and work in a specific part of a district and are affected by saltwater intrusion.

Another objective was to investigate the levels of salinity and how these levels fluctuate in the region at the time of this study and also to relate these salinity levels with the replies that we received in our interviews.

5. Scope and limitations of the study

The study was conducted in two villages in the commune Xa An Thanh, district of Thanh Phu, in the province of Ben Tre in the southern part of the Mekong Delta. Twelve farmers and nine local authorities were interviewed. Therefore this study should not to be considered as an attempt to describe any large area. For a list of the interviewees see Appendix 11.1.

The interviews were made during two weeks during the change between dry and wet season. Since the study was not conducted over a longer period of time it just represented a single event. We intended to meet many different local authorities but not all were available for an interview.

6. Method

6.1. Interviews

To achieve our main objective we thought (1) the people who were affected by saline intrusion and worked with this issue, and (2) those whom we considered to be the experts on the subject, ought to be approached. Therefore we wanted to carry out the study in the field rather than to use only literature sources. The method we used for conducting interviews consisted of two main theoretical frameworks: Qualitative interviews as described by Trost (2009) were used since the number of interviewees was small. This method allowed us to get a depth in the interviews and adapt the questions to new knowledge. Participatory Rural Appraisal (PRA) methods were also used as means to involve the farmers and enable them and us to get a better understanding of the current situation (FAO, 2011).

6.1.1. Preparations

We started long before the trip to Viet Nam (three months before our departure) to list and ideas which could be reformulated to questions. These ideas and questions were based on the purpose of the project, and written information about Viet Nam and saltwater intrusion.

6.1.2. Farmers

As the questions were meant to reflect the purpose of the study and also be easy to overview they were divided into eight different sections. This overview helped us to ensure that the purpose of the study was approached by the answers which we might receive, and that no question of importance should be forgotten. The questions for the farmers can be seen in Appendix 11.2.

The eight categories were as follows:

1. *Start-up questions* were used to get to know the farmers. The questions were also used to obtain a fully natural introduction to the interview. We did not want to discourage the farmers from answering our questions.
2. *Resources and cropping system*: This category was used to get the background of the factors that had influenced or were still influencing salt water intrusion. We also practiced PRA methods by constructing a time calendar in which the months and yearly activities on the farm were documented. This technique enabled us to handle certain difficulties because the farmers did not use the “sun calendar” that we are used to, but rather a “moon calendar” which is roughly one month behind the sun calendar. The purpose of the PRA techniques is to involve the local people in a

discussion. To use a seasonal calendar (or a time calendar as we called it) is a good way to document different activities throughout a whole year as stated by the FAO (2011). A time calendar can be used to map all sorts of activities but we have limited it to agricultural activities, other sources of income and water quality and quantity throughout one year.

3. Problems associated with agricultural production: In this section there were questions addressing how saltwater intrusion is regarded by the farmers. Is it a problem or an opportunity? What dignity does a potential saltwater problem have in comparison to other problems on the farm? We asked the farmers to define saltwater intrusion as either a problem or no problem. This was to avoid imposing the views that we already had on them.

4. Discussion on saltwater intrusion: This section helped us to get the farmers' perspective on how long there had been a saltwater intrusion on the farm and what consequences this has had, directly as well as indirectly

5. Measures taken in the past: Measures that either contributed to a higher or lower salinity in the water of agricultural or aquacultural areas were discussed. These questions helped us to find out who was responsible for the measures taken. This section was closely connected with the following section with questions on how the farmer had been involved in the respective measures

6. Communication: This was an important part of the interviews as one of the purposes of our study was to identify possible social barriers which might stop the farmers from accessing the communication channels that existed at the present time. Questions were asked about decision making and participation in discussions on saltwater intrusion in the community. We also asked where these discussions took place. This section also covered questions about consultations on farming practices, saltwater intrusion and other information sources about saltwater intrusion. This also helped in investigating the awareness of saltwater intrusion and water shortage of the farmers.

7. What will the future be like? This part contained questions which were meant to tell how farmers might adapt themselves in order to deal with saltwater intrusion in a better way. It also contained questions on climate change that might give information on the farmers' awareness of this potential problem. Other questions regarded the possibilities and problems associated with a change to another cropping system and what would be needed in order to complete such a change.

8. Finishing of the interview. Questions on, if the farmer would like to add or stress anything in the interviews were brought forward as well. We also asked permission to take photographs of, and water samples from the farmers' fields.

Before we started the interview we were introduced by the interpreter as affiliates of the Swedish University of Agricultural Sciences (SLU) and of Can Tho University (CTU). We also asked if we could

use a tape recorder during the interview. The farmers were well informed about their anonymity as Trost stated in 2009. The interpreter also told the farmers of their rights to interrupt or end the interview at any time as well as their rights to ask us to stop the recorder as described by Lantz in 1993. Finally, the farmers were also told that they did not have to answer questions, which they did not want to answer or knew the answer to. Furthermore we presented the farmers with a small gift before we started asking questions.

6.1.3. The interview

The interviews were carried out with eleven of the farmers between the 18th and 22nd of April. The last farmer was interviewed on May 16th. We decided to have three assignments to carry out during the interviews. One was to lead the interview which meant telling the interpreter, if there was any doubt, what question to ask and to ask the farmers' questions via the interpreter. Another assignment was to take notes with as much detail as possible in order to have a written document for the coming analysis. The last assignment was to facilitate the interview and make it run as smoothly as possible by managing the tape recorder and the PRA time calendar. This assignment also included taking less detailed notes and to assist the asking of follow-up questions.

6.1.4. Changes in the field and processing of the information

To ensure that the questions were as complete as possible, we simulated interviews among ourselves, where we appeared as farmers or interviewers. We switched roles so that everyone would have equal possibility to contribute to the further work on the interview questions. We did not have the possibility to test the questions on a group of farmers as described by Lantz (1993). Therefore this was our way to make test interviews.

Our exercise generated additional questions and follow up questions as well as general guidelines for us on how to conduct the interviews in the best possible way. Some of the original questions were removed and others were moved to other sections. Eventually we thought that some questions needed a rephrasing in order to become more understandable for the farmers. The simulation also made us realize how you could feel when you were asked these kinds of questions and also which questions that might be inappropriate.

We put together a first draft of questions which was shown to our supervisors and commented upon. We also added some questions on investments and yields of the farmers' production to aid Can Tho University in their research. Finally, we also included some questions about climate change.

As expected and supported by the theory of qualitative interviews, the interviews and questions where changed while we were working in the field (Trost 2009). As the interview series progressed

we learned more about the situation of the farmers and about the more likely answers to our questions. This enabled us to consider new and also more in-depth follow up questions as well as other ways of putting the questions to the farmers to perhaps generate new answers.

Another change in the methodology consisted of a mid-series discussion with the interpreter on how to improve our questions as well as the different views of our questions that might exist within our group. Since the different interviews should be comparable we did not want to change the questions too much.

We also tried three different ways of conducting the interviews. The first one was to let the interpreter ask the questions straight off from a written document, the second one was to ask some of the questions ourselves and the third one to ask the questions ourselves in the order and way of phrasing that seemed to be the best one for the interviewing person.

The processing of the information obtained from the interviews included a transcription word by word of the information on the tapes. This was done to be able to interpret the given information. We also constructed “analysis sheets” in which we wrote information which we considered as vital for achieving the purpose of the study. This was done in order to compare the twelve farmers in a more easy way. The analysis sheets can be seen in Appendix 11.5.

To verify the information from the interviews we included the help of our supervisors and their colleagues who, together with us, listened to selected parts of the tapes and told us what was being asked and answered. These approaches were devised by us, the authors, and are not taken from any scientific literature on qualitative interviews. This way of working is supported both by Trost (2009) and Nadarajah (2011) as they state that there is an immense amount of different practices and that creativity is a greater aid in this case since we are inexperienced in this field.

6.1.5. Local authorities

Interviews with nine local authorities were carried out between 16th and 20th of May. In these interviews we used a different approach than during the interviews with the farmers. Regarding the local authorities, our main objective was to ask questions regarding the work the authorities carried out and regarding the measures they used to control saltwater intrusion. Their awareness of climate change and sea level rise was also something we wanted to investigate. An example of the questions can be seen in Appendix 11.3.

As a result of this objective we focused on a summary of the information on the tapes and a “communication sheet” to bring some order to the many interactions between the local authorities. The communication sheet is shown in Appendix 11.6.

6.1.6. Sources of error

The language barrier is an apparent possible source of error when conducting the interviews. This was also emphasized as there was not a direct communication between us and the farmers but instead with an interpreter as an intermediate. How we, the interpreter and the interviewee defined concepts included in the questions as well as how we understood what we were trying to ask about might differ quite a lot. This also affected how the interpreter posed the questions e.g. did he ask generally which measures and adaptations had been done to control saltwater intrusion, which we requested, or did he ask about specific measures that had been taken? Although we have not studied qualitative interviewing techniques, we still tried to use the best way to proceed when unforeseen events occurred.

In accordance with the theory of Trost (2009) on qualitative interviews, the farmers were divided into groups based on certain characteristics (gender, education and size of the farm) that were of importance to the purpose of the study since these characteristics could affect the answers which we received. The division was done in the preparation phase of the project in order to get answers with as much variety as possible. When we were in the field this was not possible to accomplish and only a 50/50 ratio of men and women as requested could be arranged.

The test interviews could not be conducted as in the theory of Lantz (1993), described above, since there was no time for it. So we made the best of the situation and acted as farmers ourselves.

The quotes that you will find in the “Findings and discussion” sections are from the interviews, and are the exact words of our interpreter. But the interpreter usually told us a summary of what the farmer said as an answer to our questions.

6.2. *Water samples and analysis*

To be able to get a better understanding of the salinity conditions which were experienced by the different farmers we met (and to understand their answers even better), water samples were taken from ponds at each farmer. Two parameters were analyzed, electrical conductivity (EC) and pH. EC is a measure of the ionic activity of a solution and measures the capacity of a transmitting current (Lenntech, 2011). Electrical conductivity was measured to give us a picture of how severe the salinity concentrations were. pH was analyzed merely to see if the water was acidic and therefore could influence our conductivity results.

6.2.1. Method water sampling

The water samples were collected in ponds in plastic water bottles with a volume of 500 ml. The last water samples were taken with smaller sample tubes. Since not all the farmers had exactly the same

farming system the samples do not originate from the same type of ponds. All the ponds though involved either fresh water prawn or tiger shrimp. From most of the farmers at least two samples were taken. Because of a lack of water bottles we were only able to get one sample each from the last four farmers. When it was possible the samples were taken from a depth of 0.5 meters to avoid the surface layer. However, this layer usually differed, since the samples had to be taken where it was easiest to climb down to the pond. As much as possible we tried to follow the draft of the water sampling method handbook written by the Department of Aquatic Sciences and Assessment at the Swedish University of Agricultural Sciences.

Usually we made sure that all the three of us had taken some samples each, and two persons were always present at the sampling. We are aware of the fact that this is not ideal if the results are to be comparable but it was more important to us that everyone practiced the water sampling technique.

A few times we were not able to take the samples ourselves but were helped by a farmer or one of the accompanying persons we had with us during the interviews which of course made it even more difficult to follow any water sampling method.

After a bottle was filled, a vacuum was created in the bottle before closing it and on one of the bottles time, date and the number of the farmer was noted.

6.2.2. Field and laboratory methods

The samples taken were analyzed within a period of 24 hours during the first week in Than Phu at our temporarily installed laboratory. The lab equipment was brought from Sweden and calibrated both at our arrival in Can Tho and then again before measurements with standard solutions from the Department of Aquatic Sciences and Assessment at SLU. This was done at the Soil Science Department at CTU.

The water samples were stored in a fridge. Before measuring, the samples were shaken in order to be homogenized before some of the content was poured in a sampling tube where the measurements took place. This was done to make sure that the original sample was not used for measuring to avoid the risk of contaminating the sample in the case something went wrong and we would have to measure them once more. All bottles and sample tubes were washed with tap water and finally rinsed in distilled water between the measurements. The measuring cells were washed with distilled water between, before and after the measurements. In the sampling tube the water was also "heated" by putting it in warm water in order to reach an acceptable temperature for the measurements.

In the sampling tube, EC was always measured first since ions from the pH-meter could affect the EC in the solutions (Demandt, 2011).

EC had to be re-measured on the 26th of April at the Soil Science Department at Can Tho University since the measurements showed values out of range and a new standard solution was needed to calibrate the equipment. The pH value was considered as accurate and was therefore only measured once.

6.2.3. Calibration of the pH-meter and pH measurements

The method used to calibrate the pH meter was as follows:

- 1) All small beakers were washed in tap water followed by distilled water.
- 2) Some BaCl₂ solution was added to the pH meter electrode (Approximately 1 cm below the hole).
- 3) The pH meter was then placed in a beaker with calibration solution of pH 7 and at the first calibration it was left in the beaker for four hours in order to get stabilized. For later calibrations this time was at most 15 minutes.

First the temperature had to be stabilized, which we measured with an extra thermometer.

When the temperature reached $25\text{ }^{\circ}\text{C} \pm 1^{\circ}\text{C}$ the calibration was started.

- 4) First pH was measured at pH 7 and rinsed with distilled water before being measured at pH 4.
- 5) After this was done the internal control was measured which showed that we were in the right interval.
- 6) The control solution was tested each time before pH samples were measured.

Concerning the temperature and the pH meter, the pH meter was installed to show the value at $25\text{ }^{\circ}\text{C} \pm 1^{\circ}\text{C}$. So before measuring these samples we first measured with an extra thermometer. When the temperature had reached the correct interval, measurements were made.

6.2.4. Calibration of the conductivity meter

In order to calibrate the conductivity meter a cell constant was needed as an input. The cell constant was determined by using a reference solution (0.1 M KCl) made at Can Tho University by one of the experienced staff at the Soil Science Department. The accepted temperature interval during the calibration and the later measurements was $25^{\circ}\text{C} \pm 0.5\text{ }^{\circ}\text{C}$.

The temperature was measured with the help of a thermometer bought in Sweden. When we noticed that the temperature was stabilized we used the thermometer in the equipment itself to

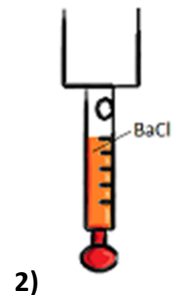


Figure 1: BaCl level in the electrode

decide at which temperature the sample was measured. We noted only a very small difference between the two thermometers (± 0.1 °C).

During the measurements the cell was used to stir the sample in order to keep the sample homogenized. When the conductivity meter stabilized the value was noted.

6.2.5. Analyses of the data

The EC results were expressed as mS/cm (equal to dS/m). This unit was later converted to ppt (parts per thousand), which is the same as g/L, by multiplying with the factor 0.64 (Guong, 2011). Since ppt was commonly used in Ben Tre we decided to convert our data to this unit in order to make it easier to compare our results with those of other researchers. As we had collected different sample amounts from all the interviewed farmers and thought it would be misleading to make an average of some of these data and not of other data, all measurements from the interviewed farmers were plotted in one diagram.

Since the pH measurements showed too low hydrogen ion concentrations to affect the EC, these data have not been further analyzed.

6.3. Literature study

As a part of the project we searched for information in articles, reports, statistical databases, and books. While searching for information we were aware of and took notice of factors like the year of publication and from where the information had been gathered. Nationality and profession of the author(s) were noted in order to get a variety of inputs from people with different backgrounds. We have tried to find information from a variety of authors and institutions in order to get an overview that is as complete as possible.

One reason for making the literature study was to gather baseline information in order to formulate our interview questions. This concerned interviews of the farmers as well as local authorities. The gained information contained different components. Amongst the issues, we wanted facts about the effects of saline intrusion on crops and soils. We also searched for information concerning the study site and the institutional levels where some of our interviews were conducted .

The daily life of a farmer in the rural areas in the Mekong Delta and social structures in Viet Nam were types of knowledge we wanted to acquire through our research. This was done in order to pose detailed questions corresponding to the different target groups of our interview study.

Our main sources of articles were databases such as ScienceDirect and GoogleScholar. Authors of the obtained articles were a variety of Vietnamese, European, Australian and U.S American people.

The majority of the collected information has been published within the last fifteen years. We have critically read the gathered information and compared with other information sources to validate facts and figures. The Statistical Yearbook of 2010 for Viet Nam has been used throughout our project.

A limiting factor while searching for information for the project has been that a lot of information, especially concerning national policies in Viet Nam, has been written in Vietnamese. This has been a limiting factor in acquiring information as we have not had the possibility to get a translation.

6.4. Personal Communication

While working on our project, we have been in touch with many different people, institutions and universities. This has been a crucial part of our thesis as we have gained more knowledge, established further contacts and received essential information necessary for our study. This phase was especially important during the planning of the project and during the analysis of our interviews.

We have for example received help from researchers at the Institute of Water and Environment at SLU concerning the laboratory part of the work. They have helped us by lending equipment for measuring pH and electrical conductivity and teaching us how to use this equipment. As part of the preparation we had a meeting with researcher Anders Wilander at the Institute of Water and Environment. He has a profound and long-lasting experience regarding studies of water issues in the Mekong Delta and provided us with information about water sampling. While we were in Viet Nam, we continued to keep in touch with the researchers via e-mail. We have also received some assistance from researchers at CTU, Viet Nam. They have checked our measurements of electrical conductivity to see if the numbers were within a reasonable range for the specific study site. At CTU we were also allowed to use the chemical laboratories in order to carry out our measurements.

Other researchers who have been of valuable help during our study are people from the Department of Urban and Rural Development (SOL) at SLU. Help from these people was especially necessary when structuring and analyzing our interviews.

In order to gain knowledge about different institutions working within the Mekong Delta, we were in touch with two persons from the Mekong River Commission. These were Erik Skoglund and Håkan Berg who are, or have been, working in the commission as Swedish representatives. During the WorldWaterWeek (WWW) in Stockholm in September 2010, we got in touch with several researchers and projects which focused on water issues in the Mekong Delta. One of these contacts was a group of German researchers and PhD students. They provided us with information about Can

Tho and of water quality issues in the delta. The team also helped us to get further contacts which we kept in touch with throughout the project.

Another contact which was established during the WorldWaterWeek was a researcher who works for the United Nations University (UNU) within the department of Environment and Health Security (EHS) in Bonn, Germany. The contact resulted in collaboration between our project and a pilot project UNU-EHS recently started with in the Mekong Delta. The collaboration consisted of meetings while in Viet Nam and exchange of ideas.

Starting six months before leaving for Viet Nam, we kept regular contact with our supervisors in Sweden and Viet Nam. Among other things, the contacts helped us in preparing our application and providing information which was necessary to proceed with our study. Before leaving for Viet Nam, we also participated in a two-day Minor Field Study course arranged by SIDA. The course provided practical guidelines to keep in mind while abroad and brought up issues such as how to conduct field studies in different contexts.

7. Background

7.1. Saltwater intrusion

Intrusion occurs when saltwater mixes with freshwater. This happens all over the world and may affect both ground water and surface water as explained by Barlow (2003).

Saltwater intrusion is a recurring phenomenon in Viet Nam. The water from the South China Sea and the Gulf of Thailand can reach far inland affecting 1.7 million ha in the Vietnamese part of the Mekong Delta. This is partially due to the flat land that is prevalent within the delta with an average height of less than 2 m above sea level (Wassmann, 2004). As Kotera et al. (2008) show the concentration of salt in the affected freshwater is highest close to the sea with some areas being affected all year round and some areas only at certain times of the year. The concentration of salt thus also depends upon seasonal changes in climate.

In Viet Nam the dry season lasts from November or December to April and the wet season from May until October or November (Wassmann, 2004). The heavy rainfall during the wet season means that the flow of the Mekong River will have an increased flushing capacity and hinder the further intrusion of saltwater (MRC, 2008). Other factors that influence the amount of saltwater intrusion are winds and properties such as the depth of the estuary. Canals used e.g. for drainage also allow for the further intrusion from the main branches of the delta (Hashimoto, 2001).

A major concern where shrimp cultivation is practiced is the salinization of the soil. This occurs when salt accumulates in the soils over the years since the water flow in the Mekong River is not enough to push the salt towards the sea (White, 2002). Karim (2006) mentioned several crops including rice which had reduced yields after the introduction of shrimp farming in the coastal area of Bangladesh and according to Grattan et al. (2002), it is documented that rice yields can be reduced by concentrations higher than 1 ppt (1.9 dS/m) which shows clearly how the dry season could make it difficult to cultivate this crop.

7.1.1. How does salt water affect farming?

Nguyen Ngoc De divides the Mekong Delta into seven regions based on their similarities regarding conditions that affect farming in the area. Two of the regions are exposed to saltwater intrusion and have saline soils. Both regions are dependent on rainwater for agricultural production. They are the Ca Mau peninsula and the coastal zone including the provinces of Bac Lieu, Soc Trang, Tra Vinh and Ben Tre.

In the dry season freshwater is limited, saltwater intrusion travels inland and farmers have had to come up with ways of handling this situation. This has resulted in the practice of having one rice crop per year using a traditional rice variety, or a high yielding variety that grows quicker (110 – 140 days) and thus can be harvested earlier allowing for two rice crops per year. This scheme can also be complemented with the growing of shrimps or crabs in the same area where rice is grown. Nguyen Ngoc De also says that the use of Banana prawn and freshwater shrimp has been on the rise in the last few years but has been practiced for more than 30 years in total.

In Thanh Phu we were told that there are two kinds of shrimp which are grown in this way “integrated” with the rice: Fresh water prawn (Vietnamese: Tôm Càng Xanh, Latin: *Macrobrachium rosenbergii*) and the Tiger shrimp (Vietnamese: Tôm Sú, Latin: *Panaeus monodon*). Regarding this area we were told that farmers either sow rice, plant seeds or use the seedling technique in which seedlings are brought up in a nursery before being transplanted to the field.

Apart from these adaptations to the saltwater intrusion in the district there has been measures taken to control the inflow of water from the sea. As seen in Figure 2 to the left dikes have been built along the coast of the district to prevent uncontrolled saltwater intrusion. Gates or sluices have been installed in the dikes to control the inflow of saltwater. Despite these efforts saltwater intrusion from the sea still occurs at the tip of the district as well as via rivers which run through the nearby Mo Cay district.

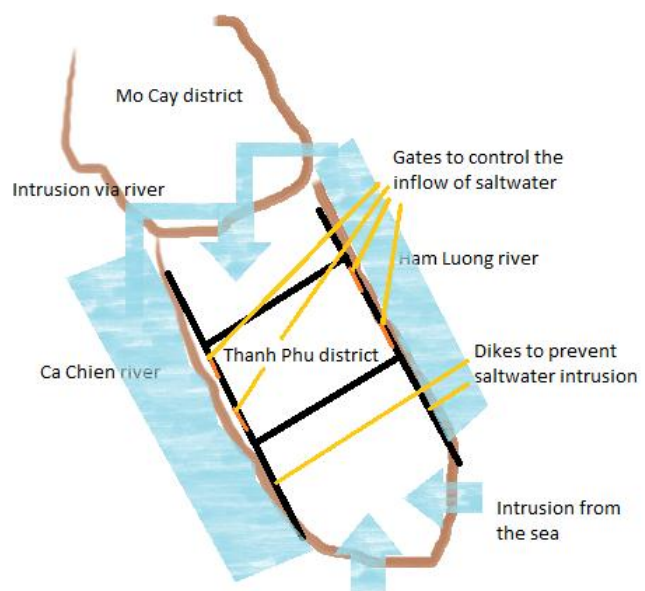


Figure 2: Saltwater intrusion in the Thanh Phu district.

7.2. Living standards in the Mekong Delta

7.2.1. General

Four ethnic groups of people live in the Mekong Delta. The largest ethnic group is the *Kinh* people who are estimated to about 92.5% of the population in the delta (De, 2005). A family in the Mekong Delta consists on an average of five members (Kotera et al, 2008).

7.2.2. Education and health care

The Mekong Delta complies with the educational system of Viet Nam although the level of education differs between the Mekong Delta and the rest of the country. About 92% of the people who live in the Mekong region have a basic education (Vormoor, 2010) mainly due to the fact that primary education is compulsory in every village (De, 2005). However, the enrollment rate in upper secondary school is only about 16% which is the lowest attendance in the whole country (Vormoor, 2010). The number of university students in Viet Nam 2010 was about 2 million (Statistical Yearbook of Viet Nam, 2010). Only approximately 140 000 of these students were from the Mekong Delta. The literacy rate of the region's citizens is estimated to be 93%. For the younger generation there is no gap between men and women in the literacy rate while the older generation has more men than women who can read and write (Vormoor, 2010).

According to the Statistical Yearbook of Viet Nam (2010), the delta contains many medical service units. The region also has approximately 250 hospitals and regional clinics. In range, they cover about 98.7% of the Mekong River population (De, 2005). Despite the many healthcare clinics, they are usually lacking resources with respect to both facilities and personnel (De, 2005).

7.2.3. Poverty rates and income

The poverty rate of the Mekong Delta was 12.6% in 2010, which was lower than the national poverty rate of 14.2% (Statistical Yearbook of Viet Nam, 2010). The provinces within the Mekong Delta with the highest poverty rates were those which were strongly affected by saltwater intrusion (Vormoor, 2010). The average income for a household in the region was estimated to be slightly lower than the national average (Kotera et al, 2008). The income gap differs between the rural and urban areas, urban areas having a higher average income (De, 2005).

Institutional sources provide loans to households in the region. The percentage of households in the delta zone which receives loans range from 40% to 90% depending on location (Kotera et al, 2008). The figures are from 2006 and illustrate the unequal economical balance in the region. There is also a difference between urban and rural areas. In 1999 the percentages of poor households in the delta were 24% and 16% respectively in rural and urban areas (De, 2005).

7.2.4. Rural areas

More than 80% of the population in the Mekong Delta lives in rural areas (De, 2005). Urbanization is an ongoing trend, both in the delta as well as on a national level (Vormoor, 2010). The main source of family income in the rural areas comes from farming (De, 2005). Farming accounts for 70-90% of the income and is based on rice production, fisheries and shrimp cultivation (Kotera et al, 2008). Other

sources of income may include husbandry and holding a selected position in the village (Kotera et al, 2008; Farmer interviews). The quality of the labor force is low in the delta and in 2001 83% of the work force was classified as unskilled labor (De, 2005). The average household in the Mekong Delta highly depends on river water for domestic use.

The farmers of the Mekong Delta use the moon calendar when referring to months (Guong, 2011). The difference between the moon and lunar calendar is approximately one month where the moon calendar is one month behind the lunar calendar.

Group farming is traditional in the Mekong Delta and practiced throughout (De, 2005). The groups may consist of a family, neighbors and friends. The groups can help each other in labor work as well as in social activities and in sharing knowledge and ideas.

7.2.5. Farming conditions throughout times

Farming has been carried out in the Mekong Delta for many generations. The Green Revolution, starting in the 1950s marked a transition for agricultural practices in the delta. New technologies were introduced such as high yield varieties of paddy (Vormoor, 2010). Chemical fertilizers and pesticides were put in use in large quantities. There was intensification as well as an extension of agriculture. The time period also marked the out-phasing of traditional farming, being replaced by engineered and mechanized agricultural enterprises.

Land areas were collectivized and private trade was prohibited at the end of the 1970s (Vormoor, 2010). Double-cropping became popular due to new irrigation systems. This change in the system did not work as efficiently as expected and land re-allocation started in the 1980s. The re-allocation resulted in a lot of farmers losing their land and still today the region of the Mekong holds a very high percentage of the country's landless people.

In 1986, a political and economic renovation policy started. This is known as the Doi Moi and is categorized by liberalization as well as political and economic decentralization. The policy also resulted in that farmers could start owning land again with a maximum period of 20 years. Efforts were put in irrigation systems and a lot of canals were constructed during this period.

Doi Moi marked a shift from rice monoculture to a more diverse and perennially based cropping system (Vormoor, 2010). Rice prices on the world market had a dip in the 1990s and simultaneously aquaculture had a boom. During this time, the Vietnamese government promoted a switch to aquaculture which further helped to speed up the process. As a result, aquaculture can be seen today in many provinces in the Mekong Delta.

7.3. State management and organization

In order to get a better understanding of the people we have interviewed in this study and especially where the authorities are placed in the governmental structure, it is relevant to describe something about the state management. This chapter will give some insights of the structure of the government, how Viet Nam is ruled and which ministries that is relevant for the theme of this study – saltwater intrusion.

7.3.1. Administrative structure

Viet Nam is a one- party state governed by the Vietnamese Communist Party which is the major policy driving force next to the National Assembly (Waibel, 2010). During the 1980's renovation policies such as the Doi Moi reform were introduced which opened up for a market economy (Adger, 2000).

The administrative structure in Viet Nam consists of four levels of government: National, Provincial, District and Commune (Fforde, 2003). Large cities like Hanoi and Ho Chi Minh City are equal to a province and a city district is equal to a district as shown in Figure 3. Each of the provinces, districts and communes have their respective People's council and People's committee. The People's committee is the executive agency of the Council at each level. The Council represents the legislative National Assembly while the People's Committees has state management functions (Waibel, 2010). Vertically, under the commune the structure consists of villages that in their turn are divided into communities or "self-management" groups, each having a community leader (Khoi, 2011).

Party members are found on all levels in the administrative structure. Linked to the Party is also the so called Fatherland Front, an umbrella organization consisting of various mass organizations. They are financed and guided by the state although they are not formal administrative units of the government. Nevertheless, they still work on behalf of the government concerning mobilizing members, distributing information and implementing local programs. The most popular mass organizations that also are working with environmental issues are the Farmers' Union (also called Farmers' Association) and the Women Union.

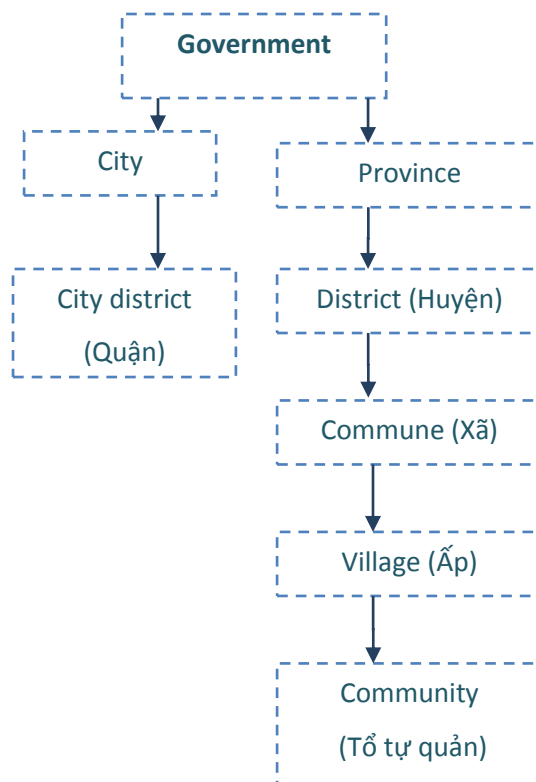


Figure 3: This figure gives a brief overview how to power is divided between the national and subnational levels, for some of the levels the Vietnamese name is also written.

A vertical structure dominates the structure of authorities. E.g. the provinces are keeping track of the actions of the district and People’s Committees are bound to regulations set by the government.

During the last two decades there has been some decentralization, though mostly from the government down to the provinces with a lesser extent of district and commune levels. Provincial and district authorities are responsible for service provision and infrastructure maintenance, although they have a restricted financial framework.

Ministries in Viet Nam are composed of three types of agencies, state management (where most of the power lies), institutes and business agencies. Those ministries that are of great importance to water and salinity issues are the Ministry of Natural Resources and Environment (MONRE) and the Ministry of Agriculture and Rural Development (MARD). MONRE was established in 2002 and took then over some responsibilities from MARD which has caused some conflicts between the ministries. To date, the main responsibilities of MONRE are for instance environmental protection, climate change and water resource management. They also manage hydro-meteorological data and water quality data collection. MARD on the other hand are dealing with more structural issues such as flood control, irrigation, rural water supply, cultivation, fishery and hydropower, the last one together with

the Ministry of Industry and Trade. The Ministry of Agriculture and Rural Development has larger economical means although that of MONRE is steadily increasing (Waibel, 2010).

7.4. Study site

7.4.1. Region: The Mekong Delta

The Mekong Delta is an agricultural region (De, 2005). Land-use in the delta is mainly determined by physical factors such as hydrology and soil. The land is characterized by fertile alluvial soils and flat, low-lying land. The delta is considered to be the major rice bowl of Viet Nam and accounts annually for about 51% of the total rice production in the country (Vormoor, 2010). More than 90% of the rice exported from Viet Nam comes from the Mekong Delta. The region also produces 70% of the total amount of fruit in the country during one year, as well as 80% of the Vietnamese fish production (De, 2005). The delta is divided into three major water resource zones: high flooded zone, fresh-water zone and saline intrusion zone (Tuan et al, 2007). During the dry season, about 2.1 million hectares of the coastal area in the Mekong Delta is affected by saltwater intrusion.

In 2010 the amount of people living in the delta was approximately 17 million (Statistical Yearbook of Viet Nam, 2010) which represents about 20% of the country's population (De, 2005). The area consists of about 32% of the country's agricultural land. The delta is one of the largest deltas in the world and covers about 55 000 km² (Vormoor, 2010) while the catchment area of the basin stretches to 65 000km² (Tuan et al, 2007).

7.4.2. Province: Ben Tre

Our field study was carried out in the coastal province of Ben Tre in the Mekong Delta. The province has an area of 2360 km² and a population of 1 257 000 inhabitants (Statistical Yearbook of Viet Nam, 2010). As in other parts of the Mekong Delta, the soil is rich and fertile and has an alluvial character. The flood plain levels out at about 0-4 meters above sea level, enabling a flow of water from the ocean into the province (De, 2005). Ben Tre belongs to the saline intrusion zone (Tuan et al, 2007).

In Ben Tre, about 50% of the farms are classified as fruit farms (Vormoor, 2010). The province is unique in the sense that the land area used for fruit cultivation exceeds the land area used for paddy cultivation. The land area used for fruit cultivation and paddy cultivation was 85 780 hectares and 37 500 hectares respectively in 2010 (Vormoor, 2010). In 2000, the land-use strategy of the farmers changed. Lots of rice fields with low yields were converted to shrimp ponds (Nhan et al, 2007). From 2000 to 2004, the production area of shrimp increased radically simultaneously as the area for rice production reduced. During these years the rice yields decreased from 102 000 hectares (ha) to 90

000 ha while shrimp increased from 19 000 ha to 33 700 ha. The province of Ben Tre has the second largest production of aquaculture among the provinces in the Mekong Delta (Vormoor, 2010).

The mean growth rate of the industry sector, measured in gross domestic product (GDP) for the years 2000-2007, was 10-15% in the Ben Tre province. Ben Tre had a decline in the agricultural sector of about 16% during the mentioned seven years. This ranks as the most significant decline in the agriculture sector among the provinces in the region. In 2010 the poverty rate in the province accounted for 15.4% (Statistical Yearbook of Viet Nam, 2010). This rate exceeded the regional rate of the Mekong as well as the national rate.

7.4.3. District: Thanh Phu

We have focused on the Thanh Phu district in Ben Tre. The district is divided into three sub-regions where each region consists of six communes (see Appendix 11.8) (Guong, 2011). The cropping system differs among the sub-regions. The cropping system in sub-region one consist mainly of rice and maize while rice and shrimp dominate sub-region two. In the third sub-region the majority of farmers have shrimp production. Two main rivers, which are estuaries of the Mekong Delta, run by either side of the district (see Appendix 11.8). The rivers are called Song Co Chien and Song Ham Luong.

7.4.4. Commune: An Thanh

The An Thanh commune is located in the heart of the Thanh Phu district, in sub-region two (Appendix 11.7). A river runs through the commune thereby dividing An Thanh into two parts. The commune has one dam which is situated by the river. The water source of the commune originates from Song Ham Luong.

8. Findings and discussion

8.1. Problem or opportunity

One of the main aims of the project was to get an understanding whether saline intrusion is considered to be a problem or an opportunity. We asked the farmers and people in local authorities of their opinions upon the matter and reasons for the answers. We also wanted to find out what the consequences of saltwater intrusion are.

8.1.1 Farmers

Problem or opportunity

When asking the farmers if they considered saltwater intrusion to be a problem or an opportunity, the answer we obtained was that seven out of twelve farmers regarded saline intrusion to be a problem (see Figure 4). Two farmers replied that saltwater was an opportunity and three people saw it as both a problem and an opportunity. However, we think that one of the farmers who answered saltwater to be an opportunity misunderstood the question as all his remaining answers in the interview pointed towards it being a problem for him. There was no distinction between the answers if they were from men or women.

During the interviews, the participants were asked to list their five largest problems related to farming. This was done before they were asked about their opinion on saltwater (“See Appendix 11.2”). Two out of the twelve farmers listed saline intrusion as one of their top five problems. Difficulties regarding saltwater included both the concentration of salt and the intrusion of saline water into the fields. The farmers usually listed only two or three problems, where lack of money to invest was the most common reply.

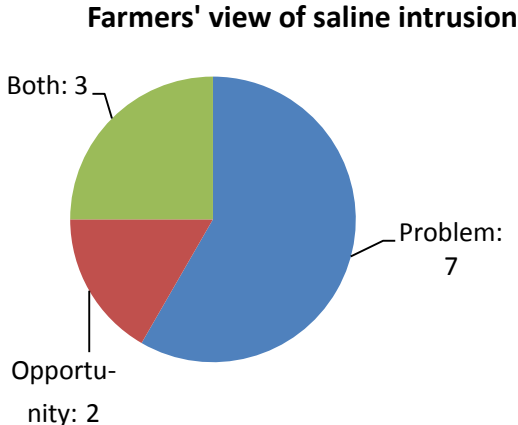


Figure 4: The diagram shows the answer we got from the twelve farmers categorized if they viewed saltwater intrusion to be a problem, an opportunity or both a problem and an opportunity.

One reason why the farmers did not mention saline intrusion could have been because saline water was a common phenomenon in the area. The intrusion of salt-concentrated water has been a fact since many decades. One reason why certain farmers listed saline intrusion as one of their biggest problems could have been because they knew we were doing our study upon that topic. They might have wanted to give us answers which they thought would please us.

However, this is not anything that we could confirm.

Consequences

Regardless of the farmers' opinions about saline intrusion, the consequences of saltwater intrusion obtained from the interviews were many and had a high variability. The overall view was that saltwater is not good for rice production while it enables shrimp and prawn cultivation. This reasoning could serve as an explanation for why some of the farmers stated the phenomenon to be both a problem and an opportunity. Many of the farmers noted that they have seen a decrease in rice yield and in the size of coconuts due to saline intrusion. Rice production is not possible during the period of saltwater intrusion. Since saltwater has started to intrude earlier than before, one consequence of saline intrusion is that many farmers have had to change their rice crops from long-term rice to mid-term and short-term rice crops. By changing the length of the rice growth the farmers are able to harvest before the saltwater period starts. If saltwater intrudes earlier than expected, the risk of yield losses is high. One farmer grew upland crops and she mentioned the difficulties associated with saltwater intrusion on the field. The farmer expressed the notion in the following way, referring to the months in the moon calendar: *"So if the saltwater appears early, on November, they may lose all their rice crop and if the upland crop is submerged with saltwater all the plants die."* (F8)

Even though one of the major positive effects of saltwater is the possibility of cultivating prawn, some farmers pointed out that freshwater prawn cannot tolerate too high levels of salinity. The tiger shrimp seems to be able to cope with higher salt concentrations than the freshwater prawn. This was noted by one farmer: *"...the tiger shrimp can tolerate higher salinity concentrations than the freshwater prawn"* (F4)

We believe that the salt tolerance of the organisms could lead to farmers prioritizing tiger shrimp over freshwater prawn. In our opinion, consequences of such a shift could be many. Apart from establishing a monoculture which might be vulnerable, the salt concentration in the soil will increase and only very salt tolerant crops could be used. A change like this would not be sustainable in the long run.

Another outcome of saline intrusion is the effect on the farmers' income. Shrimp and prawn production increase the income to a large extent even though the investment costs are high. A decrease of income was noted by the farmers due to change of the rice crop, a decreased fruit production and the risk of shrimp and prawn dieback.

The overall answer given by the farmers was that their income had decreased due to saline water. A reduced income could have many different effects. Some farmers had already experienced this while

others speculated what the outcomes of such a change would be. Two farmers replied that they had a hard time paying the school fees for their children due to a decline of income. A reply from a couple of farmers was that they needed to cut down on food expenses. Some farmers said that they would have to cut down money they give as contributions to weddings and funerals while others said they would have to loan money. As the answers differed it is not possible to draw any overall conclusions and it is difficult to predict what general consequences a decreased income might have.

Saline intrusion also affects the water used for crop production and aquaculture. Certain plants and fruit trees cannot cope well if being watered with saltwater. Some farmers had taken to start watering with well water instead of using water from the river. We believe that this can become a problem in the future if precipitation fluctuates and the amount of water is unpredictable.

Groundwater levels can then vary which would create the risk of having a shortage of well water.

Summary

The majority of the farmers regarded saline intrusion to be a problem. The consequences of saltwater are many: both direct and indirect. The farmers we interviewed sometimes found it difficult to directly list the consequences and the answers could therefore be found in other parts of the interview. An apparent consequence is the effect of saltwater on the crops and yields which will inevitably affect the income. Having an increased or decreased income affects the whole family and livelihood. A decreased income was more common among the farmers we interviewed. Apart from having to cut back on different expenses, we think that this can also cause a stressful situation with an uncertainty regarding the effects on the farm.

8.1.2. Local authorities

Problem or opportunity

Among the people in local authorities whom we interviewed, there was none who thought that the intrusion of saline water was merely an opportunity. Two of the interviewed persons regarded saline intrusion to be both a problem and an opportunity. These people were a Head of a Village and a person who owned his own shrimp company and both of them were farmers. The remaining seven interviewees claimed that saltwater was a problem and a challenge.

Consequences

A common consequence that was brought up during the interviews was the effects of saline water on farming. One of these consequences was that rice yields would decrease due to saltwater. One Head of Village told about the risks of getting salt into the drinking water. He said that this will have detrimental effects on the weight of ducks and chicken. The interviewee also mentioned that the

increasing saltwater levels will be one of the biggest challenges in the village during the upcoming five years. Some of the participants mentioned consequences such as a decrease in income for farmers and a switch to short-term rice varieties.

One person claimed that the saline water will bring about a change in the ecology of animals and vegetative system in the water. This statement indicates a long-term effect and the answer was provided by a farmer who was the owner of a shrimp company. The farmer had a university degree in fishery and therefore has an education in this field. Another reply that indicates a long-lasting physical effect is that saltwater will penetrate into the soil. Once the soil gets salt it is difficult to wash it out and this will affect the further growth of crops (see Background- Saltwater intrusion).

Some people mentioned that even though saltwater is mainly a problem, it can also have positive effects since it enables shrimp and prawn cultivation. It was noted in the interviews that too high salt concentrations though will only make the situation worse as aquaculture cannot tolerate extreme salt levels. A person owning a shrimp company mentioned that saltwater will cause a decreased growth rate of the shrimps.

One Head of Village explained that a dam existed in the village since 30 years back. He had noted a difference in cropping systems in the area throughout the years. The farmers who lived inside the dam could for example grow upland crops while farmers outside the dam were able to have rice and shrimp cultivation. As an indirect consequence of this, a division among the farmers is clear depending on the location of their farm. The Head of Village also pointed out that shrimp yields fluctuate a lot and the income from shrimp is not stable. The situation makes it difficult to make decisions for the whole village as the needs are diverse. We believe that the division could cause jealousy as well as segregation amongst the villagers.

An overall outcome of the effects of saline water is that people on all different levels have had to adapt their way of working during the last decades. The manner in which to handle the phenomenon of saline intrusion has changed as well as the focus. We believe that new policies, research and funding of this subject have been and will be needed, more under the heading "Findings and Discussions: Measures and Adaptations".

One consequence of saltwater intrusion is therefore the renewed way of working as the extent of the problem has increased. Amongst other things, knowledge and regular updating through water sampling is necessary. This is both due to the fact that the levels of salinity have increased and that saltwater has intruded further into the province. There is for example a need for people belonging to authorities to communicate with the farmers concerning these issues.

Summary

The responses and thoughts of saline intrusion varied between people in local authorities. A common note is that the majority of the interviewees considered saltwater to be a problem and a challenge. Many of the people interviewed in local authorities mentioned direct consequences of saltwater for the farmers and their fields. The connection between the answers of the local authorities and their knowledge of consequences of saltwater for the farmers could lead to the question of saline intrusion being prioritized within the different structural levels of society. Conclusions acquired from the interviews are that new ways of dealing with the issue of saline intrusion are needed.

A comparison between farmers and local authorities

The majority of the people whom we interviewed, regardless if they were farmers or working for local authorities, regarded saline intrusion to be a problem. The shared view upon the phenomenon encourages cooperation and dialogue in-between the participants. People on the different levels are working in the same direction. It would have been a more challenging task if some people, for example the Head of Districts, had regarded saltwater purely as an opportunity. The outcomes of this could have led to unfavorable decisions being made for the farmers. In addition, it is a good thing that many of the local authorities whom we have interviewed are, or have been farmers. This enables an understanding of the situation for the individual farmer.

The consequences of saline intrusion are manifold. The most obvious positive effect is the opportunity to cultivate shrimp and prawn which provide a high income. However, many of the interviewees, people being either farmers or people working in local authorities, mentioned the risk of shrimp die-back when the saltwater concentration becomes too high. Overall, the most evident negative effect of saline intrusion is the decreasing yields of rice and the change from long-term rice to mid-term and short-term rice varieties. The aspects of enabling prawn and shrimp cultivation while rice yields decrease have all clear effects on the farmers' income.

The two interview categories both mentioned consequences correlated with farming practices. In addition to this, people working in local authorities pointed out difficulties when some parts of the village and district were more affected by saline intrusion than others. In the long-run, this may cause conflicts between various local authorities and villagers. The present situation therefore indicates that saline water not only has negative effects on specific crops, but also on the village or community as a whole. Apart from the fact that saltwater may have long-term effects on the soil, the phenomenon may also have a long-term effect on the cooperation between citizens. Consequently, the complexity of saltwater intrusion can have both short-term and long-term effects on people and

their physical and social surroundings. Many of these consequences are hard to predict and may therefore be difficult to prevent.

8.2. Awareness of salinity intrusion, water samples and analysis

We were rather curious regarding peoples' awareness of salinity intrusion and climate change. How much was known about these matters, and to what extent did the knowledge differ between farmers and local authorities? Did the people feel that they were affected at all? Could the awareness be a communication barrier, a consequence of lack of communication or a proof that the communication between different levels was sufficient? In this chapter we will try to answer some of these questions based on the interviews, and the water samples which were collected by the farmers.

8.2.1. Salinity - temporal change

The history of salinity

When we asked a person for how long time he/she had been affected by salinity intrusion we could note that an overwhelming majority of both farmers and local authorities said that the saline water was typical for this area and that the water had been salty for a very long time, usually since their own childhood or further back in history. This showed us that salinity was definitely something people were aware of and that it was not regarded as a recent phenomenon. There was not a big difference between the local authorities and the farmers in this respect. However, the district officers gave us more detailed information concerning the history of salinity intrusion.

Twelve out of eighteen communes in Than Phu were now affected by salinity according to the officer from DARD. He also said that six of the communes, including Anh Thanh had been affected during the the two last years, although salinity in general was something that had happened occurred for a long time. The other district officer at DONRE told us that salinity intruded in the area since five or six years ago and showed us a map of where the intrusion took place. These two answers concern the recent years and we never got it clear why their answers differed from the others. One theory though is that the officers may have a certain range of salt concentration levels which they define as salt water intrusion. The salinity levels may have reached this range within the last five of six years which could explain the information we received.

Change over time

Ten of the twelve farmers claimed that the salinity level was worse last year, and many of them mentioned that the salinity levels had been increasing during the last three years. Many farmers also

mentioned that the dry season this year had been worse than before . Some farmers mentioned directly that the salt water concentrations had become higher which made the dry season worse than before. Others mentioned that the dry season was hotter and dryer than before and one person mentioned that the dry season lasted for longer time than usual. Since the question about the dry season was not included among the questions directed to the local authorities there is no other information to compare with.

Among the local authorities the answer was mostly that the salinity levels had increased during the last years though one Head of Village only regarded this as yearly fluctuations and the vice Head of the Commune did not give us any information about this. Nevertheless, the rest of the interviewees also had more information about EC measurements. The Farmers' Association informed us that the salinity levels during the last years changed from around 5-7 ppt to 10-15 ppt. The district officers reported even higher numbers. It was claimed that the levels were around 10-20 ppt but had reached figures as high as 30 ppt in the midparts of Than Phu. It was also mentioned by DARD that the levels in Anh Than had been as high as 18 ppt. However, it was not clear when during the dry season these levels were measured. Electrical conductivity was nevertheless measured every week in the district. The private shrimp company also informed us that a good salinity range for shrimp was 15-30 ppt and that tiger shrimp was not negatively affected even between concentrations of 5-40 ppt. Another shrimp company mentioned that a good range for shrimp was 15-20ppt. This year the private shrimp company owner, who also lived closer to the sea, had observed EC levels up to 30 ppt. Concerning the salinity levels, most farmers did not know of any salinity levels and EC data. Most of them estimated salinity by tasting the water. Only a few used or knew about the possibility to measure their own water at the private shrimp company but they never told us any exact levels of EC. Yet we are not sure what information about salinity levels farmers got from the shrimp company. A few farmers did not mention if they tested the water or not.

Sometimes we also asked or were spontaneously given information about the period of saline water versus fresh water. A few farmers and local authorities mentioned that the saline period had become longer. Many seemed to experience a period of six months with fresh water and six months with saltwater. However, six of the farmers were not asked this question and did not mention anything about it themselves why we cannot make any firm conclusions.

By summing up, one may note that people on all levels seemed to have more or less the same picture, namely that the salinity levels had been rising during the last few years, although it was mostly on a district level and at the Farmers' Association where more exact knowledge existed about

measurements on salinity, perhaps not so surprisingly since they are the ones involved in measuring the water.

8.2.2. Present status of salinity

Water data

Water sampling was an important part of the project and therefore conducted at each farm. However, the water data presented below, only shows eleven out of twelve farmers. Farmer twelve is not included. Please note that since different numbers of samples were collected at different farmers (see *Method*) we decided to show all results in the same diagram in order not to get misleading results. The data are grouped so that even if one farmer has more water samples these values will be aggregated and therefore they do not take up more space than a farmer who is only represented by one sample.

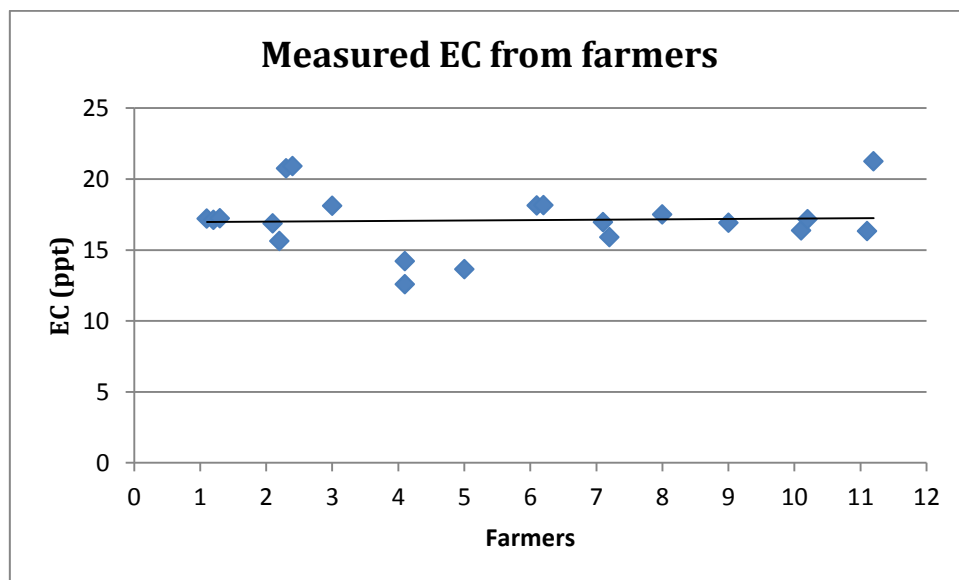


Figure 5: Measured electrical conductivity (EC) values in parts per thousand (ppt) from the interviewed farmers taken between the 18th and 22nd April, 2011. Each farmer is given equally space at the x-axis regardless of how many water samples that were collected, which means that the more water samples the more aggregated the data will be. Table data can be seen in Appendix 11.4.

The fluctuation of the data might be a result of different properties of the ponds or varying distance to the rivers. Whether the ponds were located inside or outside the bigger sluice/dam might also have had an effect upon the data. Perhaps we cannot make any firm conclusions since the data are not statistically representative but they give a picture of the salinity range in the area that can be compared with the information given by the local authorities. As can be seen in the figure the salinity levels measured range between approximately 13 – 21 ppt. In comparison with what was told during the interviews under the subheading “*Change over time*” these data falls within the range claimed to be common in the area during the last years, i.e. around 10-20 ppt.

This range is also confirmed by Trinh Anh Thong (2010). He has summarized water data from the Center for Hydro-Meteorology of Ben Tre, for the district Than Phu between February and June 2010. The water samples are taken from different sites at Ham Luong and Co Chien Rivers. The highest concentrations are found near the estuaries. In Co Chien River, at the so called Ben Trai site situated 1 km from the sea, levels of 25 ppt were noted during April. In Ham Luong, at Phu Khanh site 30 km from the sea the same levels have been noted. At 50 km from the Ham Luong estuary the lowest levels were found, with an average of 5 ppt which Thong points out as concentrations threatening fruit areas on a large scale. Southern Institute of Water Resources Research has also been responsible for water measurements in the area. Data from 2005 can be seen in Appendix 11.9 which shows concentrations of salinity between 4-16 ppt in the district of Than Phu during April in 2005.

Crops and salinity

According to an international classification of salinity severity made by the Food and Agricultural Organization of the United Nations (FAO) (1985), a salinity less than 4,48 ppt (7 mS/cm) will have no effect on soil or cropping systems. A salinity of between 4,48 – 19,2 ppt (7 - 30 mS/cm) requires the user to be more careful in their choice of crop and cropping procedures to attain conditions for a full yield whereas concentrations of more than 19,2 ppt (30 mS/cm) will require the work of an experienced farmer in addition to specially designed management procedures. A series of pilot studies before starting the actual cultivation is also advised by the FAO (1985) in this case.

The general sensitivity to salinity of different crops is also stated in the same report by the FAO. For example Corn (*Zea Mays*) is said to have the potential to give a full yield at concentrations lower than 7 ppt (11 mS/cm) and a paddy rice variety (*Oryza Sativa*) to have a full yield potential at concentrations lower than 12,8 ppt (20 mS/cm). Fruit crops generally have full yield potential below concentrations of 7 ppt.

When it comes to vegetable crops a larger variation in tolerance to salinity is seen with examples of relatively tolerant species such as Squash (*Cucurbita pepo melopepo*) (19,8 ppt) and Beet (*Beta vulgaris*) (17,3 ppt).

In our study however, we will not discuss the suitability of growing certain crops under these saline conditions. Since the suitability is also dependant on other physical and chemical factors as well as for example the culture, economic feasibility and climate of the area, such a discussion is thought to require an extensive study of its own.

Nevertheless, one general conclusion is that the salinity levels measured in the province of Ben Tre are high and crops that are salinity tolerant as well as farmers with knowledge of successful farming practices in saline conditions are required. The measured salinity of between 13 to 21 ppt suggests

that the soils can be very difficult to cultivate which is also the impression that we got from the interviews.

8.2.3. Future of salinity

Upon asking about the future of salinity intrusion and salinity levels a majority of the local authorities thought it would increase, seven out of nine were quite sure about this as can be seen in Figure 6. One person also told us that salinity levels would not decrease but we could not find out whether that meant it would increase or just stay at the same level. Among the farmers six out of twelve thought it would increase, three farmers told us that they did not know what the future would bring, two thought it would stay the same, see Figure 7. Those who answered that it would increase often based this on their experience that the salinity levels had been increasing during the last years. A common explanation for answers saying that it would decrease or stay the same was that salinity levels fluctuated over the years.

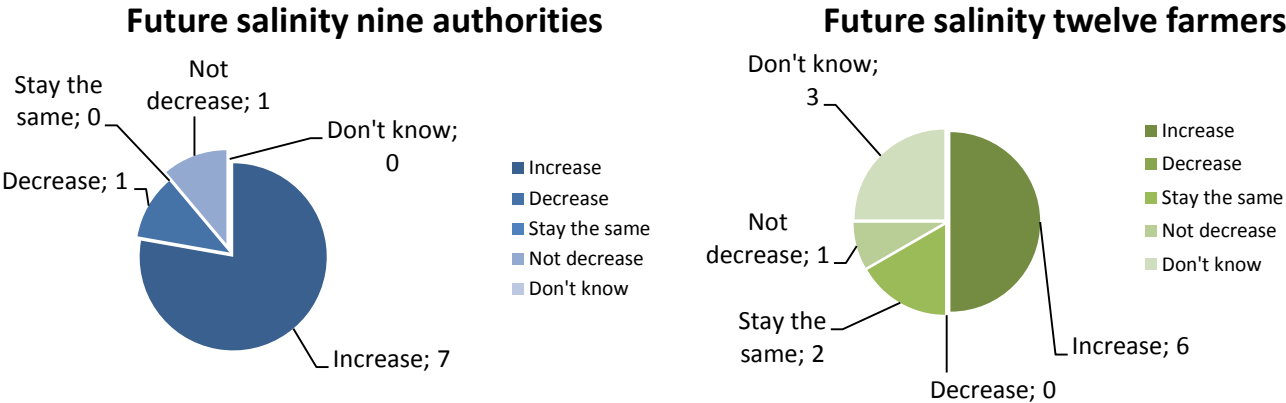


Figure 6 and 7: Thoughts upon the future of salinity told by nine local authorities and twelve farmers interviewed.

We have reached the conclusion that there is a tendency among the people interviewed to predict that the salinity levels will be worse in the future, though there is more uncertainty amongst the farmers than we could find when asking local authorities the same question. We did also notice some differences between men and women regarding these answers. There was a tendency amongst the female farmers to be more unsure about the future or thinking that the levels would stay the same in the future while most men thought salinity levels would increase. This is an interesting observation that has been difficult to explain. It might suggest that the female farmers whom we met felt more unsure about the future and perhaps lacked some of the information or confidence that many of the men seemed to possess.

8.2.4. Climate change awareness

Since climate change in the future might have effects on the salinity intrusion we thought it would be interesting to investigate the awareness of climate change among the people we interviewed. This was done to get a more holistic perspective on the questions of saltwater intrusion.

It is a difficult task trying to find out if the interviewees were aware of climate change. One has to be quite sure what is meant with climate change and it is hard to evaluate how much one should know to be “aware”. Nevertheless, what we were looking for in our answers was to see if the interviewees knew about rising sea levels and long term changes in climate and what effects that might have, on e.g. droughts and flooding. During the interviews questions concerning climate change were directed to all farmers, and some farmers were also asked about sea level rise.

The answers varied a lot. About half of the farmers had some awareness of climate change. Things mentioned were awareness of sea level rise, increased temperature, flooding and drought. One farmer mentioned that sea level rise was a familiar notion but had never heard about climate change. We got the impression that among those who mentioned climate change it was common that they thought more of short-term changes. Therefore it is difficult to say how much awareness the farmers actually had. It could also be important to note that our questions concerning climate change might have had a great impact on the outcome of the answers. These questions were mostly posted as yes or no questions which we otherwise tried to avoid due to the risk of leading the answers. We also asked the interviewees what they knew about climate change to avoid the first kind of influence on the answers but we think this could have been quite stressful for the farmers and a reason for the limited information.

Concerning local authorities we did not get an answer from all of them since some interviews had to be shortened due to a lack of time. Six answers were given and only two authorities seemed to have some awareness, namely one officer at district level and the owner of the private shrimp company who had a university degree. Both of them did also see a connection between sea level rise and salinity intrusion. Three persons did not seem to have any awareness and two had heard about climate change but we did not get any knowledge about what these persons really knew. This makes it hard to compare the different levels and draw any firm conclusions.

8.2.5. Comparison between farmers and local authorities

What was obvious after looking at the interviews was that both farmers and local authorities mainly regarded saltwater intrusion as an old phenomenon and that the salinity concentrations both had been increasing during the last few years and probably will do so in the future. Among the farmers there was more uncertainty about the future even though a majority thought salinity levels would

increase, mostly because of empirical experience. None of the farmers mentioned any specific knowledge about the salinity concentrations in the area.

Within the Farmers' Association and at the district level most of the detailed knowledge was found about salinity concentrations, though the officers at district level gave us a little bit different picture of the history of salinity intrusion than the other interviewees.

It is difficult to estimate climate change awareness but half of the group of farmers interviewed seemed to recognize and be a little bit familiar with climate change and sea level rise. However it is not possible to evaluate how much knowledge and awareness they had. Of the local authorities that were asked about climate change, it was only one district officer and the private shrimp company that seemed to be aware of climate change. They also told us that they saw a connection between sea level rise and further intrusion of salinity and higher concentrations. Though more might have been aware, but as mentioned before, not all local authorities were asked about climate change and sea level rise.

8.3. Measures and adaptations

One important part of this project was to understand what adaptations and measures to saltwater that had been done as well as to understand what adaptations and measures that were needed in the future, according to the people we met. This chapter gives some insight of the information we gathered about measures and adaptations, from the farmers as well as from the authorities. The difference between measures and adaptations was not always obvious but we have considered measures to be somewhat more physical actions whereas adaptations are more considered as a way of working or thinking.

8.3.1. Farmers

Measures and adaptations in the past and present

A very common answer from farmers when asked about salinity intrusion was that there was no one who could do anything. *Eleven out of twelve* farmers thought so. The farmers seemed to accept the situation and were not aware of any solutions. One of the farmers told us through interpretation: *"...] that saltwaters is caused by natural reasons so he don't think there could be a measure, to increase or decrease, or to make the saltwater get worse."* (F1)

At the same time, some of the farmers were able to make their own decisions, such as decide when to close or open their own gate and thereby control the intake of saltwater. Closing and opening

one's own gate was mentioned by six of the farmers and this is something we have regarded as a concrete a measure. However those who said so, also expressed their lack of power.

There were not many farmers who mentioned measures made by others. Among those who lived inside what we understood was a dam or a big gate, three farmers mentioned that a dam had been built to control saltwater intrusion.

It might as well be the case that not many measures were done by others, but it should be noted that the interpreter asked this question about techniques that the farmers used instead of asking them more generally about measures. This way of asking may have limited the answers a bit and led the farmers to a more narrow way of thinking. This restriction should be taken into account (for more discussion about this see the Method section).

Despite the helplessness the farmers seemed to feel regarding the saltwater situation, we noticed that what we defined as adaptations actually had been made in order to adjust the current conditions. This was discovered while we were studying their cropping systems, and how these systems had changed throughout time.

Within a period of ten years or more, ten of the twelve farmers had changed their cropping systems in one way or another. The earliest change was done by a farmer 22 years ago as far as we were informed. Of those farmers who had made changes, two of them had done that within a period of ten years and five of the farmers during the previous three years as shown in Figure 8. Only two of the farmers had never changed their systems. Both farmers had lived about 10 years on their respective farm using similar systems like rice and freshwater prawn or rice, freshwater prawn and tiger shrimp with the addition of coconuts and chicken for household use.

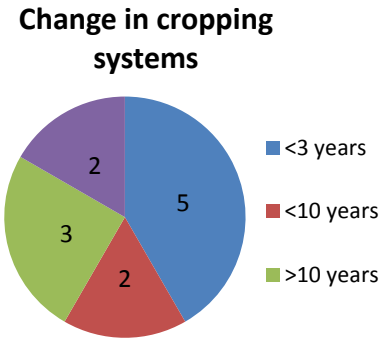


Figure 8: Number of farmers that have changed their cropping systems the last three years, ten years, more than ten years ago or not at all.

A change from rice to rice integrated with fresh water prawn and tiger shrimp seemed to be the most popular adaptations. Seven out of twelve farmers altered their cropping system in this way. One of the seven farmers also started to grow crabs. It was less common to change to only *rice and prawn* as was done by one of the farmers. This farmer changed from rice to *rice and tiger shrimp*. One farmer

had changed within the last three years from *rice and shrimp* to *rice and coconut*. The reason for this we were told was that the shrimp cultivation had failed. A few farmers had also started with coconut trees. Upon asking why these changes had been done a common answer was that this meant an increased income and that they had learned this from their neighbors. Some farmers pointed out that this was the most suitable system for this area.

The system with rice, freshwater prawn and tiger shrimp seemed to enable the farmers to have suitable crops all year around. During the rainy season rice was usually grown together with freshwater prawn. Most common was to start the rice from August and harvest in December and let the prawn grow from June/July until December/January. The dry season starts around here and saline water begins to intrude which makes it suitable to cultivate the more saline tolerant tiger shrimp, usually from around January/February and harvest in May/June.

An interesting adaptation made by a few of the farmers was to change the length of the rice crop. A long-term variety could be changed to a mid-term variety which was grown for a shorter time and thereby the farmers could avoid cultivation during months when saline water might start to intrude. One farmer mentioned how it was possible to use sown rice when the rains were early and transplanting rice when precipitation was late since the transplanting of rice could be started one month after the sowing but be ended at the same time (for more information see *Background*).

One thing we had expected was that saltwater might have changed the water used for crops. Four of the farmers mentioned upon our questions regarding water use that they used well water for irrigation during the dry season since the river water was too salty. No one had yet suffered from water shortage of irrigation water, but the question was if they had to continue to use the well water, and which consequences this might have in the future?

Future measures and adaptations

When we asked farmers if they thought they would have to *change cropping system* in the future we were given quite varied answers. Six farmers had ideas of what they wanted to have, though only two of them seemed to believe that this was possible. That was to start with short term rice and coconut respectively. The second most common answer to this question can be represented by the quote of one farmer: "...] she watch the other household and she do like the others. She does not know what she may change, how she may change the cropping system." (F10)

Other thoughts that came up were that it was not necessary to change, there was no will to change or that it was satisfying with the current cropping system which also correlates to what has been said so many times in the interviews and now in this chapter, that there is nothing to be done about saltwater intrusion.

We also asked what the farmers would *need* if they *had to change their cropping system*. That there was nothing they could do dominated the answers given to us, not surprisingly after the answers we got about changing cropping systems. Only four farmers had any wishes for the future concerning their cropping systems. Things that came up were that money was needed and that the government should do something. One farmer wanted the government to build a dam since he had quite a lot of problems with the saline water. A wish from another farmer was that either the government or the seed company should guarantee the quality of the seed and that the right variety was used for these salty conditions. These wishes seemed to be quite rare since most of the farmers did not seem to know what they would need.

Summary

Many farmers seemed to be feeling hopeless over the saltwater situation and that there was nothing to be done. What was mentioned by six farmers was the opportunity to decide when to close or open their own gate. The only measure mentioned that was done by other people than farmers themselves were a common dam/gate, which was mentioned by those who lived inside it. Not many farmers could define any adaptations being done though we defined the changing in cropping systems that had been done as adaptations to saltwater. Most farmers had changed the last ten years. It was common to change from rice to a system with rice integrated with freshwater prawn and/or tiger shrimp. Some had also started with coconut. By changing the length of the rice crop some farmers also tried to minimize the risk of the crop being affected by the saline water. These changes confirmed that farmers had adapted more or less to saline water by choosing crops and cultivating these according to the changing seasons.

Most farmers did not want or saw the need of changing their cropping systems. Only two had ideas that they themselves believed would be possible. Upon the question what was needed for them to change cropping system, four farmers gave varied answers like money, that the government should do something and getting guarantees of a good crop quality.

8.3.2. Local authorities

Measures and adaptations in the past and present

Most of the measures mentioned were done by other people than the farmers. The representative of Farmers' Association at commune level mentioned that they had found some rice variety that worked better in these salty conditions. DONRE had helped the district to build dams and gates. Measures to control the levels of salinity had been done a few years by the government. DONRE also seemed to have some funding to work with adaptations to saltwater and the officer from DONRE

knew that there were dykes around the An Thanh commune to prevent saltwater intrusion. Gates, dams and dykes were the most common answers of what had been done and the Vice Head of the Commune saw this as the only solution to control the saline water. Most people, like him, seemed to think this was the only thing that really helped.

Upon our questions what measures or adaptations that had been done by the Farmers' Association, Shrimp Companies and District, officers also gave us answers regarding what the farmers had done. The most common answer about adaptation was that farmer have had to change rice varieties and that long term varieties no longer were able to be grown. It was also mentioned that farmers had to reduce the number of rice crops used per year. The focus of both the shrimp companies was that the farmers may have to change their schedule for shrimp cultivation. The representative of the private shrimp company also said that when the salinity levels increased the farmers should take measures like building dykes to prevent intrusion and not wait for the government.

Both Heads of Village seemed to think that opening and closing of gates was the best way for farmers to take *measures* to control the levels of salinity. The fact that adaptations and measures were merely a question for higher levels was stated by one of the Head of Village's since he believed that the farmers themselves could not do much more. Another one suggested that the solution was to decrease the salt concentration by pumping well water into the ponds, but it was also noted by one of the Head of Village's that this was a solution for better-off households only, since this required investments in a pump.

Future measures and adaptations

There seemed to be a feeling amongst the local authorities that there would be a need for adaptations or measures in the future. One of the Head of Village saw saltwater and climate change as the biggest challenges during the coming five years, at the same time as he contradicted himself by saying that farmers would not need to adapt since saltwater was not totally bad. The reason for this we think could originate from the same thoughts as the other Head of Village expressed; that saltwater intrusion was a question for the people higher up in the hierarchy.

The need for new varieties and species which tolerate high salinity concentrations was mentioned by several of the interviewees, especially on District level and Farmers' Association level in the commune. These people are working together in order to find suitable crops and cropping systems. The Head of the Department of Natural Resources and Environment is currently starting up a new project that concerns salinity intrusion and cropping systems. This is done in collaboration with Can Tho University. This means that scientists and researchers might have to play an important role in the future adaptation to saltwater. There also seems to be ambitions at FA on commune level to make

demonstrations and study visits for farmers to adapt to the changing salinity conditions. The Farmers' Association on village level also saw a need of training courses to the farmers on how to prevent saltwater intrusion, when to close and open the gates and pump water into their ponds.

Summary

Dams, gates and dykes were the most common answers on measures to prevent salinity intrusion. The funding for work with salinity seemed to lie within DONRE. Upon talking about past adaptations it was mentioned that farmers had changed rice varieties, cultivated less rice crops and changed to short term varieties. The two Head of Village mentioned measures like closing and opening the gate as measures that were and could be done by farmers.

Many of the local authorities saw the need of adaptations and measures to reduce the negative impact of saltwater intrusion. The district level and the Farmers Association on commune level were starting up research on new cropping systems and crops in order to adapt to increasing salinity concentrations. FA on village level had ideas about training courses concerning practical measures the farmers could take.

8.3.3. Farmers and local authorities

Aid

Past and present

What aid has been given to the farmers to take measures or adapt to the salinity in water? The most common measures were about the farming in general such as loans given by the government or water measurements and advice concerning the shrimp farming given by the private shrimp company to some of the farmers. The latter might be the most obvious support concerning saltwater, where some of the farmers are given advice when to start the shrimp cultivation, what chemicals to use etc. One thing that might not be regarded as aid or consultation by the farmers is the community meetings that many farmers attended. Community meetings are something we have regarded as aid, since this seems to be an important meeting place to discuss cultivation of crops and exchange ideas. One farmer mentioned that it was at a community meeting he got the idea to change from long-term rice to mid-term. But otherwise, not much support from levels above seems to be provided to the farmers in order to adapt to the salinity, according to the farmers themselves. This could be one reason for the feelings of powerlessness.

What might be interesting to also bring up is what aid some of the local authorities have said is being given to the farmers. The Farmers association is told to have given some advice about what crops to

have and how to cultivate and help to bring new rice varieties to farmers from a scientist. Some demonstrations have been done by a shrimp company. A pilot study for fresh water cultivation was also done four years ago by an extension worker according to one Head of Village.

What aid has been given to the authorities? It was mentioned that DARD had some cooperation's with a University and also a plant protection company. Except for the demonstrations, it was mainly within the DONRE where the aid concerned salinity most directly. Financial support had been given by the Danish government to DONRE in order to help with things like rainwater storage and building of dykes and dams to prevent salinity intrusion. The district in their turn seemed to be giving information to the Farmers Association, the commune and a private shrimp company on e.g. salinity concentrations.

Future

We also asked both the farmers and local authorities what aid was needed in the future to take measures or adapt to saltwater intrusion. The officers on district level believed that it is the government who probably will be the most important actors in the future since the government has the money and knowledge. One officer believed that the offices for Natural Resources and Environment, Agriculture and Rural Development and Science and Technology will play the most important role in the future work with adaptation to saltwater intrusion. According to him this would be on all levels from government down to the district level. There was also a comment from the district level about existing plans of government to work with salinity but this did not function because of a lack of funding.

As being said earlier under the headline "Measures and adaptations in the future" only four of the farmers mentioned things they felt were needed if they had to change cropping systems. Support from the government with dams and money but also a guarantee of good quality from either the government or Seed Company was brought up.

Problems with adaptations and measures

Even if there are ideas of how to adapt to the salinity and how to take measures to control the salinity these things are not always easily done. The Farmers Association on the commune level told us it was hard to convince farmers that the new varieties were good as they wanted to see a successful demonstration. If a demonstration fails, the farmers do not dare to try it. The same things are also expressed within DONRE. Another constraint according to the Farmers' Association seems to be the budget and the information about new technologies and methods which are available for them to help farmers. This will limit the work that can be done.

It is also important to point out that a measure intended for one thing might have other unexpected consequences. Two of the farmers who lived inside a common dam/gate had both experienced water shortage one year when the gate was closed. Two local authorities also saw problems associated with a dam. Both mentioned the fact that the dam could not totally prevent saltwater intrusion but as said by the private shrimp company owner, a dam might even lead to that saline water intrudes even further inland. On the other hand, a dam/gate is beneficial for others who might even have a chance to grow upland crops. It seems to be difficult to please all farmers, which leads directly to the question - who should get the benefit? This is something that might cause conflicts between the farmers living inside and outside a dam and we think that this will be important to take into account when working with salinity intrusion.

There are however other factors that can be challenging for future adaptations. The Vice Head of the Farmers' Association on commune level mentioned to us the problem of the fluctuating saline water. He brought up the fact that in some places the salinity levels are stable which makes adaptation possible but in this area the saline water fluctuates a lot which makes adaptations very difficult. We gather that this might therefore be a major constraint in taking measures and adapting to saline water intrusion. This statement shows clearly how complex this question can be and that this question has to be addressed in several ways.

8.3.4. Comparison between farmers and authorities

When farmers were asked about measures it was more common to get answers on measures they had done themselves rather than what others had done, like closing their own gate, even though most of them expressed feelings of hopelessness. It was quite the opposite while asking authorities the same questions. Physical public measures were frequently talked about by the local authorities. Though, the closer in hierarchy the interviewees were to farmers, the more their answers tended to be more like what farmers had said.

Neither the farmers nor the local authorities mentioned much about changes in cropping systems during the discussions about adaptations. This could be due to the fact that the current systems had been used for some time and that people did not categorize adaptations as we do. It could also be due to the fact that farmers have changed the system mostly because this gave them an increasing income and did not directly think of salinity as a main reason. Though, income can be seen as an indirect consequence of salinity. It would perhaps not have been profitable to change cropping system from rice to rice integrated with tiger shrimp and fresh water prawn if the salinity levels were much lower, and therefore income and salinity are probably closely linked.

What differed the most were thoughts about future adaptations and measures and the need of those. It was more common that farmers felt they did not know what adaptations could be done or that none were needed. The feeling of powerlessness was common among the farmers. However, most of the authorities saw a need of adapting to higher levels of salinity. The higher up in the social hierarchy the more ideas about solutions or thoughts we were told. Most common was to find crops and cropping systems that would be suitable for the area. In our opinion, it was not surprising that the solutions were found on higher levels as authorities both have more power to make decisions as well as a higher level of education and an opportunity to communicate within a broader spectrum of people.

The same thing could be seen with aid, the authorities had more ideas than the farmers what aid would be needed in the future. This is also seen in the past where aid concerning saltwater intrusion is more clearly given to local authorities and the district than the farmers. Though, we noticed a difference in the information given about aid in the past between the two groups of interviewees. It was mentioned by local authorities that both about aid from FA and an extension worker was given to the farmers. This is nothing that the farmers confirmed. It seems that this help is not reaching all of the farmers, which is interesting. If the local authorities have a view that many farmers are getting help but they are not that might be a problem that makes it more difficult in adapting and taking measures concerning saltwater intrusion in the future.

8.4. Communication

In this section we will examine how communication is carried out regarding saltwater intrusion as stated as a purpose of this thesis. Communication is an important tool in any work and especially when dealing with complex situations that often arise when working with environmental issues.

First there is a figure in which the ways of communication are drawn according to the twelve interviewed farmers. This visualization is done to make it easier to understand and remember. Below we will explain how to interpret Figure 9 and then move on to draw conclusions from this figure and the interview transcriptions.

8.4.1 Farmers

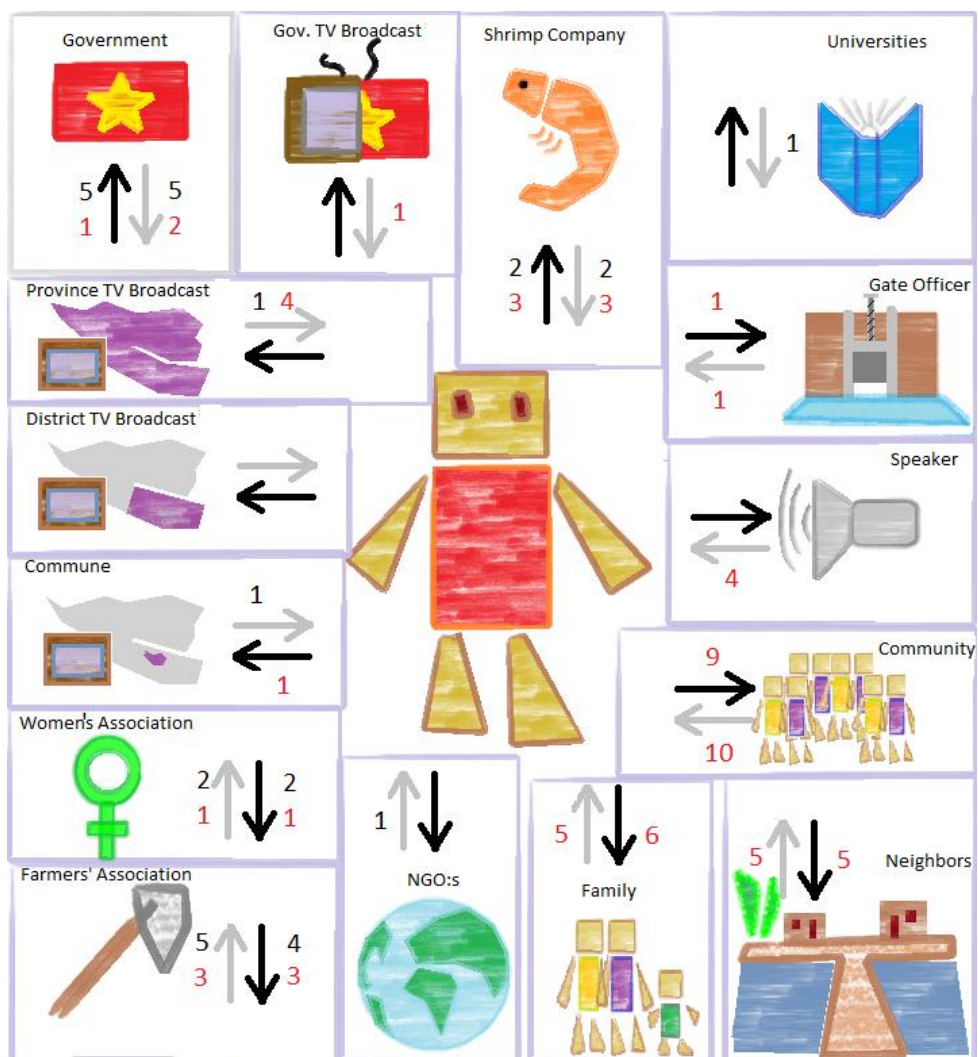


Figure 9: Communication between farmers and other stakeholders. Numbers are the amount out of twelve farmers who claimed such communication occurred.

Guide to Figure 9: The black arrows indicate farmers communicating with other stakeholders and the grey arrows indicate the reversed communication. The black numbers (on the left in each row and on

the top in each column) signify general information. Included herein is everything that we do not count as information on saltwater intrusion for example discussions on economy. The red numbers (on the right or at the bottom) signify communication on saltwater intrusion.

When only red or black numbers occur in the figure this is because we have only asked or have only received answers about saltwater intrusion and general information.

In Figure 9 there are a few ways of communication that differ from the rest in the way that they are more often used than the others. Communication below is arranged by usage with the most frequently used kind of communication first.

Community

Communication within the community seems to be most frequent when discussing saltwater intrusion. Ten out of twelve farmers get information regarding saltwater and nine out of twelve say they participate in discussions concerning saltwater intrusion. Most of these farmers have been talking about information that they get from the so called Community meetings that occur at the end of each month and in which the community leader, who is also a farmer, is the chairman.

The information that many farmers claim to get is how far the saltwater intrusion currently has reached and what salinity levels that are prevalent in their fields. Many farmers also say that they discuss together about how best to cultivate their crops and shrimps and one farmer also claimed that decisions are taken by the community when all of them have to start the cultivation. *“For example, during the meetings this man he promotes to start the tiger prawn, this idea is discussed among the members of the meetings. Finally they make a decision whether to do that or not” (F11).* Other decisions taken are when to close the gate preventing saltwater entering the paddy fields and when to pump freshwater into their shrimp ponds.

Family and Neighbors

Family and neighbors also contribute to the discussions on saltwater intrusion as stated by five farmers. What they discuss often concerns the level of salinity and how that will affect the production. *“They don’t really, like discuss about it. It is more like: ok, this year I cannot start growing rice and that’s it.” (F5).* Another comment is: *“She talked to her neighbors like: Why, today the saltwater is worse than yesterday” (F9).* What is being talked about seems to depend on the season. During the dry season saltwater intrusion can be discussed. Here is an example of the opposite: *“They always discuss about shrimp cultivation and rice cultivation when they have freshwater” (F12).*

Women's Association and Farmers' Association

Other important sources of communication on saltwater intrusion are the so called unions or associations. The ones mentioned by farmers in the interviews were the Women's Association and the Farmers' Association. Two out of the six women farmers whom we interviewed said that they were members of the Women's association and one of these said that they discussed saltwater intrusion during the meetings. The other farmer reported that the talk was mostly about economics.

Three out of five farmers who were members of the Farmers' association reported that they discuss saltwater intrusion during the meetings. One of these farmers says that the discussions and what the farmers have on their minds are reported to the commune level by the leaders of the Farmers association. He goes on to say that what is actually proposed and answered on the proposition is not something they often find out.

Gate officer

A governmental gate officer who regulated the flow of water from the main canal into the village was mentioned by three farmers. They stated that the opening and closing of the gate was scheduled. One farmer who had a position as an inspector of the village said that contacting and getting your wish through, to close or open the gate, as a private person was easily done. The inspector's job was described as: *"So he is like a bridge between the citizens here and the government [...] His job is to check every aspect of the civil life like the thieves and criminals [...]" (F3)*. One farmer who was not an inspector did not seem to think it was so easy. On the question on involvement in setting the schedule of the opening and closing the answer was *"So he does not involve in that. Usually the officials start to close the gate on November "(F5)*. Later on we learned that many farmers have smaller separate gates/sluices and some also live within an area affected by a large gate/sluice for which there are officers who open and close it. We are not sure how many of the interviewees who lived within this area and thus we do not know how many that needed to contact a "gate officer" of a large gate/sluice. That only three farmers out of twelve communicated with this officer therefore does not necessarily mean that this is not a viable way of communication.

Government

The communication with the central government mainly concerned the borrowing of money to invest in the production of the farm as described under "Aid" in the section "Measures and adaptations".

When it comes to saltwater intrusion the government has built a dam to regulate the saltwater.

Province, district and commune

When looking at these authorities of the government namely the province, district and commune only the province TV broadcast seems to reach a few of the farmers with information on saltwater intrusions. It is also the biggest source of information on climate change and sea level rise that the farmers mention. Four farmers also claim to get information on saltwater intrusion from this source. *“So he watches the television to get the information regarding saltwater, so he know where is the situation and how bad it is going to be [...]” (F1)*. One farmer however seemed to contact the commune level directly to get the gates closed when he faces saltwater intrusion. Another interesting thing that came up during this interview was: *“So I give him a hint that, why don't you contact someone at the provincial level or district level? So he says that it is quite far from this place and he does not really know anyone there so he only contact with commune level.” (F4)*. This was the only farmer who was asked about contacting specific authorities. What the answer would have been from the rest of the farmers we do not know. Another farmer mentioned that the commune level gave training sessions on the usage of chemicals.

Shrimp company

The shrimp company as we have understood it can be a private or a governmental service that helps farmers to measure salinity levels and also advise them on cultivation as described in an interview: *“...]when he wants to start the cultivation of the shrimps so he takes his water to that place to check the salinity level. So he will decide if it is good to start or not. So whenever his shrimp got disease so he bring water to that place to check again. It is also at that time that he measures the pH and salinity [...] They measure and they recommend what should he do” (F4)*.

When we asked if there were any additional sources of information on saltwater intrusion the answer from three of the farmers was “the radio” on which different programs with weather forecasts told about the current situation.

Summary

We found it interesting to notice that it is within the community and the FA that the communication on saltwater intrusion takes place. The fact that discussions are dependent on the current season might sound obvious but this was not something we had in mind when preparing the project. One explanation to the relatively little discussion of saltwater intrusion could be that ten out of twelve farmers expressed feelings of hopelessness when asked about how to deal with saltwater intrusion. They did not because of this feel a need to discuss this issue. *“...] she does not contact to anyone when noticing increased salinity in the water that because everyone here knows about it and she does*

not have to contact anyone" (F6)." ...] they do not talk to anyone because that is a common problem and everyone has the same problem" (F5).

When the farmers mentioned the Farmers Association we did not know if they referred to the one village or commune level.

8.4.2. Local authorities

This part is associated to Figure 10. Each authority has got an individual color on the arrow signifying their communication. The letters in the figure correlate to letters in the text below, where a description of the communication can be found. The numbers e.g. "4/10" mean how many times out of ten that this particular way of communication concerns saltwater intrusion. If no numbers are shown we have not been able to acquire this information in that particular interview. We had no opportunity to interview the province level or government.

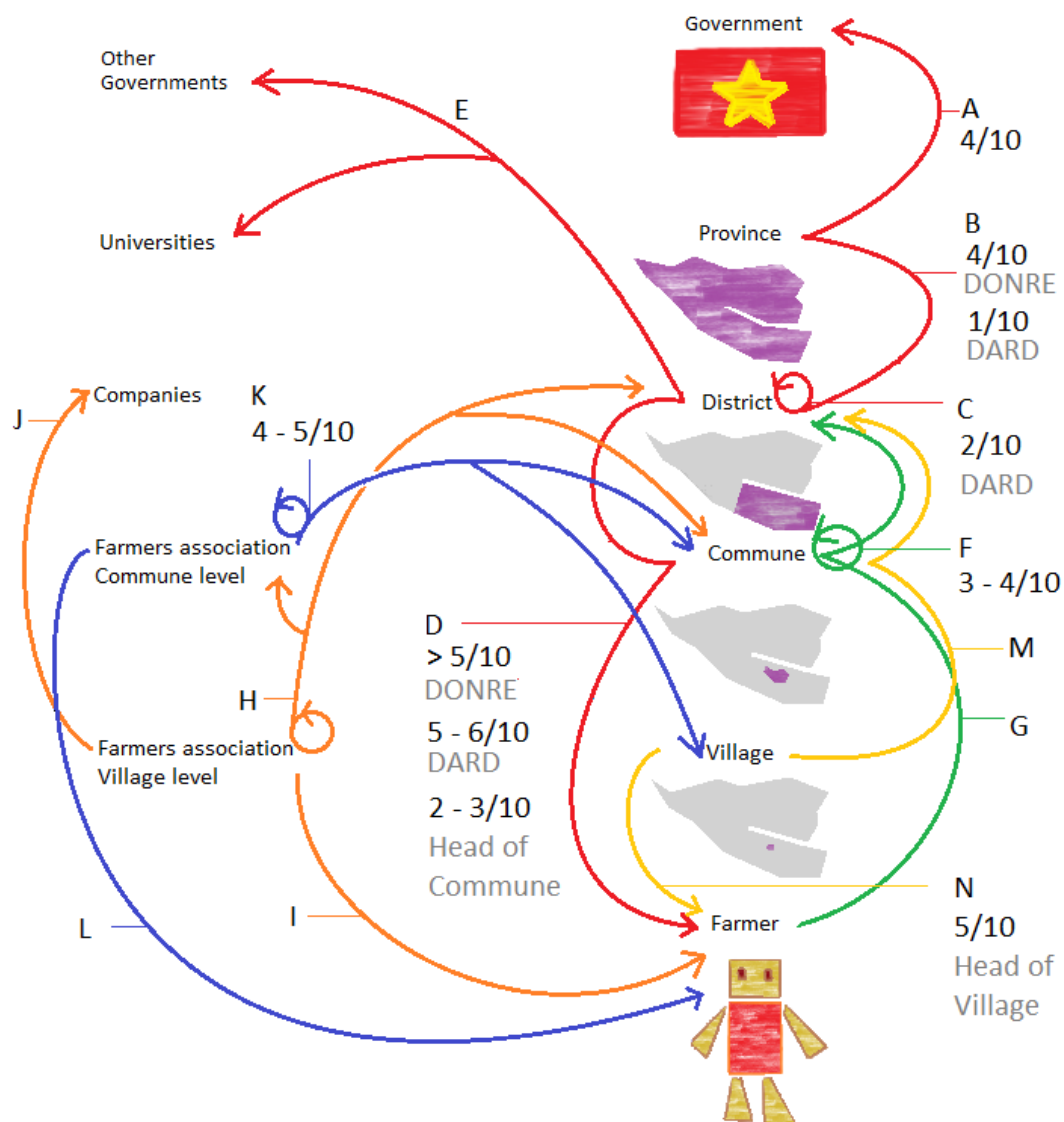


Figure 10: Communication according to the authorities.

A: The department of natural resources and environment (DONRE) at the district level communicates with the central government via the province level. This happens at regular intervals of three to four times per month and includes all sorts of reports that DONRE sends to the province where they get summarized and then forwarded to the government which sends a reply.

Issues regarding saltwater intrusion are for example: How to store rainwater, the effect of salinity on the environment and the cooperation with the An Giang University regarding saltwater intrusion.

B: DONRE also contacts the province level at regular intervals to report its environmental and agricultural activities. This occurs once per month but it is also possible to contact the province level outside this schedule if the matter is regarded as urgent.

The Department of Agriculture and Rural Development (DARD) contacts the province level. The communication does not concern saltwater intrusion very often as can be seen in Figure 10. This is not a communication on a regular basis but instead happens when there is a need for it.

C: DONRE also contacts DARD regarding water resources and climate change issues. DARD contacts other district departments on issues on water quality and cultivation problems. Two times out of the total ten times the issue concerns saltwater intrusion.

D: DONRE appears to contact the commune level only when they wish to contact a group of farmers. This could be to discuss the implementation of environmental projects that concern the farmers and contact is established through the community meetings each week. DONRE can also choose to contact individual farmers by telephone. Often the issue is competition between farmers on land use in which DONRE acts as a mediator. DARD contacts the commune level for the same reason but they seek to contact farmers on training courses in aquaculture and agriculture production or when DARD want to make surveys. This irregular communication has occurred about twelve times during the last month and five to six times out of ten concerns saltwater intrusion. Further contact with farmers through the commune is described under "G".

E: DONRE contacts universities (An Giang, Can Tho and Saigon) and governments in other countries to get help to find funding. They also contact universities when there is an environmental problem where they do not have a solution. Concerning saltwater they have received funding from the governments of Australia and Denmark to build rainwater storages as well as dams, dikes and sluices to regulate saltwater intrusion. This may occur two to three times per year.

F: Within the commune level there is a weekly meeting which deals with saltwater intrusion three to four times out of ten. They also contact other communes once per month to get information or advice from them. This is difficult however, because of the different conditions in the communes.

Economic development, agriculture and saltwater intrusion are the common themes of these discussions.

G: Farmers can contact the commune level, according to them, to make an appointment at the commune office. At this appointment they can discuss any issues. According to the commune level there is also a community meeting once a week at which the commune members are able to meet the farmers. If the commune level cannot help the farmer to solve a certain problem then the commune will contact the district level on behalf of the farmer to ask a district officer for assistance. If the farmer requests training on using some agricultural technology for example, this is also a viable way. The district officer puts together a meeting, in which farmers from the community participate, in order to learn more about their problems and/or make a survey regarding an issue or planning for the training sessions. According to DARD this occurs more frequently during the cropping season.

H: The Farmer's association (FA) on Village level claims to take contact with DARD when they discover increased salinity in the freshwater and also when they want to request training of their members on how to prevent saltwater intrusion. Such training is requested two to three times per year. DARD sends an officer to sample the water in the first scenario. The FA on the village level has an annual meeting to which a representative from the FA on commune level is invited as well as weekly meetings within the village level FA. None of these meetings deals with saltwater intrusion.

I: When contacting farmers the FA on a village level uses a loudspeaker (see Figure 9) as well as flyers which are handed out directly to the farmers. This information includes for example advice on when to pump water into the ponds and encouragement to use fertilizer to reduce acidic conditions in the soil.

J: To borrow equipment for water measurements the village level FA can contact the "Shrimp Company".

K: The FA on the commune level contacts the commune to report back on their meetings and to cooperate with specific departments. They also contact other FA indirectly as farmers are often members of more than one FA and also cooperate with other FA on training for the members in rice cultivation techniques. When it comes to policy issues they communicate on a village level. The village also gets advice on farming from the FA. Four to five times out of ten this concerns saltwater intrusion.

L: At FA meetings once per month, current issues are discussed with the farmers and this year saltwater intrusion has come up frequently. Direct contacts with farmers are also common and here saltwater intrusion discussions occur all year round in comparison to previous years when they occurred only when there were high salinity levels. The FA also visits community meetings.

M: The village level can contact the commune level when they need assistance on an issue and then proceed to the district level if the issue cannot be resolved. This is very similar to the farmers' approach and indeed we have got the feeling that the village level consists of farmers more than there are government officials. What they discuss depends much on the season's current issues.

N: By contacting the community leaders the head of a village brings messages to the farmers. It is also possible to contact farmers directly on urgent matters. This can be done at any time since all of these people are often neighbors. As seen in Figure 10 there seems to be frequent communication on saltwater intrusion. It is also possible to contact farmers at the community meeting each month, although there are no frequent discussions on saltwater intrusion in this case. According to one village head 70 – 80% of the households go to these meetings. To send messages from all governmental levels the head of village uses the loudspeaker twice a day.

Summary

The conclusions that can be drawn from all this information are that according to our authority interviewees there is a large communicational network in place in which the farmers have many levels to turn to and many chances of making their voices heard. Meetings on village and community levels and in Farmer's associations as well as messages from speakers and surveys done among the farmers are structures that are in place. Some of these communication ways are said to be used for discussions on saltwater intrusion, some are even frequently used for this purpose.

The amount of times, dedicated to discussions on saltwater intrusion give an indication on how prioritized this issue might be. Even more interesting is the fact that the authorities claim that these discussions take place at all. It must be very difficult to estimate how many times these discussions take place, but one must draw the conclusion that they are said to actually occur.

DONRE seem to be discussing saltwater intrusion the most of the two district departments which we interviewed. The communication is evenly distributed in Figure 10 with many authorities talking to the farmers and the farmers having many ways of talking to the authorities.

Of interest is also that if the commune level cannot help the farmer to solve a problem then the district level can be contacted for assistance.

When we talked to the authorities we understood that the communication depended on the specific issues of the season with saltwater intrusion being a topic during the dry season.

8.4.3. Comparison and conclusions

Answers from the local authorities differ a lot from the ones we received from the farmers whom we interviewed. There is no consultation and no discussions on saltwater intrusion with the government

level. It is said that such a communication is not needed since this is a common problem in the area and all farmers and local authorities are well aware of the effects and consequences. Could it be that the answers we have collected differ because we have worked with too few farmers and therefore, we have not got more similar answers compared to the answers of the governmental levels? After all, our information is only based on the comments given by twelve farmers. Therefore it is not representative of the commune, the district or the province level. Or is it that the government representatives and farmers do not have the same definition on the concept of saltwater intrusion or how widely this concept is to be interpreted? For example: could discussions on shrimp cultivation be considered to include saltwater intrusion.

One could also suggest that there is a lack of communication between farmers and the other levels since the information that is available to local authorities does not seem to be available to the farmers. No farmers seemed to be very much aware of the projects which were carried out by the local authorities. The farmers also did not know e.g. what would be possible to do if they had to or wanted to change their cropping system in the future (See section: Measures and adaptations). At the same time we were told by the Farmer's association that it was difficult to communicate with the farmers and convince them to change to new cropping systems. That is understandable since changing cropping system could be a risky business, especially if you don't really see the need of changing. This is nevertheless also a barrier for communication both upwards and downwards.

When comparing Figure 9 and Figure 10 the Farmer association and community meetings seem to be vital points of contact and communication for farmers to be able to make their voices heard. The village level also has a close contact with farmers and the commune level.

If the community meetings occur once per week or once per month and exactly what place in the structure that the village level has are things that still confuse us and that we do not have an answer to.

8.5. Mastering your own situation

Being able to master your own decisions and actions is something important in the context of saline water intrusion. We thought it to be relevant to get an insight and understanding if our interviewees regarded themselves of having power over their situation and what this would be defined as. We also wanted to compare between the thoughts of the farmers to those of the local authorities. For the local authorities we wanted to see how much influence the interviewees had over their own work as well as how much power their level, for example district or commune, had in comparison with others levels in the hierarchy.

8.5.2. Farmers

The farmers we interviewed showed ways in which they have mastered their own situation as well as the lack of possibility to do so.

A fact that signified that farmers have power over their situation was that all the interviewees except one owned their land. The farmer who didn't own the property had recently moved there and was hiring the land. A common phenomenon among the farmers was that they had inherited the land from their parents and that they now were the owners. Legally owning property can enhance freedom for the farmers to develop their fields as they wish. Upon the question what the main reason for using their current cropping system was, not one of the farmers claimed it was due to the fact that someone else had decided for them. A frequent answer was that they had seen what the neighbors did and followed their strategy. No one but themselves was therefore directly in charge of what they grew on their fields. A conclusion drawn is that farmers have power to master their situation to at least some degree. The answers to the question could have been different had the question been more specific and direct.

Upon the question who is involved in making decisions concerning their farm (see Appendix 11.2) eleven out of twelve farmers replied it was up to them or in collaboration with their partners. These farmers felt that no one else could decide anything concerning their farm. The one farmer whose answer differed thought the government was the only one who could make decisions relating to his farm. This farmer felt that his duty was merely to pay taxes and that the rest of the work was up to the government. His reply was this: *"He thinks that the government is the only person who can make decisions concerning his farm but as long as he pays the tax then everything will be OK". (F4)*

A lot of farmers used river water for irrigation, rain water as drinking water and well water for everyday use. Not anyone amongst the farmers answered that they were dependent on anyone else for their water supply. Neither did anyone reply that they share water with anyone else. Two farmers mentioned that they had suffered from a shortage of drinking water in the past. During this period, both of the farmers had to get water from elsewhere, either by buying or by collecting water from households which were better off. One farmer told us of having suffered from water shortage for his field and for this he blamed the government. The farmer referred to it this way: *"Last year he suffer water shortage. According to him the reason is the government failed to dig up the depth of the canal so the amount of water for irrigation is quite limited."(F4)*

In this situation the farmer considered the government to have power over a situation in which he couldn't do anything. It was the responsibility of the government to maintain the canal and when failing to follow up on this, the farmers were affected.

Many farmers considered natural phenomena to be a large factor that emphasized the lack of power behind their decisions. Due to the high salt concentrations a lot of farmers have had to switch their cropping systems in the last several years (see “Findings and Discussions- Measures and Adaptations”). This fact illustrates limits to mastering your own situation as a farmer. Another natural phenomenon which was a limiting factor for the farmers was the amount of water. Some farmers had great drought problems and had noticed a decrease of water during the last couple of years. A decrease of water would be a direct threat to the farmers’ livelihood as it would affect the whole cropping system and the farmers’ income.

Some farmers noted that they could no longer irrigate their crops with river water as this water was too salty. The result was that they had to switch to watering with well water. This change was especially evident concerning fruit trees such as coconut palms. One farmer explained that even the well water had a too high concentration of salt in the water to irrigate fruit trees with. We believe that it is valuable that farmers have alternative for irrigation water when river water isn’t suitable. However, it can become stressful if the alternative source of water becomes unsuitable as well. The above examples are some ways in which farmers are hindered in their decisions and have to change their way of living due to natural phenomena.

Responses to questions regarding changes in the farmers’ cropping practices varied a lot. Some farmers felt that there was no need to change their cropping system or that they did not want to change. One farmer wanted to start growing maize but he felt that he needed either the government or a seed company to guarantee the quality of the maize seeds first. As the farmer sees it, he is dependent on someone else before he could make his ideas come true. Lack of money was another important obstacle for changing cropping systems noted by many farmers. The high salt concentration as such was also a barrier in switching to another cropping system. One farmer answered in the following way: *“So she think there will, there will not be any kind of plant or animal that could be, that is good for this kind of condition, this land.” (F7)*

Another farmer replied that he felt hindered both by the high concentrations of salt in the water as well as the water shortage. This farmer had an integrated system of rice, tiger shrimp and freshwater prawn. He presented his situation in the following way: *“He wish to change cropping system but here is due to saltwater so he cannot do anything. ... So there is no option besides rice or shrimps in this place.” (F11)*

Out of the farmers that brought up the subject of having their own gate, the majority of these answered that they themselves decided when to open or close the gates. Most of the farmers who were not allowed to choose the schedule of the gate replied that an officer made decisions regarding

these matters. However, the farmers could influence the opening and closing schedule by sending a specific request. One farmer said that when the government officer last year had decided to close the gate, the farmer had suffered from water shortages which lead to negative consequences for him. The farmer was not informed about the closure of the gate nor was he involved in the decision. Another farmer replied that the farmers decided the schedule of the gates themselves during community meetings.

Ten out of the twelve farmers replied that they did not need to talk to anyone concerning their problems of saline water due to the fact that it is a natural phenomenon. One of the answers from a farmer was this: *“So when they notice increased salinities in water they usually do not talk to anyone because that is common problem and everyone has the same problem”* (F5).

Another farmer replied in a similar way: *“So he says like there will be no solution for that, there is no need to talk to anyone like the government or peoples in the community”* (F3).

Overall the farmers gave the impression that they felt they could not do anything to change the situation of the saltwater intrusion and that they were powerless regarding this phenomenon. This indicated a lack of power for mastering their situation.

Some of the farmers who were interviewed provided examples of how they were or had been dependent on someone else for their living. This included a farmer who had received financial support from the government. Another farmer had been provided with a new rice variety from Can Tho University. The same farmer had also received help from an aid organization to drill a well. One of the interviewees had gotten a loan from the government to drill a well.

Summary

There are a variety of factors which signify if the farmers had power over their situation and decisions. The interviewed farmers indicated that they could master their situation to some degree as the majority of them owned their land and all of them could decide themselves what to cultivate. Having their own gate and deciding the schedule of when to open or close it attests a freedom that enabled control which some farmers did not have. One important factor that steered the farmers' decisions concerning the farm was the salinity level in the water. In the past, farmers have been forced to switch cropping systems due to this while now it mainly inhibited them to develop their cultivation. Farmers have also had to change source of irrigation water because of saline water. The most important consequence of the saltwater in this context was that the phenomenon of saltwater intrusion made the farmers feel powerless. Saltwater affected their lives in many ways and the farmers did not feel that they had capacity enough to have control over it. The feeling of not being

able to influence one's own situation can be very destructive and negative both in the short-term and in the long-term.

8.5.3. Local authorities

The situation for the people at local authorities varied depending on who they were working for. The answers differed even amongst the people working on the same level. Some had a lot of power and could make a lot of decisions while others were more limited. The level of mastering your own situation was greatly correlated to where the funding came from.

One of the Head of Villages replied that he had little power to choose himself what kind of work he could conduct. It is the commune who gives him the tasks and plan of what should be done in the village. The village gets its funding from the commune level and it's the head of the commune who decides where the money should go. In addition to this, the Head of the Village needs to report back to the commune what show the money has been used for.

This view differed to the second Head of Village we spoke to. He replied that his main responsibilities were to keep farmers informed about the policies of the government rather than of the commune. This village had not gotten any funding but they had received support from the government for new technologies. The Head of Village wished to get more support from them in the future. The situation on village level is different compared to that of the commune. The commune level gets its funding from taxes as well as from the district level. The district officer gives the money to the commune and the commune level decides what the money should be used for.

The District of Agricultural Development gets their funding from the District of Natural Resource and Environment. DARD can spend their money in any way they choose though they get advice from the provincial level upon the matter. The employee believes that DARD, DONRE and the Department of Science and Technology (DOSTE) will be the ones that will play a big role in the future concerning the question of saltwater intrusion.

The officer we met at the District of Natural Resource and Environment is responsible for making a general plan for the whole district on environmental issues. DONRE can make recommendations for the district level on issues concerning environmental policy as well as infrastructural measures, such as constructions of new dams. The officer mentioned that they wanted to find a new crop that can tolerate a high salinity concentrations. He said that they were dependent on Farmers' Association for this as the FA was conducting research on the matter. The officer believed that the government will play a big role in the future work of saltwater intrusion due to the government's knowledge of salinity and their access to money.

Similarities between the answers of the two men owning shrimp companies could be seen. They both felt that they had power to choose what to do and when to do it. Their main challenges were natural phenomena such as disease on shrimp and saltwater concentrations being too high.

The Farmers' Association on commune level had scientists who provided them with a new variety of rice. The commune and the village decided where the money for FA on commune level should be used for. The budget needed to be reviewed by the members within the FA as well. The commune checked twice a year where the money for the FA had gone to.

On a village level, the Farmers' Association explained that the government steers much of their work. In the beginning of each year, the FA makes a plan of their upcoming activities. They send this to the government who then sends money back. At the end of the year the association needs to report to the government what they have used the money for. In this way the funding of the FA on village level is more directed than on commune level.

Summary

The degree of power to master your situation differs in-between the structural levels. A common note is that the lower level of society, the less influence you have on your work. This can for example be seen as the Head of Villages did not have much to decide themselves compared to the employees at the district level who could formulate plans for the whole district. It is also of importance to point out that the majority of residents within Than Phu district are farmers. People who worked on lower structural levels were usually farmers themselves and therefore have the experience of farming. Such was not the case for the Head of Districts. This can be seen as a paradox as the district has a lot of power and important decisions concerning farming practices can be made at this level.

The question of funding is closely related to freedom in making decisions. Some interviewees mentioned that they are dependent on other levels for their work, in for example research or decisions concerning the budget. While it is easy to rely on someone else for your work it can also be vulnerable as the job can get halted by doing this. It is important to realize your own role and acknowledge responsibilities in the processes. It seemed as only few of the interviewees had power to decide over their own work and tasks.

8.5.4. Comparison between farmers and local authorities

To have power over the situation differs from the farmers to the people at local authorities. The farmers have power if they for example have money to invest in new crops or have their own gate which they can decide when to close or open. For the local authorities, being able to master the

situation is closely linked to where they get their funding from and who decides how the money should be used.

In comparing the responses between the two categories, it became evident that while the farmers decide more for him- or herself, people at the local authorities are bound by their structural level of work. Farmers have more power over their situation compared to employees working on lower levels, while farmers have less power compared to the people working at higher levels such as the districts. In the context of having the ability to master the situation, for local authorities the greatest issues concern funding and choosing how the money should be spent. Meanwhile for the farmers, the important matters concern their abilities to decide over their farms. This could for example include their rights to choose when to open or close the gate(s). Saltwater intrusion was noted as a big problem and something which inhibited farmers in their work and future plans.

Overall, the farmers were more pessimistic of having power over their situation in the context of saline intrusion in comparison with people in local authorities who were more optimistic. A reason behind this could be that employees at the authority were actively working with gaining control of saline intrusion. They had for example knowledge about current research and progress being made concerning saltwater issues which the farmers did not have. For people working for institutions and governmental offices on different levels, the issues concerned more which tasks to proceed with while the farmers' situation revolved largely around what degree of living standards to achieve.

9. Conclusions and suggestions for the future

The main objective of this project was to study which impacts saltwater intrusion may have on the daily life of some selected villagers in the southern Mekong Delta. We wanted to assess if there is a need for a change in order to improve the farmers' livelihood, and if so, outline some important aspects to consider for facilitating such a change.

We are aware of the risk that these conclusions may not be applicable in a larger context because of our limited studies with a small number of interviewed persons.

Both the farmers and the local authorities whom we met in southern Viet Nam shared the view that saltwater intrusion has many problematic aspects. They also shared the belief that salinity concentrations are increasing which enables them to work in the same direction. However, many authorities had a more detailed knowledge on salt concentrations and current research projects. The authorities were also more optimistic regarding the future development compared to the farmers. We think that the sharing of knowledge and experience can transfer optimism to the farmers as well.

New ways of working together with issues concerning saltwater intrusion will be necessary. This includes collaboration between different stakeholders and levels of society. Two key factors are knowledge and funding. Together governmental authorities and scientists can therefore play an important role, regarding for example crop breeding, to find varieties that are better suited for high salinity levels.

A communication between local authorities and farmers must be prioritized with regard to keeping and developing existing pathways. Examples of such activities include community meetings and Farmers' Association. There seems to be different opinions regarding the possibilities of communication that currently exist. We therefore believe it to be necessary for farmers and local authorities to share the same views regarding the ways of contact that already exist and that are viable for saltwater intrusion discussions.

In order to achieve a sustainable change, we think that a long-term perspective and a holistic approach for future measures and adaptations will be needed. This is especially important for farmers since they are more vulnerable than local authorities regarding the changes being made. Positive short-term solutions may increase a farmer's vulnerability in a long-term perspective.

An important factor for accomplishing a long-lasting change is that people need to feel included in the decision-making process. To a great extent this concerns the farmers. We believe that if farmers feel they have the capacity to change their situation then their confidence can lead to a substantial change.

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11. Appendix

11.1 List of interviewees

The interviewees, the abbreviations used in the report, the date the interview took place as well as the sex of the interviewee are listed below

Farmer 1 (F1) April 18th 2011 Male

Farmer 2 (F2) April 18th 2011 Male

Farmer 3 (F3) April 19th 2011 Male

Farmer 4 (F4) April 19th 2011 Male

Farmer 5 (F5) April 19th 2011 Male

Famer 6 (F6) April 20th 2011 Female

Famer 7 (F7) April 20th 2011 Female

Farmer 8 (F8) April 20th 2011 Female

Famer 9 (F9) April 20th 2011 Female

Farmer 10 (F10) April 21st 2011 Female

Farmer 11 (F11) April 21st 2011 Male

Farmer 12 (F12) May 16th 2011 Female

Farmers' Association (FA) on village level April 20th 2011 Male

Owner of private shrimp company in sub-region 3 April 21st 2011 Male

Head of Village 1 May 16th 2011 Male

Farmers' Association (FA) on commune level May 16th 2011 Male

Head of Village 2 May 16th 2011 Male

Owner of private shrimp company in sub-region 2 May 18th 2011 Male

Vice- head of the commune May 18th 2011 Male

District officer at the Department of Agriculture and Rural Development (DARD)

May 19th 2011 Male

District officer at the Department of Natural Resources and Environment (DONRE)

May 19th 2011 Male

11.2 Questions for interviews with the farmers

Subjects, in order:

1. Introduction of us and the team

- a. Introduction of the interpreter, who he is and that he will interpret for us.
- b. Introduction of the three of us. We are three students from Sweden who are making a field study in order to write an essay for our university in Sweden. This project is something that we have help from Can Tho University in doing. We are here to get a better understanding of the situation in rural areas and hope to ask you some questions. We are very happy to be here and to meet you and grateful that you are taking your time to meet us! Give a small gift to the farmers.
- c. About the interview, the interview consists of some questions and this will not take more than three hours. The answers will primarily be used for our essay in our home country. They will be summarized in an essay for our project and will also be available for Can Tho University. There are no right or wrong answers and we are interested in your point of view.

We will NOT write your name or point out where this interview was done. The answers will be **anonymous**. Is it ok with you that we use a tape recorder?

It will only be listened to by us and our supervisors. Do you have any questions? It is alright to interrupt or end the interview at any time as well as to quit the tape recording. If there are some questions you would not like to answer or don't know the answer of that is completely alright. You answer the questions which you think you can answer. Once again, thank you for meeting us and taking your time!

PAUS

2. Start-up questions. Questions used to get to know the farmers overall situation.

- a. How long have you been living on this farm?
- b. Where did you live before?
- c. What was your occupation before? /What did you do for a living before?
- d. Who is the owner of the land? How did you come to own the land? (if he/she is the owner)
- e. How many people are living on the farm/ in the household?
- f. How many people in the family help out on the farm? /Are involved in the agriculture production?
- g. Are you a member of a farmer association and/or a cooperative?

PAUS

3. Resources and cropping systems

Moon calendar will be used during the interview and will be transformed to sun calendar in our analysis.

Here we want to figure out how the farmers make a living. The purpose is to get a background of the farmers cropping system which can be related to the consequences of saltwater intrusion. We would like an overview of what kind of crops the farmers have and when during the year they grow them to be able to see how it changes over time and how the farmers are adapting to different salinity levels.

- a. How many hectares do you own? Has it changed over time? Why?
- b. What cropping system do you have?
- c. We would like to do a table together with you to get an overview of which crops you have and when you grow them. Here are the months starting. And here in the left column we will write/draw the different crops which you use in a year in a cropping system. Which crops have you grown during the previous year?
- d. (When finished with the crops) Do you have any other sources of income? /the whole household. Please list them below the crops and which months these primarily are carried out.
- e. What has the dry season been like this year?
- f. What is the main reason for using this cropping system?
- g. For how long have you had this cropping system?
 - i. (If the farmers have changed): why did they change?
- h. How big is the yield for **each crop per year**? Has this changed since last year? Has this changed the last 5 years?
- i. What is the market price income for each crop this year?
- j. How much do you invest in seed for each crop every year?
- k. When do you irrigate your crops? Which intervals (day, week, month)?
- l. What are the sources of the irrigation water?
- m. Are you dependent of someone else for your water supply? (how is your water regulated?)
- n. What are the sources of your drinking water?
 - i. Share with someone else?

- o. Have you experienced any change in water supply over the last few years? If yes: What kind of change? How has the change affected you? How do you adapt to these changes?

PAUS

4. **Problems that concern the agricultural production**

- a. What are the biggest problems that are connected with crop production/aquaculture / What are the limiting factors for your production?
- b. Rank the problems please. Which is most severe?
- c. Why have you ranked the problems in this order? Why are these the most important?
- d. If the farmer doesn't list saltwater: Are you affected by saltwater? Do you see it as an opportunity or a problem having saltwater in you cropland?
- e. If needed explanation of saltwater: When there is low flow of water in the Mekong river saltwater from the sea flows in to the canals and further on into the cropland of farmers.

PAUS

5. **Discussion about saltwater intrusion**

- a. When was the first time that you had saltwater in your fields?
- b. When during one year is saltwater the most obvious?
- c. How has the level of salinity in the water in the fields changed in the last years (1, 3, 5 years?)
- d. In what way does saltwater affect your cropping system?
 - i. How does it affect the yield and /or number of harvests?
 - ii. How has saltwater affected the water used for crops/aquaculture? Follow up question: Why has it had that effect?
 - iii. Other consequences? How adapted to these?
 - 1. What does the increased/decreased income affect your household?

PAUS

6. **Measures in the past to help or to make the situation worse**

- a. Which measures have been taken in the past to reduce the impact of saltwater?
 - i. Who was responsible for these?

- ii. In what way were you involved in the process of taking the measures/ In what way were you contacted or asked to participate in the process of taking the measures?
- b. Which measures have been taken that has made the impact of saltwater worse?
 - i. Who was responsible for this?
 - ii. In what way were you involved in the process of taking the measures/ In what way were you contacted or asked to participate in the process of taking the measures?

PAUS

7. Communication with organizations, associations, authorities etc.

- a. Who do you feel has the power to make decisions concerning your farm?/Who are involved in making decisions concerning your farm?
 - i. How do they do that?
 - ii. Is there any difference when the issue concern salinity in the water?
- b. Do you contact someone when you notice increased salinity in water?
 - i. Is there somebody you would like to talk to but don't have the means to?
 - ii. Why is there no communication at present?
- c. How do you talk about saltwater in this community?
 - i. Is that within a certain organization/group or with a certain person?
- d. Have you had any consulting on the farm?
 - i. Have you had any consulting on saltwater?
 - ii. Have you had any consulting on water shortage?
- e. Do you get any information elsewhere on saltwater?

PAUS

8. What will the future be like?: measures, communication and hopes

- a. What do you need to adapt to increased levels of salinity in your cropland?
- b. What do you think of the future, will the salinity in water increase, decrease or stay as it is?
 - i. Why?
- c. What do you know about climate change?

- i. How have you got the information about this?
- d. What would you feel about changing cropping system?
 - i. If you were to start a new cropping system, what would you think would be the problems?
 - ii. Do you think you will have to change cropping system in the future? If yes, what do you need?

PAUS

9. Finishing the interview

- a. Do you have anything you would like to add to this interview?
- b. Can we get back to you if we have any further questions?
- c. Is it ok to take some water samples from your fields? These will only be used in our project for our essay in Sweden.
- d. Is it ok if we take some pictures?
- e. Is there something special you would like to emphasize from this interview?
- f. Thank you so much again for taking your time!

11.3 Questions for the District officers

1. Background

About the head of district

- g. How long have you worked here?*
- h. What did you do before you were appointed this position?*
- i. What are your main responsibilities?*
- j. What are your department's prime responsibilities?*
- k. How many households do you influence in your work?*
- l. What is the most fun part of your job?*
- m. What is the most challenging part of your job?*

10. Saltwater

Awareness

- a. For how long have this area been affected by saltwater intrusion?*
 - i. Do you know how that has development over time?*
- b. For how long has saltwater been measured in this district?*
 - i. How has this been done?*
- c. Is saltwater a problem or an opportunity?*
 - i. What can these problems/opportunities lead to?*
- d. In what way do you work with adaptations to saltwater and the effects of saltwater intrusion at your department?*
 - i. If it's a common problem:
When you started working with adaptations to saltwater, how did you work with it then?*
 - ii. Do you cooperate with anyone on this?
For examples farmers, other agencies, NGO: s, Universities?*
 - iii. Is there a separate budget for work with adaptation to saltwater intrusion and its effects?*
 - iv. Who sets this budget?*

- e. *Are there any infrastructural measures that have been made in this community to control the level of salinity?*
- i. *To control water flow?*
 - ii. *Who has been in charge of these measures?*
- f. *Who are involved in deciding the focus and approach of your department?*
- i. *How do they do that?*
- g. *Are there any official policies that you act according to when planning your work concerning adaptations to saltwater intrusion and its effects?*
- i. *How do you cooperate with the government?*
 - ii. *In your opinion, are there other policies that may indirectly affect saltwater intrusion? (E.g. policies concerning infrastructure, energy, agricultural reforms?)*
 - iii.
- h. *Do you think that salinity levels will increase or decrease or stay the same in the future?*
- i. *Over the years, have you noticed any change concerning the period of saline water versus the period of freshwater?*
- i. *How do you think it will continue in the future?*
 - ii. *Why do you think these two things?*
- j. *Who will play a big role concerning adaptations to saltwater in the future? For example: Government, farmers, foreign companies, foreign governments, ASEAN, MRC, advanced farmers, extension workers. (In the future work with adaptations to saltwater intrusion, who do you think will be the driving forces?)*

3. Communication

Communication up, side and down

- a. *Do you cooperate with province officials on any issues?*
- b. *Do you cooperate with other district officials on any issues?*
 - i. *Any district officers in another department?*
 - ii. *Any district officers in another province?*

- c. *Do you cooperate with the commune or village officials on any issues?*
 - i. *On which issues are you informed by the head of commune?*
 - ii. *Are you informed on the decisions of the commune meetings?*
- d. *Do you feel that the communication in these cooperation's are enough?*
 - i. *Why?*

Communication with farmers

- e. *How do you communicate with farmers?*
For example: In person, through community leader, employees, media, speaker.
- f. *What is this communication about most often?*
 - i. *How many times out of ten does the communication concern adaptation to saltwater?*
- g. *Which ways of communication do you feel reach the farmers the best?*
 - i. *How do the farmers contact you with any answers/questions that they might have?*
- h. *What problems do you experience when trying to contact or inform farmers?*
 - i. *How do you think those problems can be solved?*
- i. *Do you provide any service to farmers that can aid them in adapting to saltwater intrusion?*
For example: Help of extension workers. Courses in what cropping system to use. Demonstrations of cropping systems for inspiration?
 - i. *How many participate in these*
 - ii. *Is this free or is there a fee?*
- j. *Do you provide any kind of financial support to aid farmers who try to adapt to saltwater intrusion?*
 - i. *How many are interested in this support?*
 - ii. *Who can be considered for being given the support?*
- k. *Do you provide farmers with advice on how to adapt to saltwater intrusion?*
 - i. *Do you have extension workers on district level?*

11.4 Table of water data

Farmer	cond (mS/cm)	ppt	pH	temp (C)	
1,1	26,89	17,2096	6.85	25,3	
1,2	26,76	17,1264	6.96	24,6	
1,3	26,92	17,2288	6.98	25	
2,1	26,35	16,864	6.98	24,5	
2,2	24,42	15,6288	7.1	25,3	
2,3	32,42	20,7488	6.78	24,8	
2,4	32,69	20,9216	6.78	25	
3	28,32	18,1248	7.5	24,5	
4,1	19,66	12,5824	7.44	25,5	
4,1	22,2	14,208	7.32	24,5	
5	21,32	13,6448	7.3	24,8	
6,1	28,33	18,1312	7.64	25,2	
6,2	28,36	18,1504	7.56	25,5	
7,1	26,51	16,9664	8.23	25,2	
7,2	24,86	15,9104	8.03	24,5	
8	27,37	17,5168	7.44	24,6	
9	26,42	16,9088	7.83	24,5	
10,1	25,6	16,384	7.6	24,5	
10,2	26,83	17,1712	7.9	25	
11,1	25,53	16,3392	7.54	24,6	Min 21
11,2	33,2	21,248	7.58	24,6	Max 13

11.5 Analysis sheet

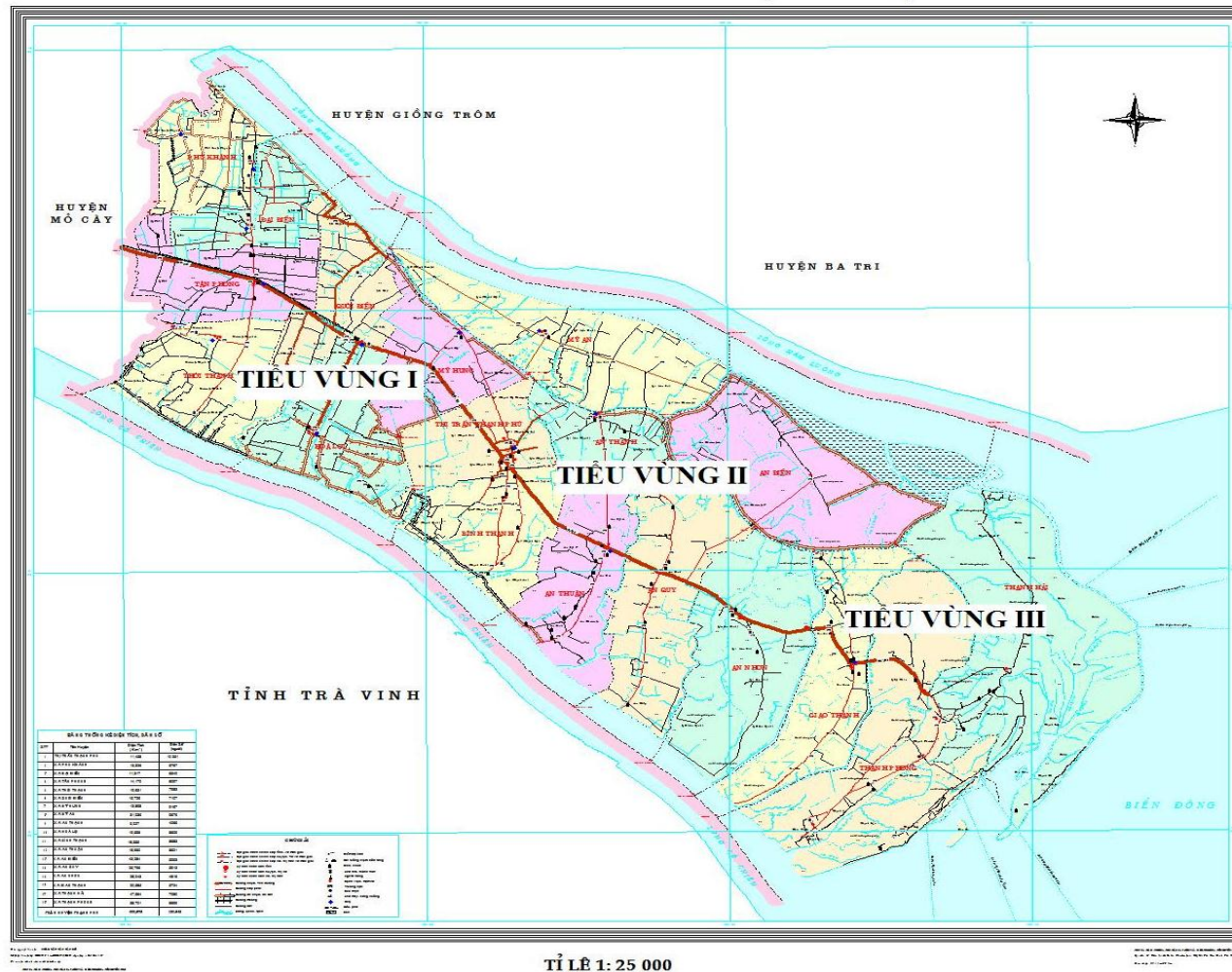
Male/ Female		Channels of communication "General" & "Saltwater"	TV National
How long have they lived there			TV Province
Why moved			TV District
Location of farm			Radio
Member of farmer association			News paper
Level of income			Speaker
Sources of income			Family
Cropping system			Neighbors
Main reason for using cropping system			Farmer association
Why change in cropping system occurred			Commune
Source of water	(Drinking :) Household: Irrigation:		District
Change in water supply	(Drinking :) Household: Irrigation:		Province
Period freshwater/saltwater			Government
Change over time with salinity		University	
Problems (max 5)	* * * * *	Discussed during FA	NGO:s
		Discussed during community meetings	Shrimp company
		Power over decisions	
		What adaptations are needed?	
		Analysis part	
Saltwater: Problem/Opportunity?		Able to affect situation?	
Saltwater affect on cropping system		Three most important direct consequences	* * *
Test salinity in water	No Yes * Shrimp company * Taste it themselves * Equipment	Three most important indirect consequences	* * *
		What is needed for these adaptations?	
		Hopeful for future saltwater?	
Measures to reduce saltwater		Hopeful for future of farm?	

11.6 Communication sheet

	How?	How often?	Whose initiative?	What issues?	How many times out of 10 does the communication concern saltwater?
Government					
Province					
District DONRE					
Commune					
FA Commune					
Village (ÂP)					
FA Village (ÂP)					
Farmers					
Universities, organizations, companies, others:					
Media					

11.8 Map of sub-regions, Thanh Phu District, Ben Tre Province

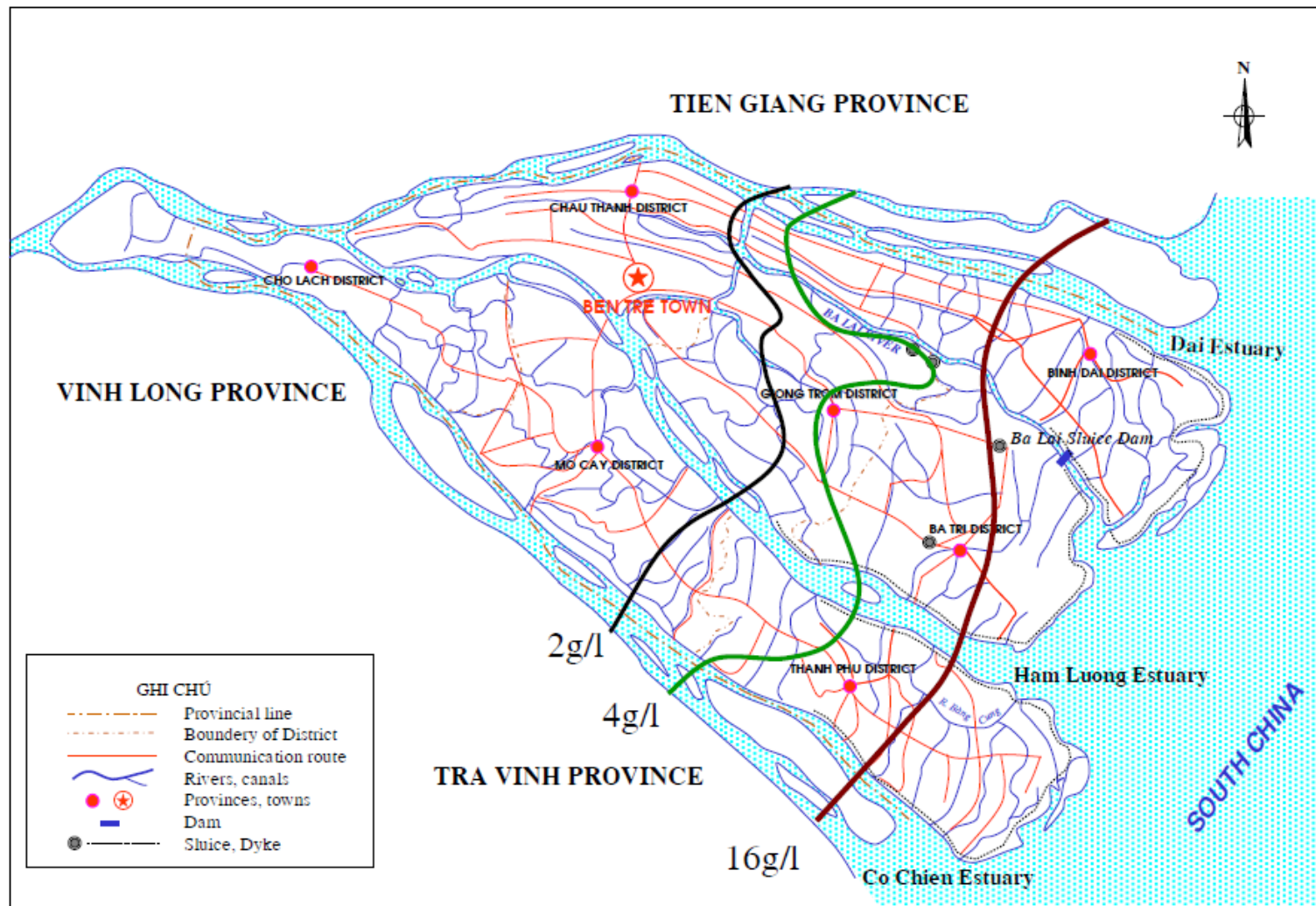
BẢN ĐỒ HÀNH CHÍNH HUYỆN THANH PHÚ



Map of Thanh Phu District, Ben Tre. The three sub-regions are marked in the map. TIÊU VÙNG = sub-region

Source: Department of Natural Resources and Environment, Thanh Phu district, Ben Tre province

11.9 Salinity isograph in the Ben Tre Province



Source: The Southern Institute of Water Resources Research (SIWRR), Viet Nam, 2005