28-3-2014

KU-LIFE

Drivers and Barriers for Change in Cropping and their Impact on Livelihood Strategies and the Environment in Kampung Tekalong

Group members

Enoch Narh Kudjordjie

Giordana Dunkhorst

Ida Helene Andersen

Mathias Freund Ø. Nielsen

Matthias Thiery

Pernille Bjarup Hansen

ILUNRM

Field course report 2014

Supervisors

Thilde Bech Bruun

Astrid Oberborbeck Andersen

Number of pages: 11.324

Abstract

The focus of this project is on the drivers and barriers that influence the choice of crops in the village of Tekalong and its impact on the social and natural environment. We found that the main drivers for cropping transitions were policies, implemented by various national agencies, such as the Agriculture Department. Policies involve various types of subsidies targeting specific crops, both commercial and subsistence, in order to ensure diversification. This reflects the government's strategy of development through diversification. Economic drivers mainly related to world market prices, but also land and soil factors influence choice of crops.

Land is very scarce, leading to large land inequalities and impacting the choice of crops produced. The shortage is becoming more problematic with population growth. Size of land also influences the choice in cropping. Larger landowners may prefer oil palm as it provides high revenues and flexibility. Local politics also seemed to be an impediment to development. We think that agricultural intensification will affect negatively the water and soil qualities. We conclude that the desire by both the government and the village to retain diversification to cushion economic shocks will ensure that the agricultural landscape of Tekalong will see further transitions in cropping, but will also retain some diversity.

Preface

Copenhagen 28th of March 2014

This report is the result of the course "Interdisciplinary Land Use and Natural Resource Management" (ILUNRM). During this course, 2 weeks of interdisciplinary field work was conducted in Sarawak, Malaysia, including both social and natural science methods. The field work started on the 27th of February 2014 with a meeting with the Malaysian counterparts and a merge of our research questions. From the 1st of March to the 11th of March we stayed in Tekalong, an Iban village in the Simunjan District.

This report represents the product of 11 intensive days, during which new cultural and social experiences and understandings were made along with an investigation of the agricultural practices. The group consisted of people with very diverse backgrounds and gave us the opportunity to learn from each other and understand new perspectives and interests in the same subject. Even though we all have different knowledge, we all have an understanding of the methods and discussion engaged in the field work and report. We share the equal responsibility for the results, analysis and the conclusions made.

Enoch Nahr Kudjordjie	*Giordana Dunkhorst*
Ida Helene Andersen	*Mathias Freund Ø. Nielsen*
Matthias Thiery	*Pernille Bjarup Hansen*

Table of authors

Section	Responsible author
Introduction	All
Methodology	All
Results & Discussion	All
Conclusion	All

Acknowledgements

This field work and design of the project was collaboratively done by students from University Malaysia Sarawak, University of Copenhagen and Roskilde University. We are very grateful to been given the opportunity to participate in this exciting field course. We want to express special thanks to the people who facilitated and enabled this experience, namely our teachers from Copenhagen; Ass. Prof. Dr. Thilde Bech Bruun, Dr. Astrid Oberborbeck Andersen, Ass. Prof. Dr. Christian P. Hansen and Dr. Ebbe Prag who prepared us for the field work. In particular, a thanks towards Ass. Prof. Dr. Thilde Bech Bruun and Dr. Astrid Oberborbeck Andersen for their availability as resource persons in the field and their help to understand cultural differences in many ways.

From the University Malaysia Sarawak would like to thank Dr. Tay Meng Guan, Mr. Nicholas Gani, Prof. Dr. Gabriel Tonga Noweg, Prof. Dr. Mustafa Abdul Rahman, Dr. Mohd Effendi bin Wasli, Mr. Kelvin Egay, Dr. Wong Swee Khong and Dr. Wee Boon Siong, who helped us carry out some of our methods, the feedback and good ideas for further elaboration and reflections.

We also owe our gratitude to our Malaysian student counterparts, who carried out the data collection with us: Esther Sheren, Freda Emmanuel, Margarita Naming, Robin Peter. Our interpreters, Lesandra Sung and Krystal Nantie Anak Thomas, deserved a great amount of appreciation too, without them we would not have been able to do most of the field work. Beside the professional input both the counterpart and interpreters gave us, they also contributed with a nice atmosphere and the beginning of new friendships across the world.

Last but not least, we would like to thank the entire village of Tekalong for hosting us and open their homes and friendly giving us the information this report is based upon. We are very grateful and honoured by their kindness and helpfulness, especially our wonderful cooks, the village commitee and the headmaster En. Nyutan.

List of Abbreviations

DO - District Office / Dissolved Oxygen

HH - Households

MPB - Malaysian Pepper Board

MRB - Malaysian Rubber Board

MCB - Malaysian Cocoa Board

MPOB - Malaysian Oil Palm Board

NKEA - National Key Economic Area

NCR - Native Customary Rights

RM - Malaysian Ringgits

WC - Water Catchment

P - Oil Palm Plantation and Rice Fields

COD - Chemical Oxygen Demand

TSS - Total Suspended Solids

UNIMAS - University of Malaysia Sarawak

UCPH - University of Copenhagen

List of Figures

List of Tables

Table of Contents

1 Introduction

Since its independence from the British Empire, Malaysia has embarked on a rapid development process based on several lucrative industries, such as natural energies and highly priced agricultural commodities. These industries, backed by wise government legislations (Chang, 2010), have since lifted many people out of poverty at a fast pace (Stiglitz, 2002).

This has however come at a cost: Malaysia is the embodiment of the seeming incompatibility between economic development and environmental protection as discussed by Dietz and O'Neill (2013). Alongside Indonesia, the Malaysian government has encouraged the deforestation of vast tracts of land in order to plant oil palm trees, and both countries now account for 85% of the total palm oil production (USDA, 2007). This factor – deforestation – cannot only be considered a Malaysian issue: it indeed has an impact on a much larger scale, as pollution knows no borders. Deforestation is one of the primary drivers of climate change, accounting for 15% of all greenhouse gas (GHG) emissions (USDA, 2007) but also has several environmental impacts such as loss of biodiversity and habitats, river pollution, or changes in micro-climates (ibid.). Voices that condemn this process tend to originate from the Global North, but they often fail to suggest any viable alternative to development, and the proposed projects, such as REDD, financed by wealthy G20 governments appear to be struggling to take-off. The Malaysian government itself does not seem so concerned about these issues, as its main priority is to raise the standards of living of its people (MPOB, 2014). In order to do this, it has created different sets of policies that aim at accelerating further this development, setting ambitious goals in terms of land area cultivated with oil palm (Ibid.). The state of Sarawak has recently reached one million hectares of oil palm, and aims to add another million by 2020 (Ibid.). To achieve this target, the government has several tools at its disposals. In Malaysia, the plantations have been largely run by either private companies or SALCRA, a state company (Banerjee and Bojsen, 2005). They can also be run by independent villagers who plant the crop in order to fully reap its economic benefits.

The village of Tekalong reflects this trend. Although small, it is an accurate illustration of the land use changes currently taking place in Malaysia, as will be illustrated throughout this report.

1.1 An unexpected study area

Kampung (Kpg) Tekalong is a village of 26 households located in the Simunjan District, in Sarawak, Malaysian Borneo. The name Tekalong derives from a tree (Artocarpus odoratissimus) whose bark was used for clothing in former times, most notably the classical Tekalong male underwear (source: village guides). The settlement is located on a hill, slightly elevated, at the foot

of mount Propok and next to a 4 square kilometers large floodplain, that gets flooded seasonally, providing the village with a lake (see figure 1 picture of the drone). Before we took on the journey to Sarawak, we were informed that this hill just barely allows the houses to remain dry during the yearly floods of the plain - which we thought would be an interesting objective of our study: How could the villagers of Tekalong adapt to future environmental changes affecting this water resource. We also knew that the village headman had explicitly expressed concerns about the water quality which had apparently been decreasing, and we built up the project based on the impact of the lake on the livelihood strategies of the villagers.

Figure 1: Aerial photo of Kampung Tekalong. March 2014.

With a real-world problem already affecting livelihoods, a request for us to investigate it, and possibilities of linking the local and global scale in a discussion on future perspectives, we went to Malaysia convinced that the water resources was an obvious focus for our research and we were ready to investigate this issue.

The investigation happened to be short: faithful to its seasonal nature, this unreliable lake turned out to be missing when the team arrived in Tekalong. An important rule of fieldwork was confirmed: you cannot predict what you will find in the field and you have to be willing to adapt (Babbie, 2009:298).

We quickly chose to change our focus since the lake we were going to focus our research on was not there at the time of research. Contrarily to the preliminary data, it quickly became apparent that the so-called problem was not that big of a problem after all: we realized that the role of the lake in peoples' livelihoods wasn't as predominant as we had anticipated. What appeared to play a more import role in everybody's livelihoods seemed to be the crops that were cultivated by the villagers, mainly pepper, rubber, oil palm and wet- and hill rice. We therefore changed our research objective towards:

1) investigating the factors that motivated the past and present land use changes
2) and assessing the impact of the those changes on the natural and social environment.

Hence the research question guiding our work in Tekalong was:

> ***What are the key drivers and barriers for the transition(s) in cropping in Tekalong and how will it/they affect the livelihood strategies of the villagers and the local environment?***

This question allowed us to explore the realities of the villagers on a broad scale. In this report however we are going to focus on what we found were the most important drivers for any transition in cropping. As we will show in the report, the main drivers for changes in land use in Tekalong seem to be political and economic factors. In our empirical study we investigate how different actors respond to these factors in the specific context of Kampung Tekalong.

1.2 Reading guide

The report contains four chapters: *Introduction*, *Methodology, Analysis and Discussion* and *Conclusion*.

The methodology will contain information about which methods we used to obtain data to answer our research question and our reflections upon those. The chapter is divided in following sections: 1. *Methodological framework,* 2. *Applied methods* elaborating on our choice

of method, and the reflections from the fieldwork, 3. Social sciences methods and 4. Natural sciences methods.

The *analysis and discussion* chapter contains the answers to the research question. This chapter is divided in five sections: 1. Past and present crops, 2. Stakeholders in Tekalong, 3. Impact on the local natural environment. The fourth section focuses on social conditions; demography, wealth distribution and the political system of the village. The fifth section presents future strategies of the village and discusses how these can impact on the social environment in the future. Each section is presenting new findings that will be discussed continuously, and each section will also draw on points from the former. In the conclusion we answer our research question by combining the main points from the discussion.

2 Methodology

2.1 Methodological framework

In this research we define livelihood strategies broadly as the means people have to make a living as proposed by Chambers in 1995 (Scoones, 2009:1). In our research we are inspired by Ellis' livelihood framework, though we do not completely rely on it. Using the different categories of assets as a check-list we aim to capture important factors among; natural, physical, human, financial and social capital assets (Ellis, 2000). The focus of our research acknowledges to a great extent Ian Scoones (Scoones, 2009:21) request for more focus on *"...cross-scale dynamic changes [...] knowledge, values, power and political changes."* in the framework of livelihood strategies.
Furthermore we find the livelihood approaches well suited for our interdisciplinary fieldwork.

> *"Belonging to no discipline in particular, livelihoods approaches can allow a bridging of divides, allowing different people to work together - particularly across the natural and social sciences."* (Scoones 2009:2)

The report investigates the sustainability of the livelihood strategies by including potential future changes envisioned by the villagers. The definition of sustainability defined in the UN Brundtland report (1987) combining social, environmental and economic sustainability is guiding our research. This threefold definition also argues for an interdisciplinary approach.

2.2 Applied methods

The following will introduce the applied methods, and explain their relevance according to the research questions. A structuralized overview of the operationalization of the report is provided in the research matrix (See Appendix 2). The natural sciences methods mainly provide data to analyze the conditions of the ecosystem-services and how they so far have been affected by the cultivation of different crops. The social sciences methods help us to gain an understanding of the world of the villagers, and their choice of livelihood strategies, among these the factors influencing their choice of one crop upon another.

All interviews and exercises described below were conducted with one of the two available interpreters, if not mentioned otherwise. The interpreters were partly Iban, but did not know Tekalong or its inhabitants before, which decreased potential bias through personal relations to the

interviewees. Nonetheless being from similar backgrounds and not having a language barrier helped them to connect much faster and easier to the respondents. This might be a cause of some bias as questions were not always translated directly but transformed according to their pre-understanding of what we wanted to know or in a way that would be easier to understand for the participants. In order to minimize this source of bias, before conducting interviews we explained the purpose of the interview and what information we were interested in to the interpreters. This was especially relevant during focus group interviews, where a lot of people talk at the same time, and the interpreter only translated a very condensed version of what was said. The language barrier was generally a barrier for us to understand our informants. Not being familiar with the language, made it hard for us to understand different subtle messages in what was being said and difficult to react to (non-verbal) details in what the informants say, that could have lead us to ask different questions.

After conducting an interview with the former village committee it became apparent that there is a conflict on the level of the decision making bodies in Tekalong. This led to the current situation, which had been in place for the last 14 years, where there is no official headman or village committee. This is due to the fact, that after the former headman died the now unofficial headman was appointed for seven years. At the time, where a new headman was supposed to be elected the village could not agree on the person which led to the current state. Nowadays the village seems to be governed by the headmaster (the head responsible of the nearby school) and a group of his relatives and friends who function as the self-declared village committee. The former headman is still unofficially in charge but cannot fulfill his duties successfully due to the lack of approval and literacy. Despite the often mentioned wish to avoid conflict, Tekalong seemed to be separated into two camps.

We chose the headmaster to be one of our key informants as he seemed to be one of the most knowledgeable and influential persons in the village. The bias created by this was tried to counterbalance via triangulation with interviews with selected people (e.g. the unofficial headman) to validate the information gained from the headmaster.

2.3 Social Sciences methods

2.3.1 Participatory Observation

We employed participatory observation in order to widen our scope of inquiry, asking the right questions, intuitively gaining an understanding of the collected data, and obtaining data that is not likely to be obtained by the other methods (Bernard, 2006). Most of the observations were made through guided tours, informal walks and discussions, PRA and focus group discussions. The observations made were later discussed during group meetings and served as basis for new questions and new methods. This method worked very well as we interacted on daily basis with the villagers. Some interviews were conducted spontaneously when the interviewees unexpectedly were stopping by or invited us in, and therefore were less structured.

2.3.2 Questionnaires

As a way of starting out, we began conducting questionnaire surveys with one adult member of each of the 26 households in Tekalong (See Appendix 3 and 4). It was a way for us to get to know the villagers and engage with them in personal relationships. The purpose of the questionnaire was to collect quantitative data about the number of people living in the village and their main income generators with special focus on cropping practices, fishing, hunting and gathering. We included some ranking exercises, to get an idea of what was perceived as the most important in terms of e.g. crops and income activities. The questionnaire also contains some open-ended questions, that provided us with qualitative data, and the questionnaire interviews often evolved into semi-structured interviews.

We conducted a pilot interview with an Iban person we met in Kuching, which helped us refine the questionnaire before conducting the actual survey. After conducting some questionnaires we realized that some questions were very difficult for people to answer as they did not know the exact answer, other questions were touching on sensitive issues and some were understood in a different way than they were meant to be. This led us to question the validity of some answers, and therefore some information (e.g. on the size of the fields and the income) was triangulated with other sources, for example observations and semi-structured interviews. Also it led to some changes in the questions (See Appendix 3). Another validity issue is that for each of the questionnaire interviews there were other people from the household or the neighboring households present. Sometimes the answers were discussed among the present villagers and in some cases it seemed like the presence of others intimidated the respondents.

2.3.3 Focus groups and PRA

Focus groups were carried out with five groups: young people, elderly, women and the representatives/decision makers of the village. In this research the focus groups varied from thematic discussions with little interruption from the facilitators, to more structured group interviews. Ranking, mapping and other PRA exercises were incorporated in some of the focus groups.

The purpose of the PRA methods was to get an in-depth insight of the villagers' local knowledge of their livelihood strategies (Brockington and Sullivan, 2003). Table 1 below shows the different focus groups and PRA sections in more detail. The methods are roughly ordered from higher to lower priority, so that those of highest importance are first.

Table 1 Focus groups and PRA

Method and participants	**Purpose**	**Reflection**
Group interview with 4 male village representatives, among these the headmaster 01/03/2014	To talk to the village representatives to get an idea of: • The village decision making structures • and pivotal stakeholders on village level	• It turned out that there is no official village committee (JKKK) and we were talking to a group of 4 self-declared village representatives • The headman is not part of the unofficial village committee • It gave us a good introduction to issues that had and are being discussed on community level • Triangulation with information from different actors on different levels is needed to get a full picture of the political structure of the village
Participatory village mapping and area mapping 8 participants 02 /03/2014 + 03/03/2014	• Create an overview of the village and the area surrounding it	• After an introduction by the facilitators, one participant was leading the exercise and did the drawing but everyone contributed to the discussion • We consider the map to be very realistic. • The map contributed as a work tool throughout the fieldwork.
Venn diagram 5 participants 07/03/2014	• To capture all the stakeholders and relations in one map • To understand the importance and role of some of the stakeholders • To understand how existing conflicts could be bypassed	• The diagram was drawn by the facilitator under the supervision and approval of the 5 participants (most of the time only 2-4 talked) • In the end it turned out to be more of a systems map than a Venn diagram, pointing out who are the different stakeholders and how they are connected but not showing the importance of each of them. • In order to have the participants draw the diagram themselves it could be

		helpful to have an example that helps the participants to understand the task (taking into consideration the possible bias caused by it).
Timeline 6 informants from the 03/03/2014 continuous task	• To find out about Tekalongs' history of land use from 1958 until now	• As Brockington and Sullivan (2003:60-61) suggest, a timeline is best developed as a PRA exercise with a group of informants, where focus is on getting the informants to discuss. • We tried to discuss the village timeline with a group of informants (three JKKK-members) who have been living in Tekalong since 1958. • We elaborated the categories (crops) we wanted to know about beforehand. • The way we got data to construct the final timeline based on different, independent sources, was a way of verifying the specific dates.
Seasonal calendar 3 participants 03/03/2014	• To understand which activities take place in the different seasons (Brockington & Sullivan 2003:61)	• Information from the questionnaire served as a basis for this method. • From the seasonal calendar, we realized that three of the four main crops, pepper, rubber and oil palm are perennial crops, which do not require seasonally allocated labor and therefore cannot be captured properly in a seasonal calendar. • Therefor we chose to make an additional cropping calendar.
Cropping calendar 2 participants 08/03/2014	• To understand the process anyone villager would have to go through if wishing to engage in the cultivation of one of the major crops in Tekalong.	• The cropping calendar was created during Semi Structured Interviews (SSI) with the headman and headmaster for the commercial crops, while the part on the rice paddy was created during a SSI with the lady of HH 14, the last one to grow both wet and hill paddy.
Focus group with	• To investigate the historical development	• By combining memories and perceptions from many people, we expected to

elderly 8 participants, 50 - 80 years 05/03/2014	of Tekalong.	get more details and be able to analyze the dominating opinions of the community as well as contradictory opinions within the group. • The method evolved more into a group interview than a focus group discussion
Focus group with young people 7 participants 19-23. 07/03/2014	• To find out what possibilities for the future the young people see in Tekalong • To find the dominant opinions of the future as well as contradictory opinions within the group • To compare the perspectives for the future of the young and older generation	• Only one girl participated in the focus group, because the girls are not allowed to go out on their own in the evening • Therefore the group cannot be considered representative for the youth in Tekalong. • It would have been more suitable to have the focus group earlier, but considering our timeframe, we could not repeat the focus group with girls only. • The young people were shier compared to the older people, and it took some time to get a discussion started. • A ranking exercise was incorporated
Women focus group 10 middle aged Women 01/03/2014	• To investigate and understand the women's role in the village • To find out if the women had a say in the decision-making processes • To find out if they had a women's association • Know about their daily activities	• We separated the interview by gender to ensure the women would speak freely. • The gender division seems less significant than expected, but we still got important knowledge on areas as their organization and about the forest products.

2.3.4 Semi structured interviews

Semi structured interviews were conducted with key informants from the village, mainly leaders of the village: The headman (*2), the headmaster (*3), the counselor, two members of JKKK, district officer, Department of Agriculture (DoA) and an elderly woman. By conducting the questionnaires we localized other villagers of importance for our research, and conducted additional interviews; among these a very poor family and a family who rely on hunting on common land. Table 2 below shows the different purposes and reflections on the semi-structured interviews in greater detail. The methods are again roughly ordered according to priority.

Table 2 Purpose and Reflections on the semi-structured interviews

Method and participants	**Purpose**	**Reflections**
Interview with the headmaster 07/03/2014 + 09/03/2014	• 1. Interview: get his opinion on the important historical events of Tekalong • 2. Interview: to get some more in depth information about the project to develop the communal forest on the other side of the lake in an oil palm plantation, the feasibility for smallholders to drain the wetlands, the prices fetched by the crops when sold by the farmers, land acquisition and ownership in Tekalong	• Given his knowledge and overview the headmaster became an important key informant for our research • We gained valuable but one sided information from him • 2. Interview was conducted in English by only one group member which eased the conversation with the headmaster
Interviews with the headman 04/03/2014 + 08/03/2014	• 1. Interview: to cross-check our information on the decision making structures in the village • 2. Interview: get his opinion on the important historical events of Tekalong	• The headman was not so easily accessible to us, as he did not introduce himself to us and it took us a few days to figure out who he was • When we finally met him the information we got from the headmaster might have influenced our perception of him • None the less he confirmed our understanding of his role in

		managing the village, though we had expected it to be sensitive issues he would reject.
Interview with two extension officers at the agriculture department 05/03/2014	• To find out the role of government in agricultural production in Tekalong	• The interview allows us to triangulate our data across scales and compare interests of individuals and officials on regional level. • Focus was on government subsidies, extension support for rice and schemes for plantations.
District Office 10/03/2014	• To learn about the land use and tenure arrangement especially NCR lands and the arrangements involved to develop them into plantations • To find out how a headman of a village is appointed • To find out about the relationship of the villagers and the district office	• The interview allows us to triangulate our data across scales and compare interests of individuals and officials on regional level.
Life story interview + Family tree 08/03/2014 The oldest person of the village, a 91 year old woman.	• To investigate the development of Tekalong through a first-hand source • To get knowledge on the demographic patterns in Tekalong.	• The interview gave us some interesting insights about what made Tekalong an attractive place to move to in the past. • Not so much information could be gathered though about the transition Tekalong went through or the differences between then and now.
Interview with a hunter and a fisherman 10/03/2014	• To make a wildlife and fish inventory • To know how the villagers use the forest, river and how they are dependent on these resources for their livelihoods	• This is especially interesting considering the seasonal changes of the lake and constant depletion of the forest respectively. Dependency and use of the lake and forest for each household is captured in the questionnaires.

2.4 Natural sciences methods

In order to analyze how the transitions affect the natural environment, we chose to investigate the conditions of the water resources and the soil on agricultural land.

We went on transect walks, following the river upstream and downstream, while having informal interviews with our guides about the landscape, nature and land use on the way. These walks together with the village map helped us choose the spots for water and soil sampling.

2.4.1 Soil sampling

Analyzing the status of the soil can contribute to an assessment of the fertility and sustainability of the current land use. The type of farming system and crop has a direct effect on the fertility of a soil (Bruun, 2009). In order to compare different crops' impact on the soil we conducted soil samples from a rubber, pepper and an oil palm field. The three fields are located next to each other and samples were taken on roughly the same slope and altitude (compare Figure 3). This sample layout was chosen under the hypothesis that the soil was the same in all three fields up until 1997 (see Figure 2). So that with the analysis we would be able to make statements about how the different land uses impacted the soil after that time.

On each field samples were taken on three different locations in order to be able to compute basic statistical analyses. The diagram below shows the pattern of crops cultivated on the three plots, where we took the soil samples from.

Figure 2 Land use pattern of the fields sampled.

In our research we also consider rice an important crop. Owing to the fact that the closest located rice field is wet land and lower altitude, we did not consider the soils and possible changes forced by land use comparable, and chose not to include it.

For each location samples were collected in 0-5, 10 and 20 cm depth in order to compare depth of horizon and organic material and the density on different depth. Key parameters such as bulk density, erodibility, acidity, active carbon and total nitrogen and carbon were analyzed afterwards to determine the fertility.

The sampling was done based on standard methods on soil sampling provided by resource person.

2.4.2 Water sampling

In order to find out how the water resources in the Kpg Tekalong are affected by changing land use patterns, water samples were collected at four locations (see Figure 3). Each of the locations were carefully selected to be able to relate the findings to the overall effects of land use changes, as well as current agricultural practices.

Water quality data were collected based on in-situ measurements and laboratory analyses. The common parameters measured are those related to water pollution due to land clearing and agrochemicals. Four water samples were collected at each location. Parameters that were measured at the site using a water checker (YSI multi-probes water meter, Model: Pro Plus) include: pH, dissolved oxygen (DO), electrical conductivity, salinity and temperature. Laboratory analyses were performed using the standard HACH equipment, to determine the chemical oxygen demand (COD), turbidity, phosphorus (P), ammoniac nitrogen (NH_3-N), nitrate (NO_3^-), nitrite (NO_2^-), total coliform count (TCC) and fecal coliform count (FCC) of the water samples. Further analysis of the TCC and FCC was carried out by our Malaysian counterparts.

The above parameters constitute the determinants of water quality standards and form the basis for the classification of river water quality monitoring in Sarawak (Sumok, 2001).

Location 1 (WC): What we call the water catchment area is a small dam *which was built with the support of the medical department to* supplying potable water for household use. It was chosen to be able to make a statement about the tap water quality of the villagers. Located upstream, this area is close to farms and is likely to be polluted. Water flows from two sources into the catchment area.

Location 2 (P): … is situated downstream from the catchment area where the water is flowing through oil palm plantations and rice fields. With this sample we were aiming at assessing the impact of oil palm plantations on the water quality.

Location 3 (DS): The downstream water sampling was taken before the water flows into the lake, close to the rice fields. Water flowing from location 2, flows into this water source and this sample was supposed to give information on the impact of all kinds of crops.

Location 4 WC (SW): The former water catchment area is located upstream, close to the current water catchment and was chosen for sampling to be able to compare the quality of the former with

the current drinking water supply. However only the COD, turbidity, ammoniacal nitrogen, NO_3^- and NO_2^- was measured as the water checker wasn't available at the time.

Figure 3 Map of the water and soil sample locations

Box 1. Reflections on our methodological approach

During the fieldwork we met some limitations for our work. The main ones were the time constraint, the fact that we only had two interpreters and occasionally the difference in the cultures between the two Universities.

As a team of ten students (6 from UCPH and 4 from UNIMAS) and two interpreters with the aim of accomplishing the research within 10 days, the group adopted a high degree of intellectual team cohesion, hard work and constructive criticism to ensure that our aims and objectives were achieved. Group members were cooperative and always ready to take up new tasks and assist other members. The group was flexible and welcomed each member's point of view. Everybody was able to express his or her opinion and at the same time respect the views of other group members. The main challenge was to merge the UNIMAS and UCPH students' objectives to a common research question taking all members academic disciplines and

knowledge into account.

Staying at one location played a significant role in the research as it determined the availability of respondents which therefore also impacted on the type of information we gathered. Our home during those 10 days of data collection was the village church. As we slowly noticed, it was always the same people who, would come to the church and react to invitations while others had to be visited at their homes in order to be included in the study. The people coming to the church were only the supporters of the headmaster, which is the majority of the villagers but still constitutes a possible bias.

During our data collection, the different methods often generated contradictory information even on events that we expected to be fixed facts such as the date of the foundation of the village. In these cases, we tried to verify the information from as many sources as possible until it was consolidated.

3 Analysis and discussion

This chapter is divided in five sections. The first section describes the past and present crops and discusses possible future crops. The second analyses the factors influencing crop choice. The third section presents and discusses our findings on how the natural Environment is impacted by the choice of crops. The fourth section presents future strategies of the village. The fifth section focuses on social structures and demography of the village and discusses the impact on the social environment in the future. Each section will start by presenting the underlying findings for the following discussion and the conclusions of the discussion will be summarized in the end.

3.1 Past and present crops

This section will explain how the land use and agricultural practices in Tekalong evolved until today and discuss the importance of the different current crops.

3.1.1 Tekalong in the past

In 1958, four families built a longhouse on the small hilltop where Tekalong is located today. They moved here from the northern village of Mugah because of the lake and abundance of fish (Lifestory interview). They started to clear the forest on the side of mount Propok to make room for their hill-, wet rice and pepper fields. At the time, what someone cleared was his to keep, and if someone needed land, it was given to him. For example the councilor of Tekalong, En. Eran was given 10 acres when he married into the village. In 1973 he bought 10 more acres at the price of about 250 RM per acre.

The forest around Tekalong has throughout the villages' history been affected by the intensifying agricultural practices of the villagers. The forest has also been heavily affected by logging activities that started commercial logging in 1973 and intensified in the 1990's with the introduction of heavy machinery. The logging lasted until 2013, when the headmaster made them stop, because he wanted to preserve the last part of the forest. Today only about 15% of the forest-area around Tekalong is left, all of which is secondary forest (See Appendix 13). The forest that is left is located across the floodplain and is shared by the villagers of Tekalong (See Appendix 5).

In the beginning of the 1960s, the Malaysian government introduced a drainage scheme to teach farmers better ways of farming which led to an increase in rice production. In 1966 another scheme was implemented, this time for rubber, which led to the introduction of rubber plantations

in Tekalong. During this time, most hill lands for rice cultivation were converted to rubber, with large areas of forests cleared for expansion of rubber farms. In 1975 a scheme targeting the production of pepper was rolled out by government which saw a massive rise in the cultivation of pepper. However, in the 1990 pepper production saw a decline due to falling market prices. In early 2000s, a forecast of high pepper prices sparkled a significant increase in pepper production that has continued until today (See Appendix 13).

3.1.2 Current crops and agricultural practices

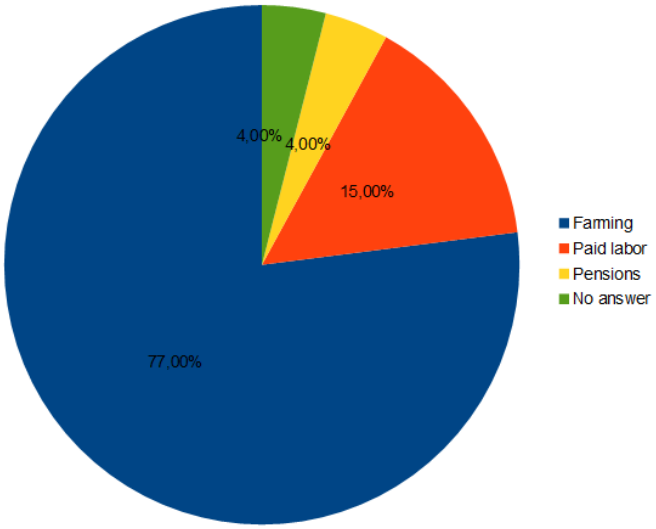


Figure 4 Most important income generators for the households of Tekalong (Total = 100%).

At present time, 79 people are living in Tekalong across the 26 households, and all of them have land and cultivate crops (Source: Questionnaire). As we can see from Figure 4, the villagers of Tekalong very much rely on farming, with more than three out of four households relying mostly on this activity as the primary income generator.

As shown in Figure 5 below, the most cultivated crops are pepper and rubber, with 73,1% of the households cultivating these on their fields. The cultivation of oil palm has risen from 0% in 2007 to almost 40% of the households engaging in this trend in 2014, showing the rapid increase of popularity of this crop in Tekalong. This is due to the very high market prices, and the possibility to convert some wetlands formerly used for rice cultivation into oil palm plantations. Most of the oil palm plantations are now about three years old.

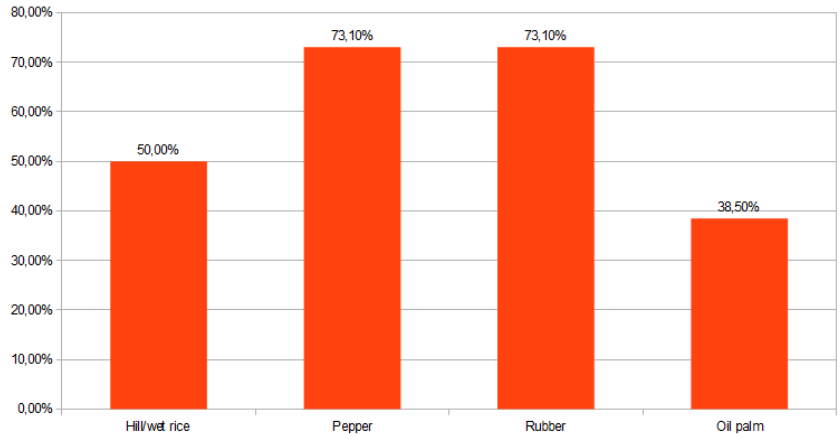


Figure 5 Percentage of households that cultivate rice, pepper, rubber and oil palm in Tekalong, march 2014.

A villager told us that only one household cultivates hill rice, while we can see from Figure 5 that 50% of the households cultivate rice. This means that the villagers are mostly cultivating wet rice at this point in time, and it is purely for self-consumption (Source: Questionnaire). Since the inception of Tekalong, the rice production has declined to where it is today, due to falling prices and high labor intensity, making it profitable for some to buy rice rather than growing it (See Appendix 13). The local Department of Agriculture are encouraging rice production by providing fertilizer to the villagers.

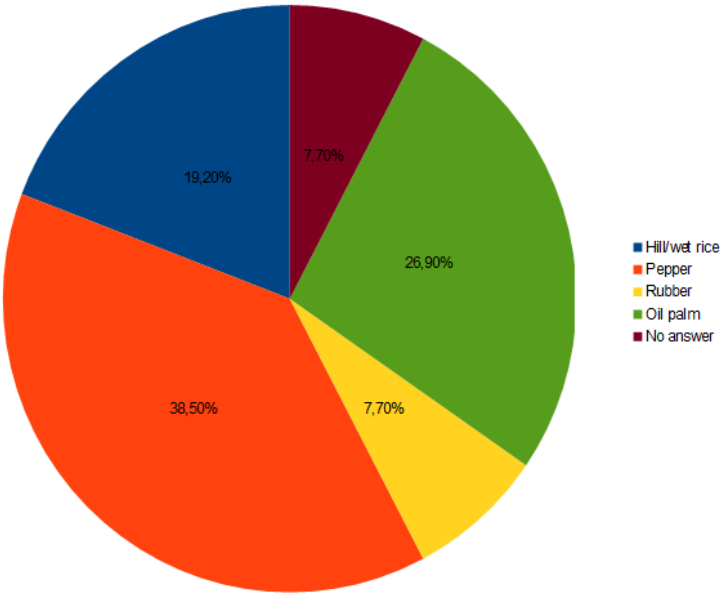


Figure 6 Percentage of villagers who answered a specific crop as most important (Total = 100%).

According to the Department of Agriculture, pepper is the main crop of the district around Tekalong. Figure 6 shows what our questionnaire respondents thought to be their most important

crops. We can see that pepper, closely followed by oil palm, is widely regarded as the most important crop by most of the households.

Only 7,7% of the households (2 households) regard rubber as their most important crop, even though it is cultivated by most households as shown in Figure 5. This is likely to be correlated with the very low price of rubber at the moment and the rapid conversion of land to oil palm. This has resulted in many of the villagers regarding their rubber field as an "ATM", which they can 'withdraw' money from, by tapping whenever they are in the need of cash. Rubber is a low labor input crop that is easy to maintain and harvest. An experienced farmer can tap 600 trees in three hours (Interview with En. Eran). A government scheme (NKEA) was implemented in 2009-2010 to boost rubber cultivation. This scheme sought to make farmers not completely neglect rubber, to secure their livelihood, in case the market prices for oil palm should decline in the future (Source: Department of Agriculture).

In contrast to the majority who ranks cash crops as most important in Figure 6, one fifth of the households (19,2%) indicated that rice is their most important crop, meaning that there is a group of people that value their crops for own consumption higher than their cash crops.

The main cropping practices are monocropping for the cash crops on the mountain side, while rice cultivation in the wetlands is considered monoculture with less fallow periods compared to the past. The transition from one crop to the other is more or less like a mixed cropping system. Land preparation practices are mainly slash and burn and terracing. Staking, weeding, fertilization and pruning are post planting activities for most cash crops. Traditional irrigation systems are also used by farmers to convert wetlands into oil palm cultivation.

Summary

The village was established in 1959 by four families who lived in a long house. Cultivation of crops mainly rice and pepper started as far back in 1959 on subsistence basis, with shifting cultivation being the main land use practice. The implementation of government schemes towards specific crops such as rubber in 1966, and pepper in 1975 saw a shift in cropping from subsistence level to a more commercial plantations.

In terms of cropping transitions, government policy and market prices have been the dominant determinants of the type of crop to be cultivated. Logging activities in 1973, and in the 1990 contributed to depletion of more than 70% of the forest resources.

Cash crops cultivated are pepper, rubber and oil palm mostly on the hill lands, with most of the rubber plantations being traditional agroforestry systems, with the pepper and oil palm fields being monocropped. Rice cultivation is on the wetlands and is on subsistence basis, often monoculture, and mostly done by women receiving government subsidies.

3.2. Stakeholders in Tekalong

This section summarizes the findings of the roles of stakeholders in cropping, the different factors influencing cropping transitions and how stakeholders and factors interact to influence the current state of cropping in Tekalong. Finally, the section summarizes the findings regarding the current state of land use and tenure arrangements.

All findings derive from the methods applied during the fieldwork to answer the main research question.

3.2.1 Stakeholders

As the venn diagram revealed (See Appendix 10), the main stakeholders in the village are the farmers and middlemen. External stakeholders include the various agricultural institutions, such as the DOA, the Malaysian Palm Oil Board (MPOB), the Malaysian Rubber Board (MRB), the Malaysian Pepper Board (MPB) and Malaysian Cocoa Board (MCB). These associations or boards are responsible for supporting farmers with the commercialization of these crops. The Table 3 summarizes the role of the various stakeholders.

Table 3 Roles of stakeholders in crop production in Kampung Tekalong

Stakeholders	**Roles**
Farmers	The farmers role is to take the final decision about which crop to grow and how to manage the farming system, including labor input, fertilizer allocation, etc.
Middlemen	They function as the link between the village and the regional market by buying the farmers harvest at an agreed price and help them with the provision of seedlings. There are two different middlemen in Tekalong, one is an external merchant who buys the pepper and rubber harvest and the other one is the

	headmaster who sells the villagers oil palm to the refinery. As the majority of the villagers do not have an official permit (which would cost 1.000 RM) to grow oil palm, they rely completely on the headmaster.
Department of Agriculture	The vision of the Agricultural department is to "*modernize, commercialize and maximize income of the farming communities* (Interview DOA) The government provides subsidies such as fertilizers, pesticides for cash crops and rice, the main staple food. The government, through the department, also helps farmers with the establishment of plantations. It is however, the responsibility of farmers to apply for these schemes. According to the department the government strategy is to "*...ensure that farmers have diversified crops and this is primarily due to future market fluctuations of specific crop products, since it is difficult to predict the future of market prices.*"(See Appendix 18). Hence the government always ensures that attractive schemes for specific crops are implemented, so farmers do not grow one crop only. Mr. Liu Joo Pin (the respondent from the DOA) notes that rice cultivation is declining as it is cheaper to buy than produce and is labor intensive as well. However he added that "*it is still the priority of government to continue subsidizing its cultivation"*. The government for example, through the Federal Fertilizer Assistance Scheme (Skim Bantuan Baja Padi Persekutuan) provides fertilizer for farmers to boost rice cultivation.
The Boards	There are several associations or boards responsible for supporting farmers to realize the vision of the government. The main cash crops such as rubber, cocoa, pepper and oil palm have specific boards as mentioned earlier, ensuring the commercialization and marketing of these crops. *On oil palm plantation and community involvement, it came out that two schemes by SALCRA and MPOB are the available options for the communities.* The MPOB scheme provides land clearing, seedlings for planting, fertilizers and other support for 4 years when the crop starts fruiting, while the SALCRA scheme involves leasing NCR lands from communities for large scale plantations for periods of 25 years or more based on the contract with the

	community. Dividends are paid after the 5th year into production. The MPOB controls the domestic price of oil palm. The Malaysian Cocoa board (MCB) and the Malaysian Pepper Board (MPB) provides similar incentives for farmers to increase production. The MPB for example gives new seedlings to farmers annually, agrochemicals as well as other extension services to farmers.

3.2.2 Factors of crop transition

From the time line, the transitions in cropping over the last 50 years could be attributed to two main factors, government policies and market prices, but also the incidence of pests and diseases, topographical factors and soil quality factors play a role. These factors were also confirmed in an interview with the DOA.

The influence of the various factors on cropping transitions is summarized in Table 4.

Box 2: Understanding the economic rationale behind the choice of crop based on land size and labor availability in Tekalong

Based on the table: *Economic analysis of the various commercial crops* (See Appendix 14), we can see that although pepper is the most profitable crop per acre, the return per man day can at best be almost equal to that of oil palm.

Based on the questionnaire findings, no landowner owning less than 6 acres has planted oil palm.

In the table above, the profitability and the return to labor of the different crops are here key factors to consider. They help explain why smallholders engage in pepper or rubber rather than oil palm. It also contradicts our assumption that only large landowners plant oil palm because smaller ones cannot afford to leave their land idle for two years or because they cannot afford the initial investment.

Indeed, if oil palm offers smaller returns per acre but frees up a lot of time to engage in other economic activities (which could be planting more acres of oil palm, or transportation of the

crops, etc…), and pepper offers higher returns per acre but is very time-consuming, while rubber provides low returns per acre but high returns per man day, as it is by far the least intensive of all the crops, and can be tapped whenever needed (unless rain), then a clear land pattern appears: large landowners will choose to plant oil palm (as is the case) and small landowners will choose to plant the two other crops (as is also the case).

This finding is consistent with labor availability. Indeed, if a couple (who does not pay itself a wage) engages in pepper production, their labor is essentially free. Thus, the overall economic benefit will be higher than if they engaged in oil palm production. However, if they engaged in oil palm, the workload would be diminished per acre, but the total returns per acre may not be economically advantageous for the household. Engaging in rubber has very little impact on the labor availability of the household, as it is very labor efficient.

Similarly, given that pepper is labor consuming, a large landowner may choose to plant oil palm because the amount he would pay in wages for pepper if he had chosen this crop instead would be very high, while his return on each acre of his land would be low if he had chosen rubber.

Therefore, the choice of crops is relative to how many people can work on the field, but also to job availability in the area. If there are many jobs, then farmers can afford to plant oil palm and find off-farm work. However, we found from the focus group conducted with the young people that there is an excess of labor relative to job availability in Tekalong, which is why the youth reported that they all wanted to leave the village.

However, if pepper is labor intensive, then it is likely that one unit of labor in the household can only manage X unit of land under pepper. Therefore, the area devoted to this crop must plateau once every household member is busy with the management of this area of land (X multiplied by household members). Once this point has been reached, and if land is still available, the household may choose to engage in oil palm (less profitable per acre, but also less labor intensive). This would also imply cutting off a small part of the pepper or rubber to free up some time.

Table 4 Factors influencing cropping transitions in Kampung Tekalong.

Factors	**Effect on cropping transitions**

Government schemes	The introduction of schemes and subsidies such as fertilizers, seedlings, introduction of new crops, agrochemicals, crop establishment etc. by government targeting rubber, rice, pepper, and oil palm has led to a massive expansion of the cultivation of such crops. This trend was observed since the mid-1960s.
Market prices	Current and projected future market prices are key in deciding which crop to cultivate, but however cannot be isolated from government policies. The government invests a lot of money into market research and this serves as a basis for the type of scheme that will generate better incomes for farmers. According to the survey, farmers are mostly motivated by the market prices. According to the key informant a typical incidence happened in 2008, when farmers were informed of higher market prices for pepper in the coming years. Most farmers were influenced to cultivate pepper and are now reaping the benefits, since according to the DOA, the price of pepper is very high at present MR 30/kg. The current price of a crop also plays a role in its ranking of importance. Nonetheless, the DOA also mentions how cash crop cultivation are mainly subject to competition from one growing period to another. Thus the age of the perennial crops at a certain time will decide whether the cropping is influenced by the changing market prices.
Tography	The topography of the land also plays a role in the choice of crop. The land area is either hilly or seasonally flooded wetland. Also it was noted from the interviews and observations that wetlands are mainly used for rice cultivation and can only be used for other crops if a high investment of labor can be afforded to drain the land. In this respect the nature of the land owned by each family plays a determining role in the choice of crop to cultivate. Regarding oil palm plantations, some investments are needed to convert the wetlands to dry lands in order to cultivate the crop. The headmaster and the wife (HH 14) reported that they both did this by digging a simple system of gullies and ditches in order to channel the water to another point. However, it

	must be noted that in events of severe floods, crops growing in this areas will be affected.
Flexibility to convert a field related to land size	When asked if smallholders could afford to do this and not have an income for two years before the plants started bearing fruits, the headmaster said that smallholders can also plant oil palm if they want, because during the first years, as the oil palm develops, they can plant rice in between and live on that, or, as we could also see in some fields, cut down only part of their pepper and plant oil palm in between, in order to be able to continue on harvesting the pepper and gain an income from this. These were the only intercropping system that we saw, but it always meant that the pepper was condemned as the oil palm was meant to take over.
Labor efficient crops	Most farmers will prefer to cultivate crops that will give them the flexibility to engage in other economic activities as discussed earlier. As discussed in our economic analysis, farmers who have other economic opportunities will prefer labor efficient crops in order to both diversify and increase their income.
Leisure	According to the questionnaire, households above 3 acres do not cultivate all of their land. In extreme cases, such as the headmaster's case, up to 30 acres are left fallows, while households 27 and 5 leave about 20 acres fallow. Although some of it may be forested (as in the headmaster's case), some are inexplicably left idle. Boserup's theory of leisure maximizing people may here come in handy: people do not seek to maximize their profit, but to ensure sufficient income

	while retaining a large amount of free time for themselves (Boserup, 1965).
Soil quality	Farmers, according to group discussions, said that when they realize a decline in the wet-rice yield after two to three years of monoculture, they allow a fallow period of a year if they have enough other land to rely on and then cultivate rice again. This applies only to wetlands. However, the soils in Tekalong according to the DOA, is the best soil for crop cultivation.
Pests and diseases	According to a focus group interview and key informant interview while developing the timeline, the incidence of pests and diseases led to a decline in the cultivation of cocoa in Tekalong. Lands used for cocoa cultivation is now used for other cash crops like rubber or pepper. This was also confirmed by the Department of Agriculture

3.2.3 Scarcity of land

Land is an important resource especially in areas where agriculture is key to the local economy. Land in Tekalong according to the villagers is very scarce. When asked when was the last time some land was auctioned for sale, some villagers said that they never heard of any. The headmaster said that the last time he bought land was in 1998. He did not hear of land for sale since then. The price of land, according to him and the headman, is between 1,200 RM to 1.500 RM per acre for NCR land. Some people however claimed that they would never sell their land, even for 20,000 RM per acre. Land bought with formal title deeds is worth 100.000 MR per acre (headmaster interview). On land status, the district officer reported that most of the land in Tekalong is NCR land, but certain areas such as the hill are title owned. Currently the only communal land in Tekalong is the surrounding forest area close to the lake. Land border disputes according to the district officer, are settled in the native court, and for conflicts between villagers and companies, resolved in magistrate court.

On the issue of land development into plantations by SALCRA or PELITA, the district officer stated that there is no contract between Tekalong and any oil palm development company. However, according to the headman, SALCRA has visited Tekalong with no known intention.

Summary

The main stakeholders in the village are the farmers and middlemen. External stakeholders include the various agricultural institutions. These associations or boards are responsible for supporting farmers to commercialize and the various markets these crops.

The transitions in cropping over the last 50 years could be attributed to two main factors, *government policies* and *market prices*. Other factors include incidence of pests and diseases, nature of land, land size and labor availability, soil quality factors, personal decision and to a less extent leisure.

The land in Tekalong is mostly Native Customary Rights (NCR) and very scarce. Currently the only communal land in Tekalong is the surrounding forest area close to the lake.

3.3 Impact on the local natural environment

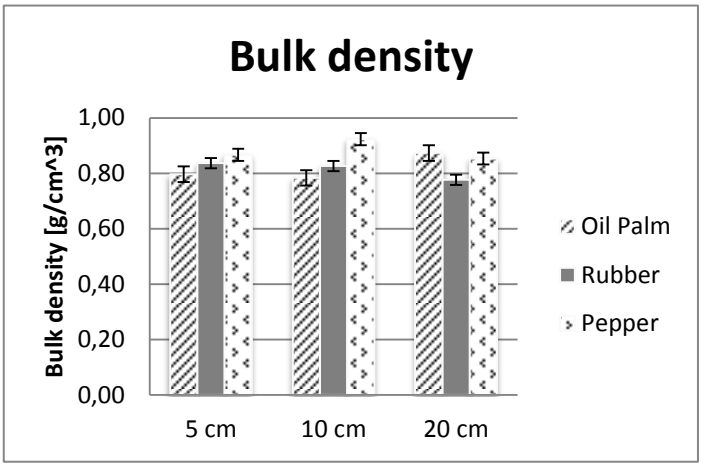
In order to assess the impact of the shift in land uses on the environment soil samples and water samples were obtained and analyzed (See 2.2 Applied Methods). The following section describes the results and insights obtained from it.

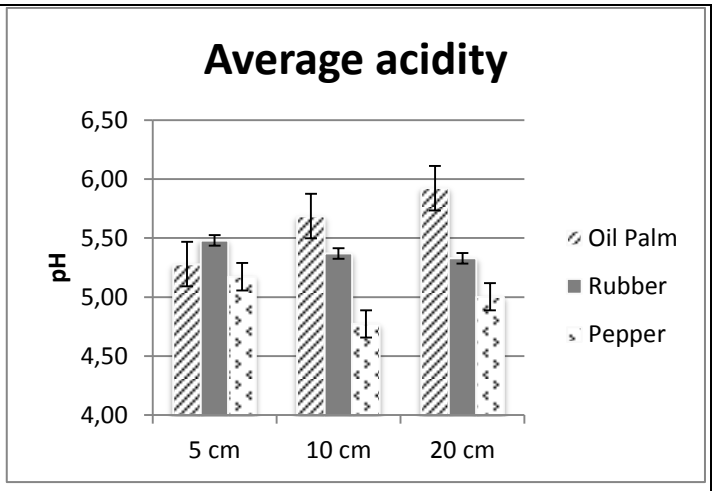
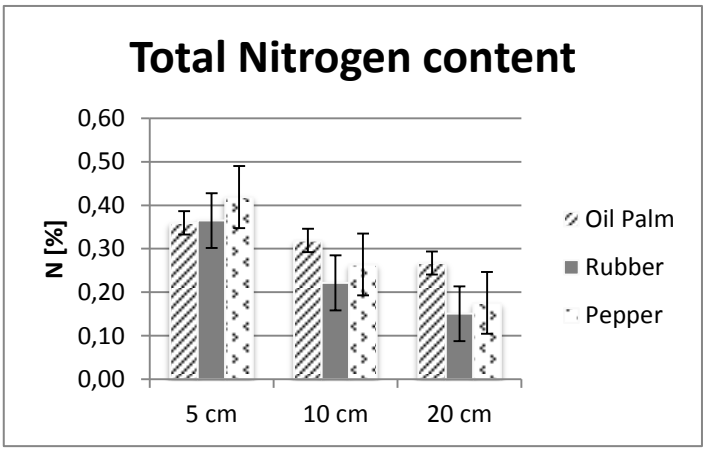
3.3.1 Soil

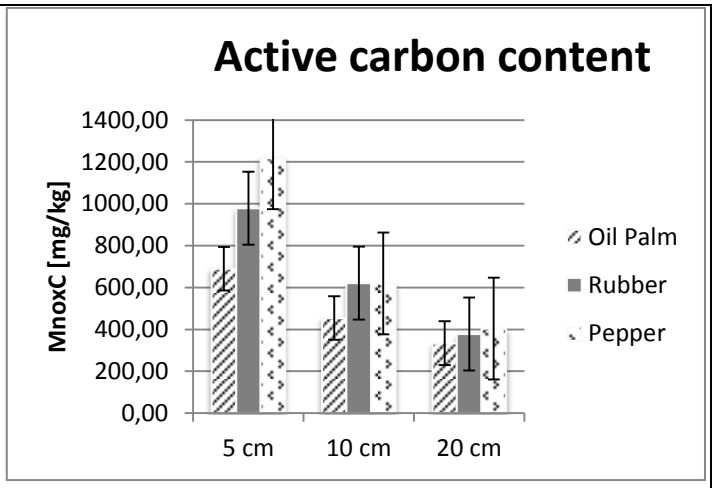
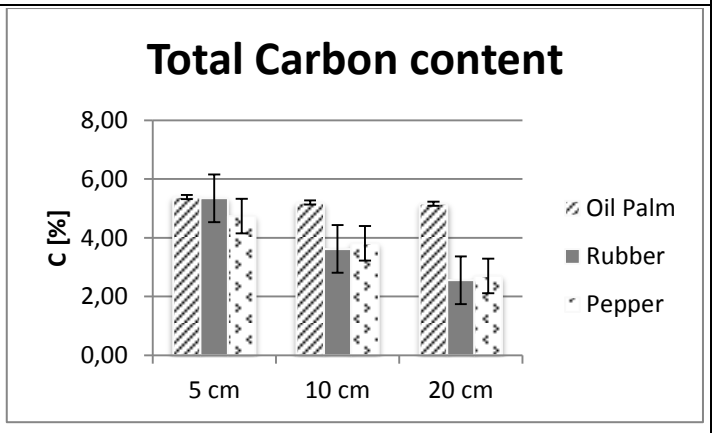
The fertility of the soil used to be a reason for people to move and settle down in Tekalong (life story interview). According to the department of agriculture the soil is called “Tarat”, and is considered the best for agriculture.

Regarding the colour and soil texture all our samples appear to be very similar, with only slight variations in the depth of the A horizon. In the rubber field all samples have a silty clay texture at all sampling depths. In the oil palm fields however the samples from the top layer (0 cm to 5 cm depth) show a silty clay loam texture and mostly silty clay in the layers below with occasional heavy clay in the deepest sampling depth (20 cm). The pepper field is the site where the A horizon is most prominent in all topsoil samples whereas between the oil palm and rubber field not much difference is apparent. The texture of the pepper field however resembles the rubber field with only slightly less content of clay. The following table gives a more detailed description of the analyzed soil parameters.

Table 5 Description and discussion of the analyzed soil parameters

The bulk density is an indicator for the level of compaction of a soil (Coulter, 1998) and can be of interest when evaluating the ability of roots to grow in the soil. A bulk density higher than approximately 1.6 g/cm^3 is rated to be restrictive for root growth (Jones, 1983). As the analysis revealed, there is very little variation between the different sample sites and depths and the level of soil compaction is far from 1.6 g/ cm^3 in each of the plots. The bulk density of all the soil samples analysed is less than one, a possible indication of high organics and some friable clay in the soils. Therefore the compaction of the soil is not yet a major concern but might possibly become a problem as the significant difference between the oil palm and rubber field at 20 cm depth indicates.	
Soil acidity is an important indicator for the availability of macronutrients. In strongly acidic soils (pH < 5.2) the N,P,K availability is reduced (Juo and Franzluebbers, 2003). In our case only the pepper soil is strongly acidic, the other soils are only slightly acidic (pH 5.2 - 6.9). As soil acidity can be caused by fertilizer application (Ibid.) the findings correspond with the higher N content in the pepper field implying that the higher N content derives from fertilizer application. The pH of the topsoil seems lower than in the other soil layers (but not statistically	

significantly) which corresponds to a higher content of organic material. Another contributing factor that could possibly account for the different pH value is plant root activity.	
Nitrogen is one of the plant macronutrients and its lack is often one of the main causes for yield decreases (Coulter, 1998). In East Asia an average of 116 kg/ha is applied to agricultural areas (ibid.) which might explain the significantly higher nitrogen content in the topsoil compared to the deeper soil depths. Noticeable is the high N content in the Oil palm field at 10 cm which might indicate leaching of the fertilizer. It seems like the pepper field received slightly more fertilizer than the other fields which corresponds to the statements about fertilizer use gained from the questionnaires.	
In the figure showing active carbon contents, the active carbon content is highest at the 5 cm depth and least at 20 cm. The pepper field samples have the highest active carbon content in the topsoil which corresponds to the findings from the pH measurement. It is	

however surprising as we expected the rubber field to contain higher amounts of active carbon due to its low level of intensification and therefore less disturbed soil horizons. An explanation might be that the rubber is the most current crop, replanted in 2009. The various land preparation practices that were conducted when planting the new generation of rubber trees might have attributed to this finding. Burning contributes massively to loss in active carbon (Neary, 2004). From the interviews, slash and burn is a common practice, and might therefore be a contributing factor to less active carbon content compared to the other fields.	
The total carbon content results indicate, that carbon is evenly distributed in the first 20 cm of the oil palm field, not so however regarding the rubber and pepper, which contain less Carbon in deeper soil horizons.	

Clay soil is regarded most suitable for agricultural purposes because of its high cation exchange capacity, which serves the crops as nutrient donators. In this respect the statements of the villagers are reflected in the analysis results. Regarding the soil fertility it must be noted that in the oil palm and the rubber field no soil organic layer could be found. In an undisturbed soil under these conditions, finding an O horizon would have been most likely and an indicator for a good nutrient status of the soil. It can therefore be concluded that the cropping activities are having an impact on

the soil fertility (also regarding Nitrogen and active Carbon content) in the oil palm and rubber field. In the pepper field the impact of the crop is probably blurred due to high fertilizer application or especially conserving cropping practices.

3.3.2 Water resources

In the perception of almost 70% of the villagers, the drinking water quality has not changed over the last ten years. But still most of the villagers expressed concern about the water quality, mentioning the higher turbidity of the water after a rain event. As a consequence all of the villagers boil or filter the tap water before drinking it.

We used these concerns and the expectation that the past land use changes might have had an impact on the water quality for a reason to analyze the water resources in Tekalong at different points. For a detailed overview of the exact results, please refer to the Appendix table 8.

According to the National Water Quality Standards for Malaysia (see Appendix 9) the drinking water quality in Tekalong can be classified as Class I for most of the parameters. Only the coliform counts, Phosphorous amount and COD are too elevated for this class and should, on the basis of this, rather be classified as IIA or IIB (compare Appendix 9). Class II means that "conventional water treatment" would be needed.

As a lot of data is missing from the former drinking water source, so that the anticipated comparison between the two sources would be highly inaccurate and has therefore been dismissed. Comparing with the downstream water at location 2 and 3, the drinking water contains 7 times less coliform bacteria but slightly higher values in phosphorous.

Contrasting the water quality at location 2 and 3 the results are slightly inconclusive. Location 2 seems to be more affected by the cropping activities as phosphorous, nitrate and nitrite levels are slightly elevated, however at location 3 the turbidity is much higher and dissolved oxygen is much lower which indicates more algae bloom.

It has to be borne in mind that only one water sample was taken from each location and no statistical validation could be done with samples from different points in time. There has not been any rain in the 24h before the samples were taken, reducing the sources of error but also not giving us a chance to know how the water quality would be after it had rained.

The continual destruction of forest and clearing of lands for agricultural purposes will lead to less ground cover resulting in an increase in surface runoffs. The combined effects are increase in TSS values, subsequently increasing the values COD, conductivity, and turbidity. Moreover, increase in the use of agrochemicals such as fertilizers and pesticides in response to expansion of plantations in the WC area are a threat to water quality. Nitrate, phosphorus, ammonia-nitrogen etc. from fertilizers will pollute the water. The general consequence is a high reduction of the water quality.

Also fish catch in DS water will be affected especially with increased agrochemical use in the plantations, as the water sources flow into each other.

In connection with this, an interview with a key informant (headmaster) reveals how the current situation and in the near future is a worry to the village. He stressed that "the declining water quality and quantity has prompted us to write to the government to provide water filter called "life saver" and also an alternative source of drinking water".

The water quantity has also declined resulting in frequent water shortages during the dryer months.

Summary

The soil in Tekalong, according to the DOA, is called tarat soil, and that it is considered the best conditions for agriculture. The analysis shows however that the soil fertility might be declining and a higher use of fertilizer might be needed in the future to achieve the same yields.

The drinking water of Tekalong can be classified as requiring conventional water treatment, which is why the so called life-safer filters will be installed in the near future. The stream water quality did not show alarming results regarding nutrient afflux from the surrounding cropping areas.

All results must be handled carefully though as the analysis presented here contain several sources of error, especially regarding the number of samples and sample locations. We therefore recommend to monitor closely the increasing forest destruction, expansion of plantations and use of agrochemicals.

3.4 Social structures of Tekalong

This section will discuss how the changes in cropping are related to the social environment; demographic distribution, wealth distribution and political structures of the village. The section starts by introducing the current condition of the village in terms of demography and wealth distribution. It discusses how these factors are interlinked with cropping.

3.4.1 Demography

There are 79 people living in Kpg Tekalong. The demographic pyramid below shows the distribution of gender and age.

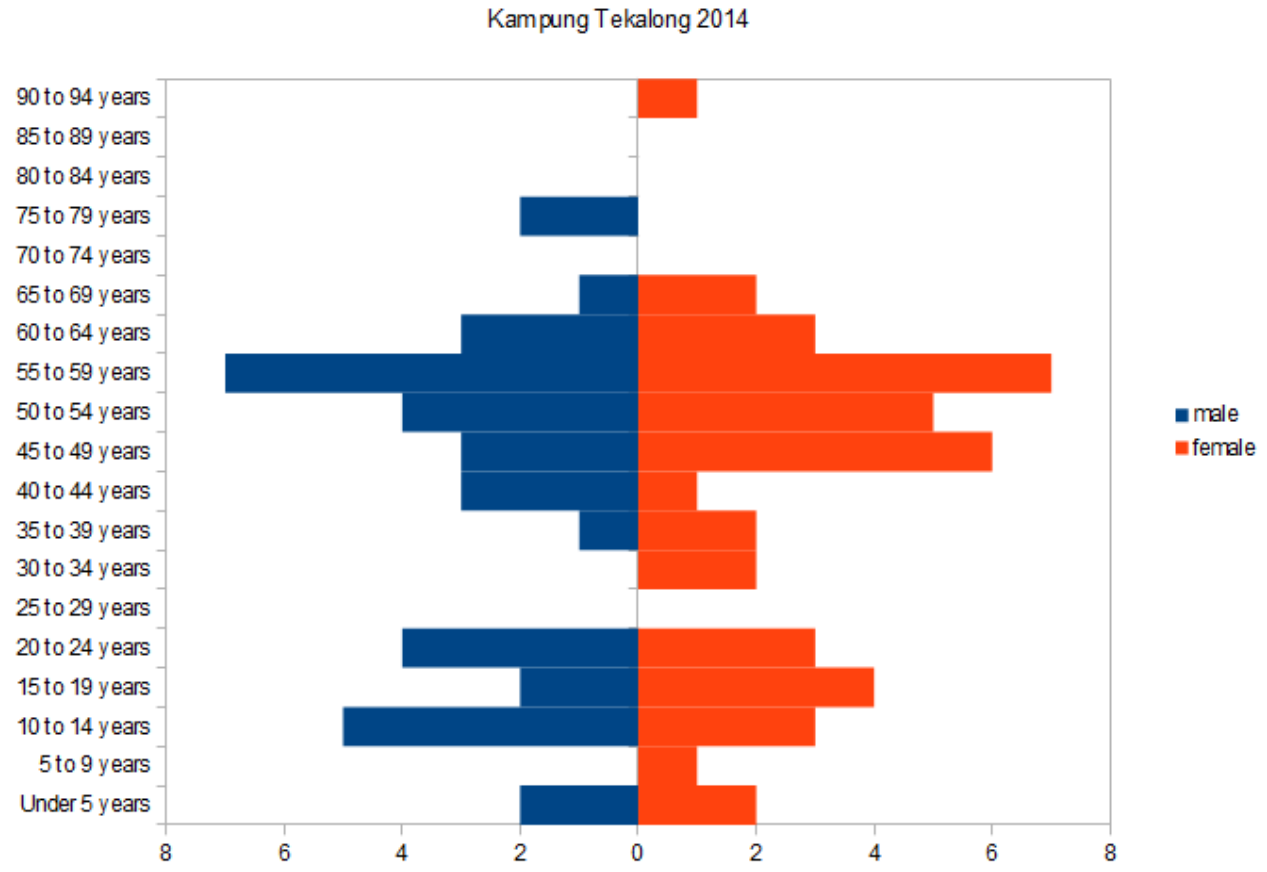


Figure 7: Demographics pyramid showing residents of Kampung Tekalong, march 2014.

Figure shows that the average age of the villagers of Tekalong is 40,7 years, while the median age is 50 years. The demographic pyramid shows that people are mostly in the age group of 45 to 59 years (40,50% of the population is in this age group) while there also is a big group of young people from 11 to 25 years old (26,50%). There is an absence of people from the mid-twenties to 40 years (only 5 persons), which is a large percentage of the child-bearing age. In accordance to this there are relatively few children under 10 years (5 persons).

If the relatively large group of people from 11 to 25 intends to stay in the village, it could result in a baby-boom in Tekalong in several years. However based on the focus group with young people, we expect a huge part of them to follow the pattern of the pyramid and move away from Tekalong for education and work purpose, resulting in a very old population (See Appendix 12). The headmaster expects that a lot of pensionists will move to the village after they will have been connected to the electricity grid which is due in summer 2014. He also expects a tarmac road to be built and be an additional factor for attracting pensionists. This will further contribute to an ageing of the population in Tekalong.

69,2% of the villagers we asked said that they expect their children to take over their occupation after them, which indicates that even though the young people intend to move away, some of them might have to or want to come back at some point to take over their parents' farms. From the focus group with the elderly we know that their wish for the children is for them to get good education, but also to come back and take over the farms, which can seem contradictory. We found that all of the young people of the focus group expect to leave Tekalong in the future, and though they want to come back, they dream of other jobs than farming (See Appendix 12). From their own perspective, opportunities for off-farm jobs and better infrastructure are the main drivers for them to come back to Tekalong. Better infrastructure in terms of roads, and electricity is also of high importance for the youth. The implementation of these in the near future is confirmed by the District Office. Thus the authorities influence on the demographic development to a large extent.

The educational level of the citizens will also influence the future livelihood strategies, thus also the future land use (Ellis, 2000). Youth is already at a higher educational level than the generation before them and many villagers also have grown up children with higher education living and working elsewhere. In some decades from now, it could lead to a situation where a lot of educated people with off-farm jobs will inherit land in Tekalong. From SSIs and questionnaires we found that people are mostly selling or leasing land to other family members, and it seems unlikely

that they will sell of land to newcomers. If the farms grow, we can expect a bigger share of the land will be used for oil palm, considering that as of now, 6 out of 7 of the farms with more than 20 acres of land cultivates oil palm. These farms also have the biggest diversity – all cultivating more than two crops. In comparison, 4 out of 11 farms with 5-10 acres have oil palm. In this category the diversity is 1-4 crops. Among the farms with 3 acres or less none are cultivating oil palm and none have more than two crops. Only two out of these eight households cultivates rice.

Another outcome of the increased educational level could be people with off-farm jobs keeping the land, and changing into less labor intensive crops. This is supported by our questionnaires, where we see that households with high income from off-farm work cultivate mainly oil palm and rubber and very little or no paddy and pepper (Examples are the teacher, the shop owner, and the headmaster). This phenomenon could gain currency if the group of people combining farming and high income from off-farm work increases.

This indicates that in both scenarios, bigger farms in terms of area and landowners with off-farm jobs will probably result in bigger oil palm plantations. This is also the result of our economic analysis on the choice of crops.

All villagers we asked said they would never completely abandon rubber and pepper in order to cultivate only oil palm, as this would dangerously expose them to the fluctuations in world market prices. This means the reasoning behind the government politics is adopted or at least shared by the villagers and not only working by its economic winnings. It can however be expected that although the farmers always said they would retain some diversity, it is likely that oil palm plantations rates will grow faster than other commercial crops and occupy a larger percentage of the total land area in the future, at least for large landowners, as explained in our economic analysis of crops. The headmaster also thinks that the rate of conversion to oil palm is very high and he is optimistic that given the stable market prices of oil palm, all things being equal, in the future, oil palm will be the main cultivated crop. This expectation is backed up by both the young and the elderly. He added that people will still cultivate rice as this is the main staple food. This foresight of diversity of cropping practices is reinforced by most farmers we interviewed.

3.4.2 Wealth distribution

Looking at how wealth is distributed in Tekalong, we can see from the questionnaire that there is a huge gap between the richest and poorest household. While there are reasons to believe that the data

on the smallest income are flawed, the highest household still earns 75 times more money than the second poorest. The mean income in Tekalong is 15.615 RM per year, while the median income is 5.443 RM per year. This indicates that the household who is in the middle in terms of revenues is actually far below the average, indicating a distribution of income skewed towards the top (Stiglitz, 2010). The top 3 households concentrate nearly 60% of all the income in the village, giving them added opportunities in terms of capacity to acquire land, education, choice of crops due to being able to meet high initial investments. Even if these numbers might be flawed due to the fact that it was hard for the respondents to answer exactly how much they earn per year, there is another way of seeing this inequality in wealth.

By looking at how much land each household owns, we can see that it spans from ¼ acres up to 80 acres of land. The mean size of land is 13,3 acres and the median size is 7,5 acres (Figure 87). We can therefore see that also the distribution of land is skewed towards the top (Stiglitz, 2010). This is also shown from the diagram below, with 19 out of 26 household under the mean line. We see that the top 3 households own a big part of the total amount, with 45% of all the land. The headmaster owns almost 23% of the cultivated land. The bottom 8 households together only own 5,3% of the total amount of land in Tekalong (source: questionnaire statistics). This is a clear indication of a very unequal distribution of land. The general worry, shared by large and small landowners alike is the division of land between children from generation to generation. This seems to indicate that if they could, people would buy more. It should be noted here that the selling system based on individuals to individuals may represent a chance for the smallholders to acquire more land, by keeping large landowners at bay and cancelling this asymmetry of bargaining power (Byres, 2003). This somewhat curious system indeed bypasses the system of supply and demand which would mean skyrocketing prices for land due to the high scarcity. However, seeing that sale of land is exceedingly rare, so their lot may not be improved anytime soon.

As mentioned before, most young people are not planning on staying and live as farmers in Tekalong, so this might not be an issue for their future livelihoods. It however indicates a transition in livelihood strategies in the future.

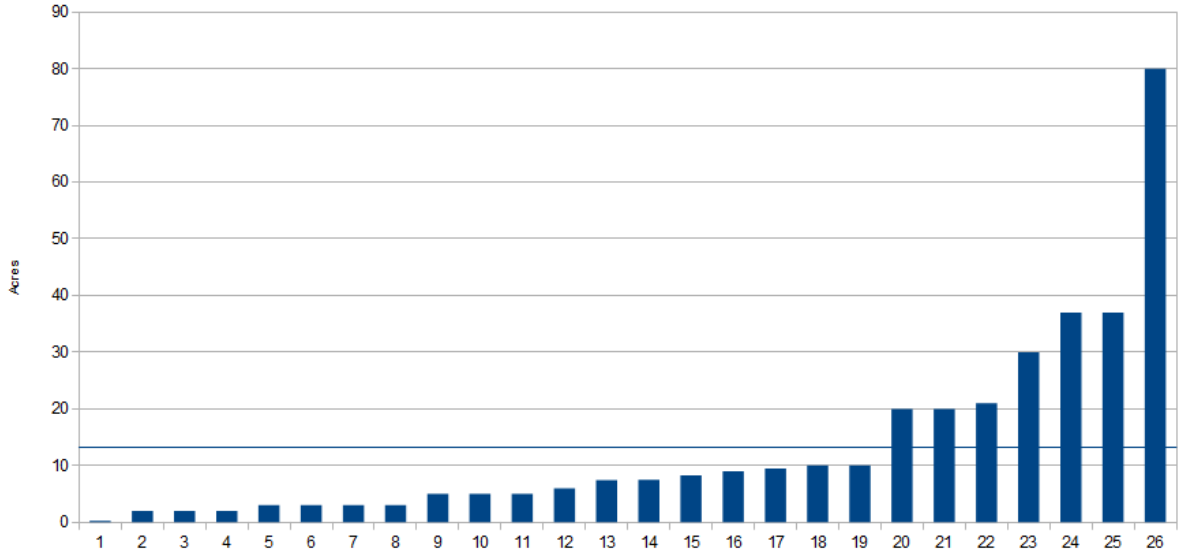


Figure 87: Land distribution in acreage between the 26 households in Tekalong from smallest to biggest, including mean line. March 2014.

Jackson (2007) argues that inequalities also influence the social fabric. An example of this is the fact that we were able to obtain data on the land size of the person who owns ¼ acre during an informal interview several days after we conducted the questionnaire with her. The lady commented that she felt ashamed to say that she owned that little, and thus preferred saying that she did not own any. While many households are poor relative to the average income, we found in the questionnaire that some are afflicted by an extreme level of poverty, and must rely on friends or neighbors for supplemental food.

3.4.3 Local politics - Conflicts and decision making

The villagers of Tekalong wish for their village to develop in terms of more people, jobs, clean water and better living conditions in general. A barrier to this, expressed by many of the villagers is the political leadership of the village.

There is a conflict about the headman in Tekalong. The issue is quite complex and sensitive as there seems to be a divide, one group against the current headman and the other group in favor. An elder of the village who is also a school headmaster now serves as the mediator in the village. In accordance with information from the headmaster, the headman told in an interview that all his duties as a headman are managed by the headmaster or by himself under supervision of the headmaster. The headman

attends meetings in the district, and delivers information to the villagers, but all applications for government support is handled by the headmaster because the headman is illiterate.

According to the village committee the situation of the leader structure slows down development in Tekalong. The headman is not the one to initiate any new direction or improvement in Tekalong. It is difficult to say if things would be different with another person in charge though, and to define the consequences of the leadership situation. One concrete example is that Tekalong did not get the water filter system yet, which according to independent sources the headman can be blamed for. It seems like the current political structure can delay many services provided by official authorities, as infrastructure and other thing in the category of physical capital (Ellis, 2000). It is definitely also a problem for the well-functioning of the democratic system that the decision maker is not the one considered accountable (Collier, 2008). Based on many formal and informal talks it is our impression that the headmaster is very comfortable with his position, and indirectly he is responsible for maintaining the status-quo.

The educational level of the villagers is crucial for the political situation in more than one aspect. Different villagers told us independently that the community was about to choose another headman with higher educational background, but they were afraid that due to this, he could fool them and they chose the illiterate headman instead. This is an interesting paradox, considering that most villagers mention the well-educated youth as the driver for development in the future. Nobody holds the district office responsible for the missing elections or seems to think that the higher political level should generally be involved in the leadership of the village. This could also be due to a lack of knowledge of the structure of the political system, as the district officer is very keen on the fact that they have the last say to approve and register the headman. The headmaster is one of the few villagers that seem to know how to act and communicate with the political system. He helps the other villagers, but he is not interested in having the official responsibility. Enlightenment of people about the political system, election procedures and responsibility of different stakeholders would probably have an impact on these conditions.

The nature and the complexity of the situation prompted us to interview the district office (DO) in charge of local elections. On the topic of how a headman is elected, the administrative officer outlined the criteria for the selection. First, the person is nominated by the people elected representative (YB) and recommended to the district office (DO). The final decision of acceptance of the nominee is made by the DO. A nominee for a headman role must have a Sijil Pelajaran Malaysia (SPM) (a form 5 public exam) status and must be proficient in customary law. Elections are held every two years to renew the mandate of the headman or appoint a new one. When asked about the Tekalong headman conflict and when to elect a new one or resolve the conflict, the administrative officer noted "*the issue is complex and this is due to local politics*" (DO). Hence the DO has currently no intention to elect a new

headman. Thus it seems like strengthening institutions on district level could contribute to positive changes in Tekalong.

A further probing question on whether the introduction of the new election system as opposed to the traditional way of choosing a headman is responsible for the conflicts, he retorted "*yes because it has taken a political dimension"* (DO). On how the community will be affected without a leader, the district officer did not answer, but says that *"issues of development in such circumstances are referred to the community leader Temenggung Anthony or Penghulu Pili"* (DO). When asked, the villagers replied they were expecting to have a new headman within two years, when there is supposed to be a new election. However they cannot tell why they expect it to turn out differently from last election year.

For a future perspective, one can argue that the DO must act to solve this problem since they make the final decision on headman election. However, seen through the light of the development of the last ten years, it seems that the villagers need to take action for the local political structure to change. Since nobody in the village wants to take the job officially, and it is not the high priority of the DO to facilitate an election it seems unlikely that the local political structure will change in the near future. However, Tekalong is experiencing a relative higher educational level among the young generations, and a political change will also rely on whether or not these are moving back to Tekalong after the end of their education.

Summary

There is an age gap of 25-40 year olds in the population of Tekalong, probably due to work and education. Many factors indicate that the average age will increase further in the near future. Main drivers affecting people to move to Tekalong in the future is improvements of infrastructure and electricity. Government institutions will be important stakeholders to implement these. For the youth in particular off-farm jobs available are a driver for staying in Tekalong.

Social inequalities might be sharpened due to the fact that large landowners will be able to engage in oil palm production and remain diverse to cushion risks. We see correlations between big farm area and high crop diversity. Farmers with large lands are also those who cultivate oil palm.

On village level the political leadership is very weak, which may hinder the community and some individuals in making use of government services. The future of the political structures is very hard to predict. However, we find the situation unlikely to change in the near future.

3.5 Future land use and livelihood strategies

This section focuses on how future land use changes can influence the livelihood of the villagers in Tekalong. This section elaborates on an oil palm development project that is expected by the villagers of Tekalong and other possible changes in livelihood strategies and food security. Other plans for future projects have been rumored, but we consider them only that (See Appendix 19).

3.5.1 Oil palm development project

There is a project to develop the communal forest on the other side of the lake by using government subsidies in order to cut and burn the whole forest and turn it into an oil palm monoculture plantation. According to the headmaster, the forest is 80 hectares and the application is currently being considered. He says one issue is that each household will by law be entitled to receiving subsidies for a maximum of two hectares, leaving 28 ha without subsidies.

As this forest is communal land, there is no other way to proceed than to divide the land equally between all the households. This is the chance for everyone to receive 3.07 ha. The subsidy scheme for OP is as follows: the government will finance the clearing of the forest, the seedlings, and the maintenance (pesticides and fertilizer) for the first two years (during which the trees are not productive). The government will also provide title deeds to each household *for free.* In short, the government will pay for everything.

Regarding the yearly forest floods, the headmaster explained that the OP trees can take the flood as long as the leaves are outside the water. OP is therefore suitable for this place. It is likely that the erosion rate in the oil palm plantation, where the soil will be bare, will be exceedingly high during the floods.

When asking two members of the HH 16, which was regarded by us as the poorest one in the village, and therefore the one with the greatest stake in this project as their marginal utility of the land will be the highest by far (Galbraith, 1998), the two respondents replied that they knew there was a project to cut down the forest on the other side, but did not know anything more about it. However, as the headmaster underlined, since the forest belongs to the whole community and to no individual in particular, the division of the forest entails an equal redistribution of the land amongst the villagers. One would assume that as the application has already been submitted, everyone in the village should be aware of their future good fortune. Yet, the poorest household was

not aware of this future project. There seems to be a lack of communication between the politicians and the villagers.

Other projects briefly outlined by the DO were regarding an upgrade of the road, and a project to better target people regarding welfare, but as the interview was finishing, we did not have enough time to obtain details about it.

3.5.2 Future land uses and impact on livelihood

As written before, the justification behind the government policies promoting rice is to ensure self-sufficiency and thus resilience to food scarcity, while the reason to encourage farmers to cultivate different crops is a means of securing their incomes against market fluctuations through diversification.

However, the increasing expansion and conversion to oil palm plantations that are also encouraged by government policies is a threat to the remaining forest which is also an important source of food. Available water resources will also be affected by these changes. This paragraph discusses the impact of deforestation on food security.

The village owns 80 ha of communal forest. The forest is used by the villagers to collect a lot of different NTFPs. From questionnaires we know that 80% of the villagers eat products from the forest. These NTFPs are mainly a variety of edible fruits, vegetables used in their everyday cooking and occasional hunting. Bamboo and other plants are used for making baskets and fishing tools but it is only for personal use. 92% of the villagers eat fish and other products from the lake. Currently hunting and gathering activities according to the key informant are practiced by about 15% and 50% respectively (Interview 2. with headmaster). According to participants in the timeline exercise, the destruction of the forest as well as the ability to purchase meat and fish on the market have already led to a sharp decline in the hunting activities. Some of the gathering of fruits, vegetables and other NTFPs from the forest are also seasonal, but most households eat forest products on a daily basis.

During different interviews, it was hard to understand how dependent the villagers are on the forest products. The focus group interview with the women told us that they would buy the products if they could not collect them anymore. They were not concerned about the money they would spend on the vegetables, because the forest would be turned into cash crops fields, thus

giving them a higher income. The problem with this statement is that the poor people with less land or the people moving to the village will have to buy the NTFPs, since they cannot collect it anymore and they might not have the same resources as the wealthy or better fortuned people in the village.

The destruction of the remaining forest means hunting and especially gathering activities will decline substantially. Despite the little concern expressed in the focus group, and considering the frequent use of the forest and lake products captured in the questionnaires, we judge this to have a huge impact on food security in terms of sufficient food as well as quality of food. The content of nutrition in the food will be affected, and may cause malnutrition. This will mainly impact the less fortunate villagers that currently are self-sufficient with food and are likely to only eat rice if the forest does not provide them food. The government's policies can be criticized for only focusing on food security in terms of sufficient food and not nutrition.

The ethno botanical knowledge about the different plant species which the villagers can find in the forest seems to be inherited from parent to child. However a lot of central knowledge about the spiritual and medical use of the plant already seems to be lost. This is explained by the lack of interest from the younger generations and the knowledge and trust in modern medication. However with the current free health system they are not economically affected by the loss of medical forest products and knowledge. The tools made from forest products seem to be of higher value, since they cannot buy them, and is needed for fishing.

Many people are currently more or less self-sufficient with food. If the forest are cleared for oil palm plantations people will heavily be dependent on the external markets for their food supply. This affects the food security negatively in terms of sufficient amount of food and in term of nutrition. The loss of the forest as a food source would mean more to the less fortunate villagers. Thus the future clearing of the forest may cause increased inequalities among the villagers. The loss of forest product and the consequences it can entails do not seems be concerned of the villagers either.

Summary

The villagers are hoping for a future project: an oil palm project. We notice following risks connected to the oil palm project:

- The loss of forest product for food and tools.

- People will heavily be dependent on the external markets for their food supply.
- Decreased food security.
- Malnutrition due to little variation in food.
- Increased inequality among the villagers.
- Exhausting the soil.

Awareness of these consequences is limited.

Conclusion

Throughout the history of the village, Kampung Tekalong has benefited several times from government schemes, such as the rubber scheme in 1966 and the pepper scheme in 1975. These were in turn motivated by economic incentives, representing a wish by the Malaysian government to foster development in rural areas through the cultivation of both subsistence and cash crops. Together with other economic incentives, most notably world market prices, these were found to be the main drivers in the choice of crops. Malaysia has thus harnessed globalization in order to connect its poor farmers to the richer part of the world (Stiglitz, 2002).

In its effort to promote economic development, the government established different bodies, such as the Agriculture Department, or the various oil palm, rubber and pepper boards which together provide technical assistance, make agrochemicals available and commercialize the final product from the farmers in order to sell it onto the world market. The efficiency of these government agencies have so far allowed the village to develop despite the problems that arise due to the conflicts regarding the position of headman in which the village is embroiled.

Regarding subsidies, we found interesting that the only subsidized agrochemicals were used for paddy planting, which is not a commercial crop. This is indeed a very pro-poor policy, on which many inhabitants of Tekalong seemed to rely for their subsistence. This reflects a desire from the government to see farmers retain some diversity in order to resist potential commodity price shocks, such as the one in 2008 (See Appendix 15, 16 and 17).

The villagers are very aware of this necessity to diversify, as was reflected in the number of crops cultivated per family, where all but one family, pushed to extreme levels of poverty, was cultivating more than one crop. Thus, according to our findings, we believe that although the trend is leaning in favor of oil palm, it is unlikely that the crop will become the only planted crop in Tekalong. Farmers indeed have different incentives depending on their land size. Hence, rubber and pepper seem unlikely to ever vanish from the landscape, as according to our analysis, they are the crops of choice for smallholders due to the high return per acre for pepper and the high labor flexibility of rubber. Oil palm, which is somewhat a compromise between the two factors, will in turn be more favored by large landowners that can easily hire labor and would prefer to use more intensively their vast tracts of land.

This difference between smallholders and large landowners appeared to us quite clearly during the research: there are indeed vast inequalities in terms of revenues or land size, a factor that will seriously constrain the opportunities for economic development of the poor majority of the people in Tekalong. Land also appears to be an exceedingly scarce factor, which is likely to perpetuate these inequalities. Given the aforementioned scarcity of land, which is enhanced due to population growth, we expect that as smallholders have children and must divide their land accordingly; their economic situation will further deteriorate since there is a shortage of off-farm works in the area. We also expect large landowners to be able to resist economic pressures better, which may lead to them taking advantage of their larger economic power to absorb smaller farms in financial difficulties. This may in turn lead to an ever greater concentration of wealth at the top, a factor that can potentially damage the social fabric in a village of such a small size (Jackson, 2007).

In terms of agriculture, Tekalong is indeed blessed, as according to our findings from the Agriculture Department, it is endowed with "Tarat soil", which is a highly rich soil. However, we found from the soil samplings traces of N leaching in oil palm plantations as well as low level of active carbon content on newly cultivated fields. As for the water samplings, we found evidences of declining quality. The potable water can thus be classified as "IIA" or "IIB", meaning that conventional water treatment is needed (See Appendix 9). The intensification of agriculture around the water catchment area may lead to further degradation. These issues could however be partly remedied with better agricultural practices. However, farmers did not seem to envision agriculture without a high level of inputs. Another factor of environmental damages transpires in the plan made by the villagers to convert the forest beyond the lake to an oil palm plantation. This project reflects the national trend of conversion to oil palm, which is the main driver for development by the government. However destructive this project seems, this is also the chance for smallholders to acquire more land, allowing them to access a higher standard of living. Thus, the age-old contradiction of economic development versus environmental sustainability as presented in E. F. Schumacher's work Small is beautiful (1974) resurrects here. In his major piece of work, he highlighted the threat that arises from the exhaustion of the natural resources in the pursuit of economic development, in this case land, water and forest, which the village dwellers rely a lot on. These factors, however, never seemed to strike a sensitive chord in the villagers, nor in the higher echelons of the government.

This is unlikely to happen in the near future: the Malaysian government indeed has plans to expand dramatically the area devoted to oil palm as a means to foster development. It will use all the tools at its disposal in order to achieve this goal, such as its various political bodies and subsidies. The impact will cross the national borders: it will not only be local, such as forest destruction and biodiversity loss, but also global as a driver for climate change (IPCC 2014). This will be done in the name of ensuring better standards of living for the Malaysians who will finally be able to catch up with the Global North. Yet the Malaysian government should soon realize that using up its natural capital will lead to future declines in agricultural production, which may be rendered more difficult in the future due to the increased scarcity of the necessary inputs.

Bibliography

- Babbie, Earl. (2009) Qualitative field research in *The Practice of Social Research*. Chapman University: 9th edition.
- Boserup, E. (1965) *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. Chicago: Aldine. London: Allen & Unwin.
- Bruun, T. B. (2009) *Environmental Consequences of the Demise in Swidden Cultivation in Southeast Asia: Carbon Storage and Soil Quality*. Springer Science + Business Media. Hum Ecol 37:375–388.
- Byres, T. (2003) Agriculture development: the dominant orthodoxy and an alternative view. in Chang, H.J. (ed.) *Rethinking development economics.* London, Anthem Press.
- Brockington, D. and Sullivan, S. (2003) Qualitative research, in R. Scheyvens and D. Storey (eds), *Development Fieldwork: A Practical Guide*, London: Sage, pp. 57 - 74
- Collier, P. (2008) *The Bottom Billion: why poor countries are failing, and what can be done about it.* New-York, Oxford University Press.
- Coulter, J.K. (1998) Tropical Soils. In: Webster, C.C. & Wilson, P.N. (Eds.). *Agriculture in the tropics*. Oxford: Blackwell Science.
- Dietz, R. and O'Neill, D. (2013) *Enough is enough: building a sustainable economy in a world of finite resources.* Oxon, Earthscan/Routledge.
- Ellis, F. (2000). *Rural Livelihoods and Diversity in Developing Countries*. Oxford: Oxford University Press.
- Feintrenie, L. Chong, W. K. Levang, P. (2010) Why do farmers prefer oil palm? Lessons learnt from Bungo district, Indonesia. *Small scale forestry*. 9:379-396.
- Galbraith, J.K. (1998) *The Affluent Society.* Boston, Mariner Books.
- Geist, H. J. and Lambin, E. F. (2002) *Proximate Causes and Underlying Driving Forces of Tropical Deforestation*. BioScience 143-150, Vol 52 No. 2
- Jackson, T (2011) *Prosperity Without Growth*. London, Earthscan.
- Jones, C.A. 1983. Effect of soil texture on critical bulk densities for root growth. Soil Sci. Soc. Am. J. 47:1208-1211.
- Juo A. S. R., Kathrin Franzluebbers. (2003) - 281 pages; *Tropical Soils: Properties and Management for Sustainable Agriculture*. Oxford University Press.

- Malaysia palm oil Board (2014) *Malaysia Palm Oil Board.* [Internet] Available from: <http://www.mpob.gov.my/> [Accessed 12 March 2014]
- Malaysian Pepper Board (2014) *Summary of Cash flow (for pepper production).* Malaysian pepper Board official website. [Internet] Available from: <http://www.mpb.gov.my/mpb/> [Accessed 25 March 2014].
- Malaysian Rubber Board (2014) *Malaysian Rubber Board.* [Internet] Available from: <http://www.lgm.gov.my/nrstat/T4A.htm> [Accessed 23 March 2014].
- Neary, D.G (2004). An Overview of Fire Effects on Soils. http://www.swhydro.arizona.edu/archive/V3_N5/feature4.pdf. Accessed on 28/03/2014.
- Banerjee, N. & Bojsen, K. P. M. (2005). Negotiability and limits to negotiability - land use strategies in the SALCRA Batang Ai Resettlement Scheme, Sarawak, East Malaysia. *Danish Journal of Geography. 105(1):17-28.*
- Scoones, I. (2009) *Livelihoods perspectives and rural development* in Journal of Peasant Studies Vol. 36, No. 1, January
- Schumacher, E.F. (1974) *Small is Beautiful: Economics as if people mattered.* London, Abacus.
- Stiglitz, J. E. (2002) *Globalisation and its discontents.* London, Penguin.
- Stiglitz, J. E. (2010) *America: freefall, free markets and the sinking of the world economy.* New-York, W. W. Norton and Company.
- Sumok P. (2001) Water quality monitoring: Sharing Sarawak experience. 6th SITE Research Seminar. http://www.sabah.gov.my/jpas/news/SITE/SITEppr09.pdf. Accessed on 26th March, 2014.
- UN Brundtland Report (1987) *"Report of the World Commission on Environment and Development: Our Common Future"*, United Nations 1987
- USDA (2007) Indonesia: palm oil production prospects continue to grow. *United-States Department of Agriculture*. [Internet] Available from:<http://www.pecad.fas.usda.gov/highlights/2007/12/Indonesia_palmoil/> [Accessed 26 March 2014].

Appendix