

SOMETHING FISHY IN TEBELU

Diversification of livelihood strategies and the role of fishing in Tebelu

**Report of SLUSE Joint Course in Interdisciplinary Land Use
and Natural Resource Management**

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First we would like to thank our counterparts from the University Malaysia Sarawak (UNIMAS) for their contribution and collaboration in collecting the data and for their wonderful sense of humor. Second we would like to thank our very helpful and indispensable interpreters, who provided us with knowledge and facilitated the interactions with our informants. Third, we would like to thank our professors, coordinators and resource persons from University of Copenhagen and UNIMAS for their useful guidance and feedback before, during and after the fieldwork. Last but not least we would like to thank and express our gratitude to the inhabitants in Kampung Tebelu who welcomed us and generously took their time and shared their knowledge and insights with us for our research.

Abstract

The study of the diversification of livelihood strategies has been typically considered as one of the keys to understand the underlying factors that drive the development of rural areas. The state of Sarawak, Malaysia, has experienced a substantially slower urban development than the peninsular states, which has led to the maintenance of a subsistence economy. Thus, the fishing industry is regarded as one of the major contributors to the state's welfare, especially in coastal areas. Therefore, the present project aims to understand the diversification of livelihood strategies in a coastal village, with a particular focus on fishing activities. For that purpose, different social and natural science methods were carried out in Kampung Tebelu in order to evaluate the importance of fishing in the village, and its relation with other activities. After the data collection and analysis process, it is possible to state that fishing constitutes the most important sector in the village from an economic and sociocultural perspective, especially between March and October. However, other activities also play an important role during the year, particularly in the wet season, revealing the crucial role of seasonality. The sustainability of the fishing industry was also assessed from an environmental, economic and social perspective. Results show that overexploitation, migrations and climate change among other issues might represent a threat to the fishing industry in the mid and long term.

Key words: *fishing, diversification, livelihood strategy, Sarawak, sustainability.*

List of abbreviations

DOF Department of fisheries

GPS Global Positioning System

JKKK Jawatankuasa Kemajuan Keselamatan Kampung

FELCRA Federal Land Consolidation and Rehabilitation Authority

PRA Participatory Rural Appraisal

SSI Semi-Structured Interview

SWOT Strengths, Weaknesses, Opportunities and Threats

Signed the 31.03.2017

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1. Introduction

The state of Sarawak is located on Borneo Island in East Malaysia. It is the largest state in Malaysia covering approximately 124,000 square kilometres. Sarawak has experienced a very long history of colonisation. The British colony has been the most influential in shaping contemporary Malaysia's economy, society and politics. There are several characteristic features of the economic development process in Sarawak which highlight the contrasts with the rest of Malaysia (Furuoka, 2014). The marine areas of Southeast Asia are recognized as a biodiversity hotspot and the sea of South China has an incredibly high species richness; around 3,350 species of fishes and an estimated 34 % of all coral reefs lives in the sea outside the coast of Sarawak (Arai, 2015). The economic tradeoffs of marine ecosystem services are abundant and once estimated to be worth US\$22 trillion per year (Constanza et al., 1997). The enormous benefits from the ocean are expressed in the 21 million tonnes of fish production that annually takes place in the

Southeast Asian countries (Olewiler et al., 2016). However, the diverse marine resources in the sea around Sarawak are under pressure from human activities; factors like overfishing, pollution and damaging fishing practices are contributing to a decline in the marine resources (Ibid.).

Sarawak stands out for its economic development based on fishing activity, which is considered to be the main contributor to the state's economy (Hamzah et al., 2013). In addition, small scale fisheries also present other important welfare dimensions. They can act as a buffer for excess labour during times of economic stress or disaster, acting as "safety nets" in the sense that they provide people with a temporary occupation during harsh times, and contribute to reduce the risk of food insecurity (Bené, 2006). Thus, in order to assess the contribution of small-scale fisheries to coastal livelihoods, it becomes of vital importance to understand

their status and socio-economic contribution (Teh et al., 2011). There are different factors that influence the quality and sustainability of fisheries. A clear example could be the status of mangrove forests, due to their importance as habitat, food source and capacity to maintain ecological quality (Sabran, 2016). There are 641,886 ha of mangrove forest in Malaysia, of which 26% are found in Sarawak. In Sarawak, mangroves are mostly found in the coastline (Abd. Shukor et al., 2004). This type of ecosystem represents a very important source of resources for the fishery industry in Sarawak area and play an important role in coastal fisheries and productivity. This mangrove estuary is dominated by *Sonneratia alba* forest and *Avicennia* forest, which serve as habitat for numerous species such as molluscs, fishes and shrimps (Hoque et al., 2015).



Figure 1. *Sonneratia alba* forest

Figure 2. *Rhizophora mucronata* forest

So in regard to the current situation, an assessment of the factors determining the role of fishing and other activities could be regarded as a necessary effort to gain a deeper understanding of the diversification of livelihood strategies in coastal villages. Therefore, an economic and socio-cultural analysis of the main relevant topics in relation to fishing and other livelihood strategies will be carried throughout the present project. Moreover, a comprehensive range of topics, including the importance of seasonality or land tenure related aspects will be described in detail.

Finally, an assessment of the environmental, economic and social sustainability of fishing

will also be performed in order to provide some insights about the mid and long term viability of this sector. In order to assess the economic sustainability of the sector, the threats, strengths, weaknesses and future opportunities of fishing will be assessed through a SWOT analysis. Other topics related to the village's social aspects and to the villagers' cultural perceptions are expected to provide relevant information in regard to evaluate the future viability of fishing.

1.1 Objectives and research questions

A number of previous articles have sought to describe the diversification of livelihood strategies in Sarawak, but significant gaps still remain. The majority of the reviewed studies tend to set the whole state as the area of study while the smaller urban centres are often ignored or misrepresented. Thus, the present project aims to address a double objective: Firstly, to gain a general overview of the diversification of livelihood strategies

and cash crops and secondly, the assessment of the importance of fishing in comparison with other livelihood strategies in Tebelu.

The following research questions were developed in order to address the already mentioned research objectives:

- What is the importance of fishing in Tebelu...
 - ...from an economic perspective?
 - ...from a sociocultural perspective?
- What is the importance of other livelihoods strategies in Tebelu...
 - ...from an economic perspective?
 - ...from a sociocultural perspective?
- What is the influence of seasonality...
 - ...on the diversification of livelihood strategies?
 - ...on the household's economy?
- Is fishing sustainable in Tebelu...
 - ...from an environmental perspective?
 - ...from an economic perspective?
 - ...from a social perspective?

It is understood that performing a deep analysis of the different dimensions of fishing and other activities becomes crucial in order to obtain valuable information and extract significant conclusions. This is why it is expected that addressing the proposed research questions will provide an accurate understanding of the importance of fishing and other relevant livelihood strategies in Tebelu.

Report organization

The report is divided on several sections which will address different aspects of the study. Firstly, a detailed description of the methodology is provided. Secondly, throughout the results and discussion section the principal theories and findings are analyzed and discussed in detail. Then, the report follows with a conclusion section where the main outputs of the study are synthesized. Finally, the report concludes with an appendix section which includes some additional information related to the project.

2. Methodology

To get a primary understanding of fishing as a livelihood strategy and further sustainability issues in Malaysia, secondary data was investigated in the beginning of the data collection process. Peer-reviewed articles was sought and found through internet sources as REX, ScienceDirect and Google Scholar. This provided valuable insights to the further investigation and planning process.

To investigate the livelihood strategies in Tebelu mixed methods of both natural and social science were used to triangulate and conduct as thorough a study as resources allowed. Six methods were used in the process of collecting primary data; questionnaire survey, observations, semi-structured interviews (SSI), participatory rural appraisal (PRA), GIS-mapping and water samples which all are shortly described in this section. The unit of analysis

is taking point of departure in the households.

2.1 Observations

Observations were used as a method to collect background information about the village, the physical structures and surroundings and to get familiar with the social and working life in the village throughout the fieldwork. Both indirect observations and participatory observations was practiced during the study period.

Village walks

During the first two days of the fieldwork, two planned village walks in Tebelu was conducted. This was done to identify the positions of relevant locations, get to know informants for our study in the village, to get familiar with the villagers and get an overview of the village in general.

During these walks a GPS device was used to collect waypoints and tracks.

Informal conversations

Through observations and showing interest in the daily life around the village we also became visible for the villagers. By greeting and talking to the villagers we got familiar with each other. This could loosen up possible tensions or nervousness which could help to get relaxed atmosphere in potential more in depth studies. Observations helped to get in contact with relevant informants, to start informal conversations and get access to interesting locations. Through observation and new information it became possible to answer basic questions, which also led to new interesting questions and areas of study. For some cases, we were invited by villagers to visit different parts of the community or their private land. In other cases we asked people we met to help us get access to what we found as interesting sites. A limitation of this method could be that talkative and open minded respondents are more likely to contribute as key informants as they were

much interested in our studies and presence in the village. A selective selection of respondents afterwards was therefore needed.

Participatory observations

To obtain detailed information different participant observations was arranged. A visit to the prawn factory provided an overview of the processing and information about the workers and the factory. Furthermore, several visits to the bund with fishing boat ranks made it possible to get familiar with the fishermen's work and equipment. We visited the fish market in Sebuyau to gain knowledge on the commodity chains. Finally, fishing trip participation with three local fishermen was established.



Figure 3. Informal talks with two men fishing for own consumption at the jetty.

2.2 Questionnaire

A questionnaire survey was conducted in order to collect quantitative data of important basic information. The questionnaire was designed before the field trip and subsequential edited and merged together with the questionnaire version from the Malaysian counterparts in the beginning of the fieldtrip. The process of discussing and the finally agreeing of the contents went fluently.

The survey was conducted on the third day of the fieldwork using systematic sampling. Four teams consisting of two to three persons were responsible for 10 questionnaires each. To ensure an equal distribution (without taken income, household size and other variables into account) the whole village was divided into four zones and every five household was surveyed (figure 4). If nobody was home, or nobody in the household wanted to respond, the next household should be asked to participate. The counting of every fifth house was

consistent. In total, answers from 39 households were collected during the time period of approximately five hours and the average time per questionnaire took 20 minutes. The questionnaire survey included 39 out of the total of 192 households in Tebelu and hence it covered 20, 3 % of the households.

One of the major limitations of the questionnaire survey was the use of interpreters. The way in which they formulated the questions might have affected the final results. This is why the interpreters were briefed before performing the survey; they were asked to ask the questions exactly as on the questionnaire in every household. Unfortunately, it was not possible to double check their interpretations as the village dialect is not a shared language in the research group. Finally, the survey sample size was limited by time constraints.

2.3 Semi-structured interviews

A total of 23 semi-structured interviews were

conducted with the aim to obtain relevant information to answer the research questions presented in section 1.2. The total duration of the interviews ranged between 20 and 60



Figure 4. The different sub divisions of the area of study.

minutes. This depended on the time availability of the respondent, in addition to his/her ability to provide valuable information for our study. A group of key informants was selected regarding to different factors, such as occupation, willingness to talk or relevant role in the community. Some informal talks were also held with the villagers on an informal and sporadic basis during our stay in the village. These practices were used as an efficient complement to the already presented questionnaires, and also to assist with data triangulation.

A summarizing list of the most relevant semi-structured interviews conducted in the community is presented in the appendix VI.

2.4 Participatory Rural Appraisal (PRA)

Participatory rural appraisal was used as a method in the research to analyze differences, preferences and competitiveness or complementarities among the livelihood

strategies (Mikkelsen, 2005). The specific objective of this exercise was to collect the necessary information through PRA sessions. The study focused on three different representative groups. Four different PRA sessions were facilitated:

Seasonal calendar

The main purpose of the seasonal calendar was to find out community perceptions on time related variations in fish species and crop species, understand how labour is organized, what natural resources are used and at what time.

Matrix ranking

The two first ones were focused on scoring the importance of different fish and crop species in different months, and a third one carried out in a household in order to understand the complementarity between the different livelihood strategies throughout the year.

Resource mapping

A resource map was planned to obtain a spatial structure of natural resources and land use. To identify the different resources an

aerial photograph of Tebelu was provided, that permitted the participant to point out the current use of land and to show us the landscape transformation due to the human influences throughout the years.

Fishing routes

A map was conducted in order to gain knowledge on where the fishermen went out to catch fish and prawns. Before going to Tebelu, the different PRAs was designed in order to have an idea of what to do. Once the different PRA sessions were put into practice a series of constraints and limitations were experienced. Some information was missed despite the professionalism of the interpreters, because these sessions involved a large number of people and getting all the information was a complicated task. In some of the sessions we



Figure 5. Paper stars used as ranking tools in a PRA session.

did not comply with the time frame and they became too long. Furthermore, the interaction and dynamics between the informants did not always flow in a desired way.

2.5 Water sampling

The water sampling was conducted in the mangrove area located in Tebelu. All water samples were taken at two different sites of the mangrove forest river at the same latitude. The study area was divided into two sites which were considered as a possible disturbed and a possible undisturbed area. The water samples were taken from upstream to downstream. *In-situ* data were collected using a Water Quality Meter and parameters such as temperature, pH, dissolved oxygen, oxygen concentration, salinity, total dissolved solid and conductivity were recorded. Limitations occurred due to the tides fluctuation as we could not manage to collect the water samples at the same time of the day.

2.6 Statistical analysis

Once the data collection process was completed, SPSS software was used to run descriptive statistics with the aim to get a deeper understanding of the information provided by the questionnaires. Besides this, Microsoft Excel 2016 software was chosen to create the different charts presented in the “Results and discussion” section. Furthermore, R studio 1.0.136 software was utilized to run a Chi-square test in order to explore potential significant differences on the fishing frequency between the dry and wet seasons. Thus, two variables were created: “Dry Season” and “Wet Season”. They included count data distributed over four different “fishing frequencies” pointed out by the respondents (from 1 to 4: Everyday – Few times per week – Few times per month – Rarely). The same software was used to generate the structure plot presented in the Appendix III.

3. Results and Discussion

The results consist of one questionnaire survey including 39 respondents, 8 PRA sessions and 23 SSIs. Furthermore, several

observations and informal talks have provided us with additional data.

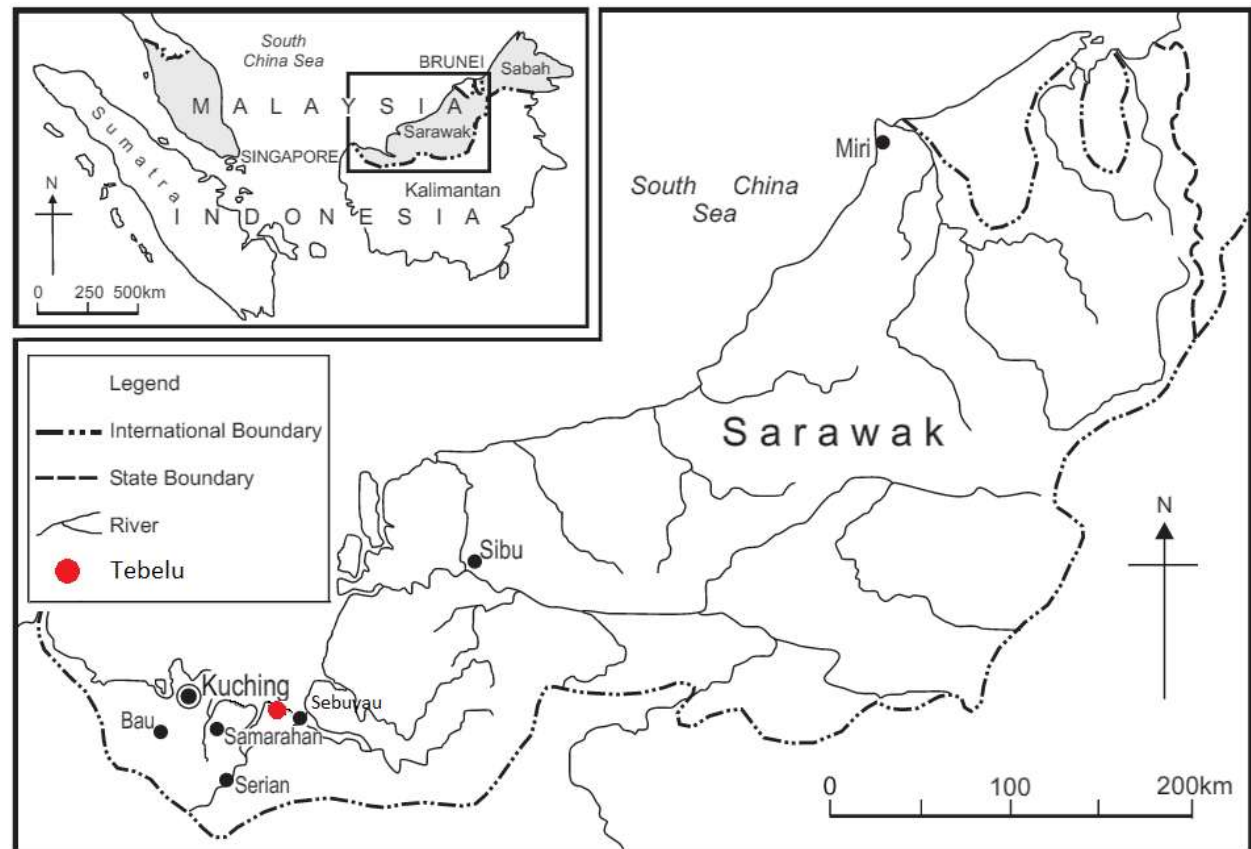


Figure 6. Location of Tebelu in the state of Sarawak in Malaysian Borneo.

3.1 Study area and description of Tebelu

The study was carried out in the village of Kampung Tebelu in the state of Sarawak in Malaysian Borneo. The village is positioned on the coordinates N 01°32'30.22''; E 110°51'39.67 and situated approximately 55 km east from Kuching (figure 6).

According to the former headman of Tebelu, the village was founded under the Japanese occupation during the Second World War as people fled larger cities such as Kuching. Originally the ethnicity of Tebelu was mostly a mix of Iban and Malay. However the majority of the households are now Malay and only one Iban and three Chinese households are left. Tebelu consists of 192 households and the total population is 1369.

According to the former headman the employment rates in Tebelu are 90% fishermen, 5% government employees and

5% are involved in agriculture. Members of the fishing association in Tebelu also stated this, however the data from our questionnaires expressed that only 77% of the respondents were involved in fishing activities (Figure 7).

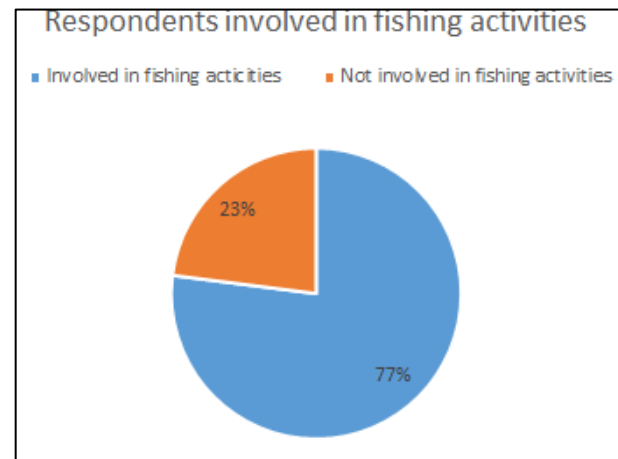


Figure 7: Percentage of households involved in fishing activities.

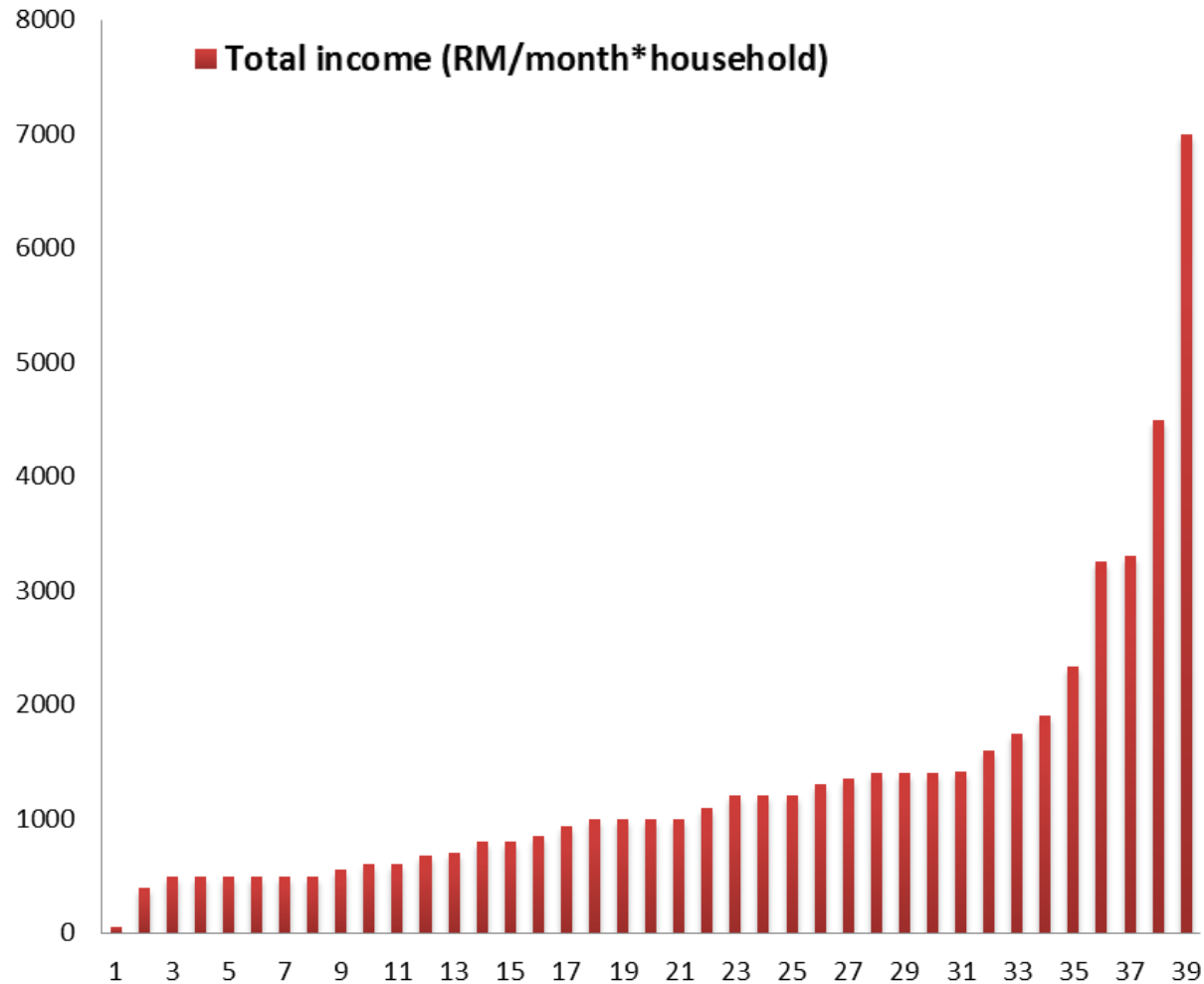
The data provided by the questionnaires revealed that the total income per household

ranged from 50 RM/month to 7000 RM/month.

However, the majority of the villagers' income is distributed around the mean (1347 RM/month) (Figure 8).

Much of the infrastructure in Tebelu has been granted by the government. The majority of households (95%) in the village have access to water systems and electricity. The main road system within the village has also been paved in 2017. Within the village there is a spread of settlements and buildings in Tebelu, consisting of 1 primary school, 3 kindergartens, 1 community hall, 4 smaller grocers, 3 mosques, 1 Wi-Fi center. A GPS receiver was used for collecting data to sample the positions of relevant informants, interesting sites, buildings or plots to construct an overview map of the village which can be seen in Figure 6.

Figure 8. Graph of total income of surveyed households.



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3.2 The role of fishing in Tebelu

The implementation of different social methods and data collection performed during our stay in Tebelu showed some important information about the sociocultural, economical and biological dimensions that fishing activities have in Tebelu. As it has been mentioned above, the majority of the respondents that took part in the questionnaire survey indicated that fishing was their main occupation. Hence, it is clear to see that fishing activities play an important role in socio-economic and social development.

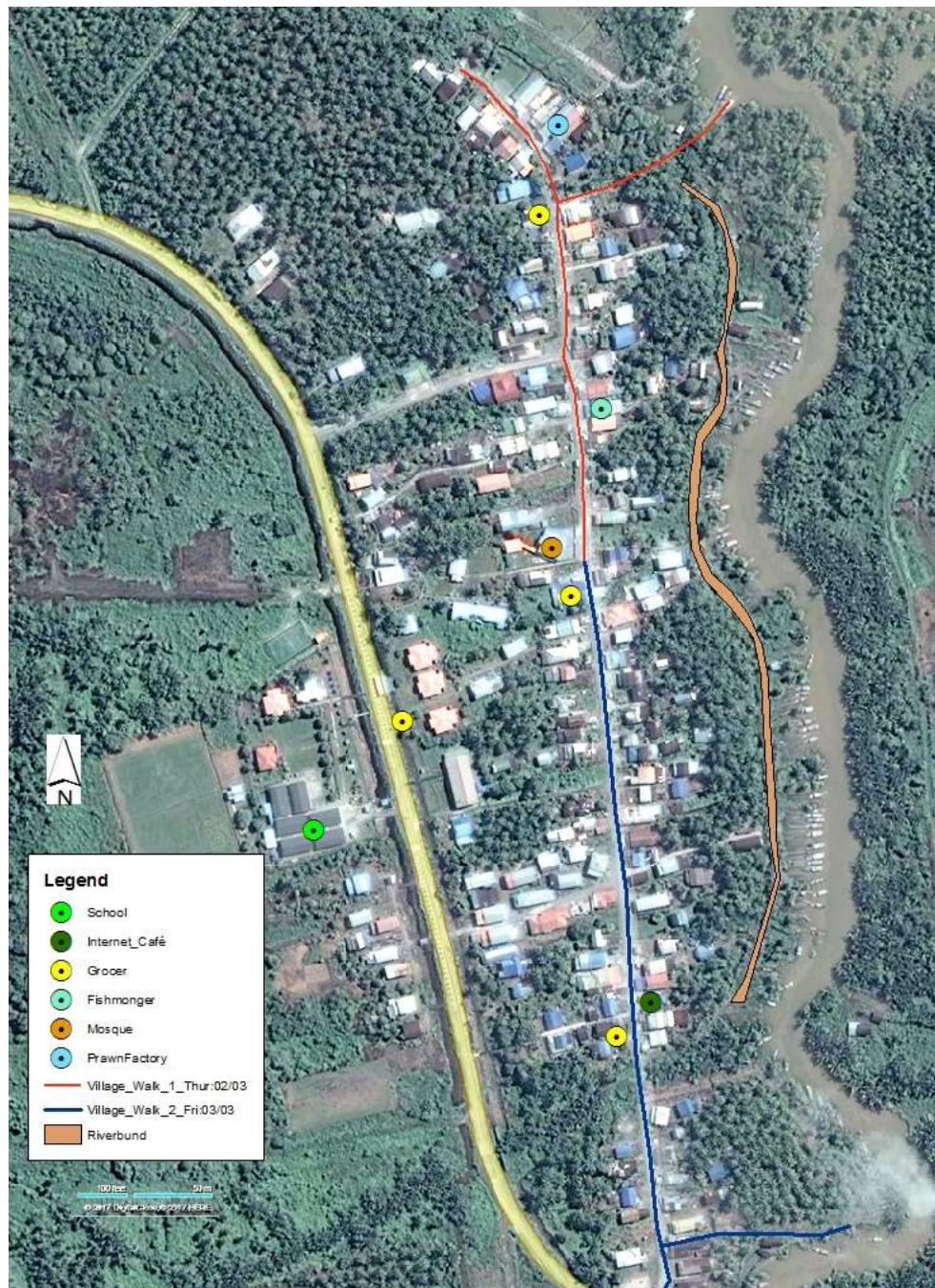


Figure 9. Overview map of Tebelu.

3.2.1 Fishing licences, methods and productive assets ownership

According to the SSI that was conducted in the household with the villager 5 (see appendix V), it was possible to clarify the different fishing licenses and regulations, as well as the different fishing methods used in Sarawak. He expressed that all fishing activities are governed by the Fisheries Act 1985 and its regulations. Marine capture fisheries in Tebelu can be divided in two categories; coastal or inshore fisheries and deep-sea fisheries. Coastal fisheries exert a greater influence in the socio-economic activities of the village. The fishing boats that operate within 30 nautical miles (nm) from the coastline range from traditional boats to commercial boats. Deep-sea fishing boats operate beyond 30 nm from shore. We can distinguish four fishing zones (figure 10).

Despite the existence of those management zones, the interviewed fishermen had different perceptions of the limits of each

zone. This is because the fishing vessels of 40 GT and above exceed their areal possibilities leading to misunderstandings regarding to the limits of their activity. This situation is leading to an increase of the conflicts between the small and large-scale fishing sectors. Competition and problems tend to increase due to the political power that large-scale fishing industry has over the small-scale sector. Fishermen in Tebelu expect a solution that will favour the traditional small-scale sector, and the commitment of the institutions to tackle the issues related with overfishing and irresponsible fishing.

In addition, some fishermen gave us an explanation regarding to their prawn fishing route (figure 11), and the existence of a conservation zone near the fishing zone activity which is designated to conserve and protect the natural resources in the area. It is prohibited to fish in the conservation zone, and if any boat is seen fishing in this area, it would be notified to the relevant authorities.

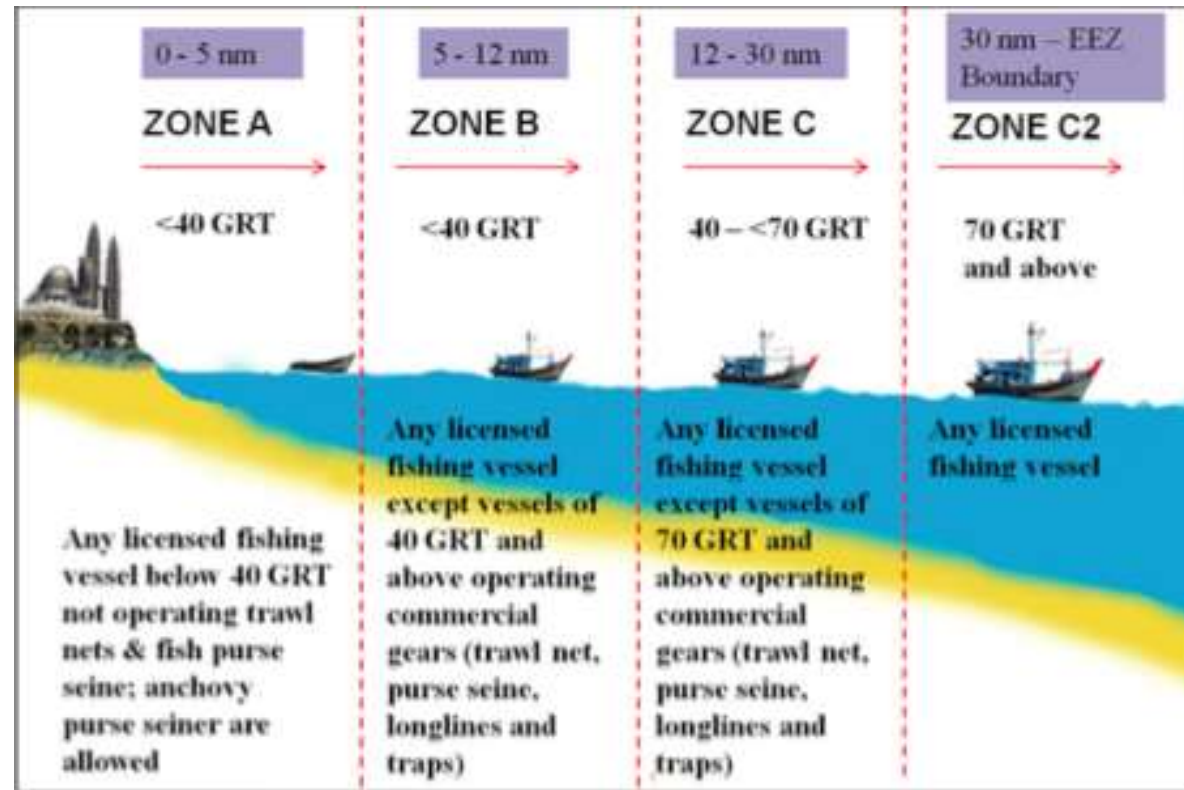


Figure 10. Fishing zones in Malaysia.

Fishing is only permitted after obtaining a fishing license with a series of requirements from the Department of Fisheries (DOF). The license is individual and non-transferable, but it used to be heritable. The

license is valid for one year, whereafter the fishermen has to apply for its renovation one month before it expires. The maximum age to apply for the license is 60 years old. There are three types of fishing license (Table 1).



Figure 11. Map of fishing route.

Data collected from the questionnaires, the PRA sessions with the fishermen and the SSI with one of the members of the fishing association, provided information about the ownership of the productive assets (fishing gear and boats) and regarding to the fishing techniques. The fishermen in Tebelu use a variety of fishing gear such as gill nets, bag nets, hook and line, trammel nets, lift nets

and traps. Different fishing techniques are used such as Pukat Hanyut (gillnetting) and Pukat Berpundi (barrier nets). There are various types of gill nets that can be used with mesh sizes ranging from 2.5 to 5 inches. According to the seasonal variability of the different species, fishing nets with different mesh sizes can be used to match the size of the desired species.

Table 1.

Fishing license		
NKRA	SF1	SFS1
Small boats	Big boats Diesel Sea	Small boat Petrol River

It was possible to participate in a fishing trip in order to get familiar with the fishing procedures. The objective of the trip was the capture of red prawn (Payak Merah) (figure 12). The fishing routes were tracked with GPS during the fishing trip to locate where the fishermen set up their nets to contrast the information from the resource mapping. It was possible to observe where they catch and sell the different species and for what purpose. This will be further discussed in section “The commodity chain of fishing”.

Several conclusions could be drawn from this experience:

- The small mesh size of the fishing net implied that young and non-commercial marine species were captured and died in the nets.
- The A-license SF1 boat needed to be operated by three fishermen and were handmade with local wood.
- The size of catches depends on the boat size but usually ranges between 100-400 kg of prawn per fishing trip.

3.2.2. Traditions and cultural “self-perceptions”

When arriving at Tebelu, observations pointed out that fishing plays a key role in the daily life of the villagers. There were fish drying racks outside almost every household and nets and other fishing equipment underneath approximately every third house. Subsequently, the purpose of those nets was confirmed as fishing nets by villager 3.

Furthermore, every time a question was raised regarding the proudness of the fisherman profession, the response came prompt; yes, they are proud to be fishermen (Villager 2, villager 4, member of Sebuyau Fishermen Assosiation). Villager 2 said that he is a fisherman because he finds it interesting and because it is his passion. He developed interest in the profession as a kid when he helped his own father on the fishing boat. This strengthens the assumption that fishing in Tebelu is a culture that has run in families for many generations. Villager 2 also stated that he would choose to be a

fisherman even if he got offered another full time job with a better salary and he said: *“I would not quit fishing for another job”*. The results from the SSI with Villager 3 provide support to the theory that fishing has cultural and traditional transcendence in Tebelu. His household earns most of their money and food from his job as crewman on a boat which fishes prawns. However, he does own some land near Tebelu that he wishes to rent out to FELCRA in order to earn more money and in that way increase the living standard of the household. When asked if he would quit fishing if he ever got to earn enough money to increase the living standard of the household he responded: *“We do not only eat vegetables! We would still need protein”*. He was furthermore asked if he would stop fishing in case he would earn enough money from FELCRA to buy his protein, but he still said that fishing is his passion and he would not stop it for anything. Another interesting point from the SSI with Villager 3 was that he would be disappointed if his two sons did not

grow up to be fishermen. However, he acknowledged the risk that the increased amount of income derived from FELCRA could have on his sons' preferences when choosing their own occupation.

The triangulation with the observations, questionnaires and SSI's respectively, concludes that fishing plays a major role in the culture and traditions of Tebelu and that the fishing profession is perceived as a preferable profession among the respondents.



Figure 12. Participating in a fishing trip.

3.3 Land use

Before arriving at the field site, preparational reconnaissance on maps was carried out. Most of the area around the village of Tebelu was pre-categorized as plantations. This presumption showed out to correspond with the findings of the research in the field. However, the questions arising with this were the following: what crops are growing on the lands, who owns it and how does it affect the livelihoods of the villagers.

The results from the questionnaires showed that 7 out of the 39 households participating in the survey owned agricultural land and that the average size of the lots were 3.2 acres.

3.3.1 Agricultural threats

With the observations of the bund encircling the village and protecting it from floods new questions arose regarding the effect of the

floods on the agricultural lands of the households. The result from the questionnaire survey showed that out of the 7 households owning land, 5 manifested to be affected by floods in the past. This was further elaborated during the “Resource mapping” PRA session where the Villager 7 provided spatial information regarding to the land use around Tebelu. He pointed out two areas where most of the agricultural lands owned by the households were located (Figure 11). He also explained how the agriculture on A1 was not affected by floods, whereas A2 (where his land is located) is very affected by sea floods and consequently by salt intrusion. This could help explain why not all of the questionnaire respondents replied to be affected by floods. Villager 7 said that he used to grow coconuts on his land, but that the salt has impaired the yield; *“My coconut is so small”* he said. Before the flood he used to spend one week farming and one week fishing respectively. Now, because of the bad yield, he is working full time as a fisherman. However, he explained

that his income was better before, when using both fishing and agriculture as livelihood strategies. Furthermore, he explained that the bund by A1 is intact whereas the bund by A2 has been damaged by a flooding accident in 2009. This was also confirmed by the former headman. An interesting point from the PRA session is that Villager 7 pointed at the area where the mangrove is missing from A2 and said that the mangrove has been cut in order to build the bund (Figure 11). Both mangrove and bund are intact by A1, which could indicate that the mangrove provides a stronger protection together with the bund than just the bund alone.

The “Matrix ranking” PRA sessions regarding to crops revealed other threats towards the agricultural practices around Tebelu. For example, papaya has a lot of fruit but a bad net yield because of squirrels and rot. Furthermore, the participants stated that oil palms are easily affected by termites and accordingly they are using pesticides to prevent such attacks.

The triangulation using observations, SSI with Villager 3 and the PRA sessions with both resource mapping and matrix ranking with crops concludes that floods affect the agricultural land of some households which might affect their income and livelihood strategies. Furthermore, it can be stated that the mangroves provide protection against floods from the sea.

3.3.2 Oil palms and future plans

From the data obtained from the questionnaires it was possible to identify those farmers that were involved in oil palm plantations. During a PRA session on crop seasonality, two farmers involved in palm oil plantations were able to verify that these plantations bring the greatest revenue in comparison with the other crops. They used to grow watermelon, rice and corn, but now palm oil plantations are preferable because of the extra profit. Among the advantages of planting palm oil, they mentioned that they



Figure 13. Map of agricultural land done from PRA session.

are cheap to cultivate and fertilizers are only needed during first three months. As reflected from the PRA session, oil palms can be planted and harvested at any time of the year and they are not sensitive to floods. In addition, as it has been mentioned in section “Traditions and cultural “self-perceptions” one of the interviewed fishermen expressed that he is considering to be involved in FELCRA as getting involved

in oil palm plantations is regarded as an opportunity for the future.

3.4 The economics of fishing

The fishing industry of Tebelu is an important economic sector as it provides a vital source of animal protein as well as promotes rural development by creating employment opportunity. This section gives an overview of the current economic status of the fishing industry in the village.

3.4.1 The contribution of fishing to the economy in Tebelu

Fishing related activities constitute the main source of employment in Tebelu. As it has been stated above, 77% of the households that participated in the questionnaire manifested that they were involved in the fishing industry. This is a clear indicator of the relevance of the fishing sector in the village. In regard to the different sources of income reflected in the questionnaires, fishing represents around 61% of the total income of the surveyed households. The remaining 39% was represented by a wide and varied range of activities, including farming, labor work or running grocery shops (Figure 14).

However, despite the core importance of fishing for the village economy, it has been observed that other occupations seem to report a higher average salary per capita. Respondents participating in fishing

activities earned an average salary of 1061.67 RM/month*household, whereas those households that were not involved in the fishing industry earned an average salary of 1655,56 RM/month*household (Fig. 13). This result does not include the Government aid. A reasonable explanation to this evidence could rely on the nature of the different occupations engaged by the villagers who are not involved in fishing activities. Some of these include jobs as teachers or civil servants, which report a remarkably higher average income according to the questionnaires.

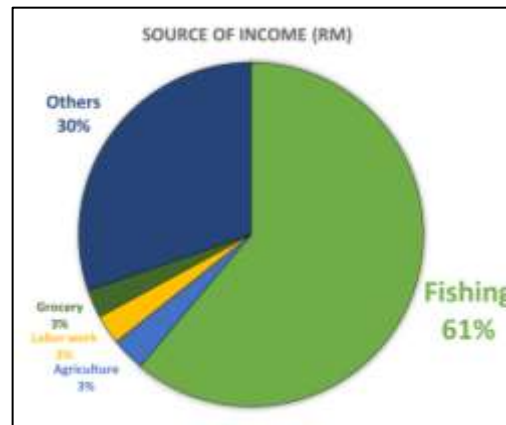


Figure 14. Different sources of income (RM).

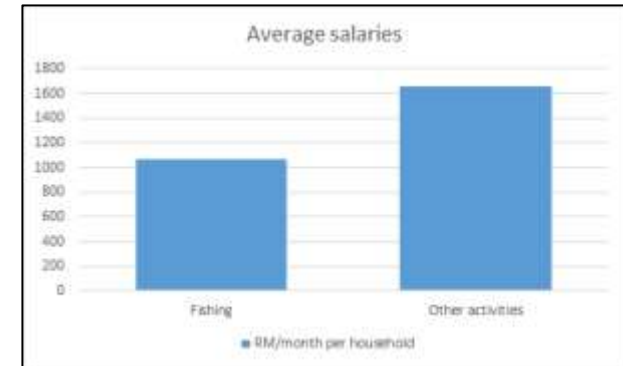


Figure 15. Average salaries of fishing and other activities.

Another relevant factor to take into consideration is the contribution of the government aid to the economy. 93% of the questionnaire participants who were involved in fishing activities acknowledged that at least, one household member received the fishing aid (figure 14). The aid consists of 300RM/month, regardless if the recipient goes fishing. According to a security guard and to the owner of the prawn factory, this has contributed to reduce the number of fishermen going to the sea, as they need less income derived from fishing activities.

Three considerations regarding to the presented data are worth mentioning. First of all, the mean incomes presented above constitute just an estimate of the average monthly salaries over the year within the households, but due to the fluctuating nature of the fishing resources, the same fluctuations are also affecting people's income. Secondly, we assumed that the answers provided by the respondents are an actual indicator of the different income sources. The presented data might miss some information due to biases based on the different nature of the facilitators (interpreters) and their approach to the same

question. Finally, we assume that the presented data represent the combined economic contribution of all the household members.

3.4.2 The commodity chain of fishing

As Ribot (1998) explains a commodity chain is the series of relations through which an item passes from extraction through conversion exchange, transport, distribution and final use (Ribot, 1998). In this section these relations are sought to be covered.

When the fishermen sorted out the species of their catch, they were able to sell the prawns directly to the prawn factory at the jetty. There were 10 people employed in the factory including the owner. Besides this, there were approximately 50 women working as daily paid workers who were in charge of processing the prawns. The amount of workers relied on the amount of

prawns, which depending on the season and weather conditions. The women could come and work from day to day as they wanted to. From these 50 women, half were living in Tebelu while the rest lived in other nearby villages. After the prawns have been processed they were sold to Seahorse Corporation S/B in Kuching. The prawn factory also imported prawns from Seahorse Corporation S/B corresponded to 5% of their production. The imported prawns from Seahorse Corporation originated primarily from Thailand or India from where they were shipped to Kuching and transported to Tebelu by trucks. According to the owner of the factory, once the prawns were processed they were sold to Sea Horse and exported to Europe, China, Japan and Korea. The factory also got some prawns from aquaculture. At a normal day, the factory got approximately 8 tons of prawns from the fishing boats. However, they could get up to 20 tons/day in the high season.

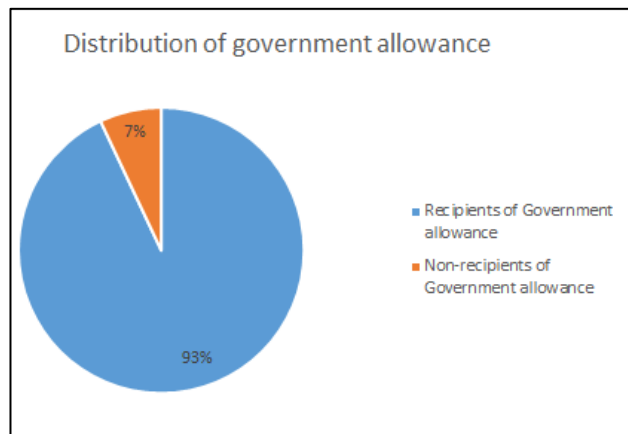


Figure 16. Distribution of government allowance.

The factory could only process up to 1.5-2 tons/day, and therefore they were selling the remaining prawns to Seahorse Corporation.

The fishermen from the fishing trip kept some amount of the catch for their own consumption. The marine species that couldn't be sold to the factory, could either be sold to the fishmongers, dried and stored or directly sold in the village or at the fishmarket in Sebuyau.

At the market in Sebuyau the villagers could sell their catch to a higher price than in the village (Table 2).

After comparing the sale prices from Tebelu and Sebuyau it is possible to observe how the value of the catch increases when sold in Sebuyau Market. However, according to a fishmonger in Tebelu it is convenient to sell the catch to him since he has knowledge of the fluctuating market prices and thereby buy at fair prices. He stated that another advantage for the villagers was that they do not have to go to the market themselves to sell their catch.

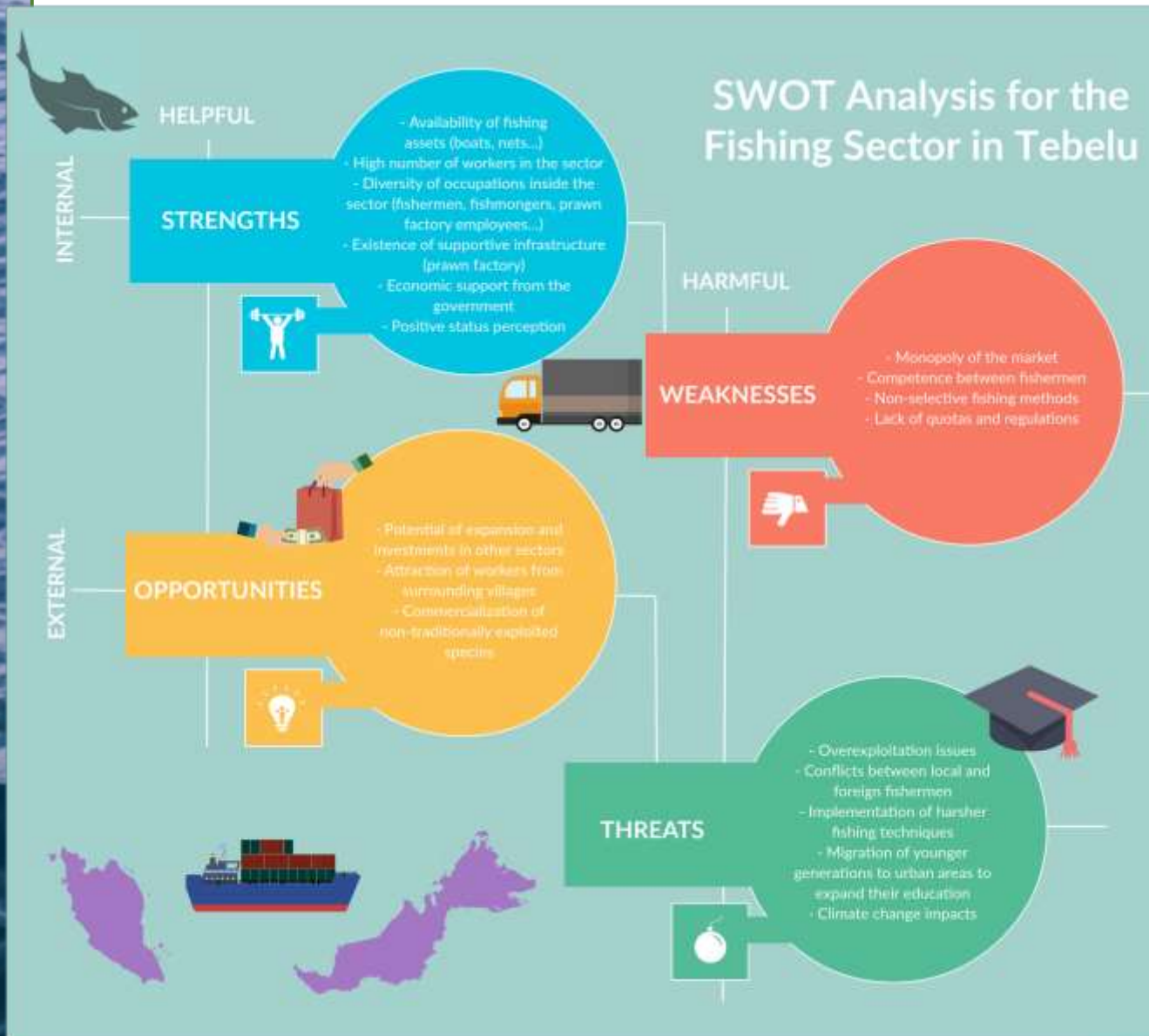
3.4.3 Economic sustainability (SWOT analysis)

The economic sustainability is typically considered as one of the three pillars of sustainable development (McKenzie, 2004). Throughout the following section, a SWOT (strengths, weaknesses, opportunities and threats) analysis will be presented and discussed in order to evaluate the economic sustainability of the fishing industry in Tebelu. SWOT analysis has been traditionally regarded as a useful tool in strategic planning (Chermak & Kasshanna, 2007) in order to search for insights into ways to achieve the desired goal (Valentin, 2001). In this project, this tool has been incorporated with the aim to include the main aspects that determine the economic sustainability of fishing in the village. The analysis is presented below (figure 17).

Species	<u>Tebelu</u> sales price (Rm/Kg)	Market sales price (Rm/Kg)
Empirang (wet)	2	7
Empirang (dry)	3	8
<u>Gongeng</u>	3	7
<u>Lumek</u>	4	7
<u>Terubok</u>	10-15	18

Table 2: Price comparison between Tebelu and Sebuyau market

Figure 17. SWOT analysis.



Consistently with the SWOT analysis, it is possible to observe that some of the main strengths of the fishing industry include the existence of a supportive infrastructure and the availability fishing gear. Indeed, the owner of the prawn factory is well known for contributing to the repair of the villagers' boats and to the acquisition of new parts if needed. This contributes to generate a positive feedback that ultimately leads to the creation of better conditions for becoming a fisherman. Moreover, the government aid provides an incentive for people who want to take up fishing activities. The diversity of occupations inside the sector and the self-perception of the villagers as an honorable occupation also contribute to strengthen the development of this activity.

Regarding the main weaknesses of the industry, the monopoly of the sea

products market by only one company in Tebelu could be regarded as a potential factor of risk. Moreover, the lack of quotas and the use of non-selective fishing techniques might enhance the episodes of competition between fishermen for the fishing resources.

In terms of the opportunities of the sector, it seems that the welfare generated by fishing activities has the potential to be invested in expanding the fishing industry, or in other sectors. The prawn factory also constitutes an opportunity for inhabitants of neighbor villages, as it is regarded as a source of employment. According to the owner of the prawn factory, there are no current plans of expansion. Nevertheless, he manifested that he is involved in other business related to construction and development. Also, during the fishing trip, it was possible to observe that a

considerable number of the captured fish species were discarded. However, the discarded fish could hold a commercial value which could represent a business opportunity in the future.

Finally, taking the most relevant threats of the fishing industry into consideration, it is possible to see that overexploitation is one of the potential factors of risk that is putting the fishing-related activities under menace. The future development of more modern and more intensive fishing techniques, in combination with competition issues with non-local fishermen might lead to a depletion of the resource. According to one member of the Sebuyau fishermen association, some inhabitants of the neighbor villages are starting to rent their boats out to foreign crewmen coming from different countries (Vietnam, Indonesia...) who are starting to fish in the same area.

Furthermore, he also claimed that big vessels using bottom-trawling have been spotted in the same area where he has been fishing during decades. In addition, the expected increased effects of climate change and the migration of younger generations to urban centers in order to expand their education constitute other potential threats to the fishing industry.

In conclusion, it could be stated that despite the fishing industry presents a solid support and good short-term prospects, in the mid and long-term the economic sustainability of this sector might be directly affected by the depletion of the marine resources.

3.5 Diversification and importance of other livelihood strategies and their complementation with fishing

Throughout the present section, the importance of other livelihood strategies and their complementarity with fishing will be presented and discussed in detail.

Data from the questionnaires provided basic and descriptive knowledge of the diversification of livelihood strategies within the village. As an example, out of the number of respondents from the questionnaire involved in fishing activities, 47% are involved as well in other activities (Figure 18).

Since the respondents replied as either from a personal view or the whole household, the information from the households could be biased. For example the main occupation might change due to seasonality or from

person to person. For this reason, more detailed information about other livelihood strategies was preferable, and therefore several households from the questionnaires were selected for SSI's. This improved our knowledge about the livelihood diversities within the different households.

One respondent from household 1 where 3 families lived together stated, that when he does not go to the sea, he did labor work and repaired boats. The household could collect wood around the village for smaller repairs such as their drying racks. Otherwise they

bought larger pieces of wood from a wood store.

For food consumption, they usually bought supplies from the market. However, they also collected snails, crabs, cassava and sayur midin (local vegetable) from the shore or nearby villages, which was described as a normal thing to do by the villagers in Tebelu. This was also confirmed by a member of household 3. The household number 2 also did home gardening and grew sugar canes, pumpkins, chilies, bitter gourd and long beans. In case there was an excessive amount

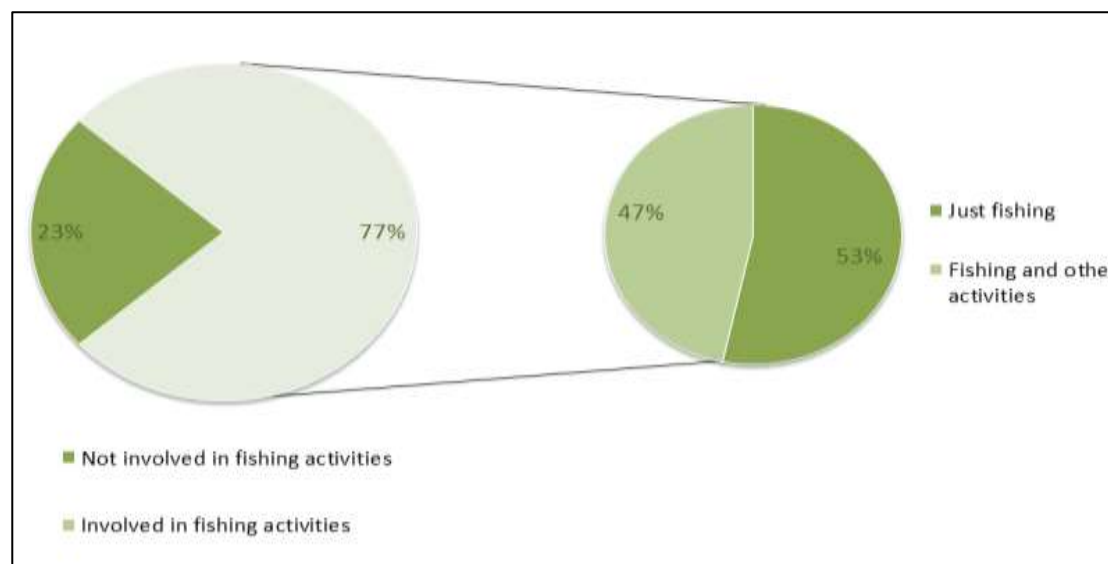


Figure 18. Respondents involved in fishing and other activities.

of the things mentioned above, they would sell it or give it to the neighbors. The entire household contributed to pay the bills.

Household 2 consisting of 5 people presented a similar livelihood diversification. The son was a fisherman, and he also repaired boats while receiving the aid from the government. 7 years ago the mother joined FELCRA and has rented out her titled land on a 20 years contract. She received revenue 3 times a year. Regarding to the bills, they were paid by all the household members. From this evidence it is possible to acknowledge the complexity that each household consists of. They typically include several members involved in different activities that contribute to a shared economy. For food consumption purposes, the family either bought vegetables from the Sebuyau market, grow them themselves or collect them from the roadsides. They had two farms, but only used one of them. They grew coconuts for selling and gathered food for consumption during the wet season.

Collecting and conservation of snail and crab for food consumption was stated as very important for the household.

It becomes also important to mention that 60% of the questionnaire respondents manifested to do home gardening (Figure 19).

The household 2 stated in the questionnaires that they did not do home gardening. However in a SSI they claimed the opposite. An explanation to this could be, that the respondent did not understand the questionnaire or that they did not see their home gardening products as important compared to the main resources of the household. From the questionnaires the most frequent species for home gardening were chili, onion, cassava, coconut and mango (Appendix VI). These and other species were consistently used for both own use and selling.

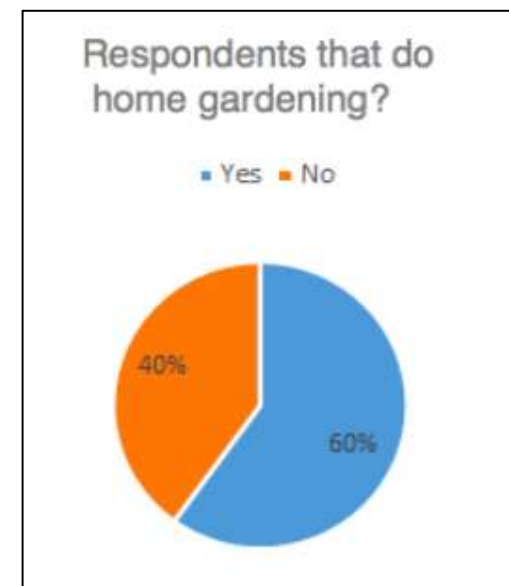


Figure 19. Households doing homegardening.

3.5.1 The influence of seasonality on fishing and other livelihood strategies

The data presented above shows that the diversifications of livelihood strategies are important for the individuals, families and therefore, for the households. In the present section the importance of seasonality will be discussed.

To assess the importance of crops, a seasonal calendar and a preference ranking were

conducted (Appendix VI) and combined afterwards (figure 20). The score of the preference ranking (income, production, food consumption, labor, market value and vulnerability) was combined with the yield data from the seasonal calendar and afterwards categorized. This suppressed the individual score, but also assisted us to get the overall importance of the different crops throughout the year. Three informants were present during the PRA session including a fisherman, a farmer, and the son of a woman involved in FELCRA.

The results revealed that the importance of each crop was dependent on its own seasonal variation. On the other hand, they were able to sell coconut throughout the year and oil palm plantations were seen as very relevant, since one of the respondents was member of FELCRA.

The importance of fish was evaluated in the same way as above, combining the species seasonal calendar (Appendix VII) with a

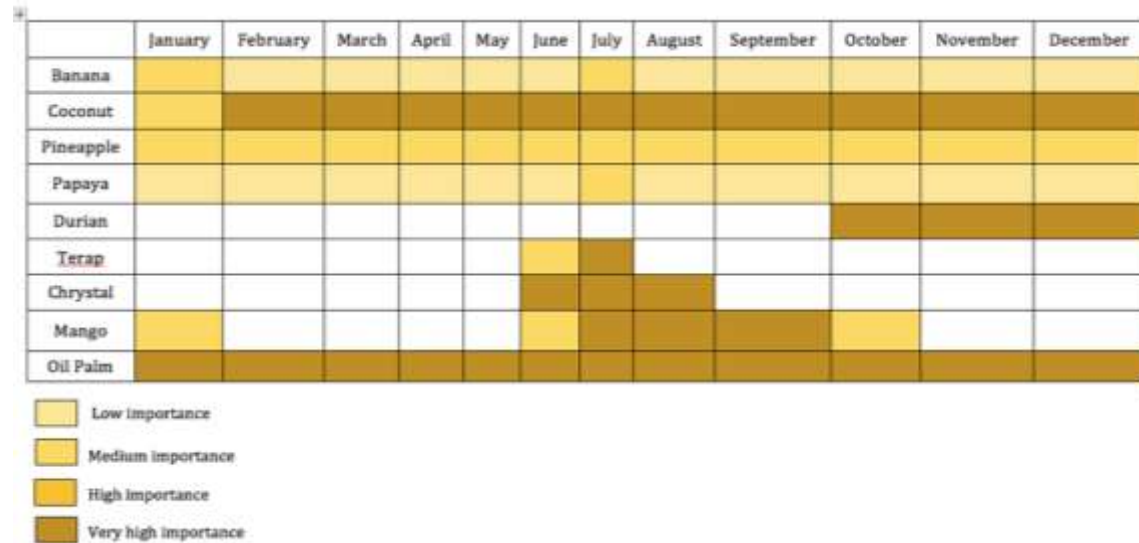


Figure 20. Seasonal calendar and importance of crops.

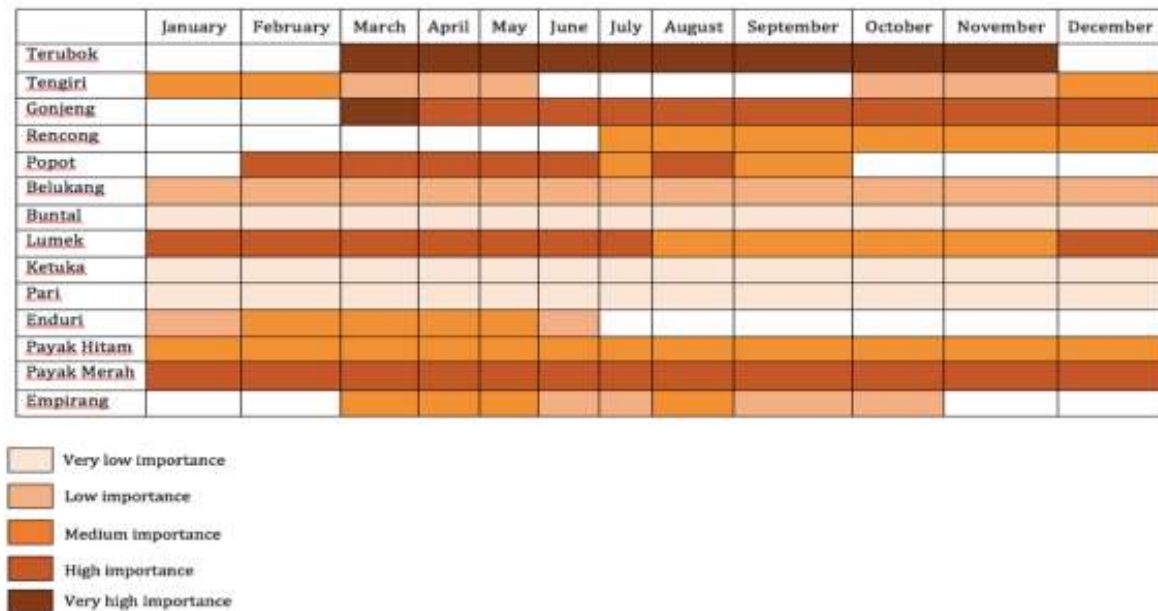


Figure 21. Seasonal calendar/importance of fish species throughout the year.

preference ranking (Appendix VII) of the most important commercial species (Figure 21). The results show the months in which the fishermen were able to catch the different species and their specific importance. The top five species included terubok, gonjeng, popot, lumek and prawns (payak hitam and payak merah). The results also indicated that most species are present from March to October, which correlates with the overall landings of fish in Sarawak (Portal Rasmi Jabatan Perikanan Malaysia, 2015) (Appendix VII). On the other hand, the months of December, January and February presented a reduction in the number of caught species.

For further examination of the diversities of livelihood strategies within a household, a seasonal calendar and matrix ranking was conducted (Figure 22). The household's income was primarily from fishing both in the dry and wet season.

The results show that the livelihood activities complement each other throughout the year.



Figure 22. Seasonal calendar and importance ranking within a household

In the dry season (March to October) the household's primary livelihood strategy is fishing and during this period they also catch fish for selfconsumption. The household members stated that during the wet season they still practiced fishing, but not as often as in the dry season. This correlates with the questionnaires expressing the frequency of fishing were higher during the dry season (Apendix 3). This evidence is also supported by a Chi-square analysis that reveals that there are significant differences between the frequencies of fishing between both seasons

($p < 0.001$). A structure plot has been used as a summary (Appendix 3). They also did home gardening (Coconut, spinach, banana) and they grew vegetables and fruits for selling and self-consumption. Besides this they bought vegetables at the market. In the wet season they supplemented their income with other activities such as massage therapist or labor work.

According to the presented data, it is possible to state that the villagers adapt their livelihood strategies to the seasonal

fluctuation of the resources. Therefore, the strategies were diverse. The exploitation of other resources was more prevalent when the fishing resources were not available.

3.5.2 The role of other livelihood strategies within the household

Rural households are the main social unit in the sustainable livelihood framework (Ellis, 2000). However, it is important to notice that there can exist different strategies within each household due to different families and individuals. Therefore in our results we often see a mix of different livelihood strategies.

According to Ellis (2000) the individuals within a household are likely to be constrained by the households livelihood strategies. As the main occupation in Tebelu is fishing and 77% of the households are involved in fishing, this might contribute to the answer of why fishing is so important. As

respondents stated that they were proud of being fishermen, this perception might be transferred to the next generations in the household. However, as mentioned according to the former headman and the owner of the prawn factory, the next generation would rather seek other opportunities than fishing due to higher educations.

The livelihood framework approach is a useful tool to understand the importance of the options and strategies the villagers adopt. Despite this, a general analysis of the livelihood strategies in Tebelu can be difficult to make, because the assets and compositions differed very much within each households.

3.6 The sustainability of the fishing industry

The term sustainability refers to the quality of something being maintained over time. This is why the future potential of the fishing

industry relies on a proper balance among the different dimensions of sustainability. These will be described and discussed throughout the following sections.

3.6.1 Missing quotas and catch yields

When conducting data in Tebelu, the impression of the gradient of the marine resources exploitation, giving by observations and interviews, was coherent. As mentioned the primary methods of catching fish is non-selective. This made it difficult for fishermen to avoid catching threatened or young species and hence also to avoid contributing to the fish decline. An observation and informal talk with a villager, who displayed the fish he just bought, showed no critique towards the species he traded, which included baby sharks. According to Dulvy et al. (2014) every third shark species is in risk of extinction. Since the villager did not know what species the shark belonged to, it is assumable that he did

not take any precautions regarding any overexploitation issues. The same impression was giving on the fishing trip; every catch was pulled onboard, saleable fish was selected whereas the rest were thrown away. When asking a member of the Sebuyau fishermen association about any quotas there might be regarding the catch of fish in Sarawak he replied that there exist no regulations. The same response came from Villager 2 who said there are no regulations he has to follow other than fishing within allowed fishing zones. The PRA session with mapping the fishing routes did however show a conservation zone in the sea outside Sebuyau. The participants explained how a fisherman from Tebelu was not allowed to fish here, and that fishermen from Sebuyau fishing in the area had to use special equipment to avoid catching young fish. Malaysia is committed to fulfill the 'FAO International Plan of Action for the Management of Fishing Capacity' and the Malaysian government has developed approaches in the attempt of managing the

fisheries resources (Department of fisheries Malaysia, 2015). However, none of those management strategies includes quotas and hence the fishermen are allowed to fish "unlimited". When three fishermen in the village were asked, if they are catching more fish now compared to years before, all replied that the catch has decreased. Villager 2 said that it is his impression that the catch of prawns has decreased 50 % over the last 10 years because "*there are too many nets*". This presumed tendency of fewer marine resources is however not in line with research of secondary data from the Malaysian government; FAO showing that the total catch of fish in Sarawak has increased. In 1997 the total amount of landings was 128,193 tonnes (Malaysia, 2001) which had increased to 147,579 tonnes in 2015 (Portal Rasmi Jabatan Perikanan Malaysia, 2015). This could be due to better fishing techniques/equipment.

The triangulation with observations, PRA, SSI and secondary data regarding the

environmentally sustainability of fishing in Tebelu concludes that the fishing practices are not sustainable.

3.6.2 Social sustainability

Social sustainability is typically considered as one of the three dimensions of sustainability (McKenzie, 2004), but the use of this term has been neglected by being conflated with other dimensions of sustainable development (Vallance et al., 2011). According to McKenzie (2004), social sustainability is "a life-enhancing condition within communities and a process within communities that can achieve that condition".

During the present study, we have considered a range of different physical and non-physical factors that determine the social sustainability of the fishing industry in Tebelu. These include aspects as democracy, education or decent housing (Dempsey et al., 2011). Throughout this section, the main aspects of social sustainability are detailed and discussed.

Regarding the physical factors of social sustainability, during the observation process carried out in the village, it was possible to observe that the majority of the villagers had access to a decent house. According to results from the questionnaires, 95% of the participants revealed that they had access to water systems and electricity. Furthermore, some villagers expressed that they received housing aid from the Welfare Department. In addition, the village is crossed by a new road that communicates the jetty with the main road that goes to e.g. Kuching. Before the construction of this road, the main access to the village was by boat. In words of the former headman, this might be due to the traditional support to the government from the villagers. As a result, the government has invested in Tebelu; for example the inner bund which has secured the village from sea floods since it was built in the 1990s. However, the interviewed security guard claimed that the government has not accomplished its promises in terms of contributing to the urban development of the

village. He complained about the government only doing something when the electoral period was close.

In terms of the non-physical factors of social sustainability, after the analysis of the questionnaires we observed that 28% of the respondents manifested that they did not receive education, and further 31% just completed primary school (Figure 23).

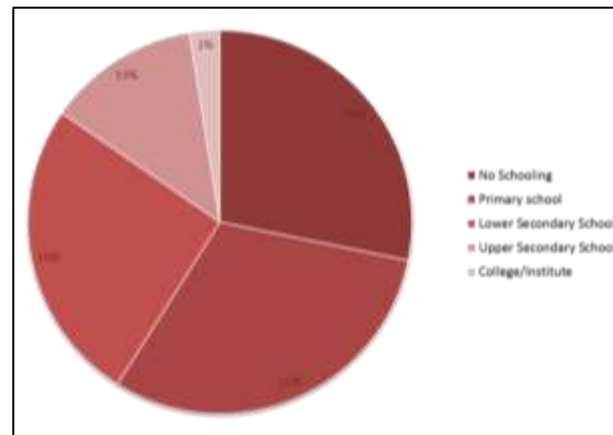


Figure 23. Distribution of education

This might represent an indicator of the low education level of the inhabitants of the village. In regard to other aspects of social

sustainability such as equity, it is possible to infer from figure 8 that there are big inequalities between the mean salaries of the richest and poorest inhabitants of Tebelu. However, the majority of the respondents answers are distributed around the mean salary. The democracy level in the village was also explored. We identified a significant lack of consistency among different respondents. The first thing that called our attention after our arrival to the village was the discovery that the former headman of the village had recently resigned his position due to medical issues. Thus, the decision making process was performed by the counsellors of the JKKK, an exclusive group formed by a reduced group of villagers. Some of the members of the group manifested that the actual reason of the headman resign was the lack of support by the villagers, as according to them, he was chosen by the government, and no by the locals. They referred to issues related to “uneven distribution of land titles”. Moreover, this hypothesis was confirmed by

the security guard. However, he also pointed out a lack of transparency in the decision making process of the JKKK. He claimed that his father and him used to be members of the same committee seven years ago, but resigned after being unable to make changes towards a more democratic management.

In conclusion, it seems that the social sustainability aspects could influence the future of the fishing industry, as it directly relies on the sustainable development of the village. On the one hand, it can be stated that the physical factors of social sustainability seem to be able to provide a solid support to the fishing industry, as the village is developing and improving its infrastructure. Nevertheless, on the other hand some of the non-physical aspects of social sustainability might contribute to put the fishing industry under threat. Inequality issues, a low education level and the lack of transparency in the decision making organisms, may lead to conflicts of different nature that could

directly or indirectly affect the future of the fishing industry.

3.6.3 Ecosystem quality

As it has already been mentioned in the introduction, many studies highlight the importance of mangroves for marine and estuarine ecosystems. This is mainly due to their role as nurseries and breeding grounds for different types of fishing resources (Hoque et al., 2015), including a wide range of shrimp species (Shukor & Hamid Bin, 2004). Some articles have revealed correlations between the areal extent of the coastal mangrove forests and the offshore prawn catches (Turner, 1977) which could imply a reliance of prawns on mangroves during their early life stages (Hatcher et al., 1989). Other projects carried out in the coastal area of Selangor, Malaysia, have shown that prawns and fish captured offshore and inshore, presented an average 65% and 60% of mangrove-derived carbon respectively in their tissues (Rodelli et al.,

1984). Thus, this evidence seems to indicate that different species make an active use of mangrove forests resources. Therefore, during the present project we aimed to assess the status of the mangrove forest in Kampong Tebelu in order to get some insights about the potential implications for the populations of commercial marine species exploited by the locals.

For that purpose, we performed different approaches described in the “Methods” section. Firstly, we aimed to investigate the water quality parameters of both sites, which included salinity or pH among others. Unfortunately, the data recorded from the “disturbed” site was heavily affected by marine water intrusion due to its proximity to the sea. Moreover, the relative high speed of the tidal cycle prevented us to collect samples at similar times, which could have influenced the activity of some parameters. Hence, we have not been successful to elaborate a consistent analysis of the water quality.

Secondly, we also expected to carry out a biodiversity assessment, selecting some key species as indicators of mangrove quality. However, the muddy terrain of the sites made it unworkable so this practice was also discarded. Nevertheless, despite the limitations of the study we were able to perform observations that might hold some meaning in terms of evaluating the quality of the ecosystem:

The river and its surroundings were full of organic and inorganic garbage. The villagers seem to use the river as their rubbish dump, which might be having an impact on the water quality.

There were no signs of deforestation and logging in any of the two sites.

We managed to identify some of the predominant species which are presented in table 3.

Group	Plants	Fish	Arthropods	Birds	Reptiles
Species	<i>Rhizophora mucronata</i>	<i>Periophthalmus</i> spp.	<i>Uca</i> spp.	<i>Egretta garzetta</i> <i>Todiramphus chloris</i>	<i>Crocodylus porosus</i>
Image					

Table 3. Predominant species.

The presence of these organisms could provide some indications in terms of the ecosystem quality of the mangrove forest. First of all, according to Wah et al., (2011), *Rhizophora mucronata* is most predominant in non-disturbed mangrove areas, although it also can appear on disturbed sites. Besides this, mud crabs (including *Uca* spp.) are regarded as typical inhabitants of mangrove dominated ecosystems (Walton et al., 2006) who dig burrows that enhance water recycling and nutrients exchange.

This, in combination with the presence of other common inhabitants of estuarine ecosystems may suggest that the mangrove

forest does not seem to be heavily degraded by anthropic activities. In any case, due to the lack of consistent results, we only can hypothesize in base of our observations. Further research is required in order to evaluate the actual state of the mangrove forest in Tebelu, while exploring the potential relationships between the mangroves and the apparent decrease in catch pointed out by the villagers.

3.6.4. Climate change

Tropical countries in Southeast Asia such as Malaysia are regarded as highly vulnerable against climate change impacts. Changes in the frequency and intensity of tropical cyclones (Knutson et al., 2010), the rise of sea-level (Ellison, 1993) and the increased frequency of droughts and floods (Chiew et al., 2013) are some of the major threats.

Narrowing down to our case of study, it seems that potential sea-level rises and floods are the main factors of risk. As Tebelu is a coastal village; therefore, changes in the sea level might lead to harsher floods. Indeed, according to the owner of the prawn factory, the factory used to be closer to the river shore, but due to a rise of the water level it had to be moved inland. Sea level rises also constitute a threat to the mangrove forest, which constitutes an effective barrier against tropical cyclones. It is estimated that between the years 1980 and 2000, at least 35% of the total mangrove forests area has been lost (Valiela et al., 2001). Thus, it

seems that climate change is likely to directly affect the different livelihood strategies of the inhabitants of Tebelu.

Hence, some adaptation measures have been implemented in the village. The construction of the bunds close to the river shore was carried out as a protecting shield against floods. According to one of the oldest villagers, since the construction of the bunds the village has not been inundated again from sea level rises. Nevertheless, floods derived from heavy rainfall have still been prevalent in the village. According to the headman and the villager that participated in the resource mapping, the flood of 2009 is regarded as one of the harshest of the last decade. So the bunds seem to represent an effective barrier against sea level rise derived floods although one of them was built at the expense of the mangrove forest that was logged to get the construction materials.

However, despite the construction of the bunds the villagers did not result to be

worried about the potential impacts of climate change. In addition, after being asked during the semi-structured interviews, the respondents did not acknowledge a significant increase in temperature, rainfall discharge or flood frequency over the years.

Therefore, seems that climate change is not regarded as a significant threat by the inhabitants of Tebelu. Nevertheless, it is likely that its future impacts could affect heavily the livelihood strategies and security of the villagers.

4. Limitations and reflections

This report is a result of collaboration between numerous academic disciplines and therefore diverse approaches to conducting academic research. The language barrier was one of the main challenges. The fact that we do not speak village dialect and had to rely entirely on translation, making information alterations and losses unavoidable. Sharing information and data with the counterparts was indeed vital to our study since the language barriers prevented us in getting all the informations during the conducted methods such as interviews and PRA sessions. Generally the social science methods worked out very well, however, it was a mistake that we did not put in questions regarding the environment in the questionnaires. Due to the limited time we had in the village, we were only able to investigate our research questions to a certain general level.

5. Conclusion

After the analysis and discussion of the main results, it is possible to conclude that fishing constitutes the most important livelihood strategy in Tebelu from an economic and sociocultural perspective. It plays a core role in the village's economic activity and also on its culture and traditions, being present in many aspects of the daily life. This is especially relevant between the months from March to October, where the fishing resources are abundant. However, other livelihood strategies showed a relevant importance during the remaining months of the year as an effective complement to the fishing activities. This combination of occupations also implied a diversification in terms of gender role, as men mainly worked as fishermen, whereas women were in charge of other duties, such as salting fish or working in the prawn factory. In regards to the sustainability of the fishing industry, the

future prospects of the sector might be under threat. Despite the fact that the fishing activities presents a solid base and external support, issues such as more intensive and non-selective fishing techniques seem to be leading to a decrease of the catches. Furthermore, other related aspects such as the migration of the younger generations to bigger urban centres in combination with a lack of democratic procedures in the village's decision making process, might affect the sector in the mid and long term. Ultimately, other issues as the contribution of the mangrove forest to the maintenance of the fishing populations remain unknown.

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Appendix I. Table of applied methods

Transect Walk	03.03.2017	To get familiar with the village and the overview of the infrastructure provided in the village	NA
Social Mapping	09.03.2017	To provide baseline for planning, implementation, monitoring and evaluation of village development activities	6
Questionnaires	04.03.2017	To provide basic information and identify key informants in the village	39
Semi Structured Interview (SSI)	05-07.03.2017	To engage the community members in a conversation relevant to their community.	21
Seasonal Calendar	07-08.03.2017	To observe the distributions of abundance throughout the year	Fishing – 6 Farming – 3 Household - 3
Preference Ranking	07-08.03.2017	To analyse social and economic preferences for livelihood activities	Fishing – 6 Farmers - 3
Water Sampling Quality	10.03.2017	To indicate the state of ecosystem and therefore the potential status of fishing	NA
Resource Mapping	09.03.2017	To identify the important resources in Tebelu and its surroundings.	3
Matrix Ranking	07,10.03.2017	To identify and learn the importance of the different species (fish & crops)	3
Focus Group	10.03.2017	To provide in-depth information regarding livelihood activities	2
Triangulation	NA	To get validation by looking at things at different angles	NA

Appendix II. Questionnaire Survey

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 specify*: _____)
5. Education level : ☐ No Schooling ☐ Upper Secondary School
☐ Primary School ☐ College/Institute
☐ Lower Secondary School ☐ University

Section B: Household Information

6. Number of members in the household: _____
7. Number of dependents: _____
8. Any family member/s left the village/migrated? ☐ Yes ☐ No
9. Any household member working : ☐ Yes ☐ No
10. What is the main livelihood activity:
☐ Fishing ☐ Agriculture ☐ Others (*Please specify* : _____)
11. How much do they earn (*approximately*)? RM/month _____

Section C: Residential Information

12. House ownership : ☐ Own house ☐ Rental
☐ Lodging with relative or other family
13. Water supply : ☐ Treated water ☐ Well
☐ River ☐ Rain
14. Power supply: ☐ Electric ☐ Oil lamp
☐ Generator ☐ Others (please state) _____
15. House phone : Have ☐ Don't have ☐
16. Mobile phone: Have ☐ Don't have ☐

Section D: Job and Income/ Land Ownership & Uses

Agricultural Sector

17. How much land area do you have:

Uses	Land area (acre)
Agriculture activity	
Fallow land	

18. 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	

19. The origin of the land ownership status:

☐ Inherited ☐ Bought ☐ Borrowed

20. Do you do any agricultural activities?

☐ Yes ☐ No

21. Is the agricultural sector your main source of income?

☐ Yes ☐ No

22. How many times per weeks you do farming activities?

☐ 2-3 times per week ☐ Daily (*Hours* :)

23. Nationality of labor?

☐ Non-Malaysian ☐ Local Villagers

24. 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					
9					

10					
----	--	--	--	--	--

25. Do you do home gardening?

☐ Yes ☐ No

26. Please list the yields of your gardening plants, their uses and revenues, if any.

No	Type of crops	Own use (√/X)	To sell (√/ X)	Revenue (RM/kg)	Affected by flood (√/ X)
1					
2					
3					
4					
5					

27. Are you involve in FELCRA?

☐ Yes ☐ No

Fishing Sector

(only for respondents involved in fishing)

28. Are you involved in fishing activity?

☐ Yes ☐ No

29. Does the changes of market price affect their income?

☐ Yes ☐ No

30. Do you acquired license to fish?

☐ Yes ☐ No

31. Do you received aids from the government?

☐ Yes (*Please specify:* _____) ☐ No

32. List all of your fishing product and yields.

Type of fish	Own use (√/X)	To sell (√/ X)	Revenue (RM/kg)	Fishing Method
Sembilang				
Belukang				
Pari				
Terubok				
Sotong				
Jellyfish				

Prawn					
Crab					

33. How often do you fish during the wet season?

- ☐ Everyday
☐ Few times per week
☐ Few times per month
☐ Rarely

34. How often do you fish during the dry season?

- ☐ Everyday
☐ Few times per week
☐ Few times per month
☐ Rarely

35. How do you sell your product?

- ☐ Fishmonger ☐ Direct market

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

36. Do you have jobs that does not involve agriculture/fishing/forest product sector?

- ☐ Yes ☐ No

37. Type of occupation:

Type of occupation	Tick (√/X)
Grocer	
Labour worker	
Mechanic	
Driver	
Factory worker	
Teacher	
Others (please state)	

38. Are you involved in the work of government sector?

☐ Yes ☐ No

Section E: Ownership of Vehicles and Equipment

39. Do you own vehicles and equipment as such:

Vehicle/ equipment	Yes (✓) / No (-)	Total (unit)	Share
Car			
Van			
Lorry			
Motorcycle			
Bicycle			
Boat (with engine)			
Boat (with no engine)			
T.V			
Radio/Video player			
Refrigerator			
Fan			
Gas stove			
Computer/Laptop			

40. What is your income from fishing activity (*approximately*)?

RM/Month _____

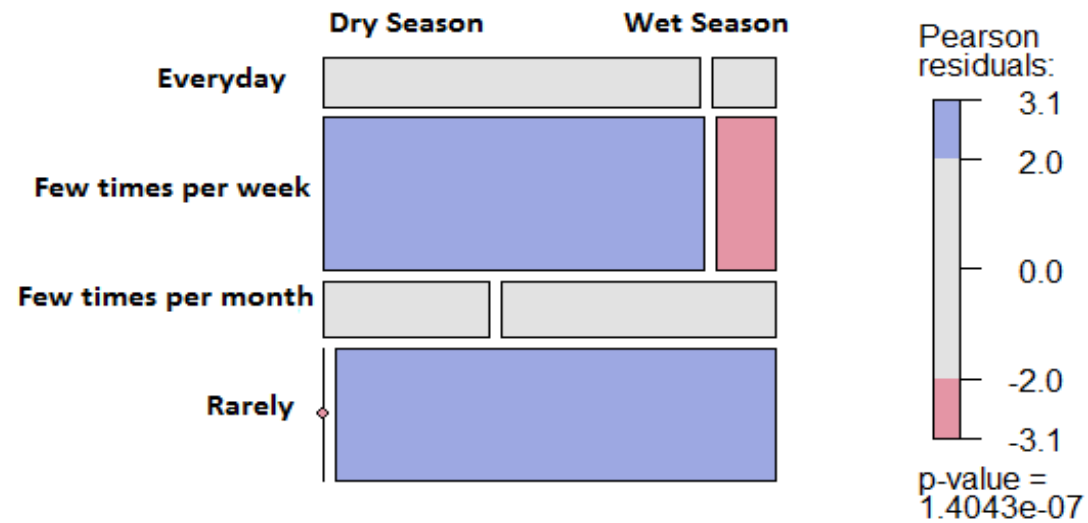
41. What is your income from agricultural products (*approximately*)?

RM/Month _____

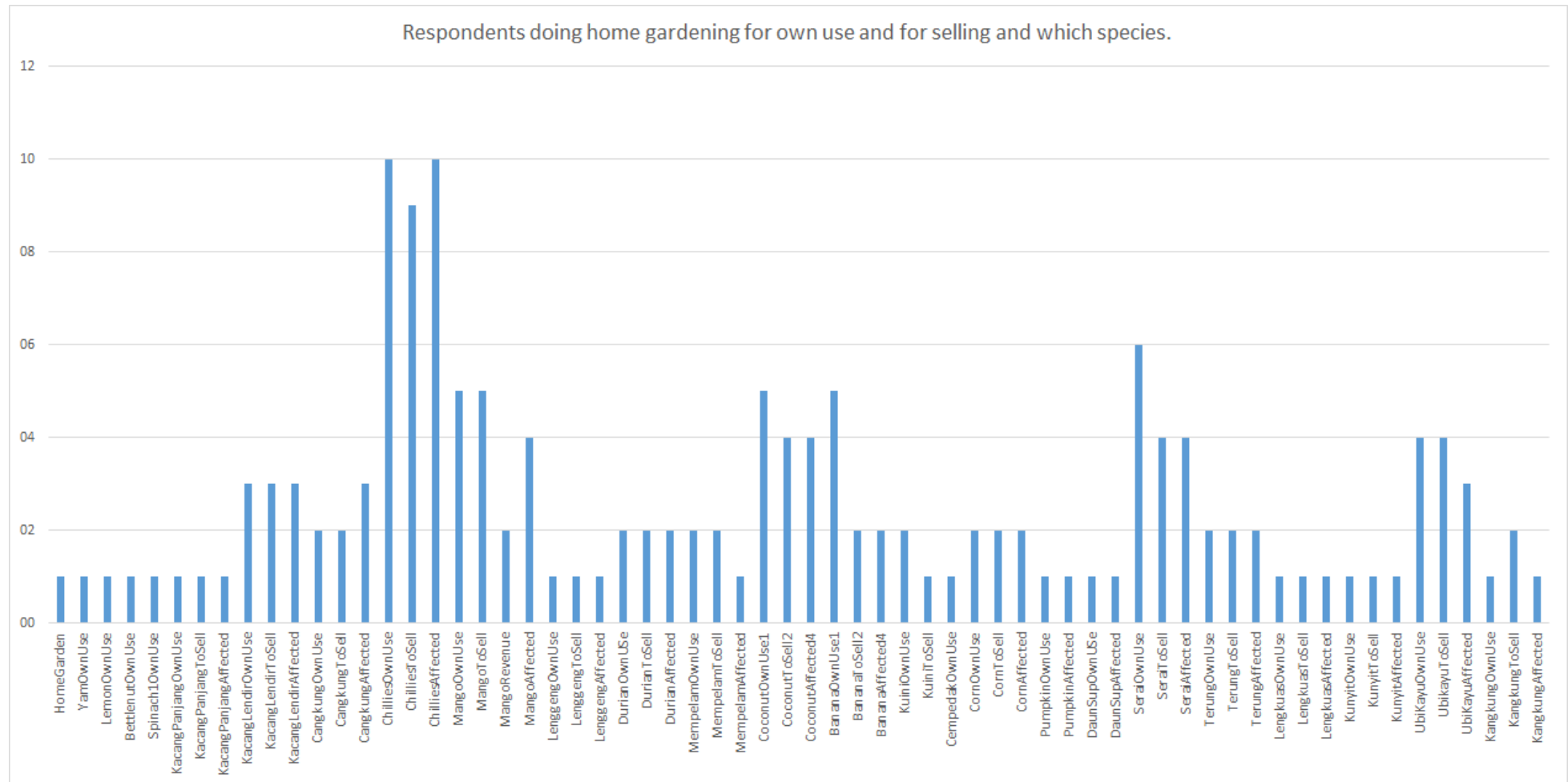
42. What is your income from other occupations (*approximately*)?

RM/Month _____

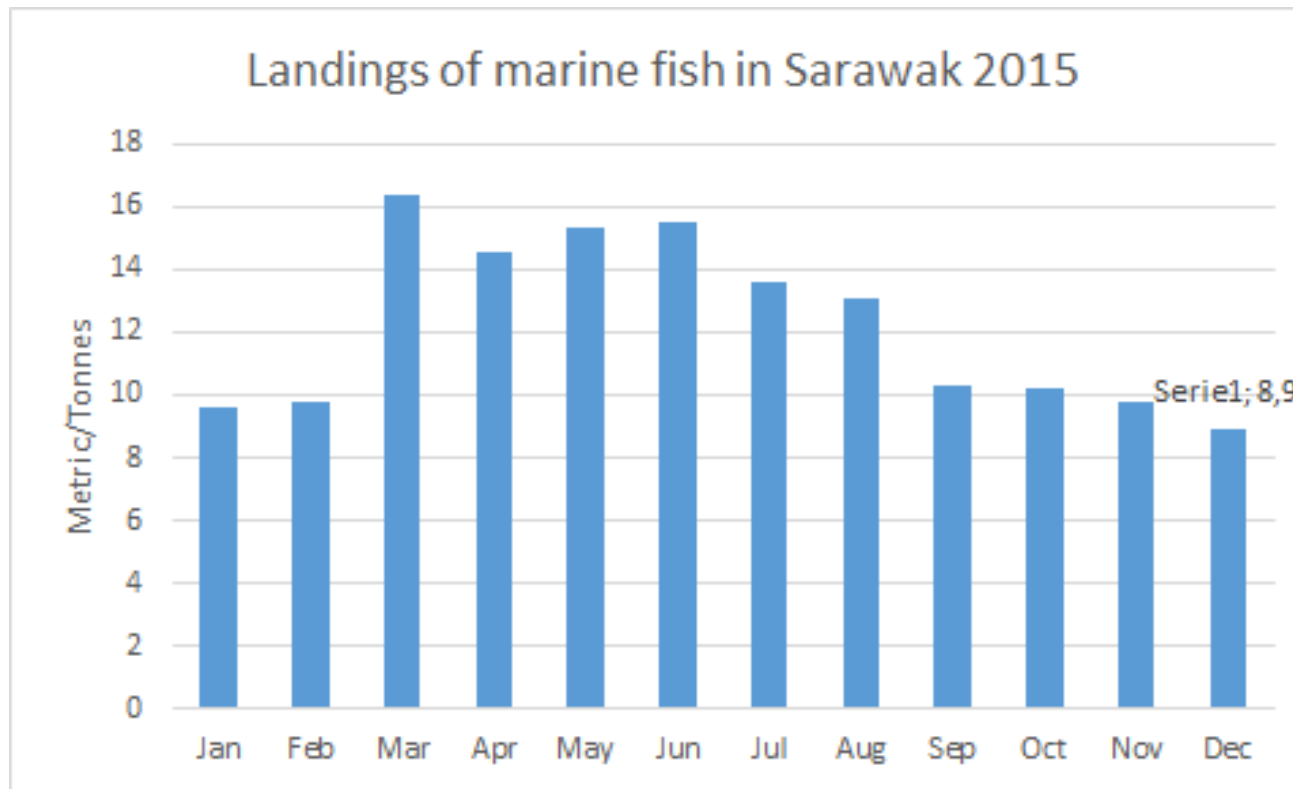
Appendix III. Graphic: Structure plot



Appendix IV. Graphic: Respondents doing home gardening for own use and which species



Appendix V. Graphic: Overall landings of marine fishing in Sarawak 2015



Appendix VI. Semi-structured interviews

- **SSI Member fishermen association:** member of board director of Sebuyau fishermen association, and fisherman himself, was able to provide meaningful information regarding to different aspects related to fishing. These included sustainability and competition, licenses, techniques and regulations. We had the chance to talk to him three times.
- **SSI Owner of the prawn factory:** businessman and owner of the prawn factory in Tebelu, gave us interesting insights about the historical context of the prawn exploitation business. He also provided us with detailed information about the factory functioning, as well as about the employees. He was a crucial informant in order to understand the production chain of sea products in the area.
- **SSI Former headman:** former headman of the village just resigned his position several weeks before our visit. He provided useful information regarding to the village structure, demography and land tenure issues.
- **SSI Villager 1:** farmer with fisherman background was able to provide a detailed explanation about the current situation of palm oil plantations.
- **SSI Villager 2:** Awak-awak/deckman who provided detailed informations about the life as a passionate fisherman and that he has had a hard time getting governmental aid even though he and his family did not have a lot of remedies.
- **SSI Villager 3:** Gave us insights about their livelihood who/which used fishing as a primary source of economic and subsistence income meanwhile other strategies as labour working was also used in the wet/off season. Furthermore we were provided with informations about the mother of the household who functioned as a housewife helping out with preparing salted and dried fish.
- **Mr. District officer:** Provided us with informations about the history of access to Tebelu over the recent years and made it clear that politicians in the district are not willing or able to provide us with legible answers regarding the procedure and criterions of getting aid.
- **SSI Villager 4:** A talkative retired fisherman with few remedies who lives with his 8 year old grandson. Provided us with interesting informations about his life story and examples of how to make a living without a permanent job. In his case, his grandson did some subsistence fishing, Mr. Amit sold dried coconuts to a man from Kuching, received some money from his children and he did some labour work whenever he was able to.

Appendix VII. Preference ranking crops

PRA: Preference ranking - Crops	Bana na	Cocon ut	Pinapp le	Papa ya	Duria n	Tera p	Chryst al	Langs at	Mang o	Gamb ir	Oil pal m
Income	1	4	2	1	3	2	3	0	2	0	5
Productio n	2	4	2	1	1	4	5	0	4	0	5
Food consumpti on	2	2	2	3	5	2	5	0	4	1	0
Labor	1	3	2	0	3	1	2	0	2	0	5
Market value	3	4	4	2	5	3	4	0	3	0	4
Vulnerabili ty	3	1	3	4	3	2	1	0	2	0	2

Appendix VIII. Water sampling results

		Disturbed site	Non disturbed site
pH	-	6,25	6,70
Temperature	°C	30,02	28,1
Dissolved oxygen	mg/L	4,73	3,70
Oxygen concentration	%	66,8	46,6
Conductivity	ms/cm	22,03	1,39
Salinity	ppt	12,00	0,65
Total dissolved solid	mg/L	1300	858

Appendix IX. Infoboxes

Infobox: Favoritism and top down aid management



While doing interviews with different households the word “favoritism” was mentioned several times. Often by people whose household seemed not to have a lot of remedies or economic flexibility. Villager 2 claimed that he has applied for money for a new house four times. Unfortunately he has not heard any response on his applications and he does not know why. He said that he has to apply to the head of the village, but as there is a lot of favoritism in the process his applications is being canceled. It is his impression that they do not like him. Villager 3 has also applied many times but has not heard anything yet. He told that some households gets aid when they are not even fishermen, while other households who really need the money, they never gets anything.

The security guard claims that some people who applies might get denied due to the way they fill in the application form and that illiterate people do not know how to fill in the forms. Because of the sensitivity of the issue, it has been difficult to get a clear answer from the former headman of the village and the district office in Sebuyau, about the criterias for getting governmental aid and why some people do not get the aid even though they have applied many times.

Infobox: The hard life of a positive fisherman



Villager number 4 is 68 years old and lives in Tebelu together with his grandson of 8 years old, in a house he has built himself. He is always smiling and waving at us even though he has had some tough experiences in his life. His wife died in 1989 giving birth to his youngest daughter. She never got to move into the new house he build. Now the house is very worn out and some places it is even possible see through the floorboards. There is also holes in the roof, but that does not matter for him because the place where they sleep is dry. He used to be a crewman at younger age but lost his license when his boat rotted away. He was very lucky to survive an otherwise tragic accident at sea when a lightning hit his boat and sat it on fire. Another boat came by and saved him just in time. The following month he spend in a hospital. He did not mind to show us his scars from the combustion. He appears different than the other men in the village because his hair is long dyed white. He gets inspiration from a Malaysian rock star. The bike in his living room is broken so now he only uses it for exercise. His grandson catch fish for them to eat and villager number 4 dries coconut to sell in Kuching.

Infobox: The role of the woman in the household



Quit quickly we found out that only the men are practicing fishing. However the women of Tebelu contributes to the households in many other ways; most of the women we talked with are seeing themselves as housewives taking care of the children, buying and preparing food, washing clothes and cleaning the house. However, women often helps the men sorting the fish when they arrive from sea in the jetty. We also observed and heard of only women who prepare the salted and dried fish. Furthermore, some women of Tebelu works at the prawn factory and contributes economical to the household. We also observed women behind the desk at grocery store and some female teachers at the school even though we are not certain they are from Tebelu.

Infobox: Non-forest products



Even though Tebelu has not got a lot of primary forests surrounding the village some households are still seeking and utilizing forest products. Villager 6 showed us his lot where he extracted glue from a tree to use in his daily life. Mr. 2.05 furthermore told us that the wooden sticks used in the fishing methods punkat hayut and punkat bundi are collected from the forests. He walks half an hour to get into the woods before finding usable trees. The participant of the PRA with resource mapping told us that he travels all the way near to Entangor to collect trees usable for the wooden sticks because the secondary forest near Tebelu does not have trees of high quality.

Synopsis - The Importance of Fishing Compared to Other Livelihood Strategies in Tebelu, Sarawak



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1 Introduction

The fishing industry has largely contributed to the uplift of the socioeconomic status of rural communities over years (Hamzah et al., 2013). This has been even more relevant in tropical developing countries, such as Malaysia (Berkes, 2001).

In this coastal country, the fishing industry is considered as a main contributor to the state's economy, being even more relevant in the Sarawak region central zones (Hamzah et al., 2013). In addition, small-scale fisheries also present other important welfare dimensions. They can act as a buffer for excess labour while during times of economic stress or disaster, they can have a role as "safety nets" in the sense that they provide people with a temporary occupation during harsh times, and contribute to reduce the risk of food insecurity (Bené, 2006). Nevertheless, despite the crucial importance of fisheries for small-scale fishing households, a decline in fish populations has been observed during recent years due to overfishing and a set of socio-ecological factors (Perret, 2013). Some of these include climate change impacts such as the increased frequency of storms, or the reliance of people on traditional fishing techniques instead of modern technologies such as sonar or GPS, which have resulted into losses in yields (Hamzah et al., 2013). Thus, in order to assure the fluent contribution of small-scale fisheries to coastal livelihoods, it becomes of vital importance to understand their status and socio-economic contribution (Teh et al., 2011). There are different factors that influence the quality and sustainability of fisheries. A clear example could be the status of coastal mangrove forests, due to their importance as habitat, food source and capacity to maintain ecological quality (Sabran, 2016).

Mangrove forest-dominated estuaries are considered to be one of the most productive ecosystems due to their role as nurseries and breeding grounds for different types of fishing resources (Hoque et al., 2015). Some of these include a wide range of shrimp species, which are collected in the mangrove waterways or in the nearby coastal waters (Shukor & Hamid Bin, 2004). This is why mangrove forests are regarded as one of the principal sources of income for native residents, as they are exploited for many activities apart from fishing, including logging, ecotourism or charcoal production (Sabran, 2016).

Therefore, substantial efforts have been made by the governments of the affected countries with the support of international development agencies in order to design programs to improve small-scale fishers' welfare and life quality. These include credit programs that aim to implement motorized vessels to alleviate the exploitation of inshore fish species (Bailey & Pomeroy, 1993).

So in regard to the current situation, it seems that evaluating the role of fishing and other livelihood strategies could directly contribute to widen locals' perceptions over their resources, and improve their life conditions. The present project aims to seek a deeper understanding of the importance of the fishing industry in Tebelu, in order to evaluate its relation with other livelihood strategies present at the village. Therefore, an

economic and socio-cultural analysis of the main relevant topics in relation to fishing and other livelihood strategies will be carried out. In addition, an assessment of the environmental, economic and social sustainability of fishing will also be performed in order to provide some insights about the mid and long term viability of this sector. A comprehensive range of topics, including the importance of seasonality, the role of climate change or the status of the coastal mangrove forest will be evaluated to obtain a more accurate perception of the environmental sustainability of the fishing industry. In order to assess the economic sustainability of the sector, the threats, strengths, weaknesses and future opportunities of fishing will be assessed through a SWOT analysis. Finally, other relevant topics related to the village's social aspects, such as the level of equity or democracy will provide information in regard to the future viability of fishing. This Malaysian village is located in the province of Sarawak, and it is believed that constitutes a clear example of a small-scaled fishing village. Thus, it will provide a suitable field to investigate about the role of the fishing industry as compared to other livelihood strategies.

1.1 Research Questions

The report will be structured over an overall assignment; *Examine the diversification of livelihood strategies and cash crop*, and a specific assignment; *Asses the importance of fishing as compared to other livelihood strategies in Tebelu*. Furthermore, three main broad research questions have been developed in order to address these assignments, which include several sub-questions:

- What is the importance of fishing in Tebelu?
 - Which are the factors that determine fishing environmental sustainability?
 - What is the economic importance of fishing?
 - What is the social importance of fishing?
 - What is the cultural importance of fishing?
- What is the importance of other livelihoods strategies in Tebelu?
 - What is the economic importance of other livelihood strategies in Tebelu?
 - What is the social importance of other livelihood strategies?
 - What is the cultural importance of other livelihood strategies?
- Is fishing sustainable in Tebelu?
 - From an environmental perspective?
 - From an economic perspective?
 - From a social perspective?

It is expected that addressing the proposed research questions will allow us to gain an accurate understanding of the environmental, economic and socio-cultural situation of Tebelu in regard to fishing and other relevant livelihood strategies.

2 Methodology

2.1 Methods

In order to answer our research questions, the following section describe the applied field methods used to collect data.

2.1.1 Questionnaire

We are using questionnaires at the beginning of the field trip in the attempt of creating an overview perspective of the village structure and composition, while collecting qualitative information such as; the proportion of people fishing and growing crops, for what purpose, which species and in which season. We are expecting to collect answers from between 30 and 50 households and we aim to conduct this research within the first three days. We are planning to split in two teams during the research with at least one Malaysian speaking person/interpreter in each team. During the process of collecting the questionnaire answers, we expect to be able to do relevant observations of the daily life in the village as well as networking with locals and establishing contact with relevant key individuals (Mikkelsen, 2005). It would be ideal if this could allow us to arrange some short interviews or appointments during the following days.

2.1.2 Observations

Discrete and participatory observations will start to be conducted the 2nd of March on the first day of the study. Important information will be based on observations during this day and continuously throughout the fieldwork period. We are expecting to do relevant observations by the coast/beach/harbor, such as at what time are fishermen leaving, at what time they are coming back, how many and what fish they are landing and ask them questions about the matter.

2.1.3 Participatory Rural Appraisal

We will be using Participatory Rural Appraisal (PRA) as a method in our research to analysis differences, unequal relationships and competitiveness or complementarities among the different livelihood strategies (Mikkelsen, 2005). We are expecting to facilitate three PRA sessions; a seasonal calendar focusing on fish species and catch

yield per month, a matrix ranking focusing on income score for different fish species and crop varieties in different months and a resource map elaborating on the spatial distribution of fishing grounds and harvesting areas. Those PRA sessions are being held to indicate changes and variations during the year and to understand the factors determining different livelihood strategies. This is especially important because of the distinctive rain season from November to February and the people of the village are assumed to prioritize growing crops, both for subsistence use and income purposes.

2.1.4 Semi structured interviews

During the questionnaire and networking process key informants are expected to be pointed out. We are planning on making Semi Structured Interviews (SSI) with those key individuals on the following days for supplementing the surveys. We are expecting to identify *outliers* from the questionnaires and hopefully conduct interviews with them to elaborate on their viewpoints. Furthermore, our target group for SSI's will be fishermen (both "part time" and "full time") and people from different categories ("poor", "wealthy", women, farmers etc.). We are expecting to get a more clear idea of what and which key informants are relevant to interview when we have done observations and when we have the results from the questionnaires.

2.1.5 Water quality sampling

To indicate the status of the mangrove ecosystem in the Tebelu area, and therefore the potential status and sustainability of the fishing, we will sample the water quality in different areas. This is to investigate if there are any correlations between fishing areas with boat traffic (disturbed areas) and areas with less traffic and fishing activities ("undisturbed" areas). We are expecting to measure the oxygen levels, salinity, pH, turbidity and maybe electroconductivity and use an ANOVA test to analyze the data. A local guide and maybe a boat will be essential to conduct this research.

2.1.6 Species Richness

On the same sites and at the same time as conducting the water quality sampling, we will also investigate the status of biodiversity in the mangrove ecosystems by measuring indices of species richness and species abundance. Observations, boxes, spades, nets, metric tape and a species guide will be used to collect, identify and measure specific groups of animals. We expect to assess the biodiversity of two different areas: from a "degraded" forest, and from an "undisturbed" forest. We are planning to take samples from three different plots (5x5m) from each site. Each plot would be a different replicate. As we are primarily expecting to collect count data, the obtained results will be analyzed with a Chi Square test. Due to resource limitations of the study, we will narrow our focus down to the study of "key species" that can be used as bioindicators of

the quality and health status of the ecosystem. We will decide on which species to focus on after doing a general research about the area and once the climatic conditions are known.

2.1.7 GPS mapping

During the fieldwork we will use a GPS receiver to sample the positions of the household numbers from the questionnaire. This is to see if there are any relationships or correlations between the spatial household distribution and patterns of the village and results from the questionnaires. We will also use the GPS to map our positions when we are conducting the water quality and species richness research. Finally we will trackpoint fishing routes during a fishing trip to locate where the fishermen catch which fish and for what purpose. The GPS sampling will also be relevant to construct an overview map of the village, where relevant plots for the research questions are pointed out.

2.2 Time schedule of field work

See appendix 4.2.

2.3 Collaboration with Malaysian counterparts

All communications with our Malaysian counterparts takes place in WhatsApp and Google Docs. A common folder has been made where scientific and non-scientific articles and documents have been shared. Furthermore, our counterparts have sent us maps showing land use and land cover of the Tebelu area as well as a summary table of fish species, fishing techniques and fishing permits of Sarawak. A version of the final questionnaire have been sent to them and further collaborations and agreements will take place on the first of March where the fieldwork process will be discussed.

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4 Appendix

4.1 Data Matrix

4.2 Time schedule

4.3 Questionnaire

4.4 Interview guide for the SSI

4.5 Participatory Rural Appraisal

Overall assignment	Specific assignment	Research questions	Subquestions	Working questions	Data needed	Rationale	Methods	Inputs	Pitfalls
Examine the diversification of livelihood strategies and crashcrop	Asses the importance of fishing as compared to other livelihood strategies in Tebelu	What is the importance of fishing in Tebelu?	What is the economic importance of fishing?	What is the importance of fishing on people's income?	<ul style="list-style-type: none"> Salaries Ranking people importance perceptions Subsidies 	To understand how fishing affects people's economy and how it is connected to their livelihood strategies.	<ul style="list-style-type: none"> PRA, literature, questionnaires, SSI PRA, literature, questionnaires, SSI Literature 	<ul style="list-style-type: none"> Fisherman PRA (5-10 participants) Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Ambiguity in answers Lack of literature Participants absence
				How does fishing affects employment rates?	<ul style="list-style-type: none"> Proportion of people employed Proportion roles in fishing (packing, fishing, driving) 	We would like to know how many people are fishing or involved in the industry.	<ul style="list-style-type: none"> Questionnaire SSI, observations 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Ambiguity in answers Participant absence
				Who owns the productive assets?	<ul style="list-style-type: none"> Boats and shrimp factories ownership 	To understand the distribution of wealth/physical capitals.	<ul style="list-style-type: none"> Questionnaire, SSI 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				How seasonality affects economy?	<ul style="list-style-type: none"> Competition and/or complementarity Fishing techniques Qualitative importance ranking 	To know the relations between farming and fishing strategies (competition or complementarity?)	<ul style="list-style-type: none"> Questionnaire, SSI Observations, questionnaire, PRA, SSI PRA, questionnaire 	<ul style="list-style-type: none"> Fisherman PRA (5-10 participants) Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
			What is the social importance of fishing?	Does fishing have any impacts on migrations?	<ul style="list-style-type: none"> Qualitative importance ranking 	To understand the dynamics of in and out-migration to Tebelu. To discuss the center/periphery effect OR push pull factors.	<ul style="list-style-type: none"> Questionnaire, SSI 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				Does fishing contribute to rise of conflicts?	<ul style="list-style-type: none"> Qualitative informations 	Land rights. Migrants-natives/local Farmers-fishers	<ul style="list-style-type: none"> SSI 	<ul style="list-style-type: none"> 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
			What is the cultural importance of fishing?	In which ways is fishing related to the identity of the villages?	<ul style="list-style-type: none"> Social status information 	To understand the relation between identity and the fishing as a livelihood strategy (what makes people fish? Status)	<ul style="list-style-type: none"> Questionnaire, SSI, observations 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				What is the role of gender in fishing?	<ul style="list-style-type: none"> Role gender division Gender proportion 	To understand if there is difference between the work, identity and practices of women and men (is it cool for women to fish?)	<ul style="list-style-type: none"> Questionnaire, SSI, observations Questionnaire, SSI, observations 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				What is the role of religion and ethnicity in fishing?	<ul style="list-style-type: none"> Influence of religion Proportion of different religions 	To know if some religions or ethnicities are more prone to fishing than others and to understand the Chinese role in the village.	<ul style="list-style-type: none"> Questionnaire, SSI Questionnaire, SSI 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
		What is the importance of other livelihoods strategies in Tebelu?	What is the economic importance of other livelihood strategies in Tebelu?	What is the importance of other livelihoods strategies (OLS) on people's income?	<ul style="list-style-type: none"> Salaries Ranking people importance perceptions Subsidies 	To understand how fishing affects people's economy and how it is connected to their livelihood strategies.	<ul style="list-style-type: none"> PRA, literature, questionnaires, SSI PRA, literature, questionnaires, SSI Literature 	<ul style="list-style-type: none"> OLS PRA (5-10 participants) Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				How does OLS affects employment rates?	<ul style="list-style-type: none"> Proportion of people employed Proportion roles in OLS 	We would like to know how many people are farming or involved in other activities.	<ul style="list-style-type: none"> Questionnaire SSI, observations 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				Who owns the productive assets?	<ul style="list-style-type: none"> Ownership of the RANDOM things 	To understand the distribution of wealth/physical capitals.	<ul style="list-style-type: none"> Questionnaire, SSI 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				How seasonality affects economy?	<ul style="list-style-type: none"> Competition and/or complementarity Other techniques Qualitative importance ranking 	To know the relations between farming and fishing strategies (competition or complementarity?)	<ul style="list-style-type: none"> Questionnaire, SSI Observations, questionnaire, PRA, SSI PRA, questionnaire 	<ul style="list-style-type: none"> OLS PRA (5-10 participants) Minimum 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers

			What is the social importance of other livelihood strategies?	Does OLS has any impacts on migrations?	<ul style="list-style-type: none"> Qualitative importance ranking 	To understand the dynamics of in and out-migration to Tebelu. To discuss the center/periphery effect OR push pull factors.	<ul style="list-style-type: none"> Questionnaire, SSI 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires, 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				Does OLS contribute to rise of conflicts?	<ul style="list-style-type: none"> Qualitative importance ranking 	To understand potential conflicts between Land rights, Migrants-natives/locals and	<ul style="list-style-type: none"> SSI 	<ul style="list-style-type: none"> 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
			What is the cultural importance of other livelihood strategies?	In which ways is OLS related to the identity of the villages?	<ul style="list-style-type: none"> Social status information 	To understand the relation between identity and the fishing as a livelihood strategy (what makes people fish? Status)	<ul style="list-style-type: none"> Questionnaire, SSI, observations 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires, 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				What is the role of gender in OLS?	<ul style="list-style-type: none"> Role gender division Gender proportion 	To understand if there is difference between the work, identity and practices of women and men (is it cool for women to fish?)	<ul style="list-style-type: none"> Questionnaire, SSI, observations Questionnaire, SSI, observations 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires, 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
				What is the role of religion in OLS?	<ul style="list-style-type: none"> Influence of religion Proportion of different religions 	To know if some religions or ethnicities are more prone to fishing than others and to understand the Chinese role in the village.	<ul style="list-style-type: none"> Questionnaire, SSI Questionnaire, SSI 	<ul style="list-style-type: none"> Minimum 30 households for questionnaires, 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Ambiguity in answers
		Is fishing sustainable in Tebelu?	From an environmental perspective	What is the status of mangroves?	<ul style="list-style-type: none"> Water quality (oxygen levels, salinity, pH, turbidity, electroconductivity) Biodiversity indices 	To indicate the state of the ecosystem, and therefore the potential status of fishing.	<ul style="list-style-type: none"> Use of water quality equipment - 5 samples from 2 plots (disturbed and undisturbed area) ANOVA-test Observations, boxes, spade, net, metric tape, species guide – 2x3 plots (disturbed/undisturbed) (species/richness or abundance) CHI² 	<ul style="list-style-type: none"> 4 group members 1 day of fieldwork A local guide/a contact person from the village who knows the area. Maybe an interpreter 	<ul style="list-style-type: none"> Lack of instrumental Meteorological issues No differences between the areas
				What is the effect of climate change?	<ul style="list-style-type: none"> Sea level rise Water quality Floods forecast 	To understand long term impacts on fishing and ecosystems.	<ul style="list-style-type: none"> Literature (previous records) and perhaps GIS sea level rise scenario Use of water quality equipment Literature (previous records), SSI. 	<ul style="list-style-type: none"> After field work, 0,5 day, 2 persons. Data from mangrove field trip. <p>Access to literature and ca. 6 villager's participation in SSI, 1 interpreter</p>	<ul style="list-style-type: none"> Meteorological issues Scarce information from the villagers Participants absence
				Are there any exploitation issues?	<ul style="list-style-type: none"> Targeted species (fishes, sea turtles...) Regulations Fishing techniques 	To understand the status and health of the fishing industry and the importance of licenses.	<ul style="list-style-type: none"> Observations, SSI, literature Literature, SSI Observations, PRA, SSI, questionnaire 	<ul style="list-style-type: none"> Ca. 6 villager's participation in SSI, 1 interpreter, participation in fishing trips, fishing crew etc. Fisherman PRA (5-10 participants) 	<ul style="list-style-type: none"> Obstacles to access the necessary information Lack of relevant literatura Participants absence
				How does seasons affect the environmental sustainability?	<ul style="list-style-type: none"> Qualitative importance ranking Fishing techniques 	To understand the impacts and dynamics of the seasonality in fishing.	<ul style="list-style-type: none"> PRA, literature, questionnaires, SSI PRA, literature, questionnaires, SSI 	<ul style="list-style-type: none"> Fisherman PRA (5-10 participants) Minimun 30 households for questionnaires 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Obstacles to access the necessary information
			From an economic perspective	What are the strengths, weaknesses, opportunities and threats of the fishing industry?	<ul style="list-style-type: none"> SWOT analysis Production chain 	To understand the sustainability of the fishing in the future.	<ul style="list-style-type: none"> PRA, SSI 	<ul style="list-style-type: none"> Fisherman PRA (5-10 participants) 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Obstacles to access the necessary information
			From a social perspective	What are factors that determine social sustainability?	<ul style="list-style-type: none"> Equity Diversity Democracy maturity Quality of life Social cohesions 	To understand how social sustainability havs an influence on fishing.	<ul style="list-style-type: none"> PRA, SSI 	<ul style="list-style-type: none"> Fisherman PRA (5-10 participants) 6 villager's participation in SSI, interpreter 	<ul style="list-style-type: none"> Participants absence Obstacles to access the necessary information

Time Schedule

[illegible]

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QUESTIONNAIRE

Thank you for participate in our survey. This survey is being done by non-governmental organization. The answers from this questionnaire are anonymous and any information you give cannot be traced back to you. You will not be identified in any reports. The following questionnaire has been prepared for... It will take about 25 minutes to answer this questionnaire. It is important for you to know, that there are no right and wrong answers. You can answer what you think is right. If you have any questions, please feel free to ask.

BACKGROUND

1. Name: _____

2. Today's date: _____

3. Address: _____

4. City, state, zip: _____

5. Gender:

☐ Male

☐ Female

☐ Not declare

6. Age:

☐ <18 ☐ 41-55

☐ 18-25 ☐ 56-65

☐ 26-40 ☐ >65

7. Ethnic origin:

8. Which religion do you associate yourself with?

☐ No religion ☐ Christian

☐ Buddhist ☐ Hindu

☐ Muslim ☐ Other religion (please specify): _____

☐ Jewish

9. Highest year of education completed:

- ☐ Less than high school ☐ Bachelor degree ☐ PhD
☐ High school diploma ☐ Master degree

10. Main occupation:

11. Amount of people living in this household:

12. How many over 18 years?

13. For how many generations has your family been living here?:

14. Have you migrated to the village?; If yes, why?

- ☐ Yes ☐ No

FISHING

15. Do you have a boat in your household? If yes:

- How many?:

- Who owns the boat/s?:

- Do you share the boat/s in the household?

16. Does someone in the household fish? If not, go to question 22. If yes:

☐ Yes ☐ No

- Who?

- Are they fishing for their own consumption?

☐ Yes ☐ No

- o Which species?

Fish species	Income Ranking				

- o Why this/those species?

☐ Easy to catch

☐ Economically valuable

☐ No other fish

☐ Others

- Are they fishing for selling? If not go to question 17, If yes:

☐ Yes ☐ No

- o Which species?

Fish species	Income Ranking				

- o Why this/those species?

☐ Easy to catch

☐ Economically valuable

☐ No other fish

☐ Others

o Who do you sell the fish to?:

17. How often do you fish?

☐ Everyday

☐ Few times per week

☐ Few times per month

☐ Special occasions

☐ Never

18. Which months are you fishing?

☐ January ☐ July

☐ February ☐ August

☐ March ☐ September

☐ April ☐ October

☐ May ☐ November

☐ June ☐ December

19. If you/they are only fishing in the high season: (If no go to question 20)

- Are you/they selling all the fish caught?
- How often do you fish in the high season?

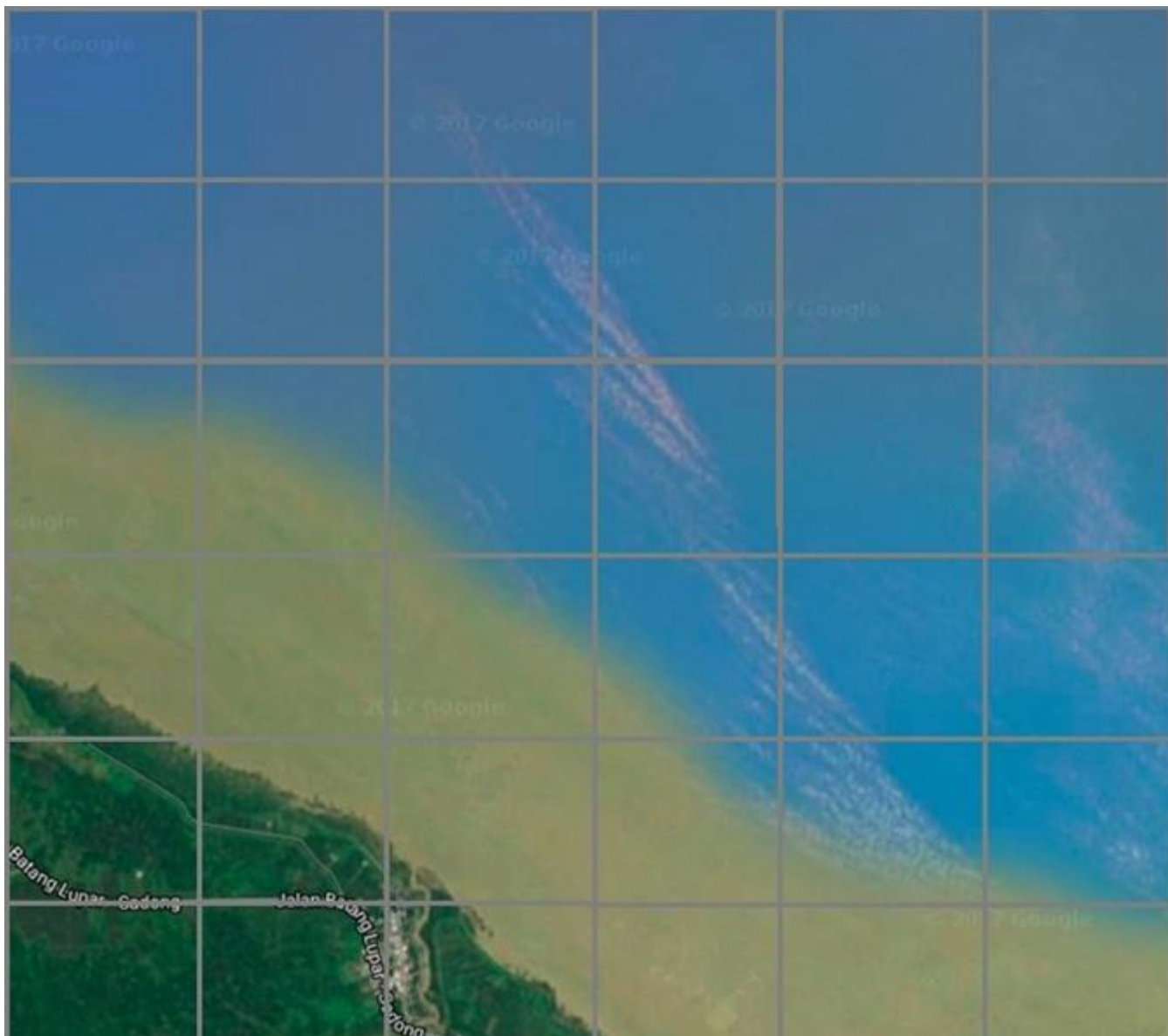
☐ A few times a month

☐ (Almost) Every day

☐ Maybe once a week

- If they have another income source, do they work more in the fishing season?
(Table?)

20. Where do you catch the fish? Circle the map



21. Which fishing technique are you using?:

FARMING

22. Does someone in the household grow crops? If yes:

☐ Yes ☐ No

- Where are they growing?

□ Around the house

☐ 1-5 km away☐ 5-10 km away

- Are they growing crops for own consumption? If yes:

☐ Yes ☐ No

- o Which species?

[illegible]

o Why this/those species?:

● Are they growing crops for selling? If yes:

o Which species?

Crop type	Income Ranking				

o Why this/those species?:

INCOME AND COMSUMPTION

23.If you or the household are both fishing and growing crops, rate the importance in the different seasons. Fill the box with an “S” in case the activity is more important for economic purposes, or fill the box with an “E” in case it is more important for economic purposes.

	<i>Fishing</i>	<i>Crops</i>		
Wet season				
Dry season				

- Do you have any other income source? If yes , which?

☐ Yes ☐ No

MANGROVE/ENVIRONMENT

24. Do you think there has been a decline in fish stocks during recent years?

☐ Yes ☐ No

25. Do you think there has been a decline in the number of wild animals during recent years?

☐ Yes ☐ No

26. Do you think the mangrove presents poorer conditions now compared to previous years?

☐ Yes ☐ No

27. Do you think mangrove is improving the fishing possibilities?

☐ Yes ☐ No

28. Have you noticed change due to the climate recently? (Sea level rise, storms...)

☐ Yes ☐ No

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INTERVIEW GUIDE

Thank you for participate in our interview. This interview is being done by non-governmental organization. The answers from this interview are anonymous and any information you give cannot be traced back to you. You will not be identified in any reports. The following interview is about your work with fishing, growing crops or at the fish factory. It will take about 30-45 minutes. It is important for you to know, that there are no right and wrong answers. You can answer what you think is right. If you have any questions, please feel free to ask.

Interview guide for fishermen

Introduction	<ul style="list-style-type: none">• Tell us about your family• Where do you live, children• Name, age, “occupation” etc.• Boat status
Fishing / work	<ul style="list-style-type: none">• Tell us about a normal “day at work”• Reason why you work as a fisherman• Preferences regarding to species• Other occupations, hobbies• Positive and negative things of being a fisherman• Amount of fish caught• Risks and dangers involved with fishing
Seasons	<ul style="list-style-type: none">• Tell us how you earn money/food outside of fishing season• Preferences in terms of occupation• Ask about how were the last and previous seasons
Before/after	<ul style="list-style-type: none">• Differences in the fish stocks over time• Concerns about the disappearance of the mangrove forest• Concerns about the impact of climate change on fishing
Status	<ul style="list-style-type: none">• Own perspective about being a fisherman• Own perspective about how others regard the work as a fisherman
Income	<ul style="list-style-type: none">• Who buys the fish and where it is sold• Perceptions about the likelihood of continuing fishing in the future
Competition/conflicts	<ul style="list-style-type: none">• Fishing legislation in Malaysia/Sarawak/Tebelu• Fishing permit/license• Conflicts while fishing

Interview guide for other livelihood strategies

Introduction	<ul style="list-style-type: none"> • Tell us about your family • Where do you live, children • Name, age, “occupation” etc.
Work	<ul style="list-style-type: none"> • Talk about a normal “day at work” • Reason why working as a ** • Crops preferences • Other occupations beside main activity (**) • Positive and negative things of your work.
Seasons	<ul style="list-style-type: none"> • Tell us how you earn money/food in the different seasons • Seasons preferences • Ask about how was the last and previous seasons
Before/after	<ul style="list-style-type: none"> • Differences in terms of difficulty to grow crops over years • Concerns about climate change
Status	<ul style="list-style-type: none"> • Own perspective of being a ** • Own perspective about how others regard the work as a **
Income	<ul style="list-style-type: none"> • Who buys the yield and where do you sell it • Perceptions about the likelihood of continuing ** in the future
Competition/conflicts	<ul style="list-style-type: none"> • Crops/agriculture legislation • Conflicts while working

Interview guide for the CEO of the prawn factory

Introduction	<ul style="list-style-type: none"> • Tell us about your family • Where do you live, children • Name, age, “occupation” etc. • Number of years in the factory • History of the factory • Reason why it is located in Tebelu
Work	<ul style="list-style-type: none"> • Amount of people employed in the factory • Amount of worked hours per day • Salary
Exportations	<ul style="list-style-type: none"> • Exportations and destinations • Quantity (kg) • Demand perspectives in the future
Status	<ul style="list-style-type: none"> • Tell us about the importance of the factory • Own perspective about others feelings about the factory
Captures and seasons	<ul style="list-style-type: none"> • Amount of kg captured per month/year • Species captured • Techniques • Shift in techniques over time • Differences in the amount/features of prawns over years • Preferred season • Ask about different tasks/activities carried out in the factory on different seasons • Vacations and holidays
Gender	<ul style="list-style-type: none"> • % of men/women employed • Different tasks for men and women
Future	<ul style="list-style-type: none"> • Previsions regarding to the fishing industry • Concerns about the decline of fish populations

Participatory Rural Appraisal (PRA) in Tebelu village

1. Introduction

- **Objective of the study**

We are using Participatory Rural Appraisal as a method in our research to analysis differences, unequal relationships and competitiveness or complementarities in the livelihood strategies (Mikkelsen, 2005). We are expecting to facilitate three PRA sessions; a seasonal calendar focussing on fish species and catch yeild per month, a matrix ranking focussing on income score for different fish species and crop species in different months and a resource map elaborating on the spatial distribution of fishing grounds and harvesting areas. Those PRA sessions are being held to indicate changes and variations during the year and to understand the factors determining different livelihood strategies. This is especially important because of the distinctive rain season from November to February and the people of the village are assumed to prioritize growing crops, both for subsistence use and for income purposes.

2. PRA tools

The PRA methodology uses different tools to search its goal of a participatory approach for guiding any issue. The following three tools were used by the research team in the exercise under consideration:

1. Seasonal calendar

2. Matrix ranking

3. Resource mapping

Description of the different tools that are going to be used:

- **Seasonal calendar** is a participatory tool that lead insight processes and needs at a local level, and help to stimulate discussions on partners over time. They provide information useful for planning. Seasonal calendar is used in this case as a participatory tool to find out community perceptions on time-related variations in different labour, land yield and fish capture patterns.
- **Matrix ranking** our main purpose for creating a matrix is to discover the group's relative prioritisation of components on a single issue. It provides an opportunity for people to identify and express priorities and options for action. It also help in targeting and allocation of resources for the priorities identified by the people. It facilitate the people to be aware of their problems and priorities through a systematic analysis.
- **Resource mapping** can be a useful tool to investigate the knowledge of the people about their own locality, their resources and their spatial distribution.

Resource mapping can help communities:

- Identify valuable resources
- Ensure that everyone has access to the resources they need Avoid duplication of services and resources

- Enhance services
- Identify flexible funding strategies
- Use data to make informed decisions
- Cultivate new partnerships and relationships

➤ Choice of the location and time of activity :

➤ Mapping process:

- Matrix ranking (1 - 5: less important to more important)

[illegible]

