# Impacts of the flood mitigation infrastructure on livelihoods in Kampung Tanjung Pisang

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**Impacts of the flood mitigation infrastructure on livelihoods in Kampung Tanjung Pisang**

This reports is based on the participation on the Interdisciplinary Land Use and Natural Resource Management (SLUSE) course. This study reflects the data collected during the fieldwork develop in Tanjung Pisang village, Sharawak in March 2017.

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**List of abbreviations**

DID Department of drainage system and irrigation

WS Water sampling

PRA Practical rural appraisal

SLF Sustainable livelihood framework

GPS Global Positioning System

SSI Semi structure interviews

KII Key informan interviews

DO Dissolved Oxygen

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**Abstract**

Tanjung Pisang is a small village located on the riverbank of the Sadong River (Sarawak). The area is affected by seasonal flooding, which affects people' livelihood and even though the department of irrigation and drainage has improved the infrastructure to mitigate the risk of flooding, it still remains a challenge for the village. Therefore, the aim of this report is to examine the maintenance of the infrastructure and its impact on livelihoods.

The main findings are that the main levee in combination with improper maintenance of the drainage system constitute produces a pooling effect, that results in long periods of flooding. The maintenance of the levee is under the responsibility of the DID, which is obligated to maintain the drainage system minimum once a year, but due to lack of funding, this maintenance is done improperly. The flooding makes an impact on people' income as it reduces the yield and viability of crops. The crops that are most affected are bananas and coconuts. The problem makes people look for new sources of income where pepper are cultivated even though it is associated with risks.

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## 1. Introduction

Floods are among the natural disasters which causes the highest impacts on people's lives. Climate is one of the main drivers impacting flooding. Thus, changes in climate variability will lead to increased weather extremes, meaning that floods will have a greater impact globally, reflecting rising cost and hence making flood management an urgent environmental and social issue for policy-makers (Ward et al. 2013). In the region of Sarawak floods are mainly caused by high tides and heavy rain (Holden 2012) and it is the combination of both factors what usually cause devastating effects on this region (Poon 2010). This extreme events appear therefore on the rainy season, between November and March, as in February 2014 (add thigs about this). The effects of the flooding is accompanied by a wide range of causal effects that change local environmental and socio-economic conditions (Few 2003). Flooding events have had devastating impacts, bearing wide adverse consequences for properties, crops, health issues, which is affecting Tanjung Pisang inhabitants' livelihoods (Diya et al. 2014).

Our study has been develop in a small village in Sarawak region. This village is located in one of the banks not far from its mouth. And its due to and the proximity of the village to the river and the river to the sea that this area high vulnerable to tidal floods. This natural disasters decrease the life quality of the inhabitants of the village.

Flood mitigation measures, such as levees and dams, can prevent the impact of flooding, but also have the opposite effect by either prolonging or making them more severe (Rufat et al. 2015). Due to the vulnerability of this area to be flooded, the DID, which is the institution in charge of the implementation of flood mitigation infrastructures in Sarawak region, established a dike and a drainage system around the villages which are more prone to suffer flood damages to reduce the impacts of the tidal floods. However the lack of maintenance of this drainage system is creating a new problem not allowing the water of heavy rains to flush out and keeping the area flooded for long periods of time.

Agriculture is one of the most affected activity by this type of flood and being at the same time one of the main economic activity in this area. In order to cope with the effects of flood farmers have been using their land in different methods to minimize the impact of flooding in their daily lives.

### 1.1 Research Questions

To get a deeper understanding of the complex issue of flooding impacts on rural areas in Malaysia, the overall objective of this study is to examine how flood mitigation infrastructure affects livelihood strategies in Tanjung Pisang.

How is the physical infrastructure organized?

How does the drainage system impact the issue of flooding?

How does flooding impact livelihoods?

1.2 Study area

Tanjung Pisang is a Malay village consisting of 58 households situated on the bank of the Sadong River (N 0124.849', E 110 38.857'). Originally the inhabitants were living in Ensenggei Melayu village located just on the opposite bank of the river and they had to move due to the erosion effect that the river was causing on their land. The community consists of farmers and fishermen whose main economic activity has shifted from fishery and swamp rice to cash crops, such as banana, coconut, maize and pepper. However, the main source of income for this families are most of the times on the aids that receives from their closest family members.

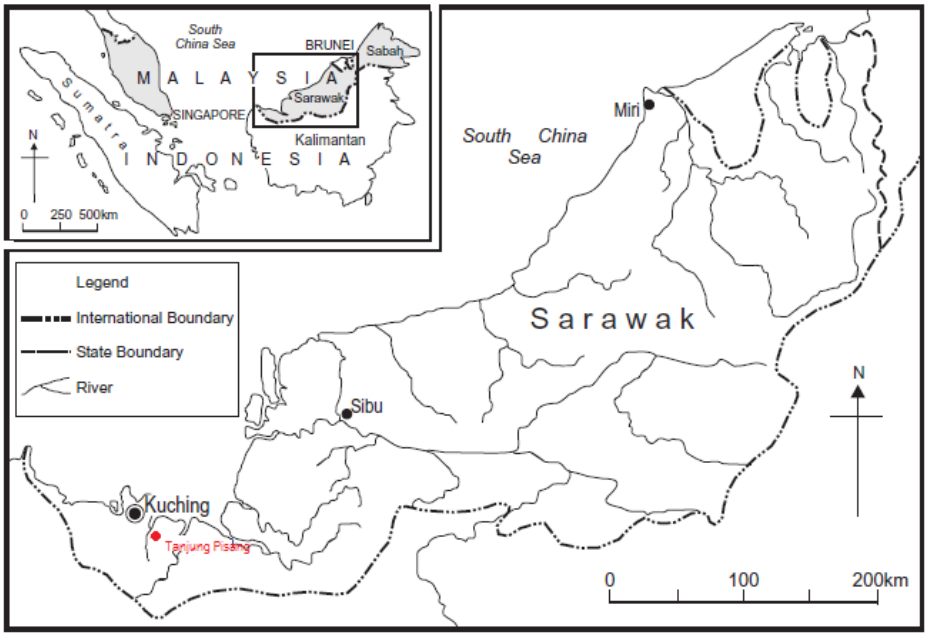


*Figure 1. Overview of Malaysia and Sarawak region. Location of Tanjung Pisang's village*

## 2. Conceptual framework

In the research project, the sustainable livelihood framework (SLF) will be applied to conceptualize and systemize the findings from the fieldwork. The framework emphasizes the diversity of ways that people make a living and it is commonly used by development practitioners working with rural communities (Scoones 2009). The purpose for applying the framework is that it can provide an overview of the livelihood context in Tanjung Pisang, as well as help in systemizing the research findings. Furthermore, it can relate the case study research findings to a larger body of literature on livelihoods (Mikkelsen 2005). The point of departure is in the SLF developed by the Sustainable Rural Livelihoods Advisory Committee in 1999, which describes the main factors that influence livelihoods (Figure 2) (DFID 1999). The framework is used to sketch out the research findings with a particular focus on how factors that shape livelihoods relate to each other and also what the core influences are on livelihoods (DFID 1999). In particular, the interest is to describe and analyse how flooding contributes to the vulnerability context, how flooding makes an impact on livelihood assets and in what way that flooding makes an impact on livelihood strategies and produce outcomes.

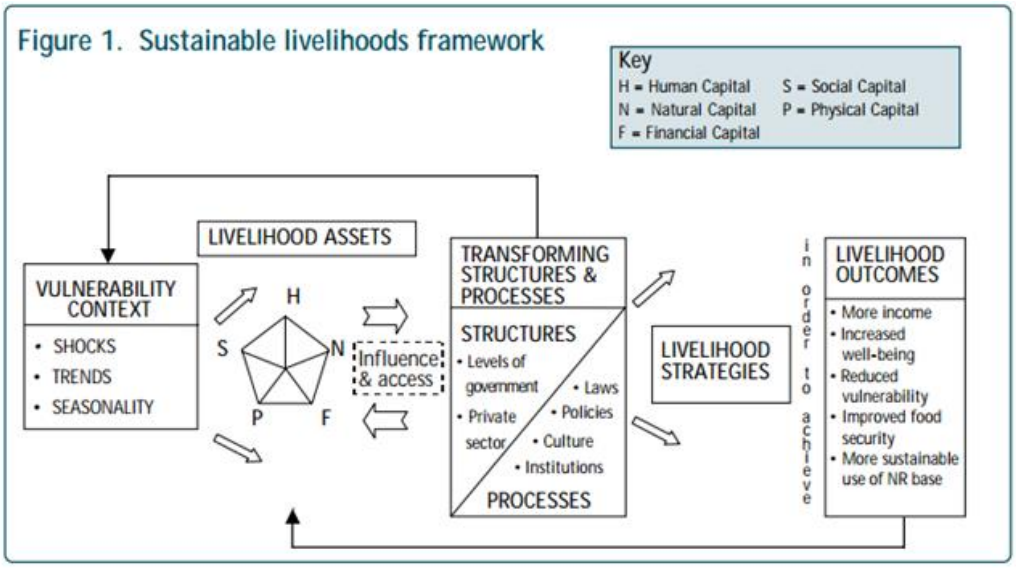


*Figure 2. Sustainable livelihood framework*

A livelihood diversification is a process in which rural families construct a diverse portfolio of activities and social support capabilities in order to survive and improve their living standards (Ellis 2000). Livelihood strategies are the decision-making linked to the activities of the households which produce livelihood outcomes (DFID 1999). Adaptation is part of livelihood livelihood strategies, and they can take place at every level of the society (Adger 2003, 2005).

In the asset pentagon, there are five types of capital that will be used to systemize the collected data on livelihoods in Tanjung Pisang (Figure 2). Flooding is able to impact all asset both directly and indirectly. And reversely, the assets can directly and indirectly shape how livelihoods are impacted by flooding, and other vulnerability factors. Measurement of vulnerability is difficult to pin down to a single variable, thus other factors will be included in the vulnerability context (Adger 2006). However, as the impacts of flooding is our main research interest, it will be dealt with in more detail than other factors that contribute to vulnerability. Likewise, physical capital in the asset pentagon will be examined more thoroughly as we are interested in the physical infrastructure of Tanjung Pisang. In the box below, the definitions of the five types of assets are shown according to DFID 1999, which will be used (Table 1).

*Table 1. Asset pentagon for the livelihood mattress.*

| ASSET PENTAGON |
| --- |
| Human Capital: The skills, knowledge, ability to labor and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives. |
| Social Capital: The social resources upon which people draw in pursuit of their livelihood objectives. |
| Natural Capital: The natural resource stocks from which resources flows and services useful for livelihoods are derived. |
| Physical Capital: The basic infrastructure and producer foods needed to support livelihoods. |
| Financial Capital: The financial resources that people use to achieve their livelihoods. |

## 3. Methodology

Our methodological approach to examine how flood mitigation infrastructure in a flood vulnerable area affects livelihood strategies is based on fieldwork participation and observation, household questionnaire survey, semi-structured interviews, key informant interviews, participatory rural appraisal (PRA) exercises and water and soil sampling. The qualitative and quantitative social science methods have been used for the purpose of gathering data from the inhabitants, as well as they are used for triangulation. The main reason that the qualitative methods are more represented than quantitative is that we were working in a research context with little information about the case area prior to the fieldwork and that we were working with a small population. Methodological triangulation has been applied to examine objects of study through different means to increase the validity of the data that have been gathered (Mikkelsen 2005). But also as a consequence of having gathered data on local perceptions on a wide range of issues that potentially could give contradictory information, especially in the case of constructing a village timeline description, and making use of both focus group interviews and SSI's.

### 3.1. Social science methods

#### 3.1.1 Field observations

While doing the field work we were observing our environment and taking notes of it. Conversations, walks and village experiences

#### 3.1.2 Transect walk

Two transect walk were conducted in the beginning of the field work in order to 1) examine the village boundaries ( Figure 3) , and 2) examine the physical infrastructure. A local guide was part of the transect walks, where it was possible to ask questions and talk about issues related to the objects of interest, as well as engage in more loose topics such as the everyday life in Tanjung

Pisang. The purpose of the transect walks was to observe the basic characteristics of the case area as early as possible and to map the physical infrastructure of the village. Observing the case area together with a local guide enabled us to ask questions about the perception of the local guide on wide range of issues (Strang 2010). During the transect walks, we recorded the entire tracks and entered the GPS coordinates to be able to locate water gates in the area and the village boundary. Furthermore, the transect walks were also used to make ground truth previous satellite imagery observations made before the fieldwork (Strang 2010).

*Figure 3. Pictures taken during the transect walk, drainage system and pepper, banana and coconut crops.*

### 3.1.3 Questionnaire survey

A household questionnaire survey was conducted during the first three days in the field. 30 heads of households were interviewed following a common questionnaire form prepared previous to the fieldwork (Appendix 8.3) amongst a total of 58 households in the village. As the households were clustered in a very small area, the sample strategy was simply to cover every second household. In some cases, neighbouring households have inevitably been surveyed. However, the aim was to avoid that the household respondents would be clustered in one part of the village. The questionnaire survey was conducted during the first three days of the fieldwork, and the interviews were conducted during mornings and afternoons. Our purpose for doing the questionnaire was to gather enough data to get an overview of the livelihoods in Tanjung Pisang. However, the questionnaire survey was also used as an opportunity to ask for elaborate answers from the household respondents, and to make field observations. As the size of the population was rather small, and due to the patience shown by our respondents, we allowed ourselves to spend additional time to converse with the household respondents. Therefore, the process of conducting the household questionnaire served a purpose that extended the questionnaire survey itself, where more open-ended answers were documented as field notes. An advantage of questionnaire surveys is that it is an efficient means to systemize data, and make it possible to make statistical analysis. However, it was also a rather time consuming activity in which some of the data that were gathered that were hardly used. Appendix 8.5

### 3.1.4 Semi-structured interviews (SSI's)

SSI's were conducted to follow-up on field observations that we had made in the beginning of the fieldwork with the intention to go into more detail with our preliminary findings. During the fieldwork, the structure of the SSI's was gradually adjusted along with our findings, and discussions of the findings (Appendix 8.4). The SSI's covered topics such as livelihood opportunities and strategies, and the impact of flooding on livelihoods. The preliminary findings allowed us to make more selective choices of whom to interview. The total amount of SSI's conducted were 15 people in which the aim was to cover at least 4 in-depth interviews with people that have farming as the main income source, and 4 in-depth interview with fishermen. And lastly, an adequate gender representation, and in-depth interviews with people whose main income sources are not from farming or fishery.

Partly, the SSI's were conducted because it proved to be too difficult to discuss livelihood opportunities and strategies, and impacts of flooding, in focus group interviews. The main advantage to make the individual interviews rather than focus group interview were that we avoided that some respondents dominated others, which was some of the issues that arose when doing focus group interviews.

### 3.1.5 Key informant interviews (KII's)

A KII was conducted during the first day of the fieldwork. A SSI with the local headsman of Tanjung Pisang, which elaborated on the information that we were given previous to the fieldwork. The purpose of conducting the KII was to gain an insight into how the issue of flooding was affecting Tanjung Pisang from a person with an influential role in the village (see annex). A second KII was conducted later during the fieldwork with an employee from DID working in the Simunjan region. Likewise, a SSI was conducted that was adjusted to the occasion that sought to address how DID works in the region, and how they perceive the problem of flooding in the case area. Lastly, a KII was conducted with the principal of the local school that helped us on the understanding of the impact of the flood on the school. She shows us her point of view about the problem and about the impacts on the school life of the students.

### 3.1.6 Participatory Rural Appraisal (PRA) exercises

Four different types of PRA exercises were conducted during the fieldwork with different kinds of set-up and purposes. Given that

- Social mapping

The first exercise that we conducted was together with four male participants from the village on the second day after the evening prayer. Among the participants were the secretary and the local headsman. The purpose of the exercise was to get insight into how they had organized themselves in the village, and to know which areas that the participants regarded as

affected by flooding, and for what reason that these areas were flooded. The participants received satellite imagery, and some assistance to map the area, whereas they showed the physical and social infrastructure of the village, perceived by them. Afterwards, we had an in-depth group conversation with the participants about the social mapping that they had made.

- Timeline exercise

The second exercise we conducted was primarily together with four male participants from the village on the fourth day after the evening prayer. Among the participants were the secretary and the local headsman. The purpose of the exercise was to get background information about the village, and to get a time perspective of how the village emerged, the development of the physical and social infrastructure, livelihood development, and how flooding events have affected Tanjung Pisang. This exercise took a semi-structured form, as we had prepared certain topics that we regarded as important to cover during the exercise. Later during the fieldwork, we had a small exercise with three people.


*Figure 4. Group members and counterparts working in Tanjun Pisang timeline*

- Livelihood exercise

Women focus group

The third PRA exercise was conducted with the purpose to analyse gender dynamics, and especially to get an insight to the daily lives of the women which we had not covered to the same extent as the men.

Men focus group

The fourth PRA exercise was conducted with the purpose to discuss the link between the impacts of flooding, the livelihood opportunities, and livelihood strategies, in a focus group. In the group was five male participants, and among them was the local headsman.

Children exercise
School visit. To try to understand how the students perceived the floods and the impact of it on their willingness to go to school we asked them to draw " things that you like and thinks that you do not like of your village", trying to link the things they do not like with the impact of this floods on the school.

## 3.2 Natural science methods

### 3.2.1 Water sampling

In order to understand the effects of flooding on the water quality 4 samples has been taken and analysed. The places chosen allowed us to understand the efficiency of the watergates in relation of the capacity to limit the intrusion of salt water inside the fields. We also measure the nutrients on the drainage system to know if there was leakage of nutrients due to heavy rains floods.

The measurements were made with Professional Plus Multiparameter Instrument YSI. First of all, the sensor was introduced in the channel of interested to get data from. Variables such as temperature, pH, conductivity etc. were read in situ. To measure the Oxigen DO was necessary to pour water into another container in order to increase the disponibility of oxygen and then read the data when the variable it finally remained stable (wait around 4 mins.)

### 3.2.2 Soil sampling

To examine the impact of flood on soil "quality" / leakage four different sites, P1, P2, P3 and P4 were selected based on a specific set of inclusion criteria in order to secure uniformity between sites. Each site was placed in the same soil zone (specific) based on information from an official governmental soil map from 1982, thus securing the same (parental material). Each site were cultivated with pepper planted less than three month prior to the sampling and were all applied approximately the same amount of chemical fertilizer, less than 300g every second week and a handful of organic material. Site P1 and P2 were located within the farmers field on the flood exposed site of the levees hence experience flooding at least once/year and both sites were surrounded by coconut and banana trees, which have been the dominant cultivar together with coco the previous 40 years. Of notice P2 were placed just adjacent to two main drains, which potential could results in fluctuation between sites. P3 and P4 were selected under the assumption of being non-flooded even though there have been records of flooding, lastly in 2011. Both sites were located just adjacent to the main levees and have a land use history of vegetables (chili, watermelon, lady finger etc.). Of notice the P4 evidently seemed swampier than P3 reflected by an apparent higher groundwater level.

On each site, samples were taken in triplicates by random selection using either an open-face auger or a bulk density tool. Using the auger the triplicates were composite to make one representative sample from the each of the sites. The samples were analysed for conductivity, pH and soil texture using the field lab located in Simunjan.

Triplicates of bulk density were brought to university of Copenhagen where the samples were air-dried in an oven, weighed and crushed using a mortar. Samples were analysed for total carbon and nitrogen by Isotope-Ratio Mass Spectrometry.

*Figure 5. Group members taking soil samples. Sample point 2, pepper field*

## 4. Results

### 4.1 Tanjung Pisang

Tanjung Pisang was founded when four farmers from Ensengei Malayu decided to settle in the area around 1960. The farmers owned land on both side of the Sadong River, but decided to move to Tanjung Pisang as a response to land erosion. At that time, it was an area of coconut plantations, which the farmers had been working on. Little by little, the farmers began constructing houses in the area. And in 1970, the first headman of the village was announced.

Throughout the years, there has been changes in land-use. In the beginning of the 1970s, coconuts, paddy rice and bananas were cultivated in the village area. This was followed by a time when the farmers attempted to cultivate coco and coffee supported by the Malaysian government. However, the construction of a levee in the 1990s changed the environment and rendered the coco and coffee scheme impossible.

Today, bananas and coconuts remain important crops to Tanjung Pisang that has grown in size and now has approximately 300 inhabitants. Paddy, pineapple, pepper, watermelon and maize are all cultivated by the farmers. Along with their cash crops, the farmers have homegardens with vegetables which are chiefly used for self-consumption. The most noticeable trend in recent years among farmers have been the introduction of pepper in 2007.

The proximity to the river has offered opportunities for the inhabitants, but is has also meant that flooding has been a challenge for the village. The tidal, heavy rain and flash floods have impacted the village since it was founded. Back then, the main priority was to mitigate the risk

of brackish water intrusion. In 1990, the Department of Irrigation and Drainage (DID) initiated mitigation measures in the village, which effectively reduced the problem.

## 4.2 Physical infrastructure

A key issue for Tanjung Pisang is to have a physical infrastructure (Figure 6) that is capable of coping with different kinds of flooding through mitigation and adaptive measures. Although, the construction of the levee succeeded in reducing the vulnerability of tidal flood, it did not mean that it was not any longer an issue in the village. In a transect walk with a local key informant, it was possible to observe how the village is located between two enclosing levees. In a PRA session (Appendix 8.7), it was said that the original plan for the main levee was disapproved by the community because the construction of the levee would go directly through the village. The inhabitants wanted an economic compensation, which the government was not willing to pay. The community proposed to the government that the levee was to be constructed around the village, close to the riverbank. However, it was rejected by the government because DID estimated that it would mean a high maintenance cost and risks associated with erosion. Eventually, an agreement was reached between the government and Tanjung Pisang, which was to construct a levee inland around the village. It was constructed 1996.

In addition to the new levee, the village applied for the construction of a minor bund in front of the village that would replace the previous bund in order to reduce vulnerability to flooding. The application was accepted by the government, and the mini bund was constructed in 1998 together with a watergate. Nevertheless, the watergate collapsed during the rainy season in 2011. A factor that may have contributed to the failure of the watergate was its construction of wood. In response, DID constructed two watergates of concrete between 2011 and 2012. In continuation of a PRA session (timeline) and the transect walk, an interview was established with the local district office of DID. The DID officer confirmed that both of the levees were built by the DID, but was not able to confirm the exact years of constructions. Similar account was given by the local headsman.

Previous to the fieldwork, it was possible to localize the watergates in the area from satellite imagery (Figure 6). Transect walks were part of verifying prior observations, together with fieldtrips to neighboring villages. Interviews contributed to understanding how the watergates and levees functioned together with official drainage reports by DID (DID, chapt. 46 ).


*Figure 6. Shows the main levee (blue) and the main road (black). The Watergates (WG), Tanjung Pisang (TP) and Ensenggei Malayu villages are also presented on the map.*

The physical infrastructure consists of three different kinds watergate systems (Figure 7).Watergates are opened and closed depending on tides. DID is the responsible for the maintenance and operation of the watergates. Watergates will be opened when the tide is low, and close before the tide is high. Small watergates that can be found on the mini bund (Figure 7C, Figure 9) function according to a one-way-system that transport excess water through a pipe during low tide. During high tide, the opposing pressure on the gates located on the riverside of the pipe will prevent brackish water from entering, while hindering excess water from flowing into the river. The larger watergates are operated manually by a district officer. One is operated by turning a handle directly connected to a gate while the largest watergate is based on an electrical system, which requires an officer to operate it directly from a watergate tower. The information about the procedures was given by DID.

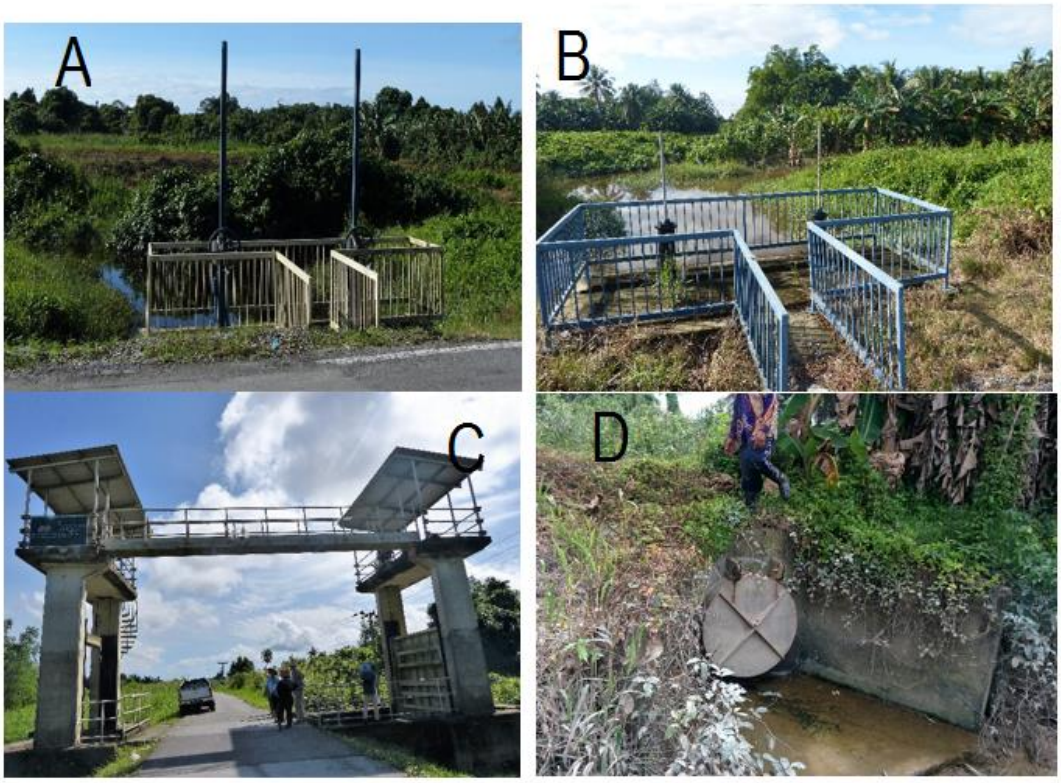


*Figure 7. The image one, two and three represent the Watergates located in the crop side. This are the ones that allows the water to run into the river when there is heavy rains. The first one has a manual mechanism while the second and the third opens and closes with an engine. The last image shows the automatic Watergate that prevent the intrusion of the water of the river through the crops.*

## 4.3 The drainage system

In conversations with farmers, it was expressed that the drainage system is their main concern. The main drainage system is located 20 meter adjacent to the main levee (Figure 8). Its function is to transport the excess water from the area to the water outlets during low tides. We were told that DID was responsible for the maintenance of the drainage system along the levee which is also where the main road stretches that connects Tanjung Pisang with other villages. It is regarded as the most important part of drainage system as all excess water has to be transported through it. If the main drainage is not maintained properly, it will act as a plug that reduces the flow of excess water from fields and result in longer periods of flooding with subsequent impact on crop yield and viability. The village secretary told that the village fund has paid for hiring a private company to improve the drainage system (Interview A4).

*Figure 8. Main levee and drainage system at the left*

The private company constructed a drainage system adjacent to the main levee in 2016 located inside the fields heavily affected by flooding (Interview A4, A5, PRA Timeline) (Appendix 8.7). It was difficult to access the drainage system because of bad maintenance, so it has not been possible to track the whole system. The channels of the drainage system was mapped based on information gathered from interviews with locals and GPS tracking (Figure 9).


*Figure 9. Map of the main drainage system and soil sample points. The blue lines mark the main drainage system while the grey ones shows the drainage inside the village. SWG are the watergates for the small levee and P1, P2, P3 and P4 the the points where the soil samples were taken*

The main drainage system was affected by vegetation, which caused water to accumulate creating unintentional water catchments and prolonged the duration of floods. Farmers describe it to be the main problem for them (Interview A1, A2, A3, A4). The frequency of maintenance does not correspond to the rate of vegetation. The problem was observable in Tanjung Pisang, and in neighbouring villages.
The fact that DID has the responsibility of clearing the main drainage system means that the farmers await action from the department. However, farmers have responsibility for maintaining the drainage inside their land. The agreement is that DID is to clear the drainage systems once per year. (Interview A1). DID owns land 50m from each site of the main levee and is responsible for maintaining this land. Farmers use this land and on the slope of the levee for cultivation, so a potential conflict between DID and farmers might arise.

It was unclear whether DID cleared the maintenance system annually from interviews with farmers. Interview with DID and farmers show that all parts are aware of the agreement. The responses regarding how frequent the maintenance of the main drainage systems occurred varied. The DID officer told that the last time the department cleared the drainage was April 2016, and that the clearances normally takes place in April/May (Interview DID). A couple of farmers raised concerns that the clearances were done superficially because DID only cut the grasses without removing the sedimentation, which led to a faster regrowth of the drainage.

### 4.4 Impacts on livelihoods

Flooding is a major challenge in two areas of the village. In the PRA (Social mapping), the participants divided the village area into two sections: the flooded and non-flooded area (Figure 9). The left side of the main drain is regarded as non-flooded, and the right side is the flooded area. Participants explained that the levee combined with the lack of drainage maintenance were causing the flooding of the area. In the interviews conducted with heads of households with agriculture as their main source of income, it generally seemed that they were more concerned with flooding than people with additional income sources.

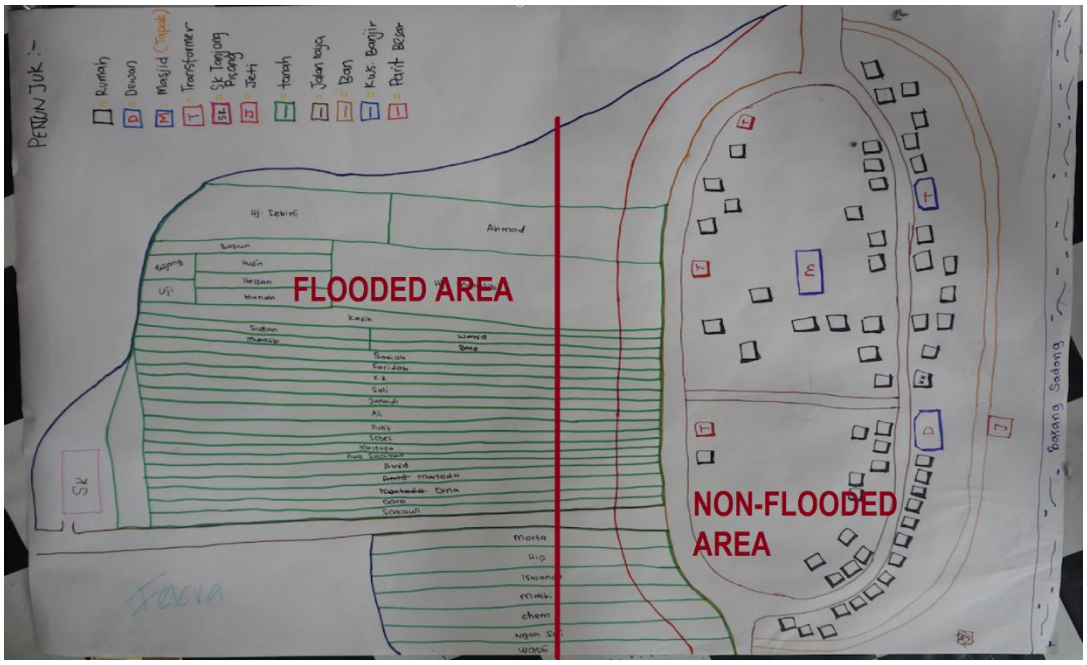


*Figure 10. Social map. Flooded and non-flooded area*

4.4.1 The efficiency of the main levee. Non- flooded area

From interviews with inhabitants, it was found that there is a shared perception that the main levee worked well to protect the community against tidal floods. A series of water samples (WSs) were conducted in order to verify the efficiency of the levee. The result shows (Appendix 8.2) that there was no impact of tidal flood in the crop area, because the values from water sample (WS) WS1,WS2 and WS3 taken inside the levee varied between 0-4 microS/cm, which indicates non saline conditions, whereas the last sample WS4 was 4,26 microS/cm, indicates slightly saline water (Slide 30, soil samples Myles Oelofse).

4.4.2 The big bund acts like a “pool”. The flooded area

As it can be seen on the map **(**Figure 9), the area flooded is where most the crops of the farmers are located and this is causing important impacts on their incomes.

- **Impacts on crops**

Farmers that owned land within the flooded area (Figure 9) were the ones most concerned with flooding. The further away, land was to the main levee, the more exposed the land will likely be. In order to examine

Flooding makes an impact on banana yields. When the flooding becomes severe, the soil becomes water locked, causing the plant roots to rot (Interview, F1). If the duration of flood is shorter, the flooding may decrease the productivity of the banana plant (Mung’ong’o & Yanda 2006). In the questionnaire survey, the results show that bananas were the most affected crop.

Coconut trees are very resistant to flooding, however the farmers perceive that the quality of the fruit is affected negatively. Another factor that can be influencing quality is the age of the coconuts trees, which is approximately 40 years old **(**Interview A3,A4, KK).

*Table 2. Percentage of households with the named crop in percentage, followed by the percentage of each of the crops cultivated that are affected by flood. 30 households were surveyed.*

| Crops | Households % (N=30) | Number of people affected by flooding cultivating the given crop % |
|---|---|---|
| Banana | 70 | 66 |
| Coconut | 50 | 50 |
| Paddy | 50 | 50 |
| Pepper | 40 | 25 |

Regarding the questionnaires results it is important to highlight that they do not take time into account, which may be misleading. Crops that have been cultivated for many years have been more exposed to flooding. In the interviews (A1, A2, A4) coconut for example, is regarded as a suitable crop for the area that is very resistant to flooding, whereas pepper is regarded as not suitable for the area and vulnerable to flooding, which is not what the results shown. However, according to the result, the percentage of coconut affected is twice as high. Therefore, the consequence is the difficulty to estimate crop vulnerability based on the survey. One factor that is influencing on the results is that, based on the timeline result and SSI's, it can be said that many of the farmers that have cultivated pepper, have done so rather recently (Timeline, SSI). Only a few had pepper have been cultivated before the flooding in 2011 so it is not possible yet to determine the effects of floods on pepper (Interview A5). Another determining factor can be the age of the coconuts trees which is currently reaching the 40 years old (Interview,A3). As the quality of the fruit is decreasing the farmers do no cultivate in the area that is deeper inside the field (timeline). This has turn into a wild forest being an attractive for monkeys and squirrels which have occupied the farmer coconuts plantations (KK, A4 interview). A lot of different inputs can affect this results.

- **Impacts on the soil**

To examine floods impact on the soil quality, we used soil conductivity, since salinity is known to influence both growth and yield of pepper (De Pascale et al. 2003), nitrogen levels and carbon levels as indicative parameters for soil quality. Soil conductivity was measured for each of the sites, P1, P2, P3 and P4 (Table 3, Figure 11) and compared to a reference table (Appendix 7.2). P1 and P3 showed conductivity of 0,92 dS/M and 0,93 dS/M whereas P2 and

P4 showed values of 0,98 dS/M and 1,02 dS/M. Values between 0-0,98 dS/M indicates that the soil are non saline and values between 0,98-1,71 indicates a slightly saline soil. Taken together these results indicates that the pepper fields are non affected by soil salinity and only crops very sensitive to salinity are unable to be cultivated on these sites (Appendix 8.3), and Smith and Doran (1996). Furthermore the results showed that there was a difference between the conductivity of the plots, P2 and P4 was in the slightly saline category compared to P1 and P3 that was non saline. This difference could not be explained by the locations, indicating that the location compared to the main levee did not affect the level of salinity in the soil. In addition it can be concluded that both the main and the mini bund protects against intrusion of brackish water to these sites.


*Figure 11. Map of the areas where soil was collected*

*Table 3. Mean values of triplicates from nitrogen and carbon taken from each of the sites. C/N ratio are calculated from the mean values of carbon and nitrogen. * indicates that P3 are significant different from P1 and P4 when compared by a T-test.*

| Parameters | P1 (0-10cm) | P2 (0-10cm) | P3 (0-10cm) | P4 (0-10cm) |
|---|---|---|---|---|
| Conductivity (ds/M) | 0,92 | 0,98 | 0,93 | 1,02 |
| Carbon % | 2,74 | 2,53 | 1,25* | 3,3 |
| Nitrogen % | 0,26 | 0,26 | 0,18* | 0,3 |

The total amount nitrogen and carbon were measured in the topsoil layer (0-10cm) (table 3). The level of nitrogen and carbon in P1, P2, P3 and P4 were 0, 26%, 0,26%, 0,18% and 0,30% and 2,74%, 2,53%, 1,25% and 3,3% respectively. Comparing each of the sites by a T-test a significant different between P1-P3 and P3-P4 was found for both nitrogen and carbon. Based on reference values from (FAO 1998) an average shallow peat swamp in Sarawak contains between 20-38% of carbon and between 0,5-2,05% of nitrogen illustrating that the examined soil have lower carbon and nitrogen values than average shallow peat soil. These results likely reflect the fact that the area was a mixture between alluvia and shallow peat soil and the top layer (0-10cm) mostly consisted of alluvial (clayish loamy) soil based on the texture analysis (figure 12, table 3). Taken together these results indicate a soil of low nutritional content compared to the reference soil (FAO 1998) and a soil whose level of carbon and nitrogen is unaffected by the location compared to the levee. It could be speculated that the reason P3 had lower values of both carbon and nitrogen was due to the sites elevation compared to the other, which is based on an apparent field observation.

*Figure 12. Horizon and profile of the soil sampled in P1.*

The lack of soil nitrogen affects plant physiology (Drew & Sisworo 1997). When there is nutrient deficiency the leaf turns yellow (Figure 13).

*Figure 13. Pepper leaf with lack of nitrogen*

4.4.3 Flood impacts on the school

Based on interviews (A3,F4, KK, PS, Focus, ) the mitigation infrastructure have a huge impact on the school (Figure 14). After a single night with heavy rain the school will be affected by flood and after a couple of days with continuing rain the water will reach the waist, making it impossible for the kids to go to the school by themselves. The problem has reached to a point where catfish can be caught on the playground (Interview PS). Another problem is that due to flooding, the snakes and bees will seek shelter at the school causing a possible dangerous situation for the children.

*Figure 14. Water sheet on the school and students*

4.5 Adaptation measures. Changing the crops through the seasons

| | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Activity | Fishing | Fishing | Fishing | Paddy/ Corn | Pepper | Lady finger/ Corn | Pepper | Banana | Corn | Banan | Lady finger | Banana |
| Earnings | | | | | | | | | | | | |
| Expenditure | | | | | | | | | | | | |


*Table 4. Livelihood matrix*

Farmers take into account that the risk of flooding varies between seasons. It is especially during rainy season that farmers choose crops that are more resistant to flooding (from October to February), especially paddy. In a PRA (Livelihoods), farmers showed seasonal harvesting of crops in a livelihood matrix (Table 4). The matrix shows that income from farming activities peak in May to June. During the dry season farming income that the incomes are highest. It is throughout the dry season that farmers prefer to cultivate as many crops as possible. Maize was regarded as a particular good cash crop to cultivate by the farmers, which they were planning to cultivate. In an interview, it was said that there were schemes for maize and watermelon, both valuable cash crops, which the farmers can apply for (A4). The maize plants are harvested within three to four months. A farmer told us that he will cultivate watermelons, maize and pepper in the dry season. The farmers that partook in the PRA session told that the dry season was when they harvested peppers. Because the crops that are more flood resistant tend to be less valuable on the market, it means that the income of the farmers are lower during the rainy season. Most of the crops are sold through middlemen, which brings the crops to the market.

*Table 5: Economic activities in households. Could be the possibility that one family could have responded more than once. Its activity they do not the main activity*

| Sector (N=30) | Income % |
|---|---|
| Agriculture | 83.3 |
| Fishing | 40 |
| Others | 76 |

4.6 Other incomes

In the questionnaire survey, it is found that the majority of households (83.3%) receive an income from agricultural activities. It is also noticeable that in many households people are working in other sectors. The most common sector apart from agriculture is fishery (40%). An advantage for the majority of the fishermen is that they are earning money from both agriculture and fishery. The income from fishery is peaking during rainy season contrary to farming activities. Fishing activities are less vulnerable to flooding, and therefore the opportunities for earning money from fishing are not affected. In interviews with fishermen, none of the interviewees have experienced, nor expressed, any concerns with overexploitation,

Among other incomes that have been common has been from the government sector, either through subsidies or government aid. We have encountered three men that have previously worked as soldiers for the national army which have returned after their service. The government is facilitating loans for women in order to support them in developing small business (PRA women). And in the household questionnaire, it has also been found that some people are working in plantations in other areas of Sarawak. Likewise, we have encountered teachers in the village.

In the majority of the households, there have been household members which have migrated. In the PRA (livelihoods), the older participants identified that young people migrating as an issue for the village. The reason for the young people were migrating was given two explanation. One explanation was that young people were not interested in working in agriculture, and therefore wanted to migrate in order to find jobs. The other is due to lack of land for the young people. The main benefit from migration is that some of the young people send money home to their families.

**5. Discussission**

5.1 Discussion of our results

In the research it was found that some of the main challenges from flooding in Tanjung Pisang are related to the lack of maintenance of the drainage system. The vulnerability to flooding is mainly caused by the inability of the village to either find the resources to clear the drainage system themselves or to reach an agreement with DID, which will guarantee that the main drainage system will be cleared with a frequency that corresponds to the growth rate of the vegetation and accumulation of sedimentation.

In the interview with DID, it seemed that the department is running on very limited resources which indicates that Tanjung Pisang will probably continue to lack maintenance of the drainage system for years to come. When visiting neighboring villages, similar problems with drainage have been observed which suggest the scale of the issue is larger than the context of Tanjung Pisang. The application for an additional watergate has not yet resulted in the implementation

of a new watergate and like the case about maintenance, it is difficult to predict if the circumstances will change in Tanjung Pisang. If the conditions for agriculture in the village will not change, it seems reasonable to think that people will gradually seek other income opportunities that are either more profitable or involve fewer risks. Part of this development is already happening now according to the discussion in the PRA (Livelihood) session. Young people are more likely to migrate to find work elsewhere, and whether it is due to aspiration for pursuing particular careers only available in the urban areas, or simply because of the scarcity of land, or a combination of the two explanations, is unclear. This trend cannot be attributed to the impacts of flooding, however if flooding continues to limit the opportunities in agriculture, it may cause more people to migrate.

The major impact of flooding on agriculture and the amount of people that have income from agriculture have meant that the emphasis has put on farming activities in the report. This has meant there is a wide range of professions which have not been examined as closely as desired. Interviews have primarily been conducted with heads of the households which generally tend to work in farming activities, fishery or the government sector. In the interviews, there has been more coverage of how people are affected and how they adapt to reduce their problems with flooding, rather than what kind of alternative activities may be favourable to pursue. This may be due to the focus on household levels, and in particular, the many interviews with heads of households. As the people likely to pursue alternative income sources are likely to be younger people, or household members with less responsibility in the household, conducting the majority of interviews with heads of household might not have been the best way to approach the issue of livelihood opportunities. This is a limitation of the study, and perhaps the focus of the study has been too concerned about the problems arising from the physical infrastructure, that it has not been able to capture the opportunities for the inhabitants.

Lastly, the farmers' strategy to increase income by cultivating pepper seems like they are making themselves more vulnerable to flooding. The high necessity for water drainage makes pepper an unsuitable plant in a flood prone area. Farmers have shared information about how frequent that they re-plant peppers, which easily get destroyed by flooding. It seems contradicting that so many farmers are planting pepper as a strategy to increase income when there is still so much uncertainties revolving around the crop. Especially because the cost of investing in pepper is very high in comparison to other crops.

## 5.2 Error analysis

This section discusses the errors that might have been including in the report before during and after our field trip mainly due to methodology used. The time to collect data and to write the report has been limited which may have influence on the quality of this document. We believed to have achieved our main objective of describing the impacts of the mitigation infrastructure of Tanjung Pisang inhabitants livelihood. We are aware of the amount of difference influences and the difficulty of having asses all of them.

### 5.2.1 Errors on our results

- During our synopsis

When preparing the synopsis and research questions, the emphasis was on describing the mitigation infrastructure, and to address more technical issues in the villages. However after arriving to the village, it became apparent that the infrastructure has much more simple mechanisms than expected.

- During the field

Questionnaires

We decided to incorporate the common questionnaire as part of our methodology. However, due to the lack of some information relevant to our study we agreed on continue asking questions in order to collect more information about the impacts of flood and their perception of the issue. We did not define the data we would like to collect with this questions and while we were analysing the data it was difficult to get any result.

Soil sampling

The examination of soil quality was complicated by the site decision, since the sites were treated with both chemical and organic fertilizers. Thus by choosing these site the analysis of the inherent soil quality was impossible. Hence the soil quality data can only be used for comparison between the examined sites under the assumption that the same amount of chemical and organic fertilizers in addition to time of application was the same.

### 5.2.2 The use of translators and guides

The impossibility to directly communicate with the villagers the use of translators and guides has been fundamental. Our translators helped us at every moment to gain an inside look on the community and to understand all the challenges and of the community. Most of the times our counterparts worked as translators facilitating us the culture integration. It seemed not to be a problem for the translators to understand the inhabitant's dialect. However, the English translation for us was weak leading into the lack of information that might be important for our understanding. Long answers by the respondent was sometime summarised in one sentence missing a lot of details which may have relevance.

The use of the guides was also indispensable to move around the village, the fields and the flood mitigation infrastructure. Also the conversations we had during the walks and trips enriched our

understanding of the village, the way of living and their culture. However, our guides were usually named by the headman, being him one of the people who has shown us most of the aspects of the village. This made us to empathise with him and his supporters and understand the village issues and the infrastructure impact with a strong influence of his point of view. The factor that we were living on the mosque and the headman's house was in front of it increased our exposition to their ideas.

### 5.2.3 Cultural differences between group members

The diversity of cultures, backgrounds, age, and gender of the team members have generated different points of views during the 12 days of field trip. This has been a positive influence for the final report. However, some difficulties have appeared in regards to working dynamics. Some lack of communication have caused occasional bad organization before exercises. However, during the fieldwork, communication led to the lack of organisation before some of the exercises prepare. E.g. when conducting the social mapping session. The problems were gradually solved during the fieldwork, but it is important to take into account the information that we missed due to this conflicts.

## 6. Conclusion

The flood mitigation infrastructure makes an impact on livelihoods in Tanjung Pisang. The farmers are normally adapting through crop rotation between wet and dry season to reduce the impact of flooding. As the main problems with flooding occurs during the rainy season, the farmers cultivate more flood resistant crops in that season. However, many farmers are cultivating pepper in order to increase income. This is in conflict with normal adaptative measures, and it shows that the farmers are willing to increase risk for the opportunity to increase future income.

At the same time, farmers consider flooding to be a key issue for them. Flooding reduces yield and in worst case, it can destroy entire crops. Coconuts and bananas that have been cultivated since the village was founded, are found to be affected by flooding. The current problems with flooding stems from construction of the main levee in 1996. The main levee in combination with improper maintenance are causing a pooling effect that prevents excess water to run through the main drainage system. This has the consequence that catchments of water are recurring problems in the crop field inside the land, while the village area located next to the river are not affected by flooding.

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**8. Appendix**

Overview table with methods

| Natural science methods | |
|---|---|
| GPS | Develop of 4 maps with the coordinates taken on the field |
| Soil sampling | 4 points sampled |
| Water sampling | 4 points sampled |
| Social science methods | |
| Common questionnaire | 30 households |
| SSI | 13 households<br><br>( 6 farmers+ 4 fisherman+ 3 other) |
| KKI | 3 people<br><br>Headman, DID representative, school principal |
| Focus group | 2 groups<br><br>Men and women |
| PRA exercises:<br><br>• Transect walk (2)<br>• Timeline<br>• Social mapping<br>• Livelihood matrix<br>• School activity | 5 |

8.1 Soil sample results

| | | | N% | C% |
|---|---|---|---|---|
| A | Flooded | Gr4 P1B1 | 0,24 | 2,27 |
| A | | Gr4 P1B2 | 0,25 | 3,07 |
| A | | Gr4 P1B3 | 0,29 | 2,88 |
| | | | | |
| A | Flooded | Gr4 P2B1 | 0,34 | 3,88 |
| A | | Gr4 P2B2 | 0,24 | 2,1 |
| A | | Gr4 P2B3 | 0,2 | 1,63 |
| | | | | |
| B | Non-Flooded | Gr4 P3B1 | 0,19 | 1,38 |
| B | | Gr4 P3B2 | 0,17 | 1,19 |
| B | | Gr4 P3B3 | 0,18 | 1,18 |
| | | | | |
| B | Non-flooded | Gr4 P4B1 | 0,32 | 3,07 |
| B | | Gr4 P4B2 | 0,3 | 3,8 |

| | | | N% | C% |
|---|---|---|---|---|
| P1 | Flooded | Gr4 P1B1 | 0,24 | 2,27 |
| | | Gr4 P1B2 | 0,25 | 3,07 |
| | | Gr4 P1B3 | 0,29 | 2,88 |
| P3 | Non-Flooded | Gr4 P3B1 | 0,19 | 1,38 |
| | | Gr4 P3B2 | 0,17 | 1,19 |
| | | Gr4 P3B3 | 0,18 | 1,18 |
| P4 | Non-flooded | Gr4 P4B1 | 0,32 | 3,07 |
| | | Gr4 P4B2 | 0,3 | 3,8 |
| | | Gr4 P4B3 | 0,29 | 3,03 |

| | | | N% | C% |
|---|---|---|---|---|
| P2 | Flooded | Gr4 P2B1 | 0,34 | 3,88 |
| | | Gr4 P2B2 | 0,24 | 2,1 |
| | | Gr4 P2B3 | 0,2 | 1,63 |
| P3 | Non-Flooded | Gr4 P3B1 | 0,19 | 1,38 |
| | | Gr4 P3B2 | 0,17 | 1,19 |
| | | Gr4 P3B3 | 0,18 | 1,18 |
| P4 | Non-flooded | Gr4 P4B1 | 0,32 | 3,07 |
| | | Gr4 P4B2 | 0,3 | 3,8 |
| | | Gr4 P4B3 | 0,29 | 3,03 |

| | weight (g) | bulk density |
|---|---|---|
| P1 | 90,54667 | 0,922768578 |
| P2 | 105,8433 | 1,078658174 |
| P3 | 136,61 | 1,392203822 |
| P4 | 87,39 | 0,890598726 |

8.2. Water sample results

| Parameter | Sampling Points | | | |
|---|---|---|---|---|
| | Tp1 | Tp2 | Tp3 | Tp4 |
| In situ | | | | |
| Temperature | 26,85 | 26,80 | 27,50 | 28,55 |
| pH | 6,73 | 6,54 | 6,48 | 6,63 |
| DO% | 2,25 | 2,40 | 21,45 | 17,75 |
| Do (mg/l) | 0,17 | 0,19 | 1,69 | 1,36 |
| conductivity ( | 0,38 | 0,17 | 0,14 | 4,29 |
| TDS | 242,45 | 108,88 | 88,05 | 2609,75 |
| Salinity | 0,18 | 0,08 | 0,06 | 2,11 |
| BOD | 3585,00 | | 3,88 | |
| Laboratory | | | | |
| BOD5 | 0,00 | 0,00 | 0,02; 0,01 | 1,97; 1,79 |
| CoD( mg/l) | 84,50 | | 42,50 | |
| TSS( mg/l) | 5298-; 4798 | | 2878; 2344 | 2875; 2980 |
| PO43- | 1665,00 | | 3,88 | 1,75 |
| NO22- | 0,11 | | 0,00 | 0,10 |
| NH3-N | 0,24 | | 0,05 | 0,27 |
| TCC ( count/ 100ml) | 2361,00 | | 2,44 | |
| FCC (count7 100ml) | 1889,00 | | 4,19 | |


*Figure Appendix 7.2. Map with the location of the water point sampl*

8.3 Common questionnaire template

Village: _____ Respondent code: _____

**Section A: Demography Background - Head of Household**

1. Gender: ☐ Male ☐ Female
2. Age: _____ years old
3. Marital status : ☐ Single ☐ Married ☐ Divorced/Widow/Widower
4. Race : ☐ Malay ☐ Iban
   ☐ Others (please state: _____)
5. Education level : ☐ No Schooling ☐ Upper Secondary School
   ☐ Primary School ☐ College/Institute
   ☐ Lower Secondary School ☐ University

**Section B: Household Information**

6. How many members are there in the household: _____
7. Number of dependents: _____
8. Any family member/s left the village/migrated? ☐ Yes ☐ No

**Section C: Job and Income**

Agricultural Sector

9. Do you do any agricultural activities?
   ☐ Yes ☐ No (proceed to Question 13)
10. Is the agricultural sector your main source of income?
    ☐ Yes ☐ No
11. Please list the yields of your plants, their uses and revenues.

| No | Type of crops | Own use (√/X) | To sell (√/ X) | Revenue (RM/kg/tonnes) | Affected by flood (√/ X) |
|---|---|---|---|---|---|
| 1 | Banana | | | | |
| 2 | Pepper | | | | |
| 3 | Paddy | | | | |
| 4 | Oil palm | | | | |
| 5 | Rubber | | | | |
| 6 | Coconut | | | | |
| 7 | Pineapple | | | | |
| 8 | Home garden | | | | |
| 9 | | | | | |
| 10 | | | | | |

12. What is your income from agricultural products (approximately)?
RM/Month_____

Forest Product Sector (Non Timber Forest Product)
(only for respondents who collect forest products and hunting)

13. Do you use/sell non timber forest products or/and hunt?
☐ Yes ☐ No (proceed to Question 16)

14. Type of forest products:

| Type of forest products | Own use (√/X) | To sell (√/ X) |
|---|---|---|
| Wild Vegetables | | |
| Medicinal plant | | |
| Wild Fruits | | |
| Wild Animals | | |
| | | |
| | | |

15. What is your income from forest products (approximately)?
RM/Month_____

Fishing Sector
(only for respondents involved in fishing)

16. Are you involved in fishing activity?
☐ Yes ☐ No (proceed to question 19)

17. List all of your fishing product and yields.

| Type of fish | Own use (√/X) | To sell (√/ X) | Revenue (RM/kg) |
|---|---|---|---|
| Fresh Water Fish | | | |
| Sea Water Fish | | | |
| Prawn | | | |
| Crab | | | |
| | | | |

18. What is your income from fishing activity (approximately)?
RM/Month_____

Non Agriculture / Fishing / Forest Product Sector
(only for respondents working in other fields)

19. How many household members are working (regular salaried job)?_____

20. Source of off farm income:

| Source of income | Tick (√/X) |
|---|---|
| Government sector | |
| Private sector | |
| Own business | |
| Pensioner | |
| Government aid | |
| Others (please state) | |

21. What is your income from this occupation (approximately)?
RM/Month_____

**Section D: Land Ownership and Uses**

22. How much land area do you have:

| Uses | Land area (acre) |
|---|---|
| Agriculture activity | |
| Fallow land | |

23. How large is the area of titled lands (grants) and do not have a title?

| Land status | Land area (acre) |
|---|---|
| With land title | |
| Without land title | |

24. The origin of the land ownership status:
☐ Inherited ☐ Bought ☐ Borrowed

**Section E: Residential Information**

25. House ownership : ☐ Own house ☐ Rental
☐ Lodging with relative or other family

26. Water supply : ☐ Treated water ☐ Well
☐ River ☐ Rain

27. Power supply: ☐ Electric ☐ Oil lamp
☐ Generator ☐ Others (please state) _____

**Section F: Ownership of Vehicles and Equipment**

28. Do you own vehicles and equipment as such:

| Vehicle/ equipment | Yes (√) / No (-) | Total (unit) |
|---|---|---|
| Car | | |
| Van | | |
| Lorry | | |
| Motorcycle | | |
| Bicycle | | |

| | | |
|---|---|---|
| Boat (with engine) | | |
| Boat (with no engine) | | |
| T.V | | |
| Radio/Video player | | |
| Refrigerator | | |
| Fan | | |
| Gas stove | | |
| Computer/Laptop | | |
| Mobile phone | | |
| House phone | | |

8.4. SSI template of questions

**Within the household**

- How does the head of the house manage the household?
- For the working parents, how do they divide the task within the household?
- What do they think the effect of the flood towards the agriculture?
- What is the livelihood strategies if their current main income is affected?

  Backup plan?
- How does their household member cooperate in managing the household?

  (e.g: working family member give monthly allowance)
- How does the problem affect you and your family?
- Is there any family member who migrate outside the village?
- Reason and background of moving?
- How do you add your side income?

**Agriculture**

- What time will you go out farming? How long it will take?

- From my observation, the villagers only sell things when it is on demand? Why is it so?
- Will you consider added value? (turning banana into chips or yam to chips, salted fish?)
- Will you consider involve in small or medium industry? (E.g: banana chip, yam chip)
- Will you gather your harvest as a group and sell it in bulk as a group? Why?
- What is the factor of choosing a crop? (e.g: pepper is high in market value, or the matured period is fast, following the trend?)
- Each crop has different fertilizer requirement. How do you gain the knowledge or information about the frequency of fertilizer application, fertile period of a crop?
- Is there any limitation and obstacle in planting these crops?
- How do you maintain your drainage? How is the cooperation with other farmers?

**Fisheries**

- For fisheries, how can you manage to maintain the boat? The expenditure? How frequent do you maintain?
- How long could a boat last
- What time will you go out fishing? How long it will take? What is the risk?
- When did you start fishing? What are some of the species you get? How much can a fish reach?
- How did you get the boat (inherit or bought or rent)?

- What is the fishering gears? (pukat hanyut, pukat tunda, fishing net, fishing road)
- What are you doing to sustain the livelihood during rainy season?
- Do you have any insurance for the boat?
- Have you had any accident before?
- What is your suggestion to improve the fisheries sector?
- Do you have subsidy for the fuel? The incentive for the catch?
- What is the bait? Where did you get it?
- Are you a license fisherman?

**Flood**

- Did the farmland have an insurance to compensate them for a flood?
- What do they think the effect of flood towards their income?
- During flood, what do you do with the crop? Leave it, or save it?
- What do they think the effect of the flood towards their family and safety?
- What is the perception of the parents of the flood, the safety and the educations of the kid?
- What do you think is the solution to the flood? Is it enough? What should be considered?

**Maintenance of the infrastructure**

- How is the drainage system managed?
- Who is responsible for the maintenance?
- How frequent is the maintenance?
- When is the last maintenance?
- Is there any maintenance by the villagers?

- Who is in charge to talk with the DID?
- Do you participate in the meeting regarding the project or maintenance?
- Any discussion of the committee or focus group for decision making regarding things within the village?
- Who propose the bund project? Why do you think that person did so?

**Community and Society**

- What do you think the main problem in the village?
- How do you communicate if there's a disaster or little problem in the village? (Flood, fire, sick people, snake, murder). How is the flow? (e.g: problem>headman>villagers>person in charge like fire brigade, police, etc)
- If something came up, does the villagers usually come up together?
- How is the cooperation among the villagers?
- How is the cooperation between the villages? (in case of flood or other disaster)
- How is the cooperation between the villagers and authorized section (e.g: DID)

- **Focus group**

- Farming system
- Time spent in the farm (Beginning-End)
- Challenges in the village?
- Flood (Time? 2011? 2004? Other than that?)
- Why? Which crops is affected? School? Others?
- Livelihood strategies?
- Agriculture?
- Which crops? Why?
- Do you change the crops? How often?
- How do you see pepper as a new strategy?

- Other source of income?
- Government aids? Loans?
- What will they use it for?

- Interest? How much?
- Is the amount the money are all the same?
- Who can get the benefit? (Single? Widow? Everyone?)
- Why women? Husbands?
- Who? Government or private?

- Industry (Small-medium)
- Did you try? Why not?

- Opinion at the future of the village?
- Is agriculture continue to be affected by flood?
- Other strategies?
- Young people leaving?
- Is it already happening?
- Any possibility for those who migrate to come back and settle down in Tanjung Pisang?
- Any possibility coming back to Ensenggei?

8.5 Semi structured interviews

**A1. Farmer (Born in 1983).**

He worked on the army from 2002-2014. He got a compensation when he retired but not a monthly aid.

The land he works on belong to his father and it's around 3 acres. The last flood occurred this February and it last up to 1 week. He thinks that the main problems for the floods is the non-maintenance of the drainage, last time that the DID came to clean it was in May. He knows that it is responsibility of the DID to clean the drainage and he believes that the flood will remain less time under a good management of the drainage. He has been informed about the benefits of the implementation of another Watergate and he agrees that this will flush out the water. This problem is affecting all the villages all the maintenance of the drainage is under DID responsibility. They have bought the land of the bund and around 50 meters more each side, they can plant there but the land belongs to the government.

He has planted mainly coconuts and bananas. He used to have paddy but due to the floods he stopped, also he has no space everything is planted with coco and banana.

He sells all his crops to a middle man. He gets around 500 kg of banana and 1000 of coconuts per month. He also sells the coconut shot to the villagers' mainly in special occasions and festivities and he receive around 15RM per piece and occasionally he sells the leaf to make brooms too.

He doesn't use many fertilizers coconuts and bananas are easy to hand. He just cut down the grass to reduce the competition. He got once and aid for fertilizers and pesticides. As his land belong to his father they share benefits 50/ 50. His father works in Kutching the same as the rest of his family.

He has decided not to move because the daily live in the village is much cheaper that in Kutching.

Sometimes he goes fishing (mainly prawns) for self- consumption. Some fishers through poison to make the prawns get blind and capture and capture them. He has not developed any small/

medium industry (Frying bananas) because he does not have time or skills.

### A2. Farmer

Originally worked in logging but stopped in 1997. Previously had fishery as source of income but went back to agriculture.

Fishery: Side income. He will both sell in the community and to a middleman, but it depends on who big the catch is.

**Flood on livelihood.**

Flood has been a problem since the DID constructed the levees in 1980th. Confirms that the mini band was build 1970th

The consequence of flooding on agriculture is that it reduces yield and kill all the crops. The coconut trees will not bear coconuts.

Drainage is a problem, but the levee is the main problem because since its construction there has been problems with flooding.

-Therefor he decided to change he cultivating to pepper, because pepper is on high demand.

**Pepper cultivation**

He learned cultivating pepper by studying the Ibanse, that cultivate pepper in the highland and he has taken some. Started cultivating pepper in 2011

He started selling pepper in 2014 already sold pepper through a middleman. Approximate 45kg/year selling to the middleman.

In 2016 the marked price on pepper was 33Rm/kg, but in 2017 it has decreased to 23RM/kg. So, he is just waiting for the prize on pepper to increase again before selling.

The can sell the pepper to an official center where the prize will be higher.

**Organisation:**

He sells individually, because the individual farmer has his own independent schedule that means they will not wait for one another. But there is a future plan to sell together if the prize on pepper is high. He thinks the price end the end of the year (2017) will be a good time to sell because the pepper prices have increased. So they will go to the official pepper center and sell. They don't have an official pepper group/ committee, they will just discus after prayer where everybody independent of cultivating pepper can contribute with their opinion.

If there is a problem and they have to do something the headman schedules a meeting in the community hall. People from the community will meet and give their opinion. The secretary will make a final report.

**Coconut.** The coconut trees are 40 years old, which decreases the yield because they bear less fruit, the roots are old so the trees fall. But there is no plans for replanting coconut because if they replant the monkeys will come back.

**Pest:** There is a lot obstacle for the coconuts, such as diseases, squirrels and monkeys. They have tried to stop the attacks from the squirrels and monkeys, but it does work. They tried to protect the banana and coconut be wrapping plastic around the stem of the trees so they cant clime the tress, but the problem is that the canopies are connected, so the cant ease jump

from tree to tree. For example if they plant corn and the monkeys attack the will eat almost all of the corn. They feel helpless because there is nothing they can do.

**Income:**

For 100kg of coconut he can get 80RM. 80RM/100kg = 0,80 cent.He can sell one coconut for 50cent.

**Pest vs. flood**

Flood is only a problem in the rainy season where squirrels and monkeys is problem they haft to consider year around.

If the monkeys eat the heart of the banana they destroy the total yield. Flood will destroy all the crops. And if both flood and monkey attack happens simultaneous there is nothing they can do. Another problem with the monkeys and squirrels is that they eat the fruit before it is ripe.

**Banana:**

When there is a flood all the banana trees dies. There is a competition within the community.

### A.3 Farmer

Agriculture. Fish for self-subsistence.

Her wife sell cakes, she makes them 3 times a week and sell them around the village. She sells them for RM 1 each package (for the dry cake). She bakes traditional cakes, mainly with rice flour. The rice flour varies its price depending on the fuel price (increase of fuel price, increase of flour price). She sometimes sells the cakes on demand to Kuching.

They used to have paddy and sell it to a middleman. He stopped this year but he planned to continue it again next year depends on the weather and condition.

There are government subsidies for the paddy, when you sell 100 kg you receive RM 24 from the government. And the kg of paddy is around RM 60.

Paddy is not that good anymore due to the rats its one of the main causes for a lot of farmers to stop producing this crop. Also when the flowers bloom, the birds cause also troubles. They might try to plant them again next year but they are not sure.

The aid for paddy fertilizers is easy to get but for other crops you have to ask for it. They do not apply for those because the paperwork is long and the aids take long to get, all the process is so slow and they don't want to lose their time.

Black paddy has a lot of value, 12 RM/ kg???. They can't afford its maintenance, worms and flood destroy it and due to its size (so tall) the wind breaks it so easily. There is another kind of paddy (Badol) that it also has a high value on the market and its shorter so easier to cultivate.

When he had paddy he usually sold it to the same shop where he got the seeds because the man in charge of the shop will buy it easily cause its rice from his seeds. He inherits the knowledge about the paddy from his father and start working on agriculture when he finish high school. He used to have paddy watermelon pumpkin, all seasonal crops.

Right now he is renting a land behind the high school, this area doesn't get flooded so he is planting now watermelons and long beans there. He pays 50 RM a year for the land rented ( ½ acre). He rent this to a friend of him, his brother do the same. The three of them has planted watermelons now and planted them at the same time on order to harvest them at the same time. They want to sell them together and share the money. Watermelon can only grow on the

warm season and it sell for 1,5-1,20 RM/ Kg. There are a lot of types of watermelon, they try to plant the biggest types to get more money out of 1. The watermelon can be harvested after 54 days after planted.

He inherited the land that is on the other side of the bund he wants to continue working on it doesn't want to rent it. He has lady finger there now  he sells the lady finger to a woman on the village that sell it on the market.  He also has Yam because is the only crop not affected by flood. After the lady finger he would like to plant maize because is fast to harvest 45 days after the plantation and it is possible to get a lot of benefits out of it (50 cent RM / piece), he plant the maize in non-rainy season cause it will surely be flood. He also has pepper it takes 2 years to have fruits. His brother went to a seminar about pepper plantation and cultivation, they are suppose to get grant in April, they are not sure about what are they going to receive.

They mainly choose what to plant depending on the weather and the season. He knows that at least 1 times a year his crops will get flood so they plant less things on this month.

( He usually works from 7.30 to 11 and for 2.00 to 4.30 ) ( Plant and harvest in different times, otherwise impossible to be able to harvest anything).

They do not process the crops because the things they have are mainly products that the people eat raw.

He clean his drainage and that helps to reduce the water level .

**They DID is responsible for the main drainage**. They usually come one time each three years. The last time they came was two years ago. They just come of they make and write down a complain. The headman writes this complains and sometimes he gather 4/5) headman's from other villages ( Salanking, T.Jarapan, Panton Malayu and Iban and Sungain Pin).  Sungain Pin and Panton got their part of the drainage clean at the end of last year beginning of this year. ( the watergate is already approved but they are still deciding on the location??). when the other villages have their own water gate, it will be hard to apply the maintenance because the participant is less.

This village is located below the mouth of the river and floods are a natural variable that the villagers are used to. It is the difficulty of the water to flow what causing a problem. They are suppose to receive a compensation when their crops get flood, however the last 3 years they just have get it once. Rain 4 hours, one week of flood.

**Regarding to school** parents are afraid to send their kids to school, they think that the watergates and the drainage will solve the flood on the school too. They have not think about changing the location of the school, the government doesn't own land where they can place it. Another solution they have thought about is add soil to the school to increase the ground level.

The initial plan for the bund was its construction in the middle of the village, however they change it ( The government) because there was houses already built.

### A4. Farmer/ Secretary

He has coconuts, paddy, bananas, pepper. And will begin to cultivate maize in May, and watermelon in April. He began cultivate pepper in 2016. The income is good for pepper. He has not sold any pepper. He expects to be able to harvest pepper for the first time in a year’s time. He expects to sell pepper to a shopkeeper in Simunjan, who will sell it to the pepper associations.
The monkeys disturb the maize and bananas, but do not eat the pepper. Monkeys are a

problem inside the flooded area. He will replace his paddy with maize. He has had land that he has not used which he will use for cultivating pepper. He has 2 acres of unused land, which he will have to clear, and afterwards use for cultivating pepper. He was asked if he had any concerns cultivating pepper in the flooded area, in which he answer that he cannot do much other than replanting. The problem with flooding depends on the weather and if they have cleared the drainage system. He thinks that it is difficult to say if more people cultivating pepper in the flooded area will mean that they will clear the drainage more often.

He thinks that squirrels and monkeys are what affects the yield, but they are not a problem.

Drainage: There are two drainage systems inside. The one further inside is the one that is now solving some of their issues with flooding (from 2016). They paid a person (or private company) to make the drainage system for them with money from the village. The plan for it was made the year before.

The responsible for the main drainage is the DID. DID cleared the (big) drainage system once last year (everything in the Simunjan). He shows the drainage systems according to a hand-written made.

He talks about the meetings in the village. They discuss the drainage systems, and many other topics during the meetings. An association of people with mixed backgrounds are present at the meetings. It is selected by the district office. They elect candidate in the community, and send a list to the district office, who chooses people that will be part of the association. The association is part of making small projects in the village, e.g. providing electricity. They write to the district office for funds. He has not been in direct contact with the office. He is the secretary of the association. The amount of meeting depends on necessity, but they tend to meet twice a year. The most common thing that they address are cleaning the village and the drainage system. And perhaps if some programs are coming into the village.

They have applied for a scheme so they can get free seeds and fertilizers; watermelon and maize. He does not know if they will get it. They have not received a pepper scheme, and it is difficult to get. The pepper association is unfriendly. They have get the seeds themselves.

The band is the first problem because it affects how the water flows, and the Watergate is too far away. Now, it is getting worse when the drainage is not maintained (37.30).

### A5. Farmer

He began planting pepper in 2007. He lost his pepper in 2011 due to the flooding. The Watergate broke. There was water a half meter high. He bought some of the seeds to the pepper, and he had received some from another person. He used to sell his pepper to a middle man in the Simunjan area. Before 2007, he was planting chilies, yam, watermelon and vegetables. In 2015, he began replanting pepper because of the price. It was rising. All of his friends also began planting peppers. Individually. He still has not sold his pepper. It just started to bear fruit. It takes around two years or three years. From 2007-2011, he would have five kilos each year (?). Previously, the price was 15-16RM/kg, now it is up to 25RM/kg. The price fluctuates a lot, but the price is good. The demand for pepper is increasing.

He says that if his pepper is lost, he will replant pepper. He thinks that the land is fertile for cultivating pepper. He has got his information from his father-in-law, an Iban, who taught him how to cultivate pepper. But he has not received any formal courses. After the flood in 2011, he had no seedlings to plant pepper so he decided to plant vegetables. The cost for one seedling 2RM, later stage 5RM. He applies organic fertilizers on his crops, excerpt for peppers.

He owns a plot inside the band. There, he cultivates bananas, and just started to replant coconuts. He cut down the coconut trees due the flooding. He does not cultivate any pepper in that area. The price for coconut and bananas are good. For him flooding is not a big deal because the drain will not be? (23.30). It is warm season, so he is not affected currently by flood. So he can cultivate all the crops. It is the same for the rainy season, but the yield is not so good. But sometimes, the cannot sell their vegetable during the rainy season, so they use them for self-subsistence during that season.

Squirrels eat the hearts of bananas. He has only bananas, coconut and a few vegetables (just) inside the band. Flooding is a bigger problem than squirrels and monkeys. However, he says that flooding does not affect him right now. Not since 2011. Before 2011, flooding was not his main problem. The problem of flooding is only within the bund area. When the flooding happened it affected the yield of bananas a lot. As long as the flood does not break the bund.

Drainage. He clears the drainage on his land by himself (inside the bund) in order to make the water flows. The villagers that own the land, they will clear the drainage. Approximately, once per year. They will clear the drainage system themselves around the minibund once per year. The village will go to a meeting to talk about when to clear the drainage systems. DID has the responsibility for the big bund. The drainage system was cleared by DID the last time in 2015. They clear the drainage with a machine.

### A6. Farmer retired

She experience huge tidal floods, water reached her waist. At that time she had crops as bananas and peppers. She is old now so she is not doing farming anymore. Her income is currently based on chickens and ducks. The chicken has seasons, one day all the chickens die, it is known as “Sampa Aya” and happens seasonally. She sell the chickens and the ducks for 14 RM/ kg. She also receive money from her daughter and sons.

## Fishing

### F1. Fisherman

He receive a subsidy for the Lkm for the Malaysian government.

Now he has a new boat (3 months), he doesn’t receive any subsidy for fuel. He leaves at 22:00 and come back at 8.00. He goes fishing almost every day (he might stay if there is a big storm of strong winds) If he can’t go fishing he works on other people’s farms . He has been a fisherman from 10 years now. He used to be a palm oil supervisor. He changed his job because he doesn’t live having a fixed timetable and also because as a fisherman he earns money depending on how much he works, he does not have a fix salary. He earns around 100 and 400 RM per night depending on what he captures. He goes fishing to the mouth of the river, where the sea and the rivers convey, he set his net and wait for the fishes to get there. He goes alone, he doesn’t like taking the risk that something can happen to his partner. He mention that all the boats are distributed on the same line so if something happens to him his ‘neighbour’ will go and help him.

He sells the fish and the prawns to a middle man. He sells the Great A prawns for 15 RM/kg and Great B for 25 RM/kg. He knows that people prefer prawns and they will always be sell. When there is high tide, there are more prawns the income increase.

He has always live on the village. He has experienced three big floods inside the village, all of them before the mini bund was built. He could even use his boat inside the village.

He sells birds, mainly to his friends for 40 RM.

His income is around 500 RM/month for fishing, around 800 RM/ month for everything that he does.

**F2. Fisherman**

He has lived in Tanjung Pisang since 1974 and has always been a fisherman. He has fisher license, which allow him to catch fish in the Malaysian area of the Chinease sea. He has to bring the license with him when he goes fishing because the navy patrols the boarders.

Fishery/livelihood.

He owns two boats with engines. One is only used for fishery in the river the other is used for fishery in the sea. There is not a consistence schedule for fishery during the day but it depends on the water condition. If the conditions are good during the day he will go fishing if good during night he will go fishing. But it is a daily job.

Water condition was explanation by a drawing. During low tide he set the nets go home and wait for the high tide to come. It is during the high tide he catches prawns and fish. During the next low tide he will collect the catch, but he haft to hurry so the crocodiles don't eat the catch. After collecting the catch he will set nets at a new location. The low tide is around 6.00 AM (set net) and the high tide is around 13.00 PM (catch) and low tide around 18.00 PM (collect).

There are no limitations on the amount of fish they can catch. No quota.

Income.

The daily catch will be sold to a middleman who sells it on the market in Simunjan. The monthly income depends on the season. During prawn season, where he only will focus on catching prawns, the average monthly income is approximately 1000RM and during fishing season it is around 800RM based on both forms of fishery 300RM plus 500RM from prawns.

There are two types of prawns

Great A: 45 RM/kg

Great B: 30 RM/kg

He catches less great A than great B. The Ratio is approximately 1:10. The average catch of prawns, both A and B, during a season is approximate 10kg, but during high season catchment of 20kg is possible. And during high season of fishery the average catch is between 30-40kg

He also sells to the community for friendly prizes.

Season:

The prawn season is from January to February and the fishing season is from July to December. During the rainy season he will only fish in the river because the waves on the sea are high. But he waits for the rainy season because it means prawn season. There is less fish and prawns during the warm season. (Even during hard condition they will go catch the prawns.

Land:

He used to own land near the school but the government reclaimed it and build the road to the school. He was compensated with money. So now he only owns land around his house. He cultivates banana and coconut, which he uses subsidence.

Expenditures:

Petroleum is the biggest expenditure, but he receives governmental subsidies for buying petroleum. Petroleum without the subsidies cost 2,20RM/L and when it is subsidized the prize will be lower by 1RM to 1,20RM/L of petroleum. He buys the petroleum from an official center (PKNS)

Organization:

They don't organize, he only fish alone. "He has a lot of experience and laughs"

Flood:

He does not have problems with flood but participate in the maintenance if there is a problem. He states that community work is part of the responsibility living in the village.

Mini band under the DID responsibility

### F.3. Fisherman

He owns land. His main income is from fishery. But he also cultivates peppers (50 trees), yam, coconut and banana for additional income. He sells. But so far, he has not sold pepper due to the pepper have not borne enough fruit to be sold. He began fishing as a teenager. When he came back (to Tanjung Pisang), it became his side-income (fewer hours spent). Fishing has always been his main income. The wife plants paddy for self-subsistence. The family sells to the market in Simunjan because they also sell in too small amounts, so the middle man want buy them. However, they explain that the middle man is not interested in paying the same amount of money as the market, therefore, they sell to get a better price for it than from the middle man.

He cuts his banana and sell them in smaller pieces. He can get approximately 2RM/kg. Coconut is solely for self-consuming (in the opposite bund). They were inherited. And old. They do not bear a lot of fruit. He has no plan to replant in the near futures because they still bear fruit, however, he plans to plant new coconut trees (around 50) in a different area (we can see on our way to Simunjan, close to the paddy rice field owned by the local headsman). He has another land in the neighboring village, inherited by his father, which is very old. There, he planted bananas, peppers and coconuts. The land they have in Tanjung Pisang, they use for cultivating paddy rice and coconuts. He has one acre in Tanjung Pisang, and one acre of land outside. And he tries to make full use of land in both lands. The most productive land that he owns, is located outside, as it is not affected by high tides like his land in Tanjung Pisang**.** The only plants that can withstand the saline water are paddy rice and coconuts. Sometimes, the paddy can withstand, and in some cases it cannot, e.g. if the tide is too high. The yield is also affected by mice attacks and paddy has a lot of diseases.

Yields. 200 kg of bananas per year. Squirrel impacts sometimes the yield.

Last year, in January/February, the mini bund broke because of high tide (24.28). But his land in the neighboring village is not affected. He says that there have always been problems with flooding in the rainy season, but the water will normally discharge very fast.

He spends most days working as a fisherman. Whereas he sometimes cultivates crops during the afternoon or evening. The wife sells their goods on the market in Simunjan.

Fishing. 3 types of net: flood nets, low-tide net, low-tide net for small prawns (33.38). He fishes in the river and in the open sea. Flood nets are used for open sea fishing. Small-scale fishery. Prawns. Many types of fish. Prawns for 50RM/kg. He can get from100-200RM/kg for 12 kg fish. There are grade A and grade B prawns. We are shown a receipt from a middle man. The middle

man will come and collect the fish. Weight them, and pay them for the purchase. He is applying for subsidies, but has not yet received any. He only pays for half of his gasoline. He collects it at LKIM (Malaysian Fisherman Association) once per month.

1970-85, rowing boats were more common. He got an engine in 2002?

Tool/ equipment is the main expenditure, because they break. He saws them himself. HE use about 2 liters normally (5.50RM in total).

480RM/Monthly. The water condition is the main factor, e.g. if low tide is too low, he cannot use his net (52.22). In the rainy season, it is easier to catch prawns. Hot season is not ideal to catch prawns. There are more fish during rainy season, but it is difficult to catch fish when there is high tide.

For him, it is easier to live of fishing. He says that fishing is less vulnerable than agriculture. They can always get some fish. When asked if it is a more secure income, he replies 'yes'. They also have to wait for a long time after planting before they can get yield. With fishing, it is different.

They are used to live of fishing. The others that do not know how to fish, so they might work with agriculture, or with palm oil.

There are 12 boats in Tanjung Pisang. The fishermen do not hire other people.

Flooding occurs during rainy seasons. The current is stronger, and when that is the case, he decides to do agricultural activities.

During the rainy season the water will get no low tide, which means he will catch very few fish. Warm season means less fish.

There are not regulations for him in the river. Only in the open sea. He has document, license, and a boat number.

He has not experienced overexploutation. However, when there is few fish in the river, they work more with agriculture.

Other remarks. During the interview, the family was present.

### F.4 Fisherman wife

Introduction: The fisherman wife was part of the common questionnaire so we already had some background knowledge of her role in the household. She is a full time housewife that take care of the kids, she has three kids, one is in boarding school the two others are 6 and 2 years old respectively. They did not own land and there was no agricultural activity related to the household. The household income was completely depended on her husband fishery and it is the husband that has the responsibility of all economical issues.

Interview:

Her role related to her husband fishery was to salt some of the fish, which they would sell. So, her husband would sell most of his catch to a middleman, a Chinese man from the same district, but she did not now where he would bring the fish. The rest he would bring back home salt it and sell it in the community for only small amount of money. They only gained few RM. Her husband only worked by him sell and not together with other people, he was not part of a cooperation.

Her husband only fish in the river because his boat is small so it is not possible for him to go fish in the sea. His boat is located down on the riverbank. He does not go every day, but it depends on the water conditions. If the water is to high he will not go fishing. In a normal day he would leave between 8-9 and come back between 17-18. There is two season from March April and the end of the year is high season/busy season.

She do not think that her kids will work in fishery because they have no interest, but she doesn't think the will go to Kuching just get a job after finishing high school.

Flooding:

Flooding around the school is a problem because it is a frequent event happening 4-5 times a year and it makes her worried. Especially in the rainy season it is a problem, but it is not only depended on the season because heavy rain for one day will flood the school. At its worse it can reach up to the waist and the kids don't know about the danger, (about snakes). It floods the road into the school. If there is heavy rain it will definitely be flood and can't stay flood for over a week. The reason why it always is flooded and stay that way is probably because the drain in full of grass.

Are there other schools close to this school that could be an alternative? -> It's too far away.

This year it has been flood already 4-5 times same previous years? -> it is the same every year. She can't remember which year the flood started. But every year when the rainy season starts the school will definitely be flooded.

Is only a problem in a specific season? -> They season do not matter, but if the rain falls heavly for one night it will be flooded.

What are kids during in the village ?-> When they come home they do their homework and play during the evning

How long is a school day? 11 years old -> monday -thuesday -> 7,15 -11 or 7,15 -13.

beak around 10. topics? ->

# Others

- **Retired army man and his wife.**

Flood is not a major problem because when it stops raining the water will level down fast. And if there is a problem the headman will call the community together and they will solve the problem or prepare

**Pepper:** This is his first year cultivating pepper, so the haven't sold any pepper yet. The hills are fore the peppers not to be flooded and they will ad more soil if necessary. He was not concerned about flood risk when cultivating pepper.

They sell **Watermelon** to a middleman. (The watermelon field is in another village not affected by flooding)

**Banana:** She will sell the banana to a friend in Kuching. She will sell the banana for 1RM/kg and mention that the middlemen only pay 0,50cent/kg.

Her friend makes fried banana in Kuching. She approximate earns 1RM/banana. There is approximate 10 banana/kg. But she doesn't get part of what her friend earns.

**Do they know why other people are not selling to friends or higher prize in Kuching?** Answer: Because they are originally from Kuching they have friends. So she thinks it at matter of connections, which many of the other villagers may not have.

**Do they participate in the maintenance of the drainage?** Answer: Maintenance of the drainage system is the individual landowners own responsibility. So if one farmer makes a drain the next farmer continues it on his own.

**DID** is responsible to maintain the main drainage and the main levee.

- **Oil palm worker**

When you are a palm oil worker you might not be affected the same way as people doing agriculture. How is the household experience flooding in the area?

Answer: Before the bund there was flooding, which is the reason they build house on pillars,

but after the band was build there was no problem.

Agriculture: The grow coconut and banana, which aren't affected by flooding.

Maintenance:

- Do they participate in the maintenance of the drainage system? Answer: Yes, they participate in the maintenance.

They only maintain the mini bund not the big bund, which is the government responsibility.

- So the DID take care of the maintenance within the fields? Answer: yes.

- **Retired army man**

Did not believe that flooding was an issue. The reason he did not believe that flood was an issue was because both banana and coconut was special adapted to these conditions. He believed that growing pepper was a big risk because of its intolerants to flooding.

Retired from the army had a high income compared to others (common questionnaire). His main income was a pension from the army and had a side income from banana and coconut.

Conflict. Agriculture was not the main income.

# Key informant interview ( KII)

- **Headman (KK)**

The reason they left the other village was because of erosion of their land.

Flood: The field area is flooded and there has not been any maintenance since 2001, so most of the area has turn into wild forest and is affected by pest, squirrels and monkeys attack. It is the DIDs responsibility to clean the area, which they haven't don for the last three years. SP they are still waiting for that to happen.

There are two levees that surround the village. The levee is actually constituting one of the main problems, since it retains the water and the drainage are not cleared properly by the DID. Since the main levee was constructed the field area can be flooded for up to 3month. He think if the DID construct and extra Watergate close to the city it would solve the drainage

problems. The community has already applied for a Watergate over 10 years ago, but haven't heard anything jet. The reason the not clean the drainage them self is because it is to labor intensive, it would take the whole village a day to clear only a small part. The have tried to make a catchment but it did not work.

There is no committee that take care of the drainage, but they maintain it them self, one responsible for each family and equally participation. If people are unable to help with the maintenance they pay. There are no specific subsidies for flooding there is only a general subsidy and subsidies for agriculture and pesticides. The government pay for both levees, the main and the one in front of the village, but hey pay for the maintenance them self. They haft to maintain the levee in front of the village every year be adding new soil to prevent the water flood the area. If the drainage is unmaintained it would raise to the waist.

Their was a big flood in 2011 after which the DID improved the levee in front of the village.

The reason they left the other village was because of erosion of their land.

Pepper. They started to cultivate pepper in the village because it worked. They tried a lot of different species but only pepper worked.

Other problems than flood that impact their agriculture is monkeys and squirrels that eats the corns.

Different forms of livelihood strategies: Fishery, agriculture and some forced to work in the city, which is mostly the youth.

Besides, coconut, banana and pepper people cultivate Watermelon and corn, which are seasonally.

**. Follow up questions to the timeline plus a conformation walk to the areas of interest**

- Originally the DID planed to construct the levees through Tanjung Pisang, but the villagers disapproved and applied for compensation, which the DID disapproved due to lack of money. Thereafter the villagers proposed that they constructed the levees near the riverbank but the DID disapproved because the maintenances cost was high due to erosion. Eventually the DID constructed a levees behind the village and one near the riverbank.
- Because of continues flooding the villagers applied for improvement of the levees and two water gates. But the approval process was to long, so eventually the villagers used their own organization money (saving, might also include government money) to improve the levees and construct two water gates, which was made of wood.
- One of the water gates broke during a period with heavy rainfall and high tide because of the high pressure and flooded the city.
- After this event the villagers called the ministers (from DID?) to see the impact of the flooding.
- Thereafter the villagers made a new application to the DID for improving and constructing two water gates, which was approved.

- **Department of Irrigation and Drainage (DID). District officer**

DID officers agree that Tanjung Pisang is prone to floods.

Maintenance: The DID officer confirmed that they were responsible for maintaining the main drainage system and that Tanjung is located in maintenance block C, which cost 200000 RM each year. There is not an official maintenance schedule, but the DID maintained the drainage

system at least once per year. They hire a private company for the maintenances. The companies varies from year to year. But because of lack of funding they weren't able to clean it more often. He confirmed that the village already have applied for a new Watergate and it was in process and that the village was fitting the criteria to get it. Furthermore he also rationalized that a new Watergate could be a solution for the village. He also confirmed that Tanjung Pisang was last maintained in April 2016 (conflicting with the headman)

He explained that the DID opens the Watergates two times a day. The open it during low tide and close it before the high tide.

The DIDs action plan when there is a flood in any area, also the Tanjung Pisang area. They will go to the villages and investigate how many people that are affected and make an assessment of the destructions.

The flood in 2011: The Watergate had some holes and some water could enter, but the area was not really flooded. (Conflicting with the village perception).

Infrastructure: He was unable to answer specific questions concerning the infrastructure of Tanjung Pisang. When asked about the reason the construction of levee around the city he answered it could be a land issue. We weren't able to get a manual of the infrastructure and were told it is very hard to get access to official document, but the application and evaluation period takes a long time.

In general on specific information we were directed to headquarter in Kuching.

- **PS. Principal of the school**

The school is one of the areas more affected by flood. (we could observed how the level of the water was still considerable even though it hasn't rained in the last days). The school opened in 1972 however, the principal started working there last year.

The problem with the school is that is located in a low part so the water accumulates there even easier. Since the bund was built this problem has heavily increased. With a couple of days of heavy rain, the flood can reach around 1, 5 meters remaining there around 1 month. The parents have to take the kids from the road to the classes in plastic tanks.

The school is built high enough to not have had to close due to floods. The school is shared between 3 villages, the ages of the kids are between 7 and 12 years and in comprises round 80 kids.

The school starts at 7.15 and finish at 13.15. There is additional education from 14.00 to 17.00.

The government gives subsidies every term one subsidy to one of the schools in Simunjan´s area. There are 15 schools so they are still waiting for their turn. The aid however, cannot be invested in environmental issues they just can spend that money for academic purposes. The government keep saying that they have a busy political agenda and have never gone to the school to see the conditions in which the kids have to study and the teachers have to work.

There is no risk of illnesses (at least that they know about). However, snakes appear when there are big floods so every time they have to check under the desks and chairs to make sure that there is none of them on the classroom. None one has suffered an attack jet. They are 'easy' to identify because the kids start screaming each time they see any kind of animal. There are catfishes on the school the kids try to catch them with rice.

During this year she has got stock on the school with some kids because of the flood. She strongly believes that the problem will be minimized if another watergate is established.

She is really concerned about the state of the school, they used to have plants and a little garden and this is not possible anymore. The kids cannot play outside and this might influence in their future.

8.6 Focus group summaries

- **FW. Focus group women**

5 womens assist.

We asked about the challenges on the villages:

At the beginning the live in the village was difficult they didn't have water, or light. They use the fire to cook, there was no road. There was a small path but all the village was full of bushes.

Later on they received the solar panels that they have been used until they received a generator ( around 1994). In 2004 the electricity was established on the village.

They used to plant a lot of crops mainly paddy but due to the floods they variability has decreased and the flood does not allow them to set paddy again.

Currently as the rainy season is almost finished they have long beans and yam. The crops that they established depend on the season.

Flood is currently a big challenge due to its huge effect in their income. The remains on the fields for around 1 or 2 weeks destroy all the crops making them to start all the ”process” again.

The maintenance of the drainage is not been done correctly, there are big fishes inside you have to dig to be able to clean it properly.

When the machine comes to clean the drainage the kids get ready to get the fishes of it:

An important problem with the cleaning of the drainage is that it used to be paddy on the bank of the drainage so when the machine comes to clean it destroy the crops. There is no economical compensation for this.

The womans has an scheme

IAM Malaysia, they receive a loan to start planting their crops. The interest rate is very low, 1%. The amount of money that they receive depends on their income.

They process some of their products as the bananas, they do banana chips, they do not use machines and due to this is a hard work that they can't do in big amount. They prefer sell their products individually so they work ” has hard as they want”. One of the women's give the chips to his soon that works there and he sell them for 1RM/ 6gr.

The young generations have migrated to Kutching. Womens when they get married they tend to come back. Mans to, but if they are working in Kutching they tend to have their family here and then come back on the weekends( daily if they can afford it).

Regarding to schools women are afraid to take their kids to school, they have fun when there is a flood. The water reach the waist level. If the water is clear enough is even possible to sea the fishes.

- **Focus group men**

Summary: In the beginning of the focus group, the participants were asked to mention some of the main challenges that they face in the community. Young people migrating was regarded by all the participants as an issue that the community were facing. In the beginning, the seemingly regarded as a trend, was attributed to young people not interested in working with agriculture, therefore they were moving outside. The word 'explore' was used, we were told by our translators. When asked how many of their children able to work was working in agriculture and fishing, the participants responded that, they did not. Later, it was said that when the youth returned home from other places, in some case, they were assisting their fathers. Either by assisting in the field, or through remittance to the family household. Remittance was dependent upon how much money that they were earning. If high income, the youth would send money home, if low income it would not be the case.

The following mention was transportation in which the participants talk about the construction of the main road (of concrete), as an important event. Before that it took a long time to go to other places. Likewise, they stated that when they began to have boats with engines, it made it much easier for them to go to places. Before boat with engines, the most common boats in the village were rowing boats. A road construction was regarded by the

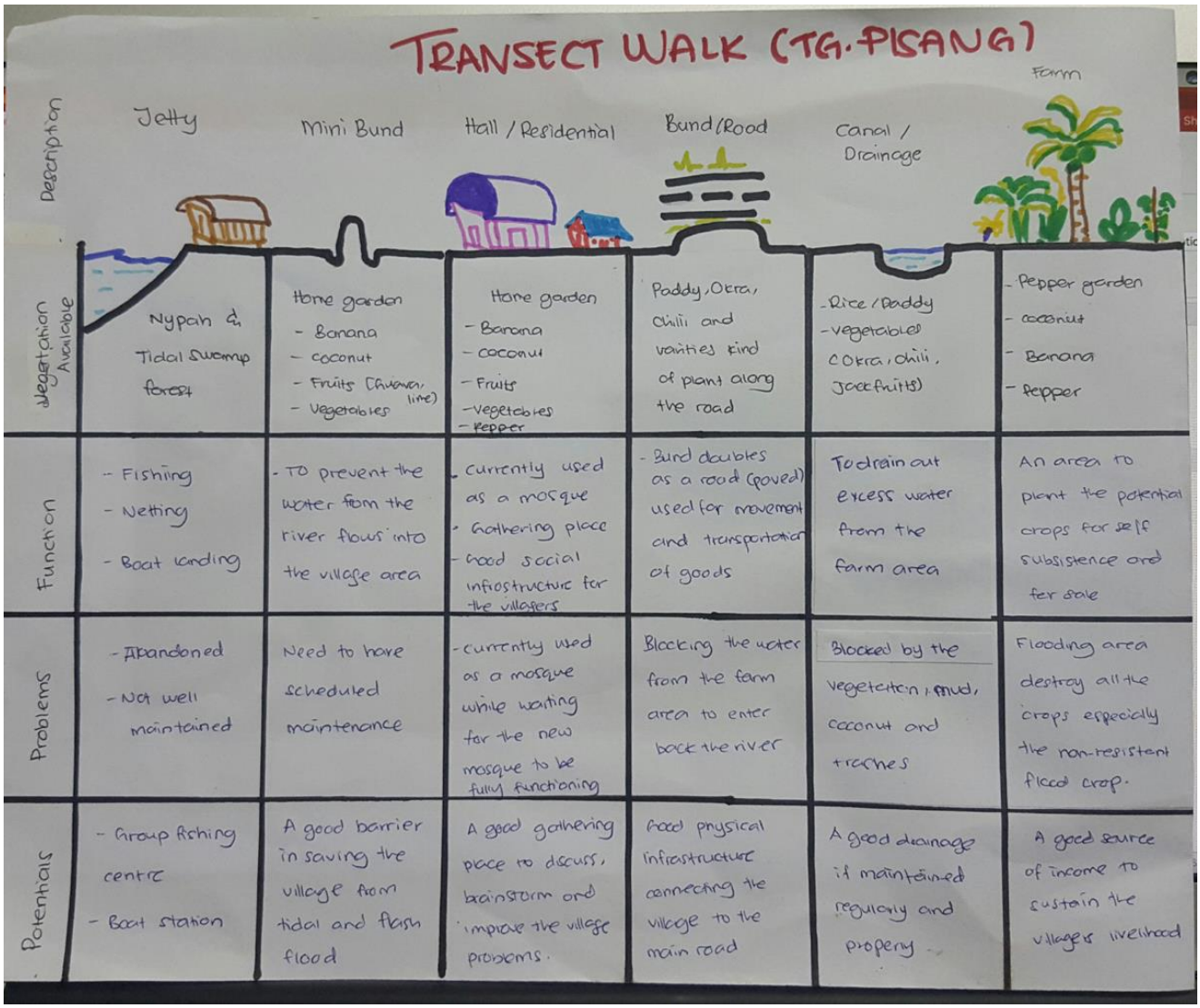
In the end of the session, the some of the participants filled out a livelihood matrix.

Discussion: The focus group interview suffered from difficult circumstances, and it seems unlikely that a focus group interview would be possible to conduct given an immediate re-scheduling of the event, from the evening to the afternoon, and the decision to do the session with participants with very different background, including the local headsman. The objective was to find people with similar background and status. However, the local headsman was invited, and furthermore it was only goers.

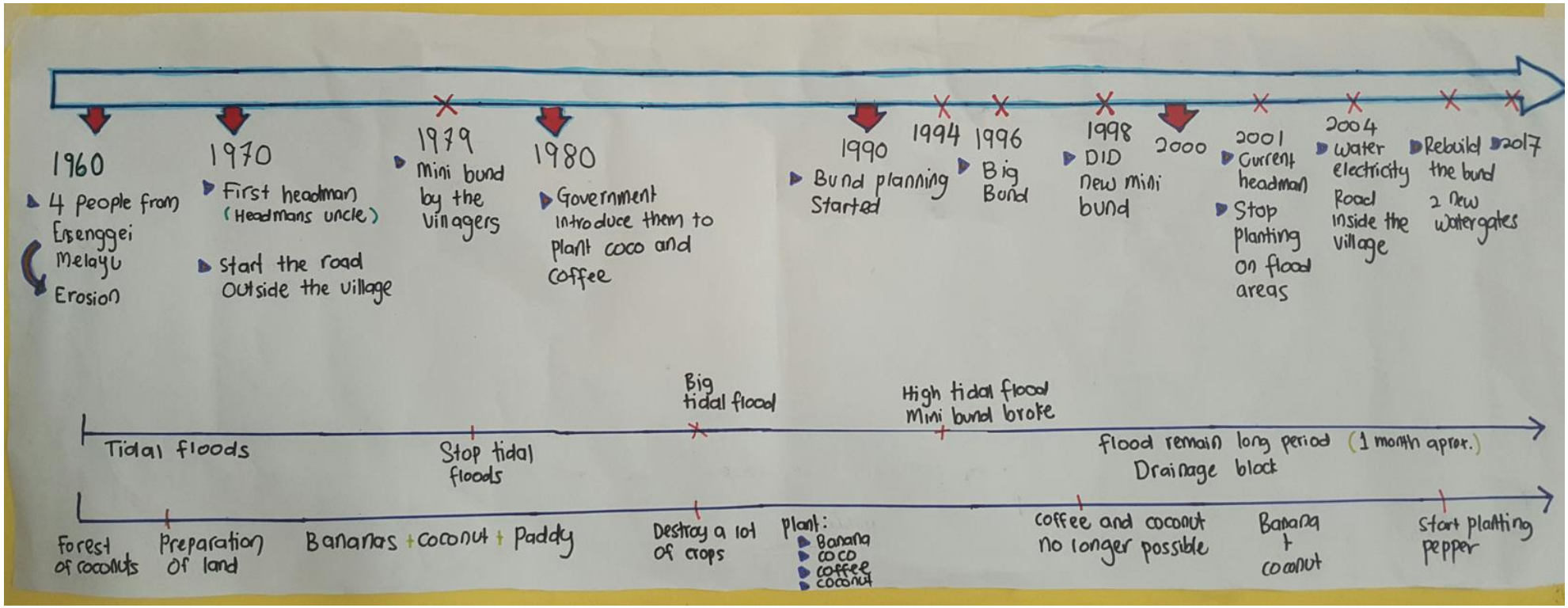
The focus group interview suffered from lack of structure which can be attributed to an immediate re-scheduling of the event, from the evening to the afternoon shortly after the mid-day prayer. Furthermore, were some of the most dominant people in the village, especially the local headman. The plan was to avoid the dominating people we have talked with previously, but it was a compromise made by us, as it was required for the Malaysian students to do a livelihood matrix.

8.7 PRA exercises

Transect walk

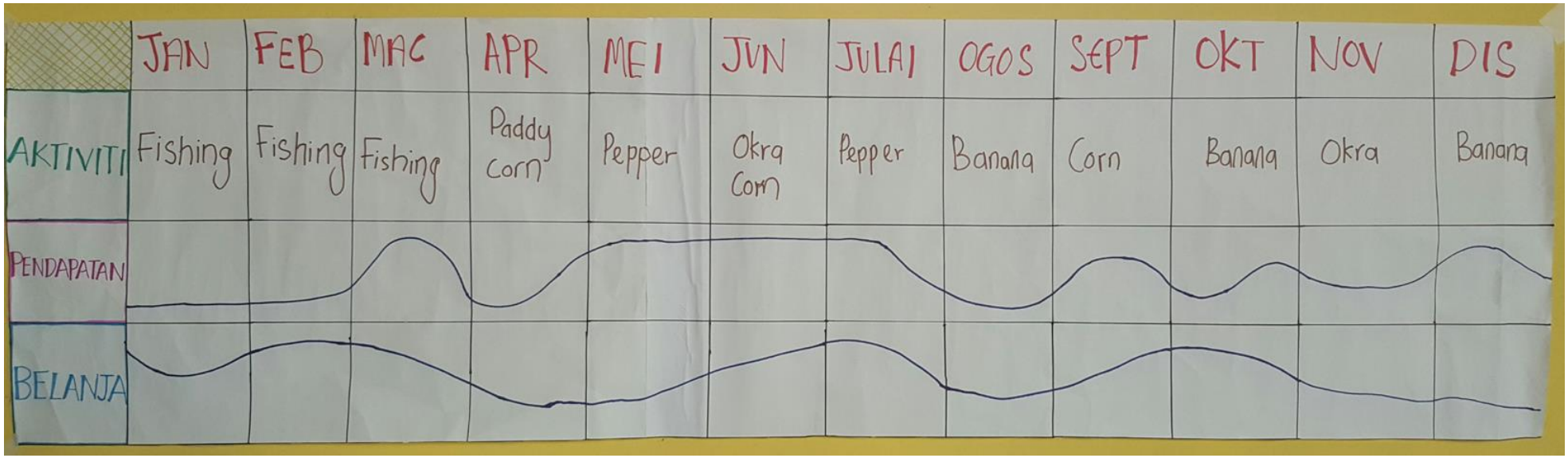



Timeline


1960
4 people from Esenggei Melayu
Erosion
1970
First headman (Headmans uncle)
Start the road outside the village
1979
Mini bund by the villagers
1980
Government introduce them to plant coco and coffee
1990
Bund planning Started
1994
1996
Big Bund
1998
DID new mini bund
2000
2001
Current headman
Stop planting on flood areas
2004
Water electricity
Road inside the village
Rebuild the bund
2 new watergates
2017
Tidal floods
Stop tidal floods
Big tidal flood
High tidal flood Mini bund broke
flood remain long period (1 month aprox.)
Drainage block
Forest of coconuts
Preparation of land
Bananas + coconut + Paddy
Destroy a lot of crops
Plant:
Banana
coco
coffee
coconut
coffee and coconut no longer possible
Banana + coconut
Start planting pepper

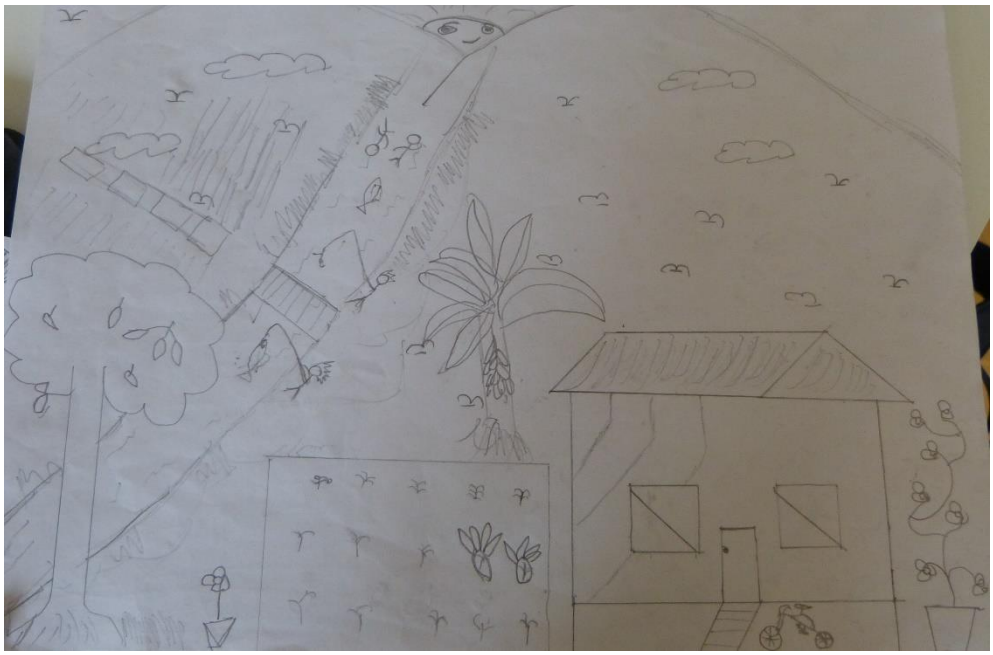
Social mapping

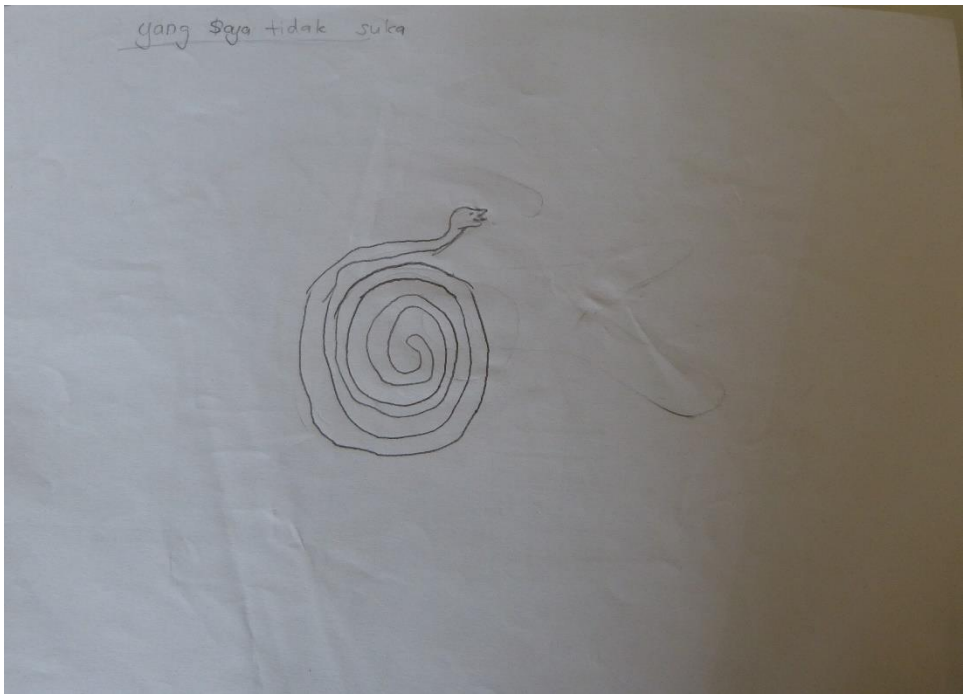

Livelihood matrix


JAN
FEB
MAC
APR
MEI
JUN
JULAI
OGOS
SEPT
OKT
NOV
DIS
AKTIVITI
Fishing
Fishing
Fishing
Paddy
Corn
Pepper
Okra
Corn
Pepper
Banana
Corn
Banana
Okra
Banana
PENDAPATAN
BELANJA

Activity on the school

As we were required to go to the school for a motivation talk we used that visit to develop an activity with the students to try to qualitative quantify impact of the flood on the school and the influence of it on the students. We divide the students and gather them in village groups. We asked them to make a draw about the things that they liked and do not liked about their village in groups of 2 / 3 members.





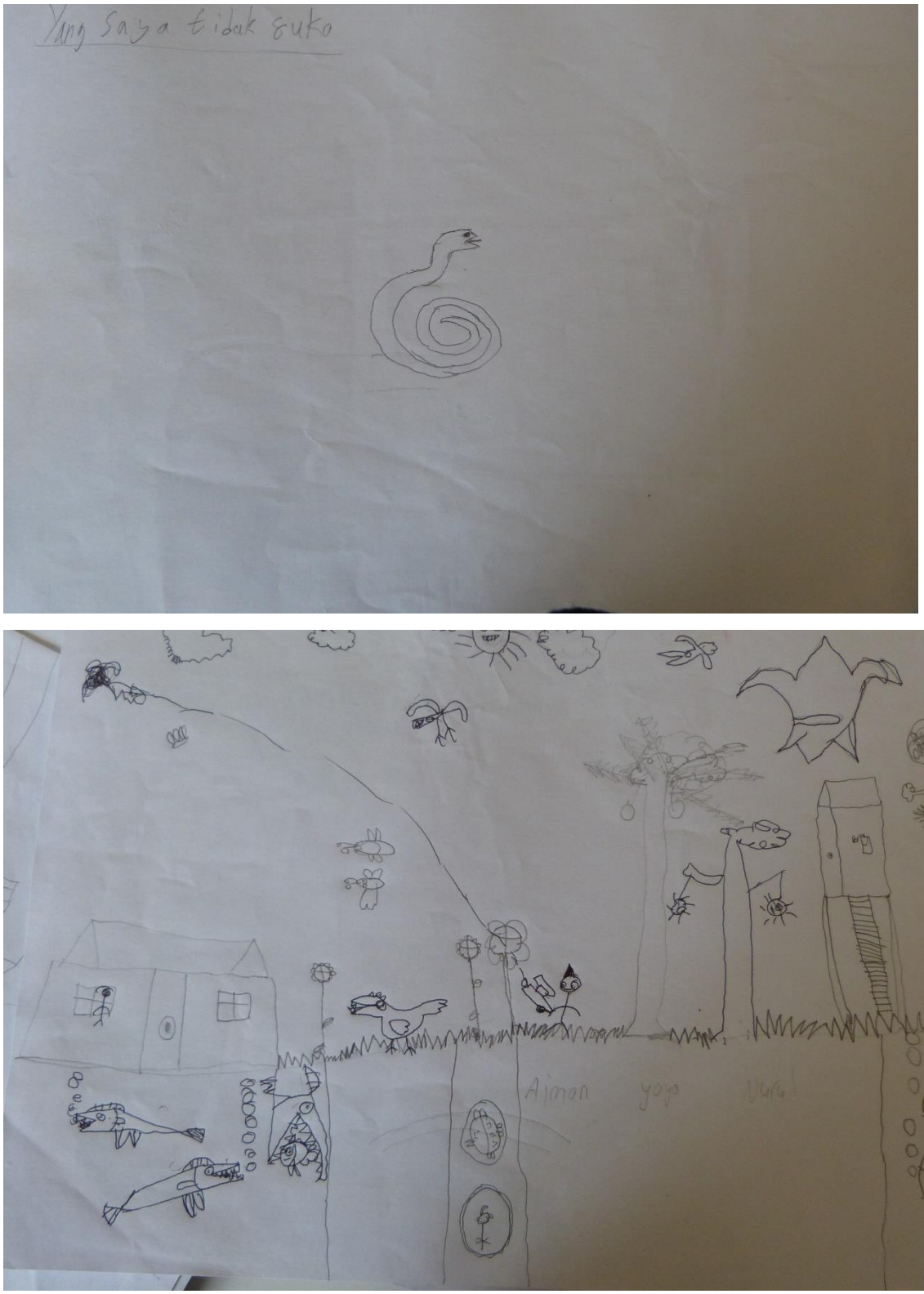



Figure Appendix 8.8 Draws of the kids. Thigs they do and do not like of their village

8.9 Conductivity parameters

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**Table 1. Electrical conductivity measurement and salinity classes for a 1:1 soil:water suspension (Soil Survey Staff (1993), Janzen (1993), and Smith and Doran (1996)**

| Electrical Conductivity (dS m-1 at 25 C) | Salinity class | Crop response | Microbial response |
|---|---|---|---|
| 0 - 0.98 | Non saline | Almost negligible effects | Few organisms affected |
| 0.98 - 1.71 | Very slightly saline | Yields of very sensitive crops restricted | Selected microbial processes altered (nitrification/denitrification |
| 1.71 - 3.16 | Slightly saline | Yields of most crops restricted | Major microbial processes influenced (respiration/ammonification) |
| 3.16 - 6.07 | Moderately saline | Only tolerant crops yield satifactorily | Salt tolerant microorganisms predominate (fungi, actinomycetes, some bacteria) |
| > 6.07 | Strongly saline | Only very tolerant crops yield satisfactorily | A select few halophilic organisms are active |

8.10 Synopsis

# Flood mitigation and livelihood strategies on Tanjung Pisang

# Synopsis

University of Copenhagen. Thematic course: Interdisciplinary Land Use and Natural Resource Management (ILUNRM/SLUSE)

24th of February 20017

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## 1. Introduction

Floods are among the natural disasters which causes the highest impacts on people's lives. It is estimated by the United Nations that from 1995-2015 43% of the natural disasters are due to flooding (UN Weather Disaster Report 2015). Costs were estimated to be $19 billion in 2012 on global scale and are projected to continue to increase, as it has been the case for the past decades (Ward et al. 2013). Floods can take form as fluvial when rivers overtops their banks and spillover, or pluvial when heavy precipitation leads to overland flows inundating areas. Groundwater and coastal flooding are two other types of flood events, where the former occur in areas with saturation-excess overland flows, and the latter being caused by tidal surges, storm surges and tsunamis (Holden 2012).

Flooding is accompanied by a wide range of causal effects that change local environmental and socio-economic conditions. Flooding in itself is a natural phenomenon and it upholds beneficial impacts for the environmental conditions and societies (Few 2003). However, this report will focus on the complex adverse impacts of flooding on rural livelihoods. Climate is one of the main drivers impacting flooding. Thus, changes in climate variability will lead to increased weather extremes, meaning that floods will have a greater impact globally, reflecting rising cost and hence making flood management an urgent environmental and social issue for policy-makers (Ward et al. 2013). Events of flooding will increase in frequency and magnitude in coming years (Manupipatpong & Anbumozhi 2012), but it is important to recognize that flooding events are shaped by human and environmental factors, therefore considering flooding as part of socio-ecological systems is one way to consider the scope of the issue (Adger et al. 2005), e.g land management and wider land use transitions (Holden 2012).

Flood mitigating measures, such as levees and dams, can prevent the impact of flooding, but also have the opposite effect by either prolonging or making them more severe (Rufat et al. 2015). Adaptation and mitigation strategies are two ways of approaching the impacts of flooding often combined (van Vuuren et al. 2010). Ultimately, van Vuuren et al. 2010 states that 'For agriculture, only a scenario based on a combination of adaptation and mitigation is able to avoid serious climate change impacts'.

In Asia, flooding is a serious issue. The UN estimated that 95% of the flood disasters from 1995-2015 have occurred in the continent (UN Weather Disaster Report 2015). Also, as agriculture continues to employ a large share of the workforce their income is heavily affected by this natural disaster (Jung 2012). An ongoing urbanization combined with changing land use practices to supply the urban demands are underlying drivers that put pressure on the water systems. This makes many coastal areas more prone to flooding and create risks of accelerated erosion, loss of wetlands and mangroves and inundation of seawater into freshwater sources (Reddy et al. 2012).

In Malaysia, flooding events have had devastating impacts, bearing wide adverse consequences for livelihoods, from properties, materials, crops to raising health issues (Diya et al. 2014). Traditionally, flooding and other natural disaster events have been managed through a top-down approach by the Malaysian government (Chan 1997). Studies on flooding impacts in Malaysia have predominantly focused on flood risks in urban context whereby cities such as metropolitan Kuala Lumpur (Shamsuddin 2013) and deltaic Kutching (Mah et al. 2011) have been the research areas. However, the focus in this report is on flooding impacts on rural livelihoods which is an issue seemingly less covered by the academic community. Here in specific a village on Borneo, Tanjung Pisang.

Tanjung Pisang is a Malay village consisting of 56 households situated on the bank of the Sadong River (N 0124.849', E 110 38.857'). Originally the inhabitants were living in Ensenggei Melayu village located just on the opposite bank of the river. The community consists of farmers and fishermen whose main source of income has shifted from fishery and swamp rice to cash crops, such as banana, coconut, maize and pepper. This change has potentially occurred because of easier an access to the market due to infrastructural improvements (roads and bridges) and due to an enormous worldwide demand for cash crops (FAO, 2002).


*Image 1. Borneo Island. Sarawak area delimitated. Location on Tanjun Pisang in Sarawak.*

The proximity of the village to the river constitutes a huge challenge for the inhabitants since recurring flash floods in combination with high tide destroy people's crops and homes, affecting people economy and livelihood strategies. As an adaptive measure, the community has built levees along the river. Also, the department of drainage and irrigation (DID) have constructed a drainage system consisting of water channels and water outlets. Thus, the drainage system act as a combined income and risk minimizer since it allows farmers to exploit otherwise useless land and secure crop. However, these adaptive measures have so far not been able to solve the problem. Lack of maintenance and monitoring have been attributed the main causes of failure. This suggests infrastructure and organization as part of the problem with flooding in Tanjung Pisang.

To get a deeper understanding of the complex issue of flooding the overall objective of this study is to examine how flood mitigation infrastructure affects livelihood strategies in Tanjung Pisang, which will be answered through a number of specific research questions. The questions that have been developed are the following:

- *"Which are the effects physical and social of flooding?"*
- *" What were the previous impacts of flooding?"*
- *"How is the flooding mitigation infrastructure and the drainage system organized?"*

## 2. Methodology

1. Natural science methods

**Soil sampling**

An important question to address is the impact of flood on soil quality, which have direct influence on crop productivity and viability but also indirect effects on people's livelihood strategies and socio-economic situation. In addition, drainage system is another factor, independent of flooding that could affect soil quality and hence people's livelihood strategies, by increasing nutrient leakage.

In order to examine soil quality a collection of 900 cm3 would be analysed. Soil conductivity would provide valuable information concerning the influence of high tide. Other parameters include organic matter and pH since land use transition from wetland into agriculture land combined with the drainage system potentially would affect these parameters.

Areas of interest will be pinpointed on a map for the purpose of visualisation, overview and for later sampling. This location would be chosen in relation of our own observations or the locals' interest. Question could be based on a ranking system after the likelihood of an area being flooded and on soil quality.

Execution of sampling:
1. Soil samples will be selected randomly and taken in triplicates.
2. Air dried.
3. Analysed in the laboratory.

Potential errors of drying: Reduced content of carbon due to oxidation and decreasing pH.

**GPS mapping + ArcGis**

GPS (Global Possitioning System) would be use in order to visualize the area with aerial photos and to map the area of study while we are there.

The aerial photos would be analysed in ArcGis before going to Tanjung Pisang to have an overview of the area and to map the watershed where the village is located. A mapping of the different crops would be done to have a better understanding of sizes of the land and the product variability.

WGS 89 coordinates would be taken with GPS (Garmin eTrex 10). This coordinates not only would be used to map the area and the structure of the mitigation infrastructure and water canals. But also to record specific sites as the location of soil samples, specific crops or precise location of certain interviews.

**Water sampling**

In order to evaluate the effect of floods and tidal, water samples will be analysed. These water samples will provide information on salinity, nutrient and pollution levels, which would be relevant if used for irrigation besides for having environmental consequences on the local ecosystem.

The amount of water analysed would depend on the laboratory that the counterpart university will provide and its capacity.

2. Social science methods

**Questionnaire**

A common questionnaire will be conducted during the fieldtrip. It will serve as an important tool for quantifying the social context linked to the problems facing the community. However, the questionnaire is currently being re-worked by our Malaysian counterparts, thus many aspects in this regard will be discussed after the arrival in Malaysia.

**Interviews**

During the fieldtrip, a wide range of qualitative methods will be applied. A mind map (Appendix 4.2.) has been sketched out that is showing the issues so far discovered that are related to flooding in the Tanjung Pisang. This can be used as a guideline for doing semi-structured interviews. It is expected that many interview will be held in an informal context with farmers.

· Targeted semi-structured interview

Semi-structured interviews are a series of questions focusing on a targeted sector. Having conducted the questionnaire, these interviews will take departure in the more open questions related to the issue, in which we are concerned, that require elaborated answers, conversation and field observations. The criteria for selecting farmer will be to cover a wide range of concerns, e.g. soil quality, crop selection, harvest schedules, previous experiences, and flooding impact. In this way, it is also intended that the interview will be representative for issues in the area. It is likely that follow-up interviews will be needed as well with the interviewees.

The location of the interviews should reflect the issues that are addressed, e.g. an issue such as crop selection is best addressed in the field of the farmer, rather than in his/her house. This also enables field based observations directly related to the interview, and it may enable a more fruitful dialogue between us and the interviewee. Furthermore, there may be cultural aspects which we will experience that will surprise us, which may be of relevance for the research.

· Key informant interviews

Key informants interviews are in-depth interviews with people with specific background and competencies. The aim is to get one or two interview with key informants that will enable a

more thorough understanding of flooding mitigation and livelihoods in Tanjung Pisang and perhaps also the regional context.

So far, two key informant interview are considered. First, an interview with local headman of Tanjung Pisang, and secondly an interview with a spokesman from the Department of Irrigation and Drainage. Each of the interviews will likely give an overview of livelihood strategies, in particular the headsman, and they will both have knowledge about the consequences of flooding in the area. Whereas, it may be possible to make follow-up interviews with the local headsman, it will probably not be the same case at DID. The two interview will give us an insight to the organizational issue of flooding mitigation, and will also touch upon the failure of maintenance in the village.

· Focus groups

The focus groups are interviews addressed to a small group of people (between 2-5) that is has been identified to have something in common and their interactions is helpful in order to comprehend a research problem.

In this research, focus groups would be selected to deeply understand the impacts of flooding in people's livelihoods. Two different groups, farmers affected by flood and farmers non-affected by flood, would be assessed assuming that their income would be affected differently and in consequence their livelihoods. We also presume that this two groups would have different perceptions on the efficacy of the mitigation infrastructure and its management.

**The Participatory Rural Appraisal (PRA)**

The PRA method it focuses on the perception of the farmers to the problem and conduct their own analysis to figure out perceptions on issues. The researcher has limited contribution however, it is important to ensure that they take part on the activities that the farmers develop to have an insight view of the problem.

In Tanjung Pisang the PRA would be used in order to examine the effects that the floods have on the soil and the crops visiting the field that are currently being exploited and trying to evaluate the quality and quantity of the crops production, e.g. ranking of crops based on value, resistance, ecology, etc.

**Timeline and social mapping**

Timeline is a method used to put a series of related events into a chronological order in order to get an overview of subject of interest. To be able to understand the mechanisms and the influence of past floods events on the inhabitants' livelihood this method would be used, in particular local responses related to livelihoods.

A group conformed of 6 - 8 elderly people would be selected and will be asked to recall major flood events, magnitude of the flood impact, the crops that were exploited at that time and the effect of the floods on those crops.

Social mapping is helpful tool to help the researchers on the understanding on the village throughout the inhabitants' perceptions. In this case a random selection of people would be

asked to draw things such as their crops location, areas most affected by floods or areas with fertile soils.

**Field observations and walkabouts**

Field observation would be written down during the field trip period in order to complement the information that are not possible to be asked about or unexpected events.

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