FACULTY OF SCIENCE
UNIVERSITY OF COPENHAGEN

# Diversification of Livelihood Strategies in Rural Sarawak:

# A case study of Serubah Ulu

Interdisciplinary Land Use and Natural Resource Management, 2015

Charlotte Engell Denham

Lærke Damsø – Jørgensen

Melanie Wentz Mason

Peter Musinguzi

Carolin Mages

# DIVERSIFICATION OF LIVELIHOOD STRATEGIES IN RURAL SARAWAK: A CASE STUDY OF SERUBAH ULU


## Malaysian students:

Nurul Azzah Zainal, Emily Edang Baru, Nurul Hidayah Ngadi, Ian Shatner Mike, Muhammad Hafizuddin Kamarudin

## Supervisors:

Torben Birch - Thomsen

Catherine Maria Heppe


## Number of words:

10.985


## Authors:

Charlotte Engell Denham

Lærke Damsø – Jørgensen

Melanie Wentz Mason

Peter Musinguzi

Carolin Mages

# Table of Contents

## List of Figures

## List of Tables

## Abbreviations

| | |
|---|---|
| AEA | Agricultural Extension Agent |
| DBH | Diameter at Breast Height |
| FAO | Food and Agriculture Organization of the United Nations |
| FELDA | Federal Land Development Authority |
| GPS | Global Positioning System |
| ILUNRM | Interdisciplinary Land Use and Natural Resource Management |
| JVC | Joint Venture Concept |
| KII | Key Informant Interview |
| KU | Københavns Universitet |
| PRA | Participant Rural Appraisal |
| SSI | Semi - Structured Interview |
| MPOB | Malaysian Palm Oil Board |
| NCR | Native Customary Right |
| NTFP | Non Timber Forest Product |
| Pox C | Permanganate Oxidizable Carbon |
| PPLU | Past and Present Land Use |
| RM | Malaysian Ringgit |
| SALCRA | Sarawak Land Consolidation And Rehabilitation Authority |
| SOM | Soil Organic Matter |
| SU | Serubah Ulu |
| UNIMAS | University of Malaysia Sarawak |
| USDA | United States Department of Agriculture |

## Acknowledgements

This report is the result of the Interdisciplinary Land Use and Natural Resource Management (ILUNRM) course. The contents are based on data collected during a study in Serubah Ulu, Sarawak, Malaysian Borneo, from the 28th of February to the 10th of March. First, the authors would like to thank their Malaysian counterparts from the University Malaysia Sarawak (UNIMAS) for their dedication and support in the collection of the data necessary for this report. Second, special gratitude is expressed to the interpreters who provided essential translations, explanations and facilitated interactions between students and villagers. We furthermore greatly appreciate the 'Danish' and Malaysian SLUSE staff for the guidance offered to us throughout this field course. The authors also thank the coordinators and professors at UNIMAS who, through their support and assistance provided essential guidance and put great effort into planning and ensuring the logistics of the fieldwork. Furthermore, special thanks is extended to the Danish supervisors who provided instruction, support, motivation and knowledge before, during and after the stay in Sarawak. Finally the authors would like to express boundless gratitude to the residents of Serubah Ulu, who were extremely generous in providing their time, opinions, insights and hospitality.

## Abstract

The cultivation of cash crops has been suggested by the Malaysian government as a tool for achieving poverty alleviation on a national level. Therefore the cultivation of cash crops has been promoted by the government for several decades, which has led to an increase in the cultivation of first rubber, then pepper and finally oil palm on a national level. The village of Serubah Ulu, located on Malaysian Borneo, has followed this trend as well and has incorporated cash crop cultivation into their livelihood strategies. On the basis of this, the objective of this study is to to assess local livelihood strategies, diversification levels and their correspondence to trends within Serubah Ulu.

To investigate this research objective, a triangular approach was chosen making use of both natural and social science methods. On this basis we found that the introduction of cash crops in SU has contributed to a diversification of the local livelihood strategies, helping the villagers to withstand shocks and trends. It was additionally found that SU had formerly diversified their livelihoods through participation in tourism activities. However, with the decrease in tourism from 2010, SU became more dependent on cash crops, which made their livelihoods less diversified. The introduction of cash crops contributes to improved infrastructure, increased mobility and with this an increased potential for engaging in off-farm labor. On the other hand it was found that the cultivation of oil palm could have a negative impact on soil properties.

Table of Authors

| Section | Author | Co – Authors, Editing |
|---|---|---|
| 1. Introduction | Melanie | Carolin |
| 2. Methodology | All | |
| 3.1 Study Area | Charlotte | Lærke |
| 3.2.1 Livelihood Activities and Diversification Levels | Charlotte | Carolin |
| 3.2.2 Agricultural Practices in Serubah Ulu | Melanie, Lærke | Carolin |
| 3.2.3 Tourism | Peter | Melanie |
| 3.2.4 Non Timber Forest Products (NTFP) | Peter | Melanie |
| 3.2.5 Remittances | Peter | Melanie |
| 3.3 Decision Making Processes and trends of change in Serubah Ulu | Melanie, Lærke | Carolin |
| 3.4 Potential impacts of oil palm cultivation on soil properties in Serubah Ulu | Carolin | Lærke |
| 4. Conclusions | All | |
| 5. Reflection | Carolin | Melanie |

# 1. Introduction

The country of Malaysia is located on the Southern tip of the Malay Peninsula and on the North West side of the island of Borneo. It is further divided into 13 states, with only two located on the island of Borneo, Sarawak and Sabah, comprising Malaysian Borneo. The country's capital, Kuala Lumpur, is located on the peninsula, and is where national policy is developed. Unlike the peninsular Malaysian states ruled by hereditary leaders, Sarawak and Sabah are appointed governors by the national government. Although Malaysian Borneo is still under the jurisdiction of the national government, they do retain some state level constitutional puragatives (Central Intelligence Agency, 2015).

The country officially gained independence in 1957, which is the same year the national government made a commitment to reduce poverty by improving the lives of the rural populace through land development (Simeh & Ahmad 2001). With the inclusion of the states of Sarawak and Sabah, in 1963, the indigenous peoples of Borneo, called Dayaks, were included in the national commitment.

The largest sub-group of the Dayak is the Iban. Traditionally, the Iban people practice swidden rice agriculture, which consists of a rotation of slashing and burning forest land, rice cultivation and fallow periods. Cultivation generally only lasts one year or growing season with a long term fallow, allowing for the re-growth of secondary forest (Bruun et al. 2009). Although swidden or "slash and burn" cultivation is often deemed environmentally harmful, it can in fact provide important ecosystem services to resource poor farmers including carbon storage, improved biodiversity and increased vegetation growth (Bruun et al. 2009).

These practices are done on land which is under native customary rights (NCR) which the Iban have access to and consider their land, but to which they have no legal land titles. As part of the national government's commitment to the rural poor, there has been a push to move the Iban people away from swidden to market driven agriculture (Ngidang 2002).

Using agricultural expansion as a poverty alleviation tool, both the national and state governments have supported cash crop cultivation which has led to the expansion of rubber, pepper and oil palm. These government projects are often referred to as schemes, with each scheme offering different benefits and detriments. Major results of the promotion of these schemes include a reduction in forested land which places pressure on the swidden system and thus reducing fallow lengths and increases the possibility of reduced soil quality (Bruun et al. 2009). Additionally, the local decision making process behind cultivation choices is being driven by the government and global market trends (McCarthy & Cramb 2009).

## 1.1 History of Malaysian Development Schemes

The national government of Malaysia began developing policy in relation to land development for the purpose of poverty alleviation in 1957. The first major step was the creation of the Federal Land Development Authority (FELDA), which quickly led to the first government rubber scheme covering 4,050 acres and operated by resettled, landless farmers. By the year 2000, FELDA was managing 374,043 acres of rubber under government schemes (Simeh & Ahmad 2001).

In 1972, also in the name of poverty alleviation, the national government began promoting pepper subsidy schemes in the Borneo state of Sarawak. These schemes are much less restrictive than others, as they focus on providing subsidized fertilizer during the three year maturation period before fruit set begins (Wadley & Mertz 2005). This is usually done through sate sponsored agriculture extension service agencies.

FELDA became involved in the cultivation of oil palm in 1961, with the first scheme covering an area of 938 acres (Simeh & Ahmad 2001). Although different scheme management systems have been tried in the past, the joint venture concept (JVC) is the most commonly employed system in regards to oil palm today. The JVC, "[...] is conceived as a joint-partnership between the private sector, landowners, and government agencies. [...] It is described as a marriage between capital, land, labour, and expertise" (Ngidang 2002). In short, the rural communities provide the land and labour while receiving financial and technical assistance from the private sector and government agencies, respectively.

Within the state of Sarawak, these JVCs are usually overseen by the Sarawak Land Consolidation & Rehabilitation Authority (SALCRA), differing from FELDA in that cultivation is done *in-situ,* as opposed to resettlement schemes.

With the assistance of SALCRA, the first JVC was started, in the Lubok Antu district, in 1976 (Ngidang 2002). By 2010, 12 million hectares, or 12% of Malaysia's land area had been converted to oil palm production (Sayer et al. 2012). It is currently the most economically viable cash crop in Malaysia, and like the cash crops implemented before, the national and state governments are pushing for the continued cultivation of oil palm as a poverty alleviation tool (Sayer et al. 2012).

Although many disadvantages have been studied in regard to the JVC, such as government land grabbing through JVCs (Doolittle 2009) and soil degradation (Bruun et al. 2013), many benefits have also emerged including infrastructure improvements. As oil palm cultivation expands, so too does transport infrastructure, giving once remote areas access to jobs and markets, as well as health and education services (Cramb & Sujang 2011). Despite divisions in regards to the appropriateness of oil palm as a poverty alleviation measure, it is a growing element within the Iban livelihood strategies in rural areas of Malaysia.

## 1.2 Objective and Research Questions

Within the village of Serubah Ulu (SU), we find similar patterns emerging. SU is a community where agriculture is the pillar of villagers' livelihood strategies. The current livelihood strategies in the studied area consists of a shifting reliance on cash crops, with oil palm being currently favoured, introduced and promoted by the government and at the same time being subject to global market trends (McCarthy & Cramb 2009). Rice continues to act as a subsistence buffer during times when market prices for cash crops are low (Cramb 1993). They further diversify their livelihood strategies through activities like tourism, the collection of non-timber forest products (NTFPs) and remittances. Bearing in mind the importance of diversification and market trends guided by government schemes, the following study objective has been developed:

*To assess local livelihood strategies, diversification levels and their correspondence to trends within Serubah Ulu*

By using the definitions provided by Ellis´ livelihood framework, the strategies and diversification level of the livelihoods of the villagers of SU were studied. The livelihood framework was also used as a guideline, assisting in coherent understanding of the livelihood concept. Definitions used are provided in Appendix 2.

With this in mind, the following research questions have been developed:

1. *What are the current livelihood strategies of the villagers in Serubah Ulu?*
2. *How are livelihood strategies selected and how are decision making processes influenced by external factors?*
3. *How do livelihood activities impact the community of Serubah Ulu?*

## 1.3 Study Area

The study was carried out in the Iban longhouse of SU, in the state of Sarawak in Malaysian Borneo. It is positioned on the coordinates N 01º 13’ 59.1”; E 111º 45’ 46.92” and is located in the Lubok Antu district of the Sri Aman division. The village is situated 30 km away from Lubok Antu, along the river Lemanak (Fig. 1).

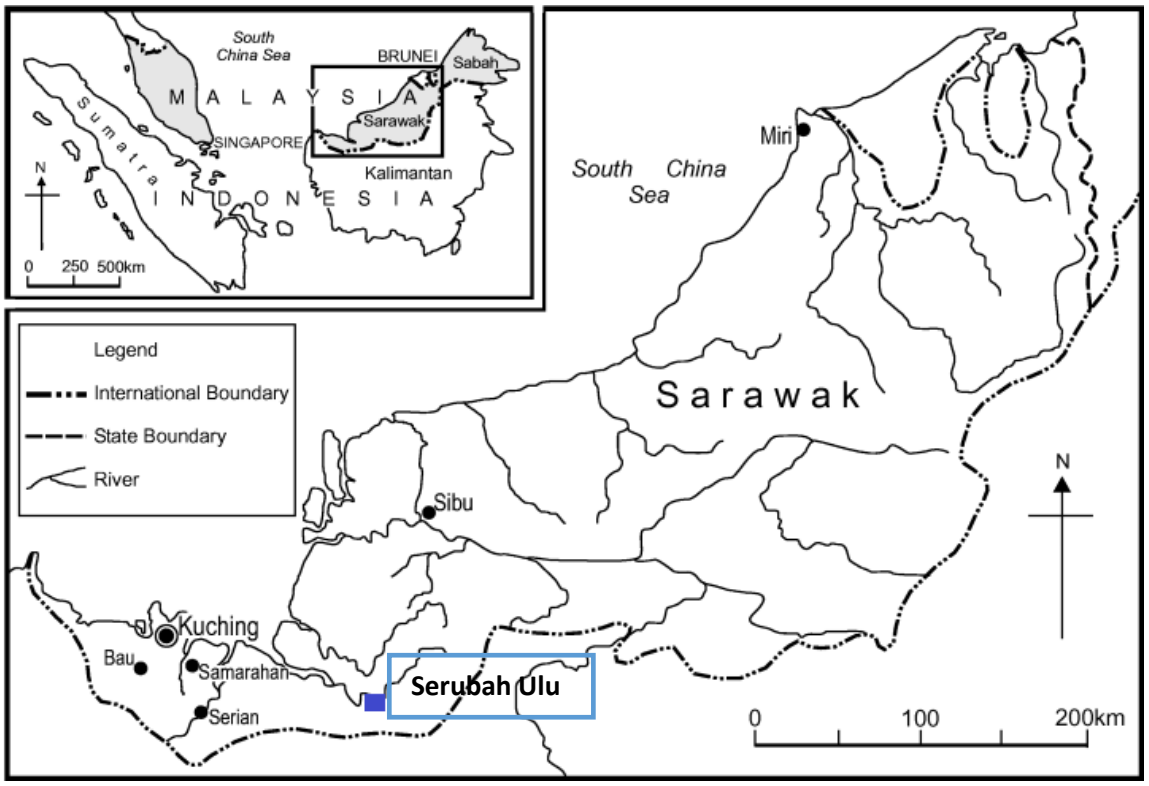



Figure 1: Study area in Malaysia (Morrison et al. 2006)

# 2. Methodology

In order to best answer the research questions, a mix of natural and social science methods were conducted during the research process in an attempt to gather quantitative and qualitative data. Transect walks, questionnaires, focus groups and participatory rural appraisal (PRA) activities were conducted for exploratory assessments and to gain a broad overview of the community. A forest inventory, soil sampling, and semi-structured interviews (SSI) allowed for more in depth information about specific community and individual characteristics, and acted as a tool for data triangulation. The household acts as the primary unit of measure for this project (Ellis 2000).

Additionally, this research project was conducted during the rice harvest, which is one of the busiest times for households in SU. As such, some of the sampling methods that had been previously prepared had to be discarded and focus was placed on the households and farmers that were available at the time.

## 2.1 Natural Science Methods

A description of the natural science methods as carried out in the field is presented below, as well as general reflections on what worked well and what could have been improved.

### 2.1.1 Forest Inventory

To understand the level of biodiversity within the nearby secondary forest, an inventory was conducted with the assistance of a village guide and an UNIMAS forest professor. Track 1 (Table 2) led to the survey site and a global positioning system (GPS tool) was used to track and mark waypoints. A sampling plot was identified to assess an area x 10m, which was then divided into four subplots using masking tape. A demonstration on how to identify and measure trees was done, using the diameter at breast height (DBH) method. With this several plant species within the demarcated area were identified. Due to time constraints a full inventory could not be conducted. The forest species found within the sampled plot can be found in Appendix 4.

### 2.1.2 Soil Sampling

Soil properties and quality can be influenced by physical, chemical and biological changes induced by cropping (Hartemink 2003). Therefore the choice of land use and management practises can have major effects on soil fertility. With the space for time substitute method, as explained in a study from Bruun et al. (2013), land use changes over time can be investigated. To determine soil fertility, several parameters must be taken into account, such as physical properties (i.e. soil density, texture, colour and thickness), and chemical factors (i.e. pH, carbon, nitrogen).
The aim of the method is to compare physical and chemical soil parameters of oil palm fields of different ages with the same land use history to a reference field. The reference represents the soil properties of the fields, as they have been before cultivation. The results can give information about the longterm effects of oil palm cultivation on soil properties.

The initial aim of selection was to find three oil palm fields defined as:

- Continuous oil palm cultivation on site for 1 – 5 years
- Continuous oil palm cultivation on site for 6 – 10 years
- Continuous oil palm cultivation on site for more than 10 years

Additionally, for the fields to be scientifically comparable, all needed to have been cultivated using the swidden, rice cultivation system before oil palm planting began, and have similar soil texture and color, location, slope and farm management practices (i.e. fertilization methods, planting methods).

A supplementary field site was to be selected in the nearby secondary forest, acting as a reference. The selection of the fields was originally to be based on the questionnaire results, but due to the reduced availability of farmers, sites were chosen based on farmer readiness. Furthermore, the low variance of ages among the oil palm fields resulted in only two fields being chosen for sampling, a three year old field and an 18 year old field. Sampling a third oil palm field in the mid-range could have allowed for more substantial conclusions about the effect of oil palm cultivation on soil properties. However this was not possible as most farmers started planting oil palm either 15-20 years ago or in within the last five years. Ultimately, several factors led to a reduction in the representativeness of the soil sampling, including the decrease in the number of fields sampled, the large age gap, and the missing slope measurements.

For each field three soil profiles were dug approximate 50 cm deep. All pit locations were at the same altitude to ensure that the soil properties and conditions remained constant.

The different layers and their thickness were determined for each profile as well as their texture and colour. Volume specific samples were taken within each pit, sampling two depths for each profile, representing the top soil (0 – 5 cm) and a lower layer at 15 cm.

After sampling, soils were left undisturbed to air dry before being packaged and transported to Copenhagen. In table 1, the analysed parameters from the soil laboratory at the KU are listed:

Table 1: Parameter and Methods for Soil Analysis

| Parameter | Method |
|---|---|
| Bulk Density | Weighing of the volume specific sample |
| pH | Measured in a 1:2.5 soil: (distilled) water solution with a pHM210, Standard pH Meter, MeterLab |
| Carbon (%C) | Isotope – Ratio Mass Spectometry (IR – MS) |
| Pox - C | Measured in a spectrometer after preparing a dilution of soil, (distilled water) and $KMnO_4$ |

## 2.2 Social Science Methods

A description of the social science methods as carried out in the field is presented in the following, as well as general reflections on what worked well and what could have been improved

### 2.2.1 Transect Walks (using GPS tool)

Six transect walks were conducted in order to get an overview of the study area with a specific focus on possible village boundaries, current land use, and identification of soil sampling sites. During these walks a GPS tool was used to collect waypoints thought to be relevant to the study. Waypoints and tracks were used in combination with existing maps to locate and plot tracks. The plotted areas can be seen in Figure 2. This method was very useful as it allowed for exploration of the physical environment and participant observation. The limitations included indistinct boundaries between SU and the neighbouring communities of Serubah Ili and Ng. Kesit, which is the result of overlapping farming areas and community forests being utilized by more than one community.

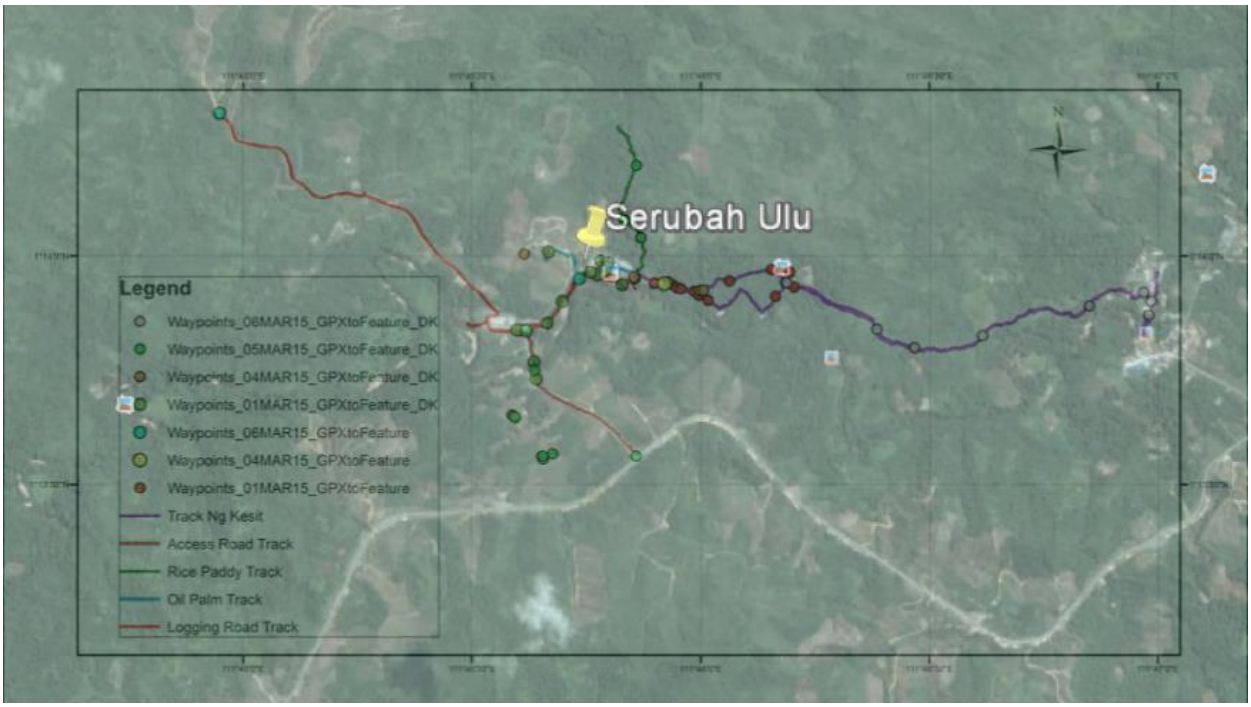



Figure 2: Map of Serubah Ulu and its surroundings

Table 2: List of conducted GPS tracks

| Reference No. | Name | General information |
|---|---|---|
| T1 + T2 | Track Ng. Kesit | T1 covers a trail cleared for tourism, creating a loop through secondary forest. T2 extends the track all the way to Ng. Kesit, passing through community forest, as well as rubber and pepper fields. |
| T3 | Access Road Track | T3 covers the access road which passes Serubah Ili, the cement bridge and oil palm, rubber and pepper fields. |
| T4 | Rice Paddy Track | T4 passes first through cocoa, then hill rice and finally rubber trees, with the community timber processing area located on the trail. |
| T5 | Oil Palm Track | T5, cleared by the community with a rented tractor, passes through an oil palm field intercropped with rice and a pepper field |
| T6 | Logging Road Track | T6 creates the Western boundary of the community. This logging road is surrounded by oil palm and rubber fields. |

### 2.2.2 Questionnaire Survey

In order to get an overview of SU´s demographic composition and livelihood activities, a questionnaire was conducted with the goal of questioning all households, with an outcome of 25 of the 26 households participating. Before initiating the questionnaire, a pilot study was done which led to minor modifications being made. The questionnaire was also used for identifying farmers for SSIs. This was a successful method as it provided a large part of the data used for the report. However, in hindsight, clearer and more uniform questions about land use could have improved the quality and validity of the data.

### 2.2.3 Focus Group Interviews

Focus group interviews were conducted in order to understand the community's perceptions and insights about specific topics that were deemed important through the initial analysis of the questionnaire and informal conversations. The following focus groups were conducted with:

- Five women to gain knowledge about tourism with regards to its history within the village, common activities, its importance as a livelihood strategy and data triangulation. Also, to identify problems and constraints related to tourism. The women were identified using key informant sampling with the headman acting as the key informant. This was a successful method as the participants had all been involved in tourism activities and the discussion was conducted without outside interference.
- Five men, simultaneously with the women's focus group. They were asked the same questions and identified in the same way as the women, but with the aim of receiving different perspectives and insights. The Focus Group was also successful in that the discussion was conducted undisturbed. A limitation which emerged was the influence of the power hierarchy as the headman tended to dominate the male focus group.
- Fifteen people to identify and discuss the decision making process behind land use, with a focus on crop choice. Snowball sampling was utilized during the implementation of the questionnaire to bring in participants. This led to a loss of control over who and how many people participated. The large group was difficult to seat together in a circle which led to a lack of participation and ultimately a complete failure as a group discussion never fully evolved. This was exacerbated by using the covered communal veranda of the longhouse, the "ruai", which allowed participants to come and go throughout the discussion. Additionally, one of the participants spoke English which led to her domination of the discussion.

### 2.2.4 Semi – Structured Interviews and Key Informant Interviews

SSIs and Key Informant Interviews (KIIs) were conducted in order to explore agricultural practices in greater depth, as it was identified by the villagers as a highly important activity for their present livelihood strategies, and assisted with data triangulation. The following SSIs and KIIs were conducted with:

- An agricultural extension agent (AEA), based in the district office in Engkilili, who has been assigned to work with the SU villagers on pepper and rubber cultivation. The AEA was able to provide detailed explanations about planting and management practices, but was unable to provide much information in regards to oil palm as he informed us that oil palm cultivation is overseen by the Malaysian Oil Palm Board (MOPB). He was chosen on the basis of his in depth knowledge of agriculture and as such deemed a key informant.
- The headman of SU, in regards to local cultivation practices, land use, history, and community processes. He was chosen on the basis of his in depth knowledge of SU and as such deemed a key informant.
- A professional tour guide with Borneo Adventure Travel Agency, who was able to provide details about past and present tourism dynamics in SU. He was chosen on the basis of his in-depth knowledge of tourism and as such deemed a key informant. This KII was a bit rushed as there was no advanced knowledge of his arrival. However, once the opportunity arose, questions were quickly drafted. This interview was short and the questions could have been improved, but considering the time constraints, this KII was successful.
- Four farmers, each cultivating oil palm. The farmers were stratified into those cultivating more than five acres of oil palm and those cultivating less than five acres of oil palm. These strata were further sub divided into farmers with oil palm above five years of age and below five years of age, Table 3. The participants that fit these strata were identified using the questionnaire and four were then randomly chosen to participate in the SSIs, leading to one farmer being interviewed for each of the defined strata.

Table 3: Stratification of farmers for SSIs

| No. of farmers | Age and size of oil palm field |
|---|---|
| One farmer | More than five acres under oil palm cultivation for more than five year |
| One farmer | More than five acres under oil palm cultivation for less than five years |
| One farmer | Less than five acres under oil palm cultivation for more than five years |
| One farmer | Less than five acres under oil palm cultivation for less than five years |

### 2.2.5 Participatory Rural Appraisal (PRA) methods

A variety of PRA activities were carried out to utilize the knowledge of the villagers, a key element to the study, in relation to their lives and environment.

#### 2.2.5.1 Community Timeline

In order to gain a more in depth understanding of the history of SU, with a focus on events the villagers deemed important, a community timeline was constructed with the help of several villagers. The initial targeted participant was the headman, but as activity progressed, he was joined by ten additional participants. This participation was welcomed, but it was difficult to control the level of participation as the PRA was conducted in the “ruai”. However, much of the information was obtained from the headman with the rest of the community adding a few comments on the events not covered in detail. The age and gender diversity of the participants helped generate more accurate data. A picture of the timeline is presented in Figure 3.

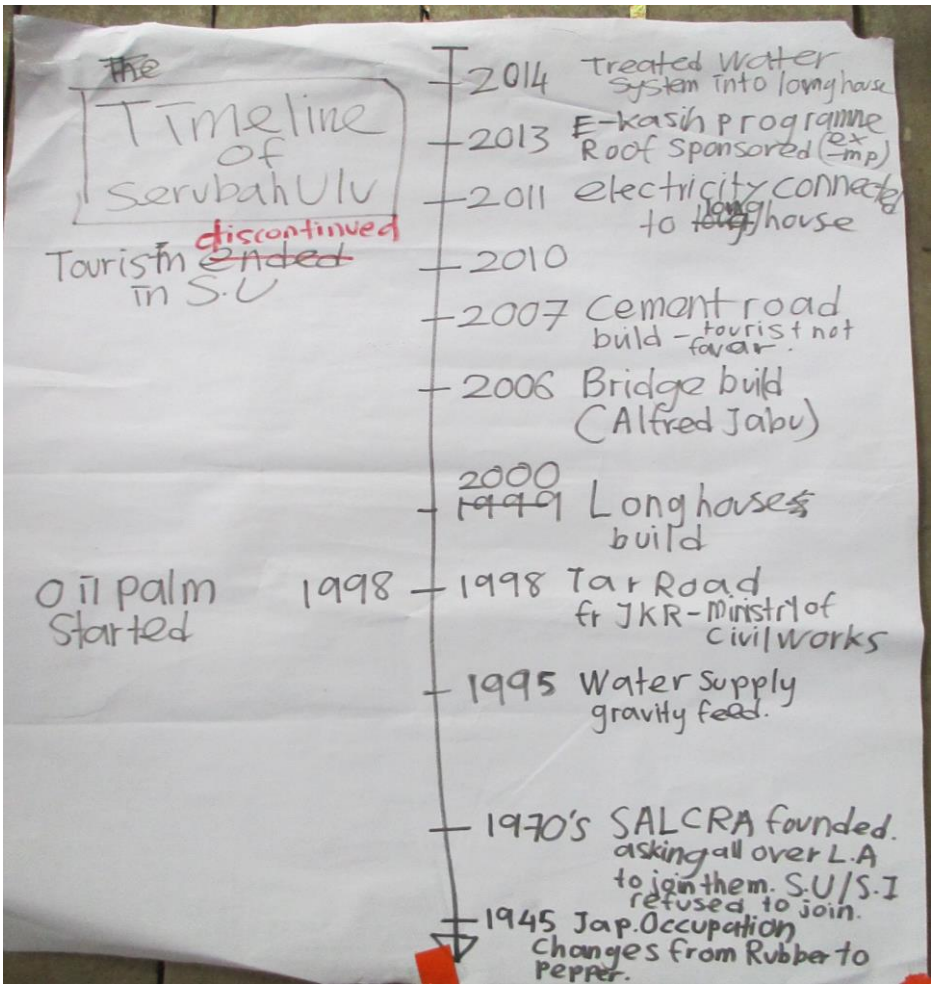



Figure 3: Timeline elaborated by the villagers

### 2.2.5.2 Family Tree

After the timeline was completed, a family tree was developed with the same group as described in 2.5.5.1 in order to understand community connections and relationships which could also reveal household patterns and tendencies beneficial to the study. The chart developed, seen in Figure 4, was essential for planning future methods as it provided details about the households and their relationships. Due to the fact that many household members contributed to the exercise, the data obtained could be triangulated.

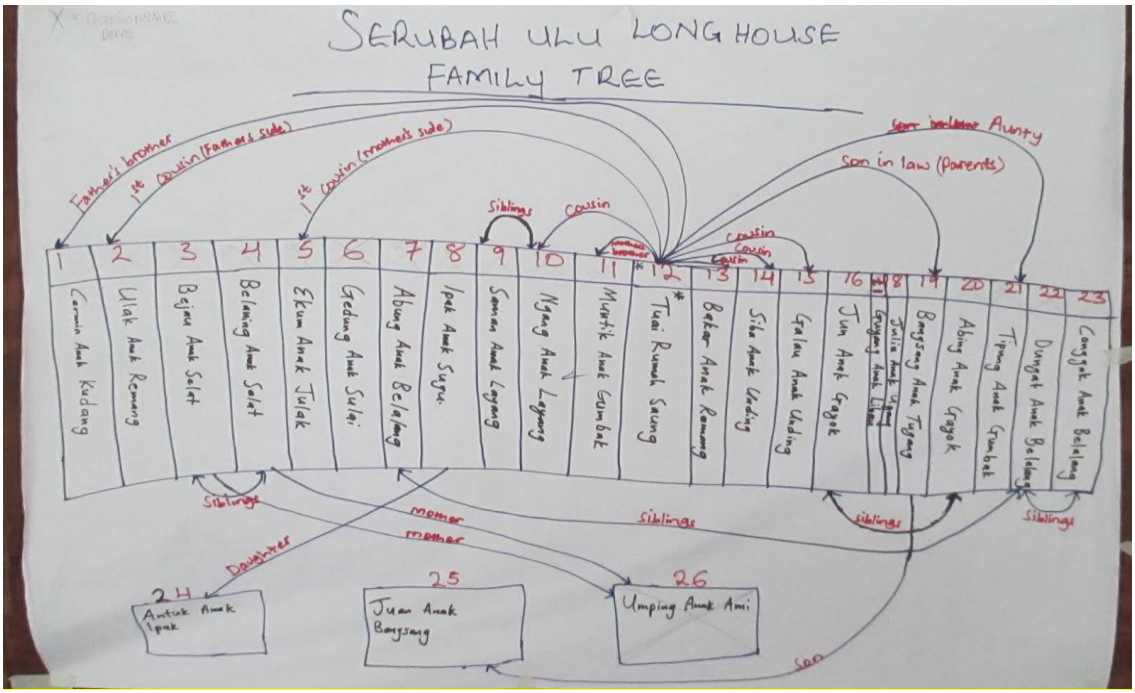



Figure 4: Family tree elaborated by villagers

## 2.2.5.3 Community Mapping

The community was so engaged and open to the PRAs, that it was decided to conduct the community mapping exercise after the family tree, instead of the following day as previously planned. The goal was to draw two maps of the community as it currently looked including land use, infrastructure, and important natural features. These maps could be compared for data triangulation. Participants came and left, but two key groups emerged. One composed of three participants and the other composed of two. See Appendix 3 for photos of the maps. This was a very successful activity, but as the goal was to obtain data on community perceptions, the maps were not always a correct representation of the geography.

## 2.2.5.4 Past and Present Land Use (PPLU) Map

A past and present land use (PPLU) mapping exercise was conducted in conjunction with the focus group, which discussed land use. The community maps were brought out to aid in comparison, and the villagers were asked to map out the land use history of SU. Two key groups emerged, with two participants mapping in one group and three in the other. This was a much greater success than the focus group, but the English-speaking villager remained a limiting factor. However, two maps were

created by the end of the evening (Figure 5 and 6). The students who were not involved in mapping were able to engage the other adult villagers in informal talks and colouring activities with the children.


Figure 5: Past and present land use map – covering the period until 2000


Figure 6: Past and present land use map – covering the period from 2000-2010

### 2.2.5.5 Decision Making Ranking

While conducting the SSIs with the farmers, a ranking based on the decision making behind planting oil palm was conducted. The four most important reasons for planting, as perceived by the students based on the questionnaire, PRAs and informal conversations, were written, in Iban, on slips of paper. After the SSI was completed, the interviewees were asked to arrange the paper in a ranking format with the most relevant reason for planting at the top and least relevant at the bottom. This only worked well in two of the SSI as the other two farmers could have been illiterate.

## 3. Results and Discussion

In the following section the results of the study are presented, these have been intertwined with a discussion of how they relate to the study.

### 3.1 Village Description

The villagers of SU moved into their current longhouse in the year 2000. Before that, the community lived in the Serubah longhouse, capable of housing 53 households, in conjunction with the villagers who now reside in Serubah Ili. The Serubah longhouse was becoming dilapidated and in need of repairs. One group suggested building a new longhouse using traditional materials as this would attract tourists and provide additional income. The other group thought it would be more appropriate to build a new, modern longhouse, as they felt tourism was not a profitable enough livelihood activity. This led to a divide in the community of Serubah, causing the traditional group to establish SU, and the modern group to establish Serubah Ili. Although they have separated, the communities are still close to each other. Also, as many Serubah Ili and SU families are interrelated, there continues to be good relations between the two.

SU did in fact build their traditional longhouse using natural materials for the purpose of attracting tourists, with a separate building for overnight tourists stays. In total, there are 26 households living in SU, 23 in the longhouse, and three, due to a lack of space for expansion, residing in individual houses (Figure 7).


Figure 7: Map of Serubah Ili and SU, with photos of the modern and traditional longhouses.

## 3.1.1 Demographics

SU consists of 112 Iban inhabitants, 59 females and 53 males, shown in the following population pyramid (Figure 8).

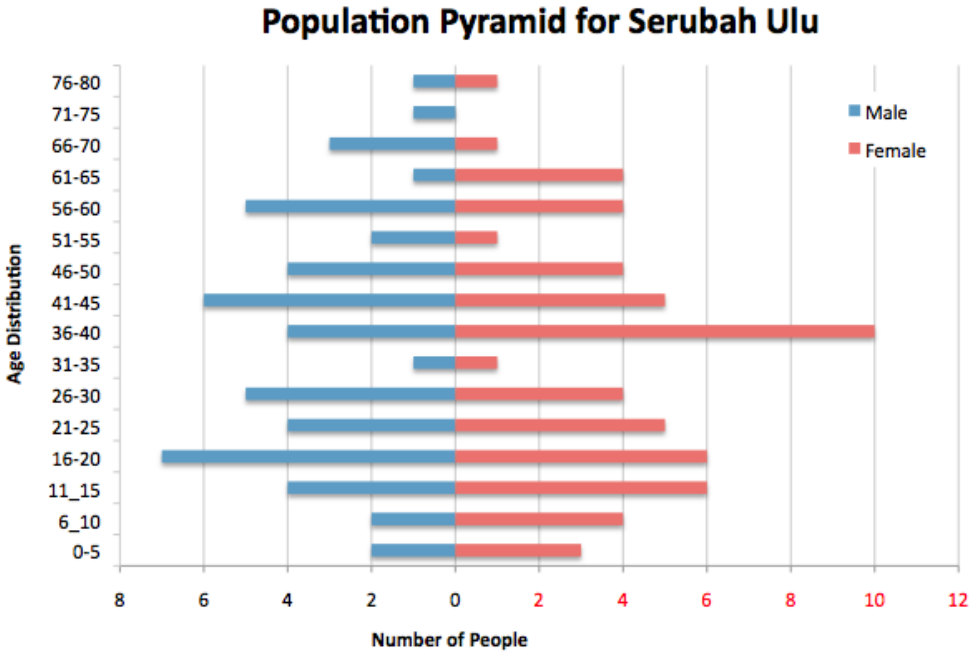



Figure 8: Population pyramid for SU (n= 25).

Upon first glance, the SU age pyramid resembles that of Western Europe, or any country with low fertility rates. This is unusual as the national Malaysian population pyramid, as shown in Figure 9 is closer to what is expected in a developing country, a wide base indicating high fertility rates (Daugherty and Kammeyer, 1995).

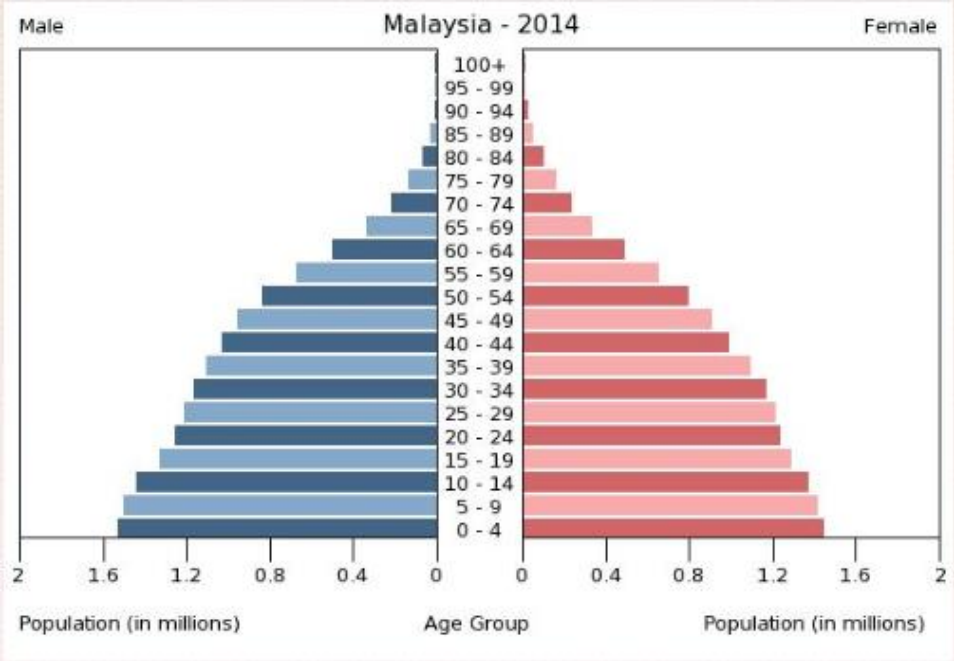



Figure 9: Population pyramid for Malaysia; Source: (Central Intelligence Agency, 2015)

Despite the population pyramids appearance, SU may not differ from the national statistics. It is possible that the older generation living in Serubah chose to live in a more tradition manner, whereas the younger inhabitants have chosen the modern route. This could have led to the older population living in SU, and the younger population residing in Serubah Ili. This is further compounded by the fact that the older population is outside the optimal procreation age range, ultimately leading to fewer youth and a narrow pyramid base.

### 3.1.2 Infrastructure

The infrastructure in SU has changed remarkably during the last 10 years. In 2005, SU received a bridge, crossing the Lemanak River and connecting the access road with the community. Additional road improvements were made in 2007 using cement. In 2011 the longhouse had received electricity. In order to expand oil palm production, in 2012 the villagers created a dirt road, with a rented tractor, this extends through the oil palm field west of the village (Figure 2; track 5). One of the households was turned into a small shop in 2013, and finally, in 2014 SU was connected to a metered water system. The water system, the bridge, the cement road, the electricity and the shop were sponsored using national funds distributed by the state government.

The majority of the villagers have emphasized that the infrastructural improvement has been positive, claiming easier harvest to market transport and increased mobility.

### 3.1.3 Land Use

In addition to the overview the community (Appendix 3) and land use maps (Figures 6 and 7) provided, a broad illustration of how the villagers diversify their agricultural activities was given. Pepper fields tend to be located relatively close to the longhouse given their high maintenance requirements (Hansen & Mertz, 2006). However, it is also common to see pepper fields interspersed in rubber plantations. This shows that villagers do not simply diversify their crops, but also the planting locations. A further interesting point is the possible correlation between the discontinuation of tourism in 2010 and the increase in oil palm cultivation since that time. There was disagreement among the villagers as to whether or not this correlation existed. Some claimed the oil palm expansion was the result of trend following, while others claimed it was to make up for the loss of tourism. Although the researchers attempted to assess this correlation, the data ultimately implied it did not exist.

## 3.2 Livelihood Strategies

The villagers of SU are actively engaged in rural livelihood diversification, which allows for an increased survival rate and the possibility of an improved standard of living (Ellis 2000). A variety of agricultural, non-farm and remittance incomes are at play in SU, but in order to ensure a secure livelihood, these activities are typically diversified.

A more in depth presentation of SU's main livelihood activities is described in the following subsections.

Figure 10: Pictures of the livelihood strategies with the highest percentages of involvement at present – left to right: Rice (subsistence crop), oil palm (cash crop) and NTFP (edibles)

### 3.2.1 Livelihood activities and Diversification levels

Agricultural and natural resource-based activities are the livelihood strategies that play a particularly important role in SU. The labour market on the other hand was found to be of minimal importance to the majority of households. In Figure 11 the livelihood activities that the villagers are engaged in can be seen.

Based on the questionnaire, the households tend to diversify their livelihood by engaging in 5-8 different activities. However, this profile does not include all activities as hunting and fishing also occur infrequently. The number of households involved in these activities is unclear, making them unsuitable for inclusion in the final livelihood activities graph

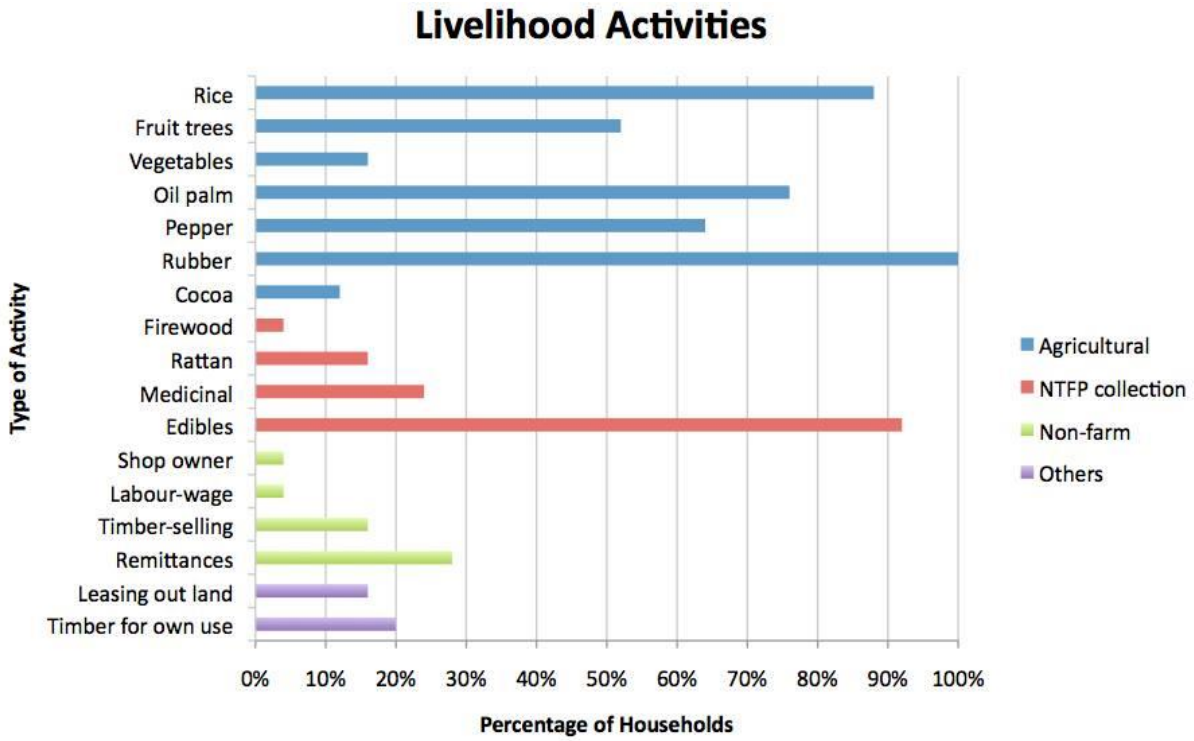



Figure 11: Livelihood activities of the villagers in Serubah Ulu

The presented results are only related to the percentage of households involved. Looking at Figure 11, rubber has the highest percentage of households' involvement, followed by rice cultivation then collection of edible NFTPs. The top three livelihood activities highlight not only the importance of agriculture, but the high level of diversity there in.

The importance of each activity in terms of the amount of income it generates is unclear. But, as an income generating activity the picture is slightly different from the above graphic as not all households are harvesting all cash crops presently. For example, only 4% of the households were found to be harvesting rubber, despite the fact that it has the highest level of village engagement. Pepper was being utilized as an income source by 16% of households and 48% are currently harvesting oil palm.

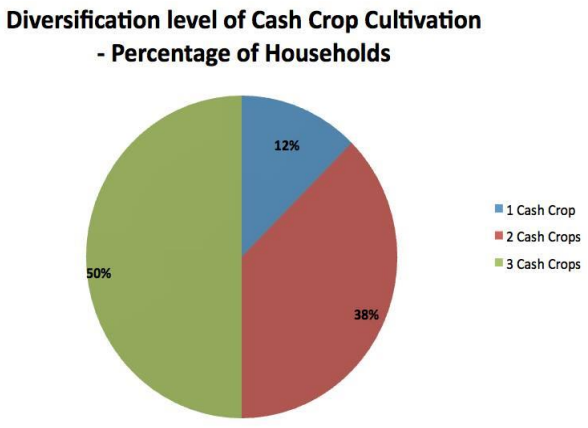
## 3.2.2 Agricultural practises in Serubah Ulu

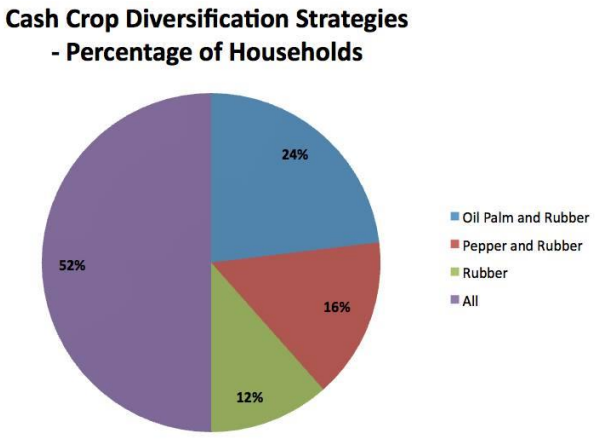
Three main cash crops, rubber, pepper and oil palm and one subsistence crop, rice, stand out as pillars of the rural livelihood diversification strategy utilized in SU.

Approximately two generations past, cash crop field boundaries were marked using fruit trees, with the durian tree being favoured. This system is still upheld today, and the fields are passed down through family lines.

Although villagers cultivate cash crops as a form of income generation (Mertz et al. 2005), an increase in the types of cash crops planted does not always correlate with an increased income. According to the headman, "[…] It (oil palm cultivation) can help stabilize the income, but not necessarily increase it". Rice also acts as a stabilizing crop as it is a main subsistence crop grown and provides food security year round, but especially when market prices for cash crops are low and stagnating income generation.

Half of the households in SU are currently cultivating all three cash crops simultaneously, 38% of the households are currently cultivating two cash crops and only 12 % of HHS are relying solely on one income generating crop, which in all cases is rubber (Figure 13). There is also variance in the way these cash crop diversification strategies are structured, with some households choosing an oil palm and rubber combination, while others favour a pepper and rubber combination (Figure 13).




Left: Figure 12: Diversification Level of Cash Crop Cultivation

Right: Figure 13: Diversification Strategies

As oil palm is currently the most harvested crop, it has received a higher degree of focus within the study. However, to disregard the others would be a misrepresentation of the Iban livelihood strategy. This study is merely a snapshot in time, a time when oil palm is the prominent cash crop.

### 3.2.2.1 Subsistence crops

Rice is the staple of the community, and therefore the most important subsistence crop. 88% of the households' (22 households) are currently cultivating rice, as a mono-crop or intercropped. The rice production of SU is, according to the villagers, adequate for their own consumption, however according to the headman, small sales of rice do occur amongst the villagers in times of need. Other subsistence crops include fruit trees, vegetables from home gardens and livestock in form of chickens and pigs.

It should be noted that all households engage in at least one subsistence activity, those who were found not to be cultivating rice where instead cultivating vegetables.

Despite of the value of rice as a subsistence crop, it was also found to be the crop that is most commonly cleared for the cultivation of the cash crops; oil palm, rubber and pepper, see Figure 14. When planting cash crops, farmers prefer to clear rice fields as the soil is more fertile. This could be the result of improved soil fertility related to the burning that occurs under swidden agriculture (Kleinman et al. 1996). However, when we look at the PPLU map and Figure 14, rubber is also being replaced with oil palm.

When asked about a possible reduction in rice production, as a result of this clearing, the villagers responded that they had no worries about reduced food security because rice can easily be intercropped with oil palm. This practice can be conducted until the palm canopy closes or fruit set begins. At this stage they can then convert forested areas into new rice fields.

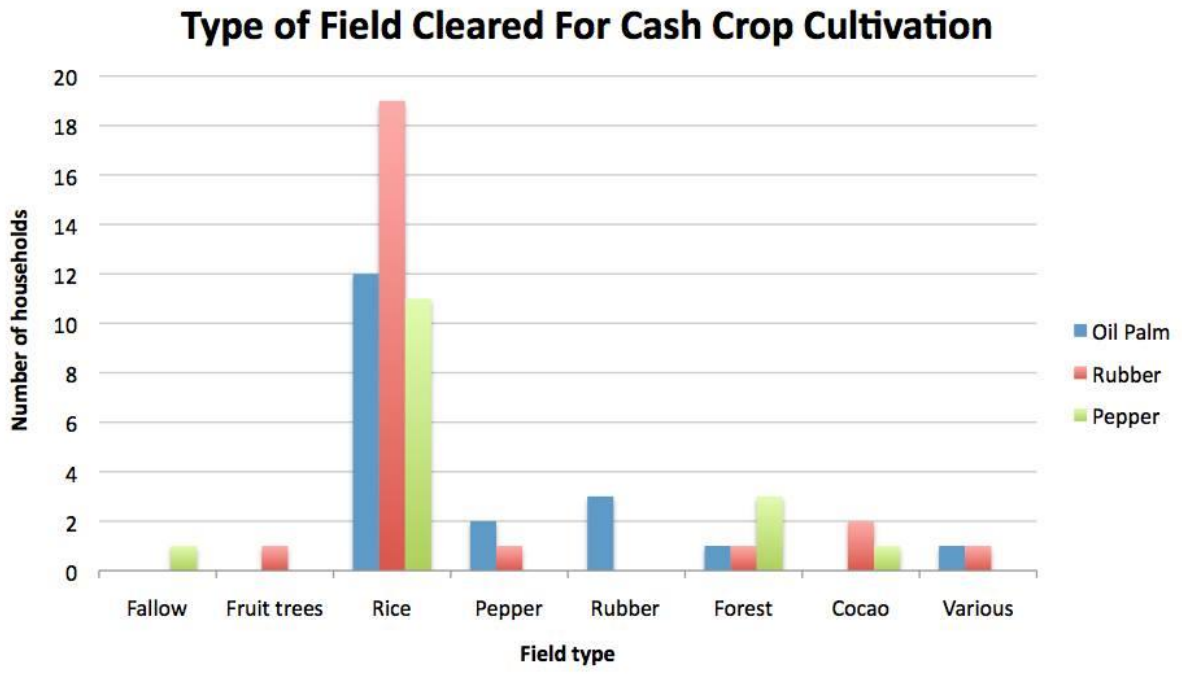



Figure 14: Type of field cleared for cash crop cultivation

### 3.2.2.2 Rubber cultivation

Rubber was the first cash crop introduced in SU more than 100 years ago by the headman's grandfather. SU originally cultivated *Brazilian Rubber*, but converted to *Sarawak Rubber* in 1983, which was introduced by the national government. Initially, rubber was only cultivated in South-East SU, but has spread to the North and the West of the village, covering almost all land areas around the village. Rubber trees are planted with eight feet between each tree and six feet between rows, and thus allows for 908 trees per acre. Rubber can be tapped on a daily basis, and this is normally done during the cooler morning, as the latex is more liquid and thus flows better. It is not tapped during the rainy season as the latex is water soluble (Malaysian Rubber Board, 2014).

When a rubber tree is planted, it takes approximately five years before it has matured enough for tapping latex. The lifespan of rubber trees can be very long, sometimes lasting up to 100 years, but the rubber trees will only be producing big amounts of rubber for a period of 20-25 years after reaching maturity (Malaysian Rubber Board, 2014). Following the advice of the AEA, a 12-12-17 fertilizer (nitrogen, phosphate and potassium oxide) is recommended for fertilizing rubber trees. The fertilizer should be applied four times per year for trees up to four years of age, and applied three times per year on trees five years and older. Also, it should be broadcasted by hand into the field after the saplings have been transplanted. Currently, all households in SU are cultivating rubber trees as seen in Figure 15.

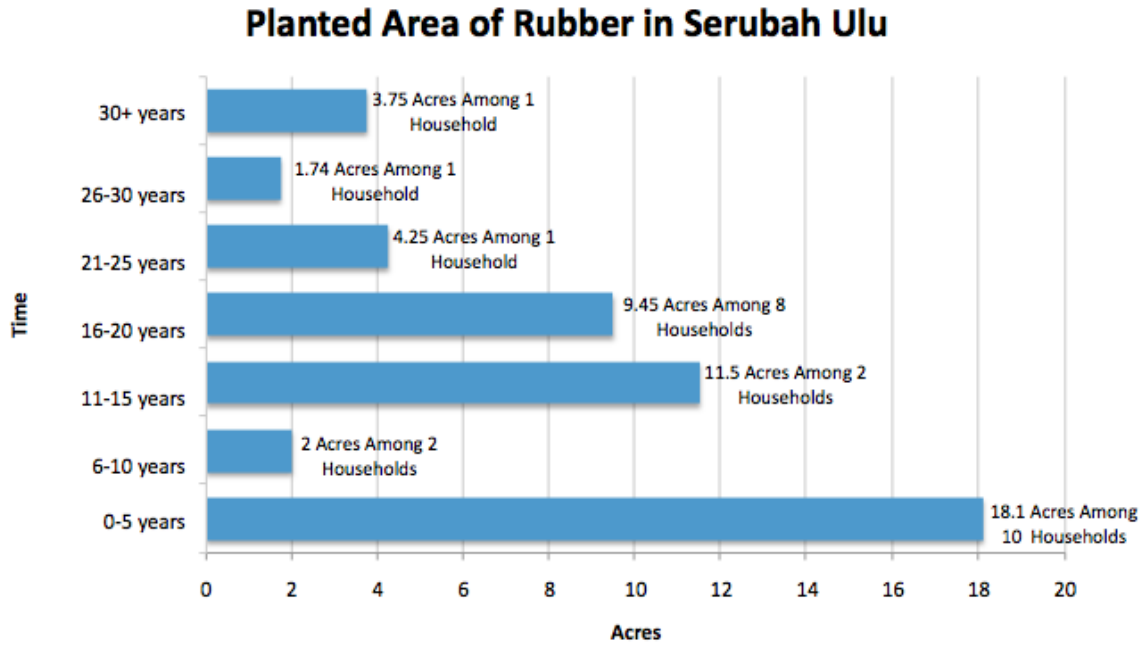



Figure 15: No. of acres of rubber cultivated in Serubah Ulu;

* *HH13 not included, as the amount of trees is noted as "lots", but over 20+ years

As illustrated in Figure 15, 51 acres of rubber are currently being cultivated in SU. However, due to low rubber market prices, only one household is currently tapping rubber. This is probably resulting from their non-engagement in other cash crops, which leaves rubber being the only income activity for that household. Although very few houses planted rubber in the 6 – 10 year range, the cultivation spike within the past five years suggests an increase in cultivation. However, when compared to the production level of rubber on a national level, Figure 16, the opposite pattern is emerging. A decrease in production has in fact been occurring since 2011. However, similar to oil palm, it is not simply an increase in cultivation, but the number of families engaging in the activity.

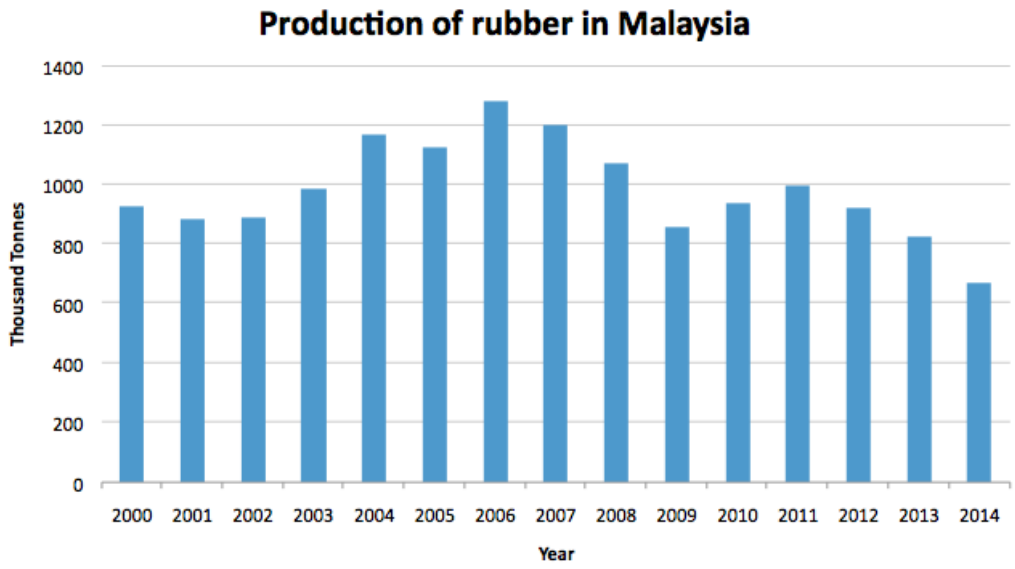



Figure 16: National production of rubber in tonnes in Malaysia; (Source: Malaysian Rubber Board 2014: Natural Rubber Statistics 2014)

### 3.2.2.3 Pepper cultivation

Pepper was the second cash crop introduced in SU during the Japanese occupation in 1942. It was first planted along the riverbank in the village and in a thick strip going south from SU. Pepper poles are planted with six feet between each pole, and there is thus approximately 1210 poles per acre. Although pepper is a less land intensive crop than rubber, it does require more external inputs (i.e. fertilizer) than rubber, with fruit production only lasting four to five years (Wadley & Mertz, 2005).

The villagers often sell black pepper, as the process of preparing black pepper is faster and easier than preparing white pepper. Villagers with more than 200 pepper poles receive subsidized pesticides and fertilizer from the Malaysian Pepper Board. Though, this is only possible, if the farmers

have access to undisputed land and plant the poles themselves. When harvested, the villagers sell the pepper to a local middleman.

As shown in Figure 17, 16 out of the 26 households in SU are currently cultivating pepper, 14 of these started planting pepper within the last five years. Therefore, similar to the other cash crops, the number of families engaging in cultivation has increased, as well as production area. However, the increase in area could simply be the result of a new planting cycle, as pepper has a short life cycle when compared to rubber and oil palm.

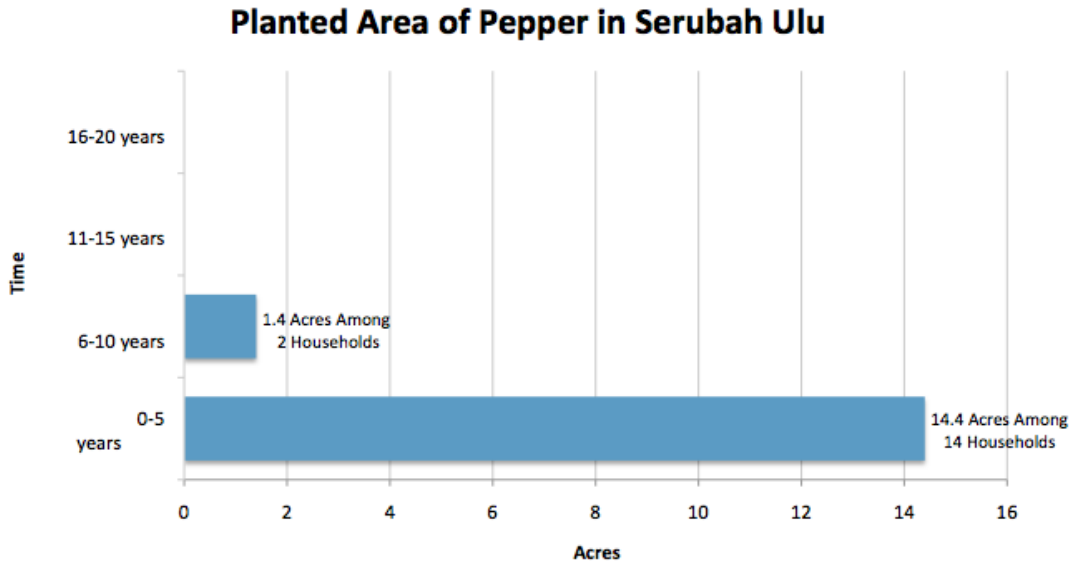



Figure 17: Acres of pepper cultivated in SU

The short planting cycle of pepper makes it difficult to compare local production with national production, as there is limited data on past pepper production. However an undulating pattern in the national graph can be see, that illustrates a cyclical pattern in SU as well as on national level, see Figure 18.

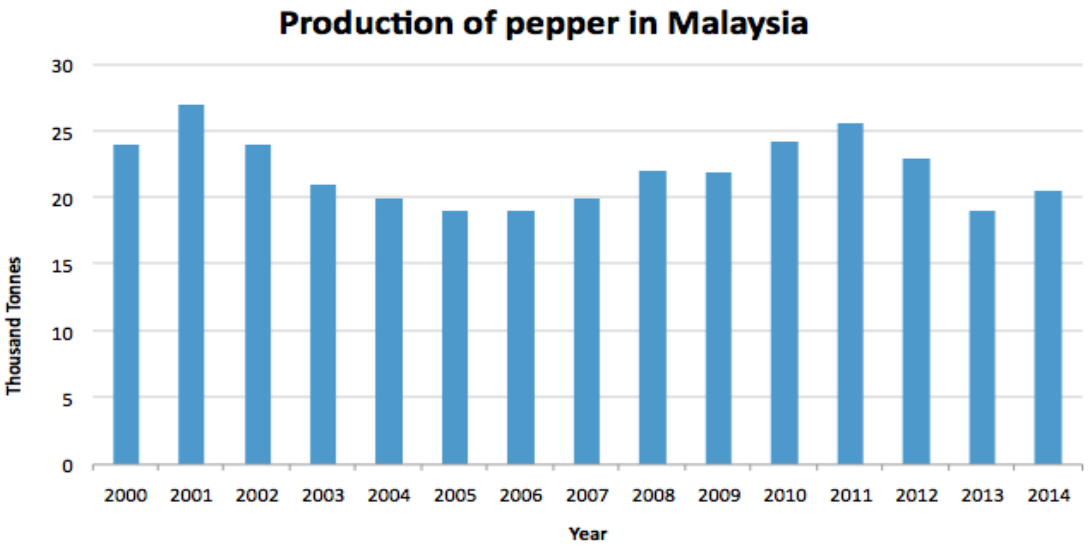



Figure 18: National production of pepper in tonnes (source: Malaysian Pepper Board, 2014)

### 3.2.2.4 Oil Palm cultivation

Oil palm was introduced in Serubah between 1984 and 1986 by the father of the current SU headman. The first oil palm field was located near the entrance to SU, bordering the main road. The second oil palm plantation was located adjacent to the logging road near SU. Oil palm plantations are often placed near existing roads, or roads are created, to expedite the transport of the harvested fruit. This is because the fruit should arrive at the factory within 24 hours of harvesting or the value of the oil will be reduced (Rehm & Espig 1991). All of the land that has ever been under oil palm cultivation has been under NCR. This means that the individual farmers chose to plant oil palm and undertake the start-up and maintenance costs. Although SALCRA approached the community of Serubah 40 years ago, the farmers were not interested in entering into a JVC. Since that time SALCRA has not returned and the land remains untitled, under NCR.

Once the land has been cleared, oil palm saplings (10 -12 months) are planted in the plantation in a triangular pattern with 30 ft. between all trees, resulting in about 56 trees per acre. The tree will begin to bear fruit in 4-5 years. After about 30 years, the trees become too tall for effective harvest, and are cut down. As none of the oil palm trees have reached this stage in SU, it is uncertain if the land would then be left fallow or re-cultivated. Under optimal conditions, the plantations will yield 12 tons of fruit per acre (Rehm & Espig 1991).

There are currently 147 acres of oil palm under cultivation in SU. This number has continued to increase over the past 20 years, similar to the cultivation levels occurring on a national level, Figures 19

and 20. However, the number of families engaging on oil palm cultivation has increased drastically over the last 5 years, conjecturing that more families are participating, but on smaller plots of land.

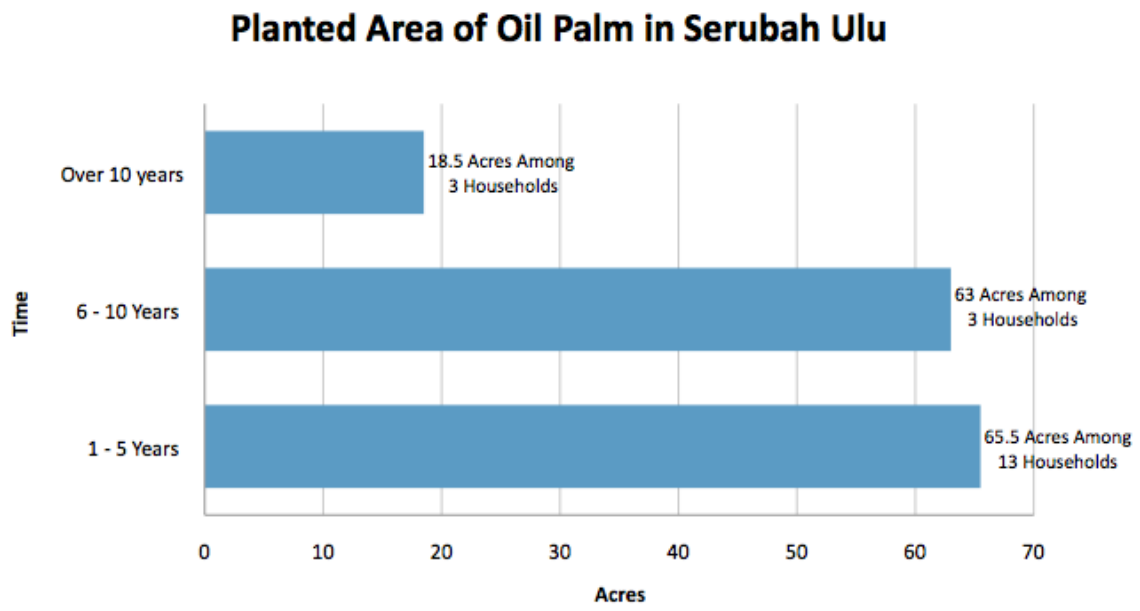



Figure 19: Area of oil palm cultivation in Serubah Ulu

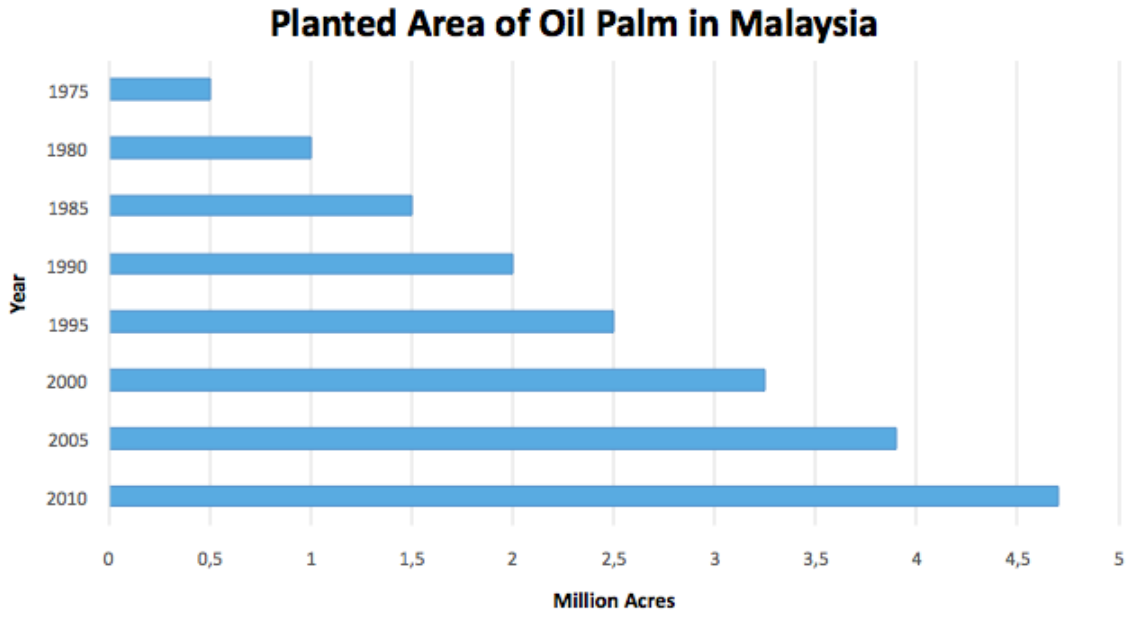



Figure 20: Planted Area of Oil Palm in Malaysia; source: Palm world, 2015

Since oil palm is the only cash crop grown in SU that does not receive any subsidies from the government, all costs must be assumed by the farmers. This means that seeds, which are currently 4.20

RM/seed, and fertilizers must be purchased. Fertilization strategies vary greatly among farmers but the most common way is to apply the fertilizer around the tree while it is immature. Once older, the fertilizer is either broadcasted by hand or applied in rows between the trees. The number of times the fertilizer is applied varies from twice a month to twice a year, with even greater variance in the amount applied by different farmers. Ultimately, the data shows some inconsistencies in fertilizer use and costs. Some farmers claim to spend more money on fertilizer than their oil palm is bringing in economically. Others have confessed to use government subsidized rice and pepper fertilizers on their oil palm. This results in inconsistencies in the profit data, but a general outline of the profit margins has been developed for oil palm, presented in the local value chain for oil palm.

### 3.2.2.4.1 The Local Oil Palm Value chain

Before October 2014 the SU villagers were able to sell their oil palm for 500 RM/ton to the SALCRA subsidized mill located a 15-minute drive away. When transportation costs were subtracted, the average profit was approximately 400 RM/ton.

Unfortunately, in October 2014, an important piece of machinery broke down in the mill. It was fixed, but since that time the mill is no longer accepting smallholder oil palm fruit. This has led to the selling of the oil palm fruit to a private mill in Engkilili, a 30 minute drive away, offering 325 RM/ton. As this new option is the only possibility, SU residents have had no choice but to accept the lower price.

According to the AEA, this large price gap exists because the private mill is not subsidized by SALCRA and as such is unable to offer the higher prices. Despite the changes in the mill, the transportation system has generally stayed the same. The headman of SU will transport the fruit in his pick-up truck for 100 RM/trip, or the headman from Lubok, a neighboring longhouse community, will transport it for 90 RM/trip. However he is not always available. The farmers can call the transporters anytime to set up an appointment, who brings the fruit to a middleman who then takes it in bulk to the mill.

The 81.5 acres of mature trees in SU are currently producing 1.4 tons of fruit per acre per year, a very low output when compared to earlier cited 12 tons that is possible. However, the 207 tons of oil palm harvested in 2014 and early 2015 brought in over 60,000 RM. When averaged, this is approximately 5,500 RM per family. This can be an important source of income, especially when rubber prices are low and pepper prices are uncertain.

A bright spot to be found amongst statistics of poor production and lowered profits, is the good savings culture that seems to be present in SU. None of the farmers questioned has any debt related to

oil palm start-up costs. All had saved money from tourism activities or other cash crops to buy seeds. Many have bought seeds in small groups over time, while others have saved and bought in larger quantities.

Nonetheless, it is apparent that the government's commitment to reduce poverty through agricultural modernization is not having the desired impact. Farmers remain squeezed between the buyers and suppliers, which is a continuation of the traditional dependence Malaysian farmers have on Chinese middlemen, ultimately increasing the marginalization of these rural populace (Fold 2000).

### 3.2.3 Tourism

In Sarawak, tourism is a key industry, especially in regards to longhouse visits and overnight stays (Yea, 2002). SU's involvement in tourism has had some positive results, such as the supplementary income it provides, but the activity has also negatively impacted the community.

Tourism played an important role as a livelihood activity in SU when it began in 1982 until its discontinuation in 2010. Despite the claims of discontinuation, tour guides still occasionally bring tourists to SU. During the time of high tourist traffic, tourists donated books and stationary to the longhouse children. However, wages earned by the long house members from tourism were very low (Table 4). This was aggravated by the fact that the tourism agencies did not allow the villagers to receive tips. Also, as suggested by an UNIMAS employee, the interactions with the tourist companies could have left residual scars on the community.

Table 4: Earnings of Longhouse members involved in tourism activities (source: Questionnaires)

| Household members participating | Activities | Amount earned/day (RM) |
|---|---|---|
| 1 | Rice harvest demonstration | 170 |
| 6 | Local tourist guide | 53 |
| 11 | Cooking | 20 |
| 11 | Dancing | 8 |
| 5 | Musician | 4 |
| 1 | Handcraft making | 10 |
| 1 | River rafting | 10 |
| 1 | Boat transport | 120 |
| 1 | Managing | 20 |
| | **Total amount** | **415** |

A comparison between salaries, given by the tourist companies to the villagers (Table 4) with prices per tourist brought into the village (Table 5) illustrates longhouse villagers were exploited by paying them a fraction of the profits received. An average of ten tourists was brought, per overnight trip, each paying 1,500 RM. This adds to a total profit of 15,000 RM per trip for the tourist agencies. The longhouse received approximately 37.5% of the total amount received from one tourist, 400 RM, as payment for hosting. This could be one of the reasons why the villagers prefer if tourists came to the longhouse without the companies.

Table 5: Tourist Companies and their charges for long house experiences (Sources: Borneo Adventure (2012) and Lonely planet (2015))

| Borneo Adventure | | | |
|---|---|---|---|
| Activity | Duration | | Price (RM) / person |
| Longhouse and river experiences | Days | Nights | |
| Taong longhouse Life | 3 | 2 | 1,510 |
| Menyang Tais longhouse to Nanga Sumpa Trek | 4 | 3 | 2,330 |
| Menyang Tais longhouse & Hilton Batang Ai | 3 | 2 | 1,570 |
| Menyang Tais longhouse life | 3 | 2 | 1,462 |
| Menyang Tais longhouse to Nanga Sumpa Trek | 43 | 3 | 2,33 |
| Lubok Kasai Jungle Experience | 4 | 3 | 2,228 |
| Ulu Ai Experience (Nanga Sumpa) | 3 | 2 | 1,588 |
| Mongkos Bidayuh Longhouse Day Trip | 1 | - | 494 |
| Land Dayak longhouse | 1/2 | - | 274 |
| Mongkos Bidayuh longhouse & Semenggoh | 2 | 1 | 898 |
| Borneo Interland | | | |
| Private Tour from Kuching: Cultural experience in Serubah Village | 2 | 1 | 825 |

It is important to note that the community members, according to conducted interviews, have used the opportunity of tourism discontinuation to engage more in farming activities. 96% of the villagers said they have used the time that was spent on entertaining tourists for farming.

### 3.2.4 Non Timber Forest Products (NTFP)

SU displays a high dependency on the community forest for collection of various plants, which are important for various purposes (Figure 21 and Appendix 4). It is important to note that the collection of edible plants is the most important use of NTFP. Medicinal plants, timber for domestic and commercial purposes, construction materials for dwellings and rituals appear secondary to the former. Firewood collection is the least important NTFP activity, as the community uses gas for cooking. The longhouse community does turn to the forest more in times of scarcity or bad harvests, which is in line with many studies that have been conducted, noting the importance of forests as safety net in the rest of the world (Shackleton & Shackleton, 2004)

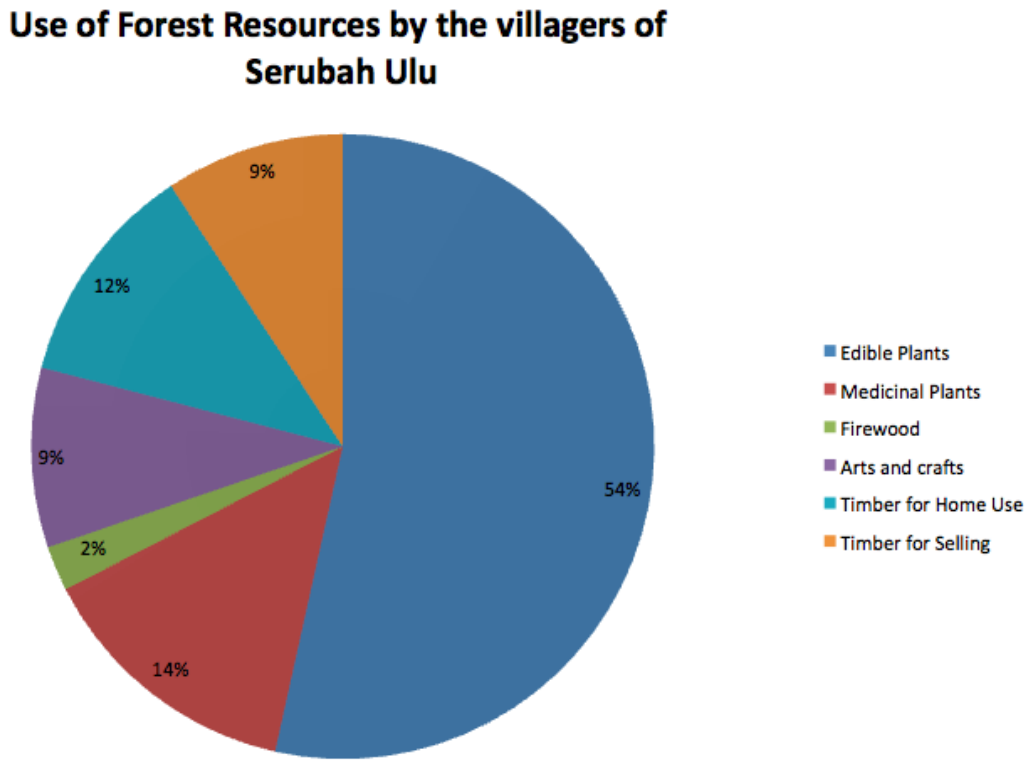



Figure 21: Household involvement and their extent of collection of NTFPs from community forest

### 3.2.5 Remittances

It is common practice in many developing countries for young adults to work and live in urban areas and send remittances home to their families (Cramb, 2012). This pattern is also evident in SU, as 28% of the households receive remittances. Although it is not as important as income earned with cash crops, it is the most common off-farm activity that villagers are engaged in.

Although only about a quarter of all households receive remittances, this number does have the potential to increase. With increased mobility, through infrastructure improvements, and the government mandated policy of children completing secondary school, more young adults are now capable of seeking off-farm professions.

In summary the villagers of SU have a range of livelihood activities in which they engage. How some of those livelihood activities are chosen and which decision making processes lie within these choices is going to be investigated and discussed in the next section.

## 3.3 Decision making processes and trends of change in Serubah Ulu

The decision making process behind certain livelihood strategies is often influenced by more than independent choice. On several occasions, the villagers spoke about how their decisions were made on both a personal level and in relation to national market trends. The frequency that this was brought up by the villagers was sufficient for it to be deemed an important driver of livelihoods within SU, and as such, is presented in a discussion below.

### 3.3.1 Cash crop cultivation

Through the ranking, it was found that the main reasons behind the choice to cultivate oil palm were, in order of importance, low rubber prices, following national trends, and to make up for lost income when tourism was discontinued. Although the low rubber prices and lost income reasonings are relevant, they do fit into the general diversification strategy utilized specifically to strengthen households against such shocks and trends. This makes the following of national trends stand out as something different and therefore interesting to study further.

During the land use focus group, two participants of high status in the community discussed the inclination of the Iban to follow market trends so as to stay current. As one of the participants stated, "[…] Iban culture is to follow agricultural trends, specifically those promoted by the government. Planting popular cash crops is what we have to do not to be left behind." This highlights the importance government and outside influences have on local decision making strategies in regards to cash crop choice.

Not only is SU influenced by market trends, but also the national government. During the 1960s, rubber prices suffered a prolonged decline, which resulted in the national government expanding their economic base through the cultivation of oil palm. From this it can be concluded that the choices behind which schemes the government chooses to promote is also influenced by market prices (Fold, 2000). After a cultivar has proven to be profitable and integrated into government schemes, the crop becomes easier to market. This is the result of processing mills being constructed linking the local value chain to the national and global markets. Ultimately, the decision making process behind cultivation choices, whether for government schemes or smallholder income generation, is driven by market prices.

The theory that the villagers follow these market trends so closely was tested by comparing cultivation data collected in the field with national market price trends (Figures 22, 23 and 24). The emerging patterns do seem to signify that SU uses market information when choosing which cash crops to invest in.

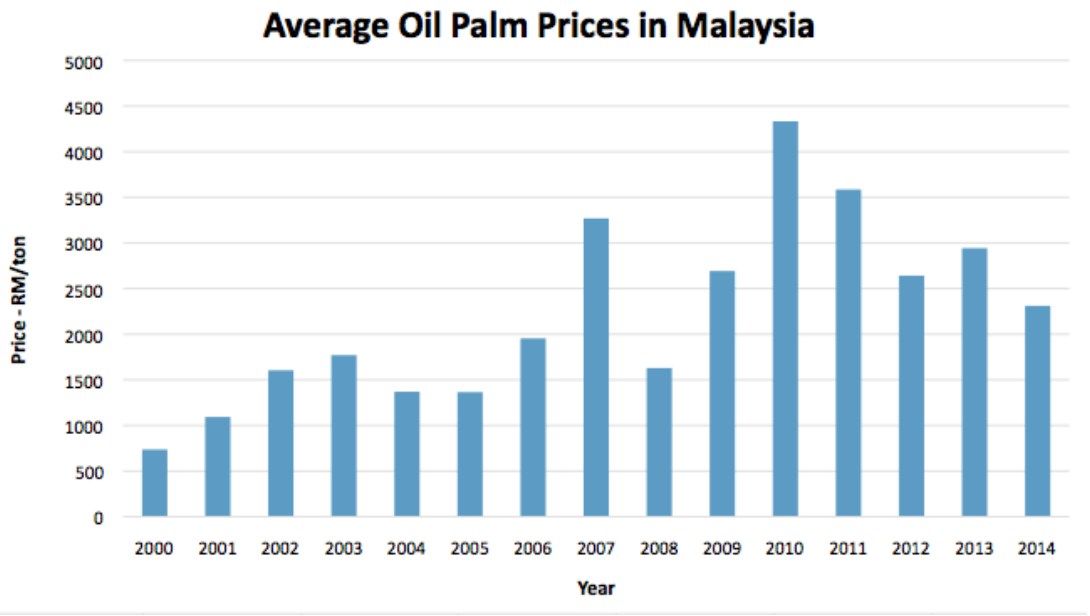



Figure 22: National average oil palm prices; source: IndexMundi (2015)

Figure 23, illustrates a depreciation of rubber prices since 2011. The villagers now state that as of March 2015, the price of rubber has reached a 15 year low of 2 RM/kg. The price spike occurring in 2011 may account for the cultivation spike seen in SU over the past 5 years. As rubber prices have fallen, the villagers have discontinued rubber tapping and focused their energies on oil palm production. This cessation of tapping could be further exacerbated by tree immaturity, as 18 of the 51, or 35 %, of the cultivated acres are still immature.

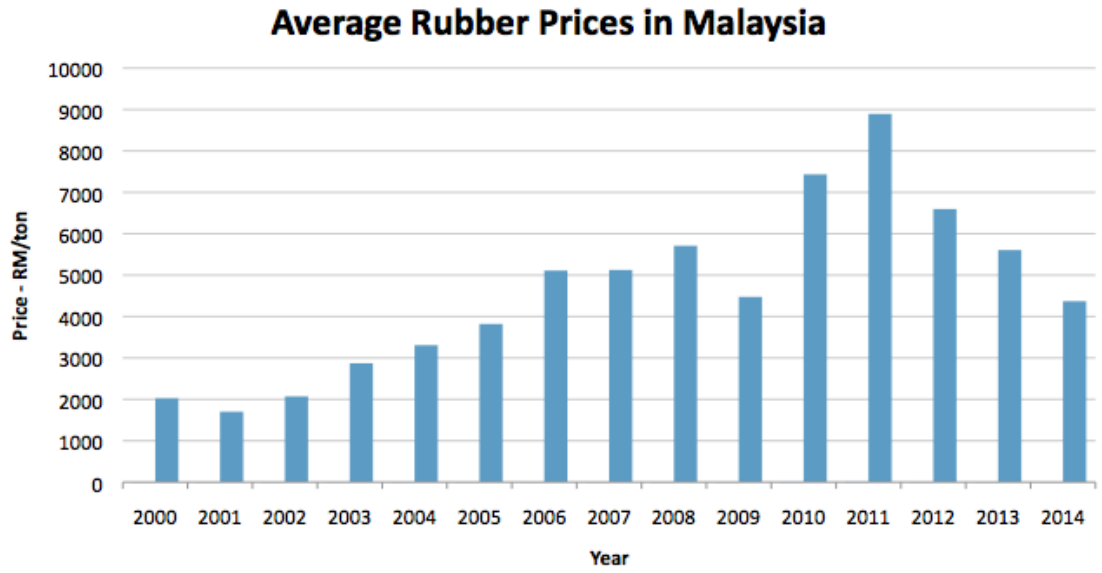



Figure 23: National average rubber prices: Malaysian Rubber Board (2014)

Since 2009, there was a steady appreciation of pepper prices, as seen in Figure 24. The life span of a pepper pole is only about 10 years, which means the 60% of households who have begun cultivating pepper within the last 0-5 years, might simply be starting a new cycle of cultivation. However, the rise in pepper prices could have been an influencing factor for the households to continue cultivation over the past 5 years.

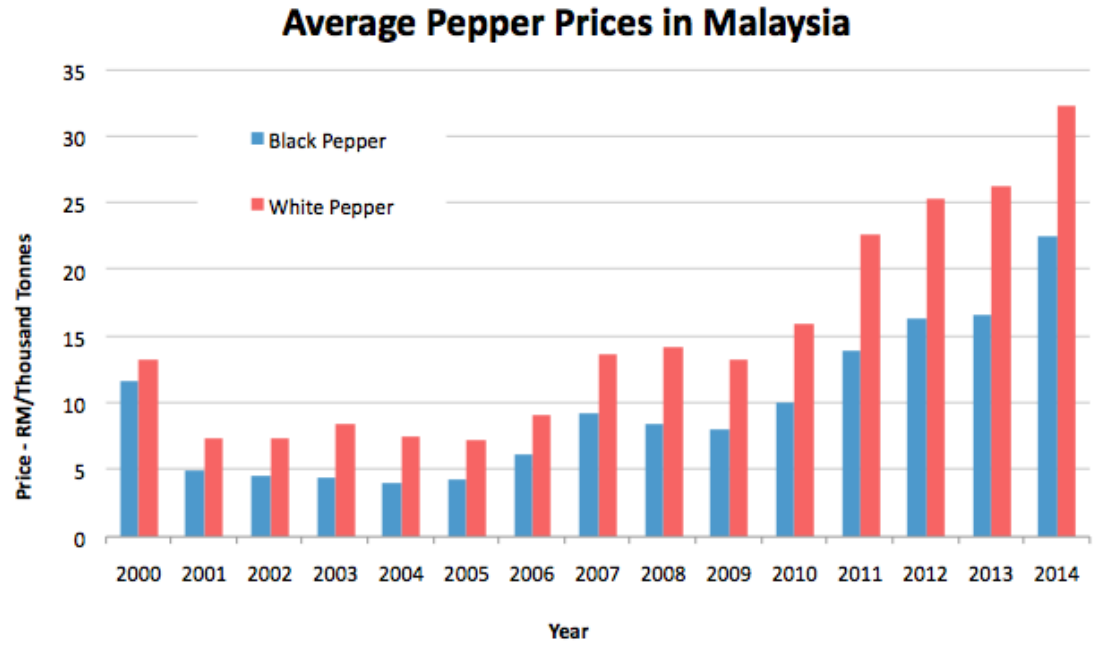



Figure 24: National average pepper price; source: Malaysian Pepper Board (2012)

### 3.3.2 Additional livelihood strategies

Tourism was utilized as a livelihood strategy until 2010. It is unclear whether this discontinuation was the choice of the tourist agencies or the villagers, as each claim to be the responsible decision maker. It is probable that this is not related to market trends, as tourism is still a profitable industry in Sarawak. However, despite protests from the villagers, tour guides still occasionally bring tourists unannounced to the longhouse for short visits. However, as they are no longer participating in overnight stays, and come infrequently, are providing only small returns.

Finally, the choice to use NTFP could coincide with times when income generation has stagnated. Some farmers claimed to have relied on NTFP more heavily after the discontinuation of tourism, in a sense, providing a safety net.

Ultimately, a number of factors play into the decision making process behind livelihood strategies. However, based on the villager's perceptions and the data, diversification and market trends are the main factors that are considered during the decision process.

## 3.4 Potential impacts of the current oil palm cultivation on soil properties

In the village, smallholder oil palm plantations are commonly established by first clearing forest or fallow land, and then planting oil palm saplings or seeds after cultivating rice for at least one season. Intercropping with mainly rice often continues in the first few years.

In both fields that were sampled, fertilizer was applied about 3-4 months before the study, broadcasted between tree rows. The owners of both fields mentioned usage of herbicides. However the amount of weeds in the younger oil palm field was noticeably higher than in the older oil palm field.

The first observations during the soil sampling were that the soil contained high levels of clay and the topsoil, which is the first layer of the soil, was generally darker than the lower layers. This was confirmed in all soil profiles. Differences in color are due to a higher content of soil organic matter (SOM) in the topsoil (Borggaard, 2007). All study sites could be identified as mainly clay rich silt loam soil (clay contents between 10 – 27%), with a color ranging between very dark grey in the topsoils to a brownish yellow in lower layers, which reflects the presence of aluminium (Al) and iron (Fe) in the soil (Bashan and de-Bashan 2010). The colors were identified using a Munsell color chart.

Even though base saturations were not determined and soil profiles were only approximately 50 cm deep, which does not allow for the investigation of texture changes and thickness in detail, soils can most likely be classified according to the USDA and FAO taxonomy which categorize them as Ultisols

or Acrisols, respectively (FAO, 2015 (Schachtschabel 2010)). Ultisols are highly weathered, acidic soils that have developed over long periods of time in tropical or subtropical climates, as in Sarawak (Dubbin 2001).

Left: Figure 25 Soil profile in the three-year-old oil palm field

Right: Figure 26: Soil sampling in the reference field using volume specific sampling equipment

It could generally be observed that on all fields there were particles of charcoal in the soil, mainly in the depths between 0-15 cm, which could be a sign of former land use and shifting cultivation. A more detailed description about color, thickness and texture of the sampled field sites can be found in Appendix 5. For a comparison of soil properties, several parameters were analysed and shown in the following Table 6.

Table 6: Overview of results from soil analysis

| | OIL PALM (3 years) | | OIL PALM (18 years) | | SECONDARY FOREST | |
|---|---|---|---|---|---|---|
| Sample Depth | 0 - 5 cm | 15 cm | 0 - 5 cm | 15 cm | 0 - 5 cm | 15 cm |
| Bulk Density ($g/cm^3$) | 0.83 ± 0.08 | 1.26 ± 0.03 | 0.77 ± 0.04 | 0.99 ± 0.29 | 0.57 ± 0.05 | 1.04 ± 0.06 |
| pH | 4.84 ± 0.16 | 4.93 ± 0.12 | 4.36 ± 0.05 | 4.62 ± 0.12 | 4.13 ± 0.19 | 4.68 ± 0.10 |
| Total Carbon (t/ha) | 2299.10 | 1398.60 | 1751.75 | 1168.20 | 1544.70 | 1539.20 |
| Total Carbon (kg/ha) | 930.41 | 565.99 | 708.91 | 472.75 | 625.12 | 622.89 |
| %C | 5.54 | 1.11 | 4.55 | 1.18 | 5.42 | 1.48 |
| %N | 0.43 | 0.13 | 0.32 | 0.11 | 0.35 | 0.11 |
| Pox C (mg/kg) | 480 ± 344.46 | 48 ± 67.88 | 528 ± 179.60 | 0 ± 0 | 816 ± 89.80 | 72 ± 58.79 |
| CMI | 30.98 | 59.05 | 28.61 | 0 | Reference | Reference |

In the top the soil seemed to be more dense in both cultivated fields than in the reference field, which supports the argument that the soil will get more compacted due to cultivation as suggested in Tanaka et al. 2009. Looking at suitable values for plant growth in clay rich soils, the density of all fields seems to be in an ideal range between 1.10 – 1.47 (NRCS, 2001). The high amount of clay indicates a relatively low cation exchange capacity (CEC) value that points out relatively low soil fertility (Zech, Schad, and Hintermaier-Erhard 2014)

The increase in density down the profile for all fields can be contributed to high clay contents, which also indicates a decrease of soil porosity downwards (Coulter 1998; Cramb 2005; Chapin 2011).

The best pH for oil palm cultivation is a range of 5.5-7. However the oil palm also thrives at lower values when provided with the right fertilizer (Rehm & Espig, 1991). The pH in the sampled fields is very low within a range of 4.13-4.93, where remarkably the secondary forest has the lowest pH on average. Reasons for that could be the amount of rainfall during the rainy season that can have a decreasing effect on the pH or the higher amount of biomass in the forest resulting in a higher degree of root respiration and plant decomposition, leading to soil acidification (Harter, 2002). Furthermore it can be noted that the pH of the older oil palm field is measured to be more acidic than in the younger field.

Nitrogen contents vary within a range from 0.11-0.43%, where the content in the deeper layer is smaller than the amount of nitrogen stored in the topsoil. The same pattern evolves for the total carbon content, which ranges between 1.11-5.54%. The carbon content of the older oil palm field is lower in the topsoil, which is also suggested in the literature (Tanaka et al. 2009).

To see changes in soil properties caused by land use and land use changes the labile pool of SOM can be determined with the measurement of Pox C. The amount of labile carbon in the soil can predict soil management effects on the soil quality which have an impact on pH, CEC and the availability of nutrients (Gruver 2003).

The Pox C in the reference field is higher than the available carbon in the two cultivated field sites. A general trend is that values are higher in the topsoil, than in the lower layer, which is due to higher hummus contents in the soil organic matter (SOM) (Culman et al., 2012). Comparing the two oil palm fields the Pox C content in the 18 year old oil palm field is higher than in the three year old field, which contradicts the findings of Bruun et al. 2013 that identified dramatic declines in SOC stocks after 15 years of oil palm cultivation, as well as an exponential decline as oil palm plantations age in general. However, as standard deviations are relatively high in the oil palm fields, carbon contents could be regarded as similar. While Pox C indicates changes in the labile carbon pool in the soil, the Carbon Management Index (CMI) considers changes in both the labile and the total carbon in the agricultural soil compared to the reference site (Blair, 1996). The greatest decline in carbon can be seen in the older oil palm field, with no available carbon in the lower layer. It must be taken into account that the low number of samples does not allow any representative conclusions or interpretations. For a statistical analysis as well as statements about the actual change in carbon stocks a greater number of samples need to be collected and analysed.

Regarding the measurement of soil properties, several errors must be taken into consideration, including errors in soil sampling, soil handling and storage as well as in the soil analysis. One mistake during fieldwork was a missing slope measurement, which brings errors into the comparability of the soil sites. Even though slopes were taken into consideration with eye measurements, the use of a clinometer would have been more precise. Other errors could have happened in the identification of field sites and soil sampling due to limited time and field availability. During soil sampling and soil analysis human errors play an important role, but are normally minimized by limiting only one person to conducting the measurements. As the ILUNRM course is for study purposes, every student had the opportunity to take fields samples, which can lead to errors.

Furthermore, possible effects of temperature, the method of drying the soil, removing clumps and grinding, can affect the properties of the soil.

From the results in can be said, that when comparing the oil palm fields in relation to the labile carbon content, oil palm cultivation has a negative long-term effect on soil properties. However conclusions should be made carefully in regards to the small sampling sizes.

# 4. Conclusion

The livelihood strategies undertaken in SU are diversified so as to withstand shocks and trends. However, this diversification is focused primarily on cash crops as non-farm work plays a very small role in the community. As such, government schemes and market prices play a role in choosing which cash crops are cultivated. Oil palm is favored by the government and currently has the highest market price, making it the preferred cash crop in SU at this time. Though as seen in the soil analysis, the data collected suggests that the cultivation of oil palm can have a long-term negative impact on soil properties. This is especially in relation to carbon stocks in the soil, which seems to be declining with the cultivation period of oil palm. On the positive side, the improved infrastructure that has been the result of government assistance and oil palm cultivation, has led to increased mobility in the area. This leaves room for increased potential for a wider economic base for the villagers of SU through increased off farm labor. A possible constraint to this labor expansion is the relatively old age of the villagers. Nonetheless, the youth who are residing in SU are going to boarding school on a regular basis, allowing for the possibility of the age gap to be filled. Furthermore, tourism used to be an important secondary form of cash generation, but was discontinued due to differences between the villagers and the tourism agencies. This creates more reliance on cash crops and increases the need for further diversification, and reduced reliance on cash crops.

# 5. Reflections

After the intense initial planning of the research project, one of the first major challenges for the group was to agree upon the research objective and questions in relation to the actual situation in the field. Furthermore, as cooperation with the Malaysian counterparts was established only upon arrival, some time was needed to merge ideas. Even though the main research interests could be brought into consent, the overarching objectives of the Danish and the Malaysian groups remained different. This led to some difficulties in goal achievement, the methods utilized and the use of the interpreters. Due to different perceptions of goals and objectives, some issues couldn't be investigated in depth. However all students made a big effort to use all resources as effectively as possible.

As a result of the former engagement in tourism, villagers seemed to be reserved and careful about the student's presence in the longhouse. As students stayed in a separate guesthouse, the distance was also physically, which made the cultural integration difficult. However most villagers, as well as students tried to be open minded and spent a lot of time in the longhouse. However, as some issues could not be talked openly about with foreigners this separation must still be taken into account.

Some topics that weren't considered inappropriate before fieldwork, seemed to be delicate upon arrival. For example governmental issues, politics and SALCRA involvement were sensitive issues. Generally, using translators influenced the way the group interacted with villagers, as language was a barrier. In the first few days of fieldwork, poor communication with the interpreters led to some misunderstandings and loss of data, which could be overcome by going through the methods and questions in detail before conducting them in order to get a common understanding. After those clarifications, the work with the interpreters was vastly improved.

Furthermore two of the Malaysian students were able to speak some Iban, which helped conducting interviews more efficiently. However, as they weren't fluent in the language, some information might have been lost in translation.

Generally the social science methods worked out very well, however, due to time constraints and because of our interests in issues related to livelihood strategies, very little time was left for natural science methods. This restricted the number of samples and replicates we took. Therefore, the validity of the soil and the forest assessment results are weak, but we saw it as a chance to learn about different methods.

Looking back it would also have been interesting to look further into the differences and similarities with the nearby village of Serubah Ili, as the two villages had lived together in one village and are still very close.

# 6. References

Bashan, Yoav, and Luz E de-Bashan. 2010. *Microbial Populations of Arid Lands and Their Potential for Restoration of Deserts BT - Soil Biology and Agriculture in the Tropics*. *Soil Biology and Agriculture in the Tropics*. Vol. 21. doi:10.1007/978-3-642-05076-3.

Blair, G. et al., 1996. The use of a Carbon Management Index (CMI ) to monitor changes in soil carbon. 436 (34).

Borggaard, O.K., Hansen, S., Holm, P.E., Husted, S., Jensen, C.R., Petersen, C. and Schørring, J.K. (2007) *Jord, Van dog Planter*. Samfundslitteratur, Life Sciences, Copenhagen

Borneo Adventure Sdn. Bhd. Co (2012). Sarawak. Available: http://borneoadventure.com/tour/sarawak/ [accessed: 20.03.2015].

Bruun, T.B. et al., 2009. Environmental Consequences of the Demise in Swidden Cultivation in Southeast Asia: Carbon Storage and Soil Quality. *Human Ecology*, 37(3), pp.375–388. Available at: http://apps.webofknowledge.com.ep.fjernadgang.kb.dk/full_record.do?product=WOS&search_mode=GeneralSearch&qid=22&SID=U2tk7kKg9KoJNTgqHcE&page=1&doc=1 [Accessed March 19, 2015].

Bruun, T.B. et al., 2013. Improved sampling methods document decline in soil organic carbon stocks and concentrations of permanganate oxidizable carbon after transition from swidden to oil palm cultivation. *Agriculture, Ecosystems & Environment*, 178, pp.127–134. Available at: http://www.sciencedirect.com/science/article/pii/S0167880913002235 [Accessed March 12, 2015].

Chapin, F.S., 2011. *Principles of terrestrial ecosystem ecology*, Springer Science & Business Media.

Central Intelligence Agency (2015): South East Asia: Malaysia. Available: https://www.cia.gov/library/publications/the-world-factbook/geos/my.html [accessed: 18.03.2015]

Coulter, J., 1998. Tropical Soils. In *Agriculture in the Tropics*. pp. 48 – 81.

Cramb, R., 2005. Farmers' strategies for managing acid upland soils in Southeast Asia: An evolutionary perspective. *Agriculture, Ecosystems and Environment*, 106(1), pp.69–87.

Cramb, R. & Sujang, P.S., 2011. "Shifting ground": Renegotiating land rights and rural livelihoods in Sarawak, Malaysia. *Asia Pacific Viewpoint*, 52(2), pp.136–147. Available at: http://doi.wiley.com/10.1111/j.1467-8373.2011.01446.x [Accessed February 4, 2015].

Cramb, R., 1993. Shifting cultivation and sustainable agriculture in East Malaysia: a longitudinal case study. *Agricultural Systems*. Available at: http://www.sciencedirect.com/science/article/pii/0308521X93900557 [Accessed March 19, 2015].

Cramb, R. A., 2012. Beyond the longhouse: Iban shifting cultivators come to town. *Revisiting rural places: Pathways to poverty and prosperity in Southeast Asia*, 68-87.

Culman, S. W., Snapp, S. S., Freeman, M. A., Schipanski, M. E., Beniston, J., Lal, R., & Wander, M. M. , 2012. Permanganate oxidizable carbon reflects a processed soil fraction that is sensitive to management. Soil Science Society of America Journal, 76(2), 494-504.

Daugherty, Helen Ginn and Kammeyer, Kenneth C.W, 1995: An Introduction to Population, 2nd edition, The Guilford Press

Doolittle, A.A., 2009. Native land tenure, conservation, and development in a pseudo-democracy: Sabah, Malaysia. *The Journal of Peasant Studies*, 34(3-4), pp.474–497. Available at: http://www.tandfonline.com/doi/full/10.1080/03066150701802793#.VN3kh_nF9ag [Accessed January 22, 2015].

Dubbin, W., *Soils*. The Natural History Museum, London, 2001.

Ellis, F., 2000. *Rural Livelihoods and Diversity in Developing Countries*, Oxford University Press. Available at: http://books.google.com.et/books/about/Rural_Livelihoods_and_Diversity_in_Devel.html?id=9LSqQgAACAAJ&pgis=1 [Accessed January 18, 2015].

Fold, N., 2000. Oiling the Palms: Restructuring of Settlement Schemes in Malaysia and the New International Trade Regulations. *World Development*, 28(3), pp.473–486. Available at: http://www.sciencedirect.com/science/article/pii/S0305750X99001345 [Accessed February 26, 2015].

Gruver, J., 2003. Quality Control for a new Permanganate. In *Conservation, Southern Conference Tillage*. pp. 85–95.

Hansen, T. S., & Mertz, O. (2006). Extinction or adaptation? Three decades of change in shifting cultivation in Sarawak, Malaysia. *Land Degradation & Development*, *17*(2), 135–148. doi:10.1002/ldr.720

Hartemink, A. E. 2003. *Soil Fertility Decline in the Tropics: With Case Studies on Plantations.* Wageningen: CAB International.

Harter, R. D. , 2002. Acid soils of the tropics. ECHO Technical Note. 8pp. Accessible via http://echonet. org/tropicalag/technotes/Acidsoil. pdf (11 Jan 2009).

IndexMundi (2015): Palm oil Monthly Price - US Dollars per Metric Ton. Available: http://www.indexmundi.com/commodities/?commodity=palm-oil&months=360 [accessed: 28.02.2015]

Kleinman, P.J.A., Bryant, R.B. & Pimentel, D., 1996. Assessing Ecological Sustainability of Slash-and-Burn Agriculture through Soil Fertility Indicators. *Agronomy Journal*, 88(2), p.122. Available at: https://dl.sciencesocieties.org/publications/aj/abstracts/88/2/AJ0880020122 [Accessed March 25, 2015].

Lonely Planet (2015).Two-Day Private Tour from Kuching: Cultural Experience in Serubah Village. Available: http://www.lonelyplanet.com/malaysia/malaysian-borneo-sarawak/kuching/tours/small-group-tours/2-day-private-tour-kuching-cultural-experience-serubah-village/item-v-3705kch52-id#ixzz3VIrV77wq [accessed: 20.03.2015].

Malaysian Pepper Board (2012): Local Black Pepper Price. Available: http://www.mpb.gov.my/mpb/index.php/en/22-bm/statistik-harga-lada/61-pengeluaran-lada-dunia [accessed: 22.03.2015]

Malaysian Rubber Board (2014): Natural Rubber Statistics 2014. Available: http://www.lgm.gov.my/nrstat/nrstats.pdf [accessed: 22.03.2015]

MCCARTHY, J.F. & CRAMB, R.A., 2009. Policy narratives, landholder engagement, and oil palm expansion on the Malaysian and Indonesian frontiers. *Geographical Journal*, 175(2), pp.112–123. Available at: http://doi.wiley.com/10.1111/j.1475-4959.2009.00322.x [Accessed March 13, 2015].

Mertz, O., Wadley, R.L. & Christensen, A.E., 2005. Local land use strategies in a globalizing world: Subsistence farming, cash crops and income diversification. *Agricultural Systems*, 85(3), pp.209–215. Available at: http://www.sciencedirect.com/science/article/pii/S0308521X05000934 [Accessed December 23, 2014].

Morrison, P.S., Murray, W.E. & Ngidang, D., 2006. Promoting indigenous entrepreneurship through small-scale contract farming: The poultry sector in Sarawak, Malaysia. *Singapore Journal of Tropical Geography*, 27(2), pp.191–206.

Ngidang, D., 2002. Contradictions in land development schemes: the case of joint ventures in Sarawak, Malaysia. *Asia Pacific Viewpoint*, 43(2), pp.157–180. Available at: http://doi.wiley.com/10.1111/1467-8373.00171 [Accessed February 13, 2015].

NRCS (2001): Bulk density. Available: http://soilquality.org/indicators/bulk_density.html [accessed: 25.03.2015]

Palm World. (2015). Available: http://www.palmoilworld.org/about_malaysian-industry.html_[accessed: 18.03.2015]

Rehm, S. & Espig, G., 1991. The cultivated plants of the tropics and subtropics. Available at: http://www.cabdirect.org/abstracts/19916776928.html [Accessed March 25, 2015].

Sayer, J. et al., 2012. Oil palm expansion transforms tropical landscapes and livelihoods. *Global Food Security*, 1(2), pp.114–119. Available at: http://www.sciencedirect.com/science/article/pii/S2211912412000181 [Accessed October 29, 2014].

Schachtschabel, Scheffer, 2010. *Lehrbuch Der Bodenkunde*. *Soil Science*. 16th ed. Heidelberg. doi:10.1097/00010694-197703000-00015.

Simeh, A. & Ahmad, T., 2001. The case study on the Malaysian palm oil *in South and South-East Asia,* Available at: http://imm-gsm.s3.amazonaws.com/docs/Assignment_Q_2012_1/ASM401_palmoil.pdf [Accessed March 30, 2015].

Shackleton, C. & Shackleton, S., 2004. The importance of non-timber forest products in rural livelihood security and as safety nets: A review of evidence from South Africa. *South African Journal of Science*, 100(11-12), pp. 658-664.

Tanaka, S. et al., 2009. Soil characteristics under cash crop farming in upland areas of Sarawak, Malaysia. *Agriculture, Ecosystems and Environment*, 129(1-3), pp.293–301.

Wadley, R.L. & Mertz, O., 2005. Pepper in a time of crisis: Smallholder buffering strategies in Sarawak, Malaysia and West Kalimantan, Indonesia. *Agricultural Systems*, 85(3), pp.289–305. Available at: http://www.sciencedirect.com/science/article/pii/S0308521X05000983 [Accessed February 4, 2015].

Yea, S., 2002. On and off the ethnic tourism map in Southeast Asia: The case of Iban longhouse tour ism, Sarawak, Malaysia. *Tourism Geographies*, 4(2), 173-194.

Zech, Wolfgang, Peter Schad, and Gerd Hintermaier-Erhard, 2014. *Böden Der Welt*. *Vasa*. doi:10.1007/978-3-642-36575-1.

# Appendices

## APPENDIX 1: Methods applied in the field

| Natural Science Methods | | |
|---|---|---|
| Method | No. of samples | Data obtained |
| Forest Inventory | 1 | A list of herbaceous plants and trees used as a livelihood strategy |
| Soil Sampling | 18 | Soil properties of different aged oil palm fields (3 years; 18 years) in comparison to a reference field in a secondary forest.<br>In situ analysis: Soil color and texture, soil profile and thickness.<br>Furthermore bulk density, pH, %C, % N and Pox C were determined in the laboratory |
| **Social Science Methods** | | |
| Transect Walks (using GPS tool) | 6 | Overview of the village and its surroundings, such as the nearby forest, its infrastructure and its agricultural land; at the same time collection of coordinates of interesting waypoints and routes throughout the area |
| Questionnaire | 25 | Information on household level about demographics, current livelihood strategies and agricultural practises |
| Focus Group Interviews | 3 | Two focus groups (women, men) about tourism: In - depth information and clarifications on tourism as a livelihood strategy, its history as an activity in the village, problems and possible claims for better payments<br>One focus group as part of the PRA – Land Use Map to obtain general knowledge about changes in land use |
| Semi Structured Interviews (SSI) | 4 | In - depth knowledge as well as triangulation of information concerning oil palm cultivation, remittances and decision making processes in regards to agricultural practises, fertilizer application, loans and local value chains |
| Key Informant Interviews (KII) | 3 | Three KII:<br>1) Agricultural Extension Agent: Information on common agricultural practises and the role of the government in agriculture within the area, as well as about projects the villagers had applied for<br>2) Headman: History, organization and livelihood strategies of SU, current organization, agricultural practises as well as some insights into the decision making processes in the com- |

| | | |
|---|---|---|
| | | munity<br>3) Tour guide from the Borneo Adventure Travel Agency: Information about the current structure of the tourism sector operating in SU |
| PRA – Timeline | 1 | Important events and village history of SU as perceived by the community |
| PRA – Family Tree | 1 | Information about the number of households, village members and their relationships; general overview of the community members living in the longhouse |
| PRA – Community Mapping | 1 | Two maps of the community as well as current land use practises close to the longhouse as perceived by a group of men and women respectively;<br>General overview of the study area, the village and important landmarks |
| PRA – Land Use Map | 1 | Two maps of the community showing present land use, history of the implementation of cash crops as well as information about different government schemes in the village, information about SALCRA |
| PRA – Ranking Decision Making | 4 | Most important reasons that lead to the decision of the land use change to cultivate oil palm as part of the conducted SSIs (see above) |

## APPENDIX 2: List of definitions based on the Ellis´ livelihood framework

Below is a list of the definitions used in the report, which have been based on the Ellis livelihood framework (Ellis, 2000).

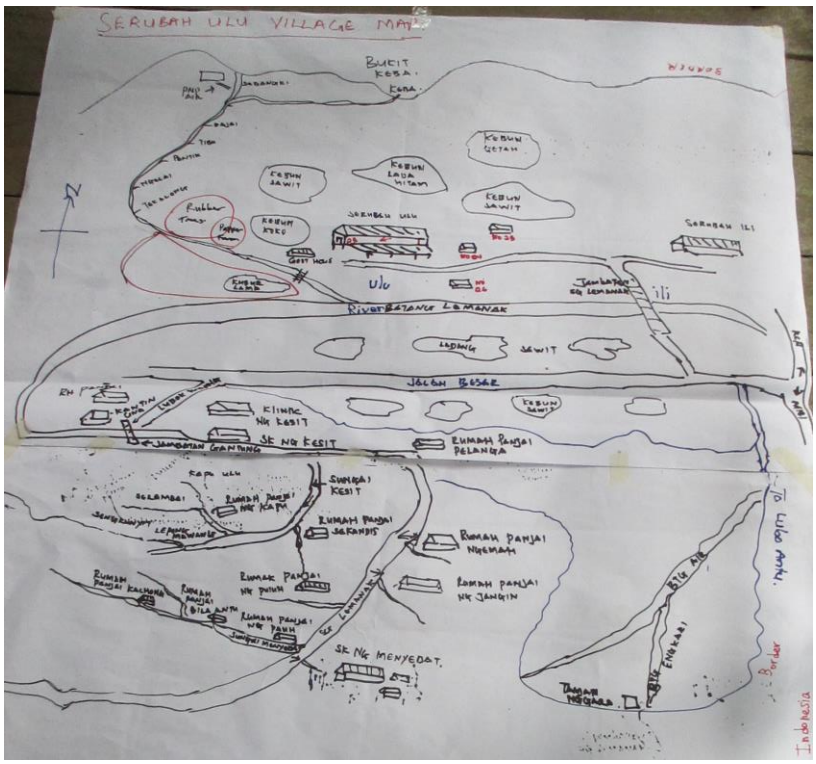
| Definition | Explanation |
|---|---|
| Household | A household is perceived as a social unit, which can include both residents and non-residents. This will allow for the recognition of non-residents contributing to the wellbeing of the residents as well. |
| Livelihood | A livelihood can be assessed on the basis of an individual's or household's access to natural, physical, human, financial and social assets, which can be mediated by institutions and social relations to other people. |
| Income | An income is a contribution to the material welfare of households from a set of one or more livelihood activities. This can both be used in relation to **off-farm income** (work on farms other than your own) or **non-farm income** (work in non-agricultural sectors, often including a shift from a rural to urban settings). |
| Livelihood strategies | A livelihood strategy is the alteration of activities by a household to adapt to its current asset position and the changing circumstances surrounding it. External trends and/or shocks can thus result in an adaption of livelihood strategies for a household over time, to respond to pressures and opportunities in the best way. |
| Diversification | Diversification relates to having many different income sources, and with these many different social relations. The diversification is created through social and economic ongoing processes, which create both opportunities and pressures on the families to adapt their livelihood strategies. |
| Trends | Trends are the interrelationship between assets, mediating processes and livelihood activities, which will be changing over time. They will in varying degrees be external to households and local circumstances. |

Ellis, F., 2000. *Rural Livelihoods and Diversity in Developing Countries*, Oxford University Press. Available at: http://books.google.com.et/books/about/Rural_Livelihoods_and_Diversity_in_Devel.html?id=9LSqQgAACAAJ&pgis=1 [Accessed January 18, 2015].

APPENDIX 3: Pictures of the maps from community mapping exercise

**Map 1:** Comprised of two women with other community members sitting around and contributing minimally. The two maps showed the community as it currently looked and included land use, infrastructure and important natural features.

**Map 2:** Composed of three men with some of the community members around seated in the Ruia and contributing minimally.

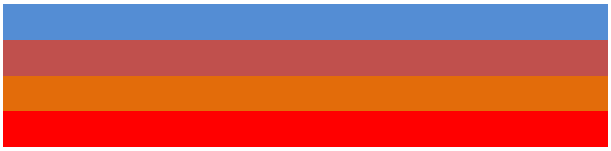


APPENDIX 4: Non-Timber Forest Products (NTFP) and their importance in Serubah Ulu

| No | Local Name | Common/ English Name | Scientific Name | Importance |
|---|---|---|---|---|
| 1. | Buah Belum | Giant Peanut Vine | Whitfordiodendron nieuwenhuisii | Food (Fruits) |
| 2. | Empili air | Tanoak, Stone Oak Trees or Tanbark Oak | Lithocarpus sp. | Feed for Pigs and Muntjac |
| 3. | Engkalak | | Litsea garciae | Food (Fruit) |
| 4. | Ensurai | Garjan | Dipterocarpus oblongifolia | Feed for fish (Flower and fruits) |
| 5. | Entawa (Iban) / Bitowa (Bidayuh) | Mulberry | Arthocarpus anisophyllus | Food (Fruit) |
| 6. | Jambu air | Creamy Star/Jambu Ara | Plethiandra sp. | Food (Fruit) |
| 7. | Jelentik | Palm trees, Bottle Palm or Ponytail Palm | Beaucarnea dolichobotrys | Food (Fruit) |
| 8. | Keladi | Elephant Ear | Collocasia esculenta | Food (Shoots, Corms and Leaves) |
| 9. | Kelampok | Sandoricum | Sandoricum caudatum | Food (Fruit) |
| 10. | Kepayang | Football fruit | Pangium edule | Food (Seeds and fruit must be boiled and fermented before consumption because they are poisonous eaten raw) |
| 11. | Kubal arang | | Willughbeia augustifolia | Food (Fruit) |
| 12. | Lengain | Cannarium | Canarium sp. | Food (Fruit) |
| 13. | Mawang | Mango | Mangifera pajang | Food (Fruit |
| 14. | Merambang | Canarium | Canarium caudatum | Food (fruit) |
| 15. | Nibung | Wild palm | Oncosperma tigillarium | Shoots are eaten as vegetables |
| 16. | Sabong | Gnetum | Gnetum gnemo | Leaves are used as vegetables |
| 17. | Selanking | Mulberry | Arthocarpus nitidus | Food (Young Leaves and Fruit) |
| 18. | Tabau | Willughbeia | Willughbeia sarawakensis | Food ( fruit) |
| 19. | Uchong | Red Angular Tampoi | Baccuarea angulata | Food (fruit) |
| 20. | Upa laris | Climbing rattan | Plectocomiopsis geminiflora | Shoots are edible but taste bitter |

| | | | | |
|---|---|---|---|---|
| 21. | Biruk | Ruffled Fan palm | Liquala sp. | Leaves used for making sun-hat critical for rice growing activities |
| 22. | Buluh engka-lat | Bamboo (clump forming bamboo) | Schizostachyum latifolium | For making blowpipe and baskets |
| 23. | Kawi tengah | | Whiteodendron sp. | Used for pepper poles |
| 24. | Nibung | Wild palm | Oncosperma tigil-larium | For making various hand-crafts such as huts and mats for decorating floor and wall of the long house<br>Poles for hut foundation |
| 25. | Ridan | Palm | Salacca vermicu-laris | Used for making Fishing poles/rods |
| 26. | Sengkajang / Engkajang | | Xylopia sp. | Paddy is spread on the bark for drying<br>Tree bark used for making doors |
| 27. | Engkerapak | | | Burn as the smoke to use for an after labor women |
| 28. | Kacip fati-mah | Kacip Fatima | Labisia pumila | Medicinal herb for women's reproductive system (easing child birth process, regulates menstrual cycle) |
| 29. | Pinang mur-ing | Areca nut palm trees | Areca sp. | Nuts are for offerings during Gawai celebration |
| 30. | Kemunting | Malabar Me-lastome | Melastoma mala-bathricum | Used as medicinal plant for treating high blood pressure |
| 31. | Pansu utai | Spurge trees, Pencil Tree or Candelabra Tree | Euphorbiaceac sp. | Leaves are used in spiritual healing of a possessed per-son by rubbing the leaf at the ribs area |
| 32. | Munti | Bamboo | Gigantochloa has-skarliana | Used for Iban traditional deli-cacy cooking (Pansoh manok/Ayam pansuh) such as fish and chicken. |
| 33. | Daun Tom-bak/Daun Sangkuh | Hanguana | Hanguana sp. | Leaves can be moulded into a temporary plate for serving food |
| 34. | Engkerubung | Macaranga | Macaranga gigan-tea | Music instrument (Playing the gong) |
| 35. | Mempelas / empelas | Tetracera | Tetracera korthalsii | Leaves can be used as sand-paper |
| 36. | Bungkang | Lilli-pilli trees, Brush cherry, Satinash, Wa-ter apple, Java apple, Rose apple, Java plum | Syzygium polyan-thum | Leaves are used to give aro-ma to the food |

**Color key:**



Edible plants
Arts & Crafts materials
Medicinal plants
Others

**Reference**

Sheridan Lawn and Landscaping, LLC, 2015: List of Latin Botanical Tree Names, Genus and Species. Available: http://www.treenames.net/ti/index.html, [accessed 29.03.2015]

APPENDIX 5: Soil properties analyzed in-situ

| Soil properties analyzed in - situ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Thickness | | | Colour | | | Texture | | |
| | | pit 1 | pit 2 | pit 3 | pit 1 | pit 2 | pit 3 | pit 1 | pit 2 | pit 3 |
| OP (3 years) | Topsoil | 0 - 7 cm | 0 - 7cm | 0 - 5cm | 10YR 3/3 | 10 YR 3/3 | 10YR 3/3 | silt loam | silt | loam |
| | 1st layer | 7 - 15cm | 7 - 12cm | 5 - 10cm | 10YR 5/6 | 10YR 5/8 | 10 YR 7/5 | silt loam (clay rich) | silt loam, clay rich | silt clay loam |
| | 2nd layer | 15 cm and below | 12cm and below | 10cm and below | 10YR 6/8 | 10YR 6/8 | 10 YR 6/8 | silt loam (clay rich, more clay than in the top layers) | silt loam, clay | clay loam |
| OP (18 years) | Topsoil | 0 - 5cm | 0 - 4cm | 0 - 4cm | 10YR 3/6 | 10 YR 4/6 | 10YR 4/4 | silt loam (clay rich but not as sticky as deeper depth) | silt loam (less sticky) | silt loam (a lot of roots and rocks) |
| | 1st layer | 5 - 25cm | 4 - 14cm | 4 - 9cm | 10YR 5/6 | 10 YR 4/6 | 10YR 6/8 | silt loam (clay rich) | silt loam | silt loam |
| | 2nd layer | 25 cm and below | 14cm and below | 9cm and below | 10YR 6/8 | 10 YR 6/8 | 10YR 6/8 | sandy clay loam | sandy clay loam (with a lot of rocks and roots) | sandy clay loam |
| Sec. Forest | Topsoil | 0 - 5 cm | 0 - 4 cm | 0 - 3 cm | 10YR 3/3 | 10 YR 3/3 | 10YR 3/3 | // | // | // |
| | 1st layer | 5-13 cm | 4 - 12 cm | 3 - 12 cm | 10 YR 4/6 | 10 YR 5/6 | 10 YR 3/4 | Silt | Silt loam (clay rich, 10-27%) | Silt loam (clay rich, 10-27%) |
| | 2nd layer (change) | 13 - 23 cm | 12- 22 cm | 12 - 26 cm | 10 YR 6/8 | 10 YR 6/8 | 10YR 6/8 | Silt loam (clay rich, 10-27%) | Silt loam (clay rich, 10-27%) | Silt loam (clay rich, 10-27%) |
| | 3rd layer | 23 cm and below | 22 cm and below | 26 cm and below | 10 YR 6/8 | 10 YR 6/8 | 10YR 6/8 | Silt loam (clay rich, 10-27%) | Silt loam (clay rich, 10-27%) | Silt loam (clay rich, 10-27%) |

APPENDIX 6: Soil parameters measured in the laboratory

| Soil properties analyzed in the laboratory | | | | | | | |
|---|---|---|---|---|---|---|---|
| Field | | Oil Palm (3 years) | | Oil Palm (18 years) | | Secondary Forest | |
| Parameter | Pit | 0 - 5 cm | 15 cm | 0 - 5 cm | 15 cm | 0 - 5 cm | 15 cm |
| Bulk Density [g/cm³] | pit 1 | 0.8855 | 1.2237 | 0.7714 | 0.6001 | 0.6333 | 1.0581 |
| | pit 2 | 0.718 | 1.3019 | 0.7327 | 1.2748 | 0.5539 | 0.9592 |
| | pit 3 | 0.877 | 1.2534 | 0.8188 | 1.1074 | 0.5166 | 1.1022 |
| pH | pit 1 | 4.96 | 5.04 | 4.3 | 4.49 | 3.97 | 4.55 |
| | pit 2 | 4.61 | 4.77 | 4.37 | 4.6 | 4.4 | 4.72 |
| | pit 3 | 4.95 | 4.99 | 4.41 | 4.77 | 4.01 | 4.78 |
| "a" (for Pox C calculation) | pit 1 | 0.020 | 0.020 | 0.010 | 0.020 | 0.010 | 0.018 |
| | pit 2 | 0.009 | 0.020 | 0.012 | 0.020 | 0.009 | 0.020 |
| | pit 3 | 0.011 | 0.018 | 0.016 | 0.020 | 0.007 | 0.019 |
| Pox C [mg/kg] | pit 1 | 0 | 0 | 720 | 0 | 720 | 144 |
| | pit 2 | 792 | 0 | 576 | 0 | 792 | 0 |
| | pit 3 | 648 | 144 | 288 | 0 | 936 | 72 |
| % C | pit 2 | 5.54 | 1.11 | 4.55 | 1.18 | 5.42 | 1.48 |
| % N | pit 2 | 0.43 | 0.13 | 0.32 | 0.11 | 0.35 | 0.11 |
| N area | pit 2 | 3013 | 1066 | 2540 | 942 | 2260 | 772 |
| C area | pit 2 | 26988 | 6384 | 24327 | 6867 | 23385 | 7620 |
| C/N ratio | pit 2 | 12.88 | 8.54 | 14.22 | 10.73 | 15.49 | 13.45 |

APPENDIX 7: Used equations and calculations for soil analysis

| Equations used for soil analysis: | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Equation | | | | | |
| Bulk Density | (weight of sample [g]/ 100 [cm³]) = [g/cm³] | | | | | |
| Pox C | MnoxC (mg/kg) = [0.02 mol/l – (a mol/l)] * (9000mg C/mol) * (0.02 l solution/0,0025 kg soil) [***] | | | | | |
| Carbon Pool Index (CPI) | [sample total C (mg g-1 ) /reference total C of (mg g-1)= C sample/C reference | | | | | |
| Lability of Carbon C (L) | [C in fraction oxidized by KMnO4 (mg labile C g soil)/C remaining unoxidized by KMnO4 (mg labile C g soil)]= CL/CNL | | | | | |
| Lability Index (LI) | (Lability of C in sample soil/ Lability of C in reference soil) | | | | | |
| Carbon Management Index (CMI) | (C Pool Index *Lability Index * 100) = (CPI *LI * 100) | | | | | |
| Additional results used for CMI calculation: | | | | | | |
| | OP (3 years) | | OP (18 years) | | Se. Forest/Reference | |
| | 0 - 5 cm | 5 - 15 cm | 0 - 5 cm | 5 -15 cm | 0 - 5 cm | 5 - 15 cm |
| CPI (Carbon Pool Index) | 1.49 | 0.91 | 1.13 | 0.76 | reference | reference |
| Lability of C (L) | 0.92 | 0.05 | 1.12 | 0.00 | 4.43 | 0.08 |
| Lability Index (LI) | 0.21 | 0.65 | 0.25 | 0.00 | reference | reference |
| Carbon Management Index (CMI) | 30.98 | 59.05 | 28.61 | 0.00 | reference | reference |
| [***] with: 0.02 mol/l is the initial solution concentration,<br>"a" is the concentration measured in the supernatant,<br>9000mg is mg C oxidized by 1 mol of MnO4,<br>0.02 l is the volume of KMnO4 solution reacted,<br>0.0025 kg is the weight of the soil being used | | | | | | |

APPENDIX 8: Updated guideline for conducted questionnaire

Interviewer: Date:

Household (HH No.): Interpreter:

If individual House which? _____

TIME:

1. DEMOGRAPHICS/ HOUSEHOLD:

| No. | Name and relation to interviewee | Gender<br><br>1 = Male<br>2 = Female | Age | Who is living in the HH permanently?<br><br>1= Permanent<br>2= regularly home (because of school during the week)<br>3= regularly home on the weekend (because of work in the city during the week)<br>4= seasonal (e.g. for the harvest) | Education Level<br><br>0 = no formal education<br>1 = primary education<br>2 = secondary education<br>3 = high education (diploma, university) |
|---|---|---|---|---|---|
| Interviewee | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |

## 2. LAND USE AND FARMING ACTIVITIES

(2.1) DOES YOUR HH OWN LAND? Yes__ No __

If NO:
Do you have land to cultivate?
Yes____ No____

Do you rent\borrow the land from someone? Yes___ No___

If YES:
How did your HH get the land?
Inherited
Bought
Other

Do you lease the land to someone? Yes___ No ____
If Yes: to whom? _____

(2.2) DO YOU GROW CASH CROPS? Which ones do you grow?

| Oil palm | How many acres of oil palm do you have? | How many trees do you have on one acre (approx.)? | How old is your youngest O.P field? How old is your oldest O.P. field? | What was your land used for before? | How many Kg of oil palm fruit do you get from 1 acre? | How much money is a kg sold for? And to whom: market, middleman, or mill? |
|---|---|---|---|---|---|---|
| | | | | | | |

Where did you buy the seeds from?
_____
How much does a seed cost?
_____

Do you apply fertilizer, pesticides or herbicides to the field?

| | YES | NO | How many times do you apply it in a year? | How many bags do you use on 1 acre for 1 application? | How much does one bag cost? |
|---|---|---|---|---|---|
| Fertilizer | | | | | |

Important: how many kg is a bag of fertilizer?

_____

| **Rubber** | How many acres of rubber do you have? | How many trees do you have on one acre (approx.)? | How old is your youngest rubber field? How old is your oldest rubber field? | What was your land used for before? | How many Kg of rubber do you get from 1 acre? | How much money is a kg sold for? And to whom: market, middleman, or mill? |
|---|---|---|---|---|---|---|
| | | | | | | |

Where did you buy the seeds from?

_____

How much does a seed cost?

_____

| **Pepper** | How many acres/poles of pepper do you have? | How many poles do you have on one acre (approx.)? | How old is your youngest pepper field? How old is your oldest pepper field? | What was your land used before? | How many Kg of pepper do you get from 1 acre? | How much money is a kg sold for? And to whom: market, middleman, or mill? |
|---|---|---|---|---|---|---|
| | | | | | | |

Where did you buy the seeds from?

_____

How much does a seed cost?

_____

Do you apply fertilizer, pesticides or herbicides to the field?

| | YES | NO | How many times do you apply it in a year? | How many bags do you use on 1 acre for 1 applica-tion? | How much does one bag cost? |
|---|---|---|---|---|---|
| Fertilizer | | | | | |

Important: how many kg is a bag of fertilizer

_____

(2.3) What other crops do you grow (that you are not selling\subsistence)

| Crops |
|---|
| |
| |

## 3. LIVELIHOOD ACTIVITIES

(3.1) WITH WHAT OTHER ACTIVITIES DO YOU EARN MONEY?

| Activities | YES | NO | SOMETIMES |
|---|---|---|---|
| Working in the city<br><br>Follow up: As what | | | |
| Selling fish (on the market) | | | |
| Remittances<br><br>If yes:<br>Who is sending you those remittances? | | | |
| Other: | | | |

(3.2) DOES ANYBODY IN YOUR HOUSEHOLD COLLECT FOREST PRODUCTS IN THE NEARBY FOREST?

Yes _____ No _____
IF YES
Medicinal ___
Edible _____
Timber for selling ____
Others (e.g. building material etc.) _____

## 4. LONGHOUSE TOURISM

(4.1) Was the household involved in longhouse tourism?

Yes: ☐ No: ☐

*(If yes: proceed to question 4.2, if no why?)*

_____

(4.2) Which roles did you have? *(May tick more than one)*

Cook ☐

Local guide ☐

Sell handcraft ☐
Cleaner ☐

Dancer ☐
General working (repair/maintenance) ☐

Others: *(Please state)* _____

(4.3) How much did you gain from the role?

RM_____ Per activity?

(4.4) Were you satisfied with the salary?

Yes: No:

a) If no why? : _____

(4.5) Did it disturb your daily routine?

Yes: No:

a) If yes how? : _____

(4.6) Were you comfortable with the tourist presence in your longhouse?

Yes: No:

If no why? : _____

(4.7) Did you experience any language barriers while communicating with the tourists?

Yes: No:

(4.8) Was/were there any complaint(s) from the tourists on your longhouse tourism activities?

_____

(4.9) Are there other tourist attractions you would like to suggest for tourism purposes?

_____

## 5. LONGHOUSE TOURISM REVIVAL

(5.1) Would you agree with the revival of the longhouse tourism? (Would you like to have tourism back) Why?

_____

(5.2) Do you spent more time on farming since tourism stopped?

Yes : No:

END NOTE

Thank you so much for helping us with our research. We might have more questions for you later. If so, would it be ok for us to contact you again?

Is it ok if we could take a picture for you?

Do you have any questions or comments for us?

Thank you for your help!

APPENDIX 9: Updated guideline for conducted interviews

**Part I - Guideline for Focus Group Interview (Tourism)**

1. Invite 5 people for each group, women and men.
2. Brief the participants about the discussion. It is open to all and every point of view counts.
3. Take note of the discussion and observe the participants' body language.

Date/Time:
Interviewer:
Place:

| QUESTIONS | DISCUSSIONS |
|---|---|
| 1. How was your lifestyle during longhouse tourism? | |
| 2. Were you happy with the longhouse tourism? | |
| 3. What were the pros and cons of longhouse tourism Serubah Ulu? | Pros:<br>Cons: |
| 4. What do you think of longhouse tourism revival in Serubah Ulu? | |
| 5. What kind of tourism activities do you want to do with tourist? | |
| 6. Do you want any training on longhouse tourism? (management, promotion) | |
| 7. Do you have any suggestion on how to attract tourists? (infrastructure, tourist preferences) | |
| 8. How much salary would you prefer / expect for the role you handle?<br>e.g.: Cook – RM___ , Dancer – RM___ , Nature guide – RM___ , | |
| 9. Who decided to discontinue longhouse tourism? The agency or the villagers and why? | |
| 10. Do you think the discontinuation happened because of the tourist agent stop prior booking before coming to the longhouse? | |

**Part II - Guideline for Focus Group Interview (Past and Present Land Use)**

| Tasks | Names |
|---|---|
| Facilitator | |
| Writers and Interpreters | |
| Observers | |
| General Interpreter | |

Introduction and Questions:

Hello. We're here to do some more mapping but first we would like to have a talk. We are going to talk about how you use your land. First we will make a few rules. Only one person can speak at a time, and they should be holding the talking stick. When you finish speaking you can pass the stick to the next person who wishes to speak. But, it is important that everyone gets a chance to speak. We want to hear what everyone has to say. There is no right and wrong answers and you don't have to answer. We just want to know what you think and how you feel. So let's get started:

By looking at the information we got from the questions we asked you over the past few days, we have noticed that a lot of you have planted oil palm since tourism stopped. We would like to talk about this a bit more.

1. Do you all feel that oil palm planting has been the most common change since tourism stopped?
2. Are you planting more oil palm BECAUSE tourism stopped? Why or why not?
3. We have also noticed that you usually clear padi when you want to plant oil palm. Do you prefer to clear padi, rubber, pepper or forest when planting oil palm?
4. Have these changes led to less land being available for growing food?
5. Why did you choose to plant rubber?
6. Why did you choose to plant oil palm?
7. Why did you choose to plant pepper?
8. Can you tell us what is good about these changes? (roads, extra income)
9. Can you tell us what is bad? (water and soil pollution)
10. We also heard that a government rubber project was coming, is that correct? Have you heard anything more about that?
11. Can you show us on the current map where that might go?
12. Were you able to choose the type of project you wanted?

13. What do you think of the project?
14. When did you apply for the project?
15. What do you think of agricultural services?

Thank you for answering our questions.

**Part III - Guideline for Key Informant Interview with the Headman**

Overall information about the headman

1. How long have you been head of S.U.?
2. How did you become head of the village?
3. Can you tell us about what functions you have as head of the village?
4. Is anyone not Iban in the community?

Overall information about Serubah Ulu.:

- When was the village founded?
- Where was the village located before and for how long?
- Why did Serubah Ili and Serubah Ulu split?
- How many households are in the village?
- Is there a reason why some people live in the longhouse and others in separate houses?
- Are there more young or elderly people in the village? Has this changed from 15 years ago?
- Can you describe your daily routine? What do you do?
- What are the main farming activities in the village?
- What are the most important crops grown for consumption (subsistence)?
- Which are the most important cash generating crops?
- When and why did you start producing oil palm?
- Have you been approached by an oil palm company?
  →IF YES: When?
- Can you explain how you make money with the oil palm?
- What happened to the closest mill/ why does it not accept your fruit anymore?
- Where is the closest mill that does accept fruit?
- What other farm activities exist?
- Does anyone who lives outside the village work in the village?
- Is the village part of a governmental development scheme/plan or other projects?

→IF YES: When did you become part of the scheme? Who asked you to join?

→IF NO: Have you been offered one (if yes, why did you turn it down?)?

Where do the village children go to school (different ages, is it close by)?

- How do they get to school? (walk, bicycle, bus, other forms of transport)
- Do they come home every day after school or do they sleep there? (e.g. is it a boarding school or not)

Thank you for taking the time to speak with us. We would very much like to see the village, its boundaries, roads, fields, the water system, and any other areas you think are important for us to see. We'll be taking a GPS with us to help us map the community. Could you be our guide or do you know of someone who could take us? Thank you.

**Part IV Guideline for Key Informant Interview with the Agricultural Extension Agent of Serubah Ulu**

List of Questions:

- Is there an agricultural extension service covering Serubah Ulu?
- How long have you been working in the agricultural extension service?
- What is your role in Serubah Ulu and Serubah Ili?
    - In relation to the different cash crops in the villages?
    - Is the extension service involved in buying/transporting/marketing/selling seeds?
    - What is your role in the production chain?
- Can you describe what happened after the mill burned down
    - How processes have changed?
    - Do you know what the impacts have been to Serubah Ulu?
- What kind of support do the agriculture department provide?
    - Cash crops?
    - Subsistence crops?
    - Serubah Ulu?
- How can farmers get support from the agriculture departments?
    - One time support/continuing
- What are the processes for applying for land titles?
- What are the criteria's for obtaining land titles?
    - Serabuh Ulu?

- Why do you not provide fertilizer for oil palm?

**Part V - Guideline for Semi Structured Interviews with farmers engaged in oil palm cultivation**

**List of Questions:**

1. Why did you plant oil palm?

Ask the farmers to rank the following reasons for planting oil palm from 1 to 4 with 1 being the most important and 4 being the least important.

A. Low rubber prices (pepper)

B. More free time since tourism stopped

C. To make up for the loss of money gained from tourism

D. Doing it because other people are/following a trend

E. Other - Blank

2. How did you make money between the end of tourism and the start of oil palm harvesting?
3. Did you rely on the forest more during that time?
4. Do you rely on the forest more during years when rice yields are low?
5. Has your income decreased or increased since tourism stopped?
6. How did you get the money to start planting oil palm? (Did you save money from tourism or get a loan?)
7. Do you have any loans from planting oil palm (from the neighbors or banks)?
8. How do you fertilize your oil palm?
9. Please explain how you transport your oil palm? Can you tell me the number of hands the fruit goes through?
10. If you go through a middleman:

a. Who calls who?

b. How often does he/she come?

c. When you deal with the middleman is the price set or is there room to negotiate?

11. Can you explain how this process is different from when you sold your oil palm to the SALCRA mill?

**Part VI - Guideline for PRA – Community Mapping**

| Method: | PRA Community Mapping |
|---|---|
| Time | |
| Students | |
| Participants | |
| Tools | Poster paper, marker/crayons, camera, recorder |

Thank the farmers for participating and explain activity

Have farmers map the longhouse, additional houses and structures, fields, roads and other points or areas they feel are important. Names should be placed on houses and fields where appropriate, so ownership can be discussed and included on the map. The students can start by drawing the longhouse if there is confusion.

**Part VII - Guideline for PRA – Land Use Map**

As this method was the second part of the Part II Focus Group – Past Land Use the mapping could directly draw on that:

We will now start mapping. We would like to thank you again for the lovely maps you made a few days ago (link to Part VII – Community Map). They gave us a lot of knowledge about current agriculture practices. Now we would like you to think back to when tourism was discontinued (2010). Can you think of what you were growing then? Can you draw what was being grown?

**Part VIII - Guideline for Ranking Decision Making**

See question 1 from the Semi Structured Interview (Part VI)

Within the Semi Structured Interview (SSI) the farmers are going to rank the most important and striking reasons for their decision to plant oil palm. For this, four pre- defined reasons are written on small pieces of paper. With the help of the interpreters, the reasons are going to be explained to the farmers. Afterwards they are asked to rank those from the most to the least important reason. Furthermore we would like to know if there are other reasons for oil palm cultivation than the suggested ones.

Question: Why did you plant oil palm?

Ask the farmers to rank the following reasons for planting oil palm from 1 to 4 with 1 being the most important and 4 being the least important.

A. Low rubber prices (pepper)

B. More free time since tourism stopped

C. To make up for the loss of money gained from tourism

D. Doing it because other people are/following a trend

E. Other – Blank

**Part IX - Guideline to questions for the identification fields for soil sampling**

Soil Sampling Questions

| | |
|---|---|
| Interviewee: | |
| Field: | |
| Date: | |

- When did you plant the oil palm?
- What did you cultivate before?
- Are you applying fertilizer?
- When did you apply it the last time?
- How often do you apply the fertilizer on your field per year?
- Could you show/tell us how you apply the fertilizer? (distance from the oil palm, how much bags etc)
- What is the name/ratio of the fertilizer?
- From whom do you get the fertilizer from?
- How often do you harvest?
- How often do you weed your fields? (we didn't ask but as there is weed all over the place probably never)
- Do you use herbicides?
- How do you transport the harvest from the field? Where to?
- When are you the busiest in the year?
- How much do you yield per harvest?

- Have you perceived any changes in the last 3 years since you started planting oil palm?
- How would you call the soil (classification)?
- Is it good or bad soil?

**Part X – Guideline for Follow Up questions for the Headman**

1. Why was the Serubah house abandoned? Why didn't one group stay? Was the building dilapi-dated?
2. Why have you increased the number of oil palm fields you inherited from your father?
3. Did the government bring the bridge, road, electricity, water, roof, shop, oil palm, rubber, fertilizer, pesticide?
4. If yes, which branch? (i.e. extension services, Azam 1)
5. Why did the government/opposition (who is the opposition) bring the bridge and road?
6. Which opposition party?

APPENDIX 10: Final synopsis before fieldwork

# THE IMPACTS OF THE OIL PALM CULTIVATION ON LIVELIHOOD STRATEGIES IN SERUBAH ULU, SARAWAK

UNIVERSITY OF COPENHAGEN

ILNURM 2015

Charlotte Engell Denham

Lærke Damsø – Jørgensen

Melanie Wentz Mason

Peter Musinguzi

Carolin Mages

Table of Contents

## Introduction

Upon expanding its independent territory in 1963, the Malaysian government made a commitment to reduce poverty by improving the lives of the rural populace, the majority of which were Iban. Traditionally, the Iban people practice swidden rice agriculture, which consists of a rotation of slashing and burning forest land, rice cultivation and fallow periods. This was done on native customary land which the Iban have access to and consider their land, but to which they have no legal land titles. As part of the Malaysian government's commitment to the rural poor, there has been a push to move the Iban people away from swidden to market driven agriculture (Ngidang 2002).

The most recent of these government development schemes focuses on joint ventures (JV).
*"The joint-venture concept (JVC) of native customary land development, which is currently being implemented in Sarawak is conceived as a joint-partnership between the private sector, landowners, and government agencies. It is described as a marriage between capital, land, labor, and expertise. The Iban longhouse communities provide the land and labor; the private sector provides the capital and expertise, and the government agencies act as the trustees or play the role of managing agent for the joint venture project"* (Ngidang 2002).

The first JVC was an oil palm plantation in the Lubok Antu district (Ngidang 2002) put into action in 1995. Since that time, oil palm plantations have been expanding rapidly. In 2010, 12 million hectares, or 12% of Malaysia's land area had been converted to oil palm production (Sayer et al. 2012). The impacts of this rapid expansion have been both positive and negative, with proponents highlighting improved infrastructure and critics underlining environmental degradation and abuse of the rural poor.

The environmental impact studies show that "native biodiversity within oil palm plantations is far lower than the natural forests they often replace" (Sayer et al. 2012) but they also "store more carbon than alternative agricultural land uses" (ibid.). Furthermore, a soil study from 2013 shows that after a 15 year period, soil organic carbon (SOC) is 40% - 50% lower in oil palm plantations than soil under the traditional swidden system (Bruun et al. 2013). From this, it could be inferred that oil palm cultivation tends to degrade soils at a faster rate than swidden agricultural practices. Furthermore, as deforestation increases and biodiversity decreases, the safety net provided by the forest for the rural poor is also disappearing (Angelsen & Wunder 2003).

The abuse of the rural poor emerges from the government's policy of declaring paddy lands that have been left fallow for more than 3 years as idol, which subjects these lands to state intervention and conversion to

oil palm; a more profitable use of the land (Majid Cooke 2012). In a more forthright article concerning land use in Malaysia it appears that, "[...] while lip service is paid to conservation and rural development goals, in reality they only occur as long as the resources in question do not hold significant value to the ruling elite" (Doolittle 2009). However, it is also important to study the infrastructure improvements that have been the result of oil palm production. As oil palm cultivation expands, so too does transport infrastructure, giving once remote areas access to jobs and markets, as well as health and education services (Cramb & Sujang 2011). Despite divisions in regards to the appropriateness of oil palm as a poverty alleviation measure, it does seem to be a growing element within the Iban livelihood strategy.

Within the village of Serubah Ulu, we find similar patterns emerging. Serubah Ulu is an Iban community, consisting of 26 households, which focuses on smallholder, agricultural production, namely oil palm and rice, with rubber, pepper and household gardens also present. Interestingly, the village is located in the Lubok Antu district, which is where the first JVC started in 1995. However, the lands of Serubah Ulu are under native customary rights (NCR) which are not currently being utilized for JVCs. None the less, oil palm still plays a large role in the community as every household is cultivating oil palm, leading to a reduced dependence on other crops and non-timber forest products (NTFP). Also important to mention, there have been complaints that the local mill has been unwilling to purchase their oil palm fruit since October 2014. With oil palm production playing such a large role in the community, the following study objective has been developed:

*To assess the impacts of oil palm cultivation on livelihood strategies in Serabuh Ulu.*

With the continued expansion of oil palm production, it is pertinent to study how oil palm is impacting the community on an economic and environmental level.

## *Research Framework*

A policy framework was developed by Ellis to analyze poverty reduction, sustainability, and livelihood strategies.

*"The purpose of such a diagram is to organize ideas into manageable categories, identify entry points and critical processes, and assist with prioritizing catalysts for change that can improve people's livelihood chances"* (Ellis 2000).

This framework will be applied to the information collected during fieldwork in order to organize and analyze the data. As the study focuses on local livelihoods, the different capitals will be studied with a focus on the local oil palm value chain acting as the critical process, defining value chain as the full range of activities which are required to bring a product from conception through the different phrases of production. This will be followed by a study of the economic and environmental impacts identified as catalysts for this study.

As the Malaysian government pushes for further expansion of cash crop production, it is relevant to study the oil palm value chain, corresponding price fluctuations and general effects production has on the environment through changing land uses and soil quality at a local level. This will help to provide a clearer understanding of why the villagers decided to engage in oil palm production, and ultimately, why villagers in Serubah Ulu have made certain decisions behind their current livelihood strategies.

## *Research Question*

With this in mind, the following preliminary research questions are presented, noting that they will be further developed and modified as data is collected and analyzed.

*1. What are the livelihood strategies of the people of Serubah Ulu?*

a. What is the current status of land use in Serubah Ulu?
b. Which crops are currently being cultivated in Serubah Ulu?
c. Which crops are commercial and which are subsistence?
d. What off-farm activities are people engaged in?

*2. How do local market mechanisms impact the local palm oil value chain?*

a. Who are the stakeholders in the local value chain?
b. What are the confounding issues of selling oil palm in Serubah Ulu?

c. What are the implications of oil palm production on the labor structures in Serubah Ulu?

*3. What are the environmental impacts of oil palm in Serubah Ulu?*

a. How do soil properties differ between oil palm plantations at different ages?

b. How has land use changed in Serubah Ulu?

## Methodology

As the ILUNRM course puts strong emphasis on promoting interdisciplinary practices, both social and natural science perspectives are included the methodology. As such, both qualitative and quantitative methods will be put into use. This attempts to ensure data triangulation and method validity. Triangulation is defined as, "[...] looking at things from different points of view – or multiple strategies, as method to overcome the problems that stem from relying upon a single theory, a single method, or a single set of data from a limited sample, and from a single investigator" (Mikkelsen 2005).

The mixed method approach will help us collecting a variety of varied samples, and in this way increase the depth of research. The data collected during fieldwork will be further analyzed in Denmark. Table 1. Gives a chronological overview of the methods planned to be conducted.

Table 7: Chronological order of planned methods

| Objective | Method | Informant |
|---|---|---|
| Introduction and data collection focusing on general information about the Headman and Serubah Ulu | Informal Interview | Headman |
| Exploring and GPS mapping of the community | Transect Walk | Headman or key informant |
| Identify KII and focus group participants, demographics and general livelihood structures | Questionnaire | 26 Households |
| Village Map – Create a map of Serubah Ulu where all households are marked<br>Crop Ranking - Discern between cash and subsistence crops and rank them by importance | PRA – Village mapping and crop ranking | Group X - 5 farmers purposefully sampled for their cultivation of oil palm |
| Identify general off-farm activities and then | Focus Group | 4-8 Villagers purposefully sampled for their partici- |

| | | |
|---|---|---|
| focus on how labor is structured around oil palm | | pation in off-farm activities |
| Identify how the local oil palm cultivation system works including general yields and profits. | PRA – Flow analysis | Group X |
| Identify and analyze past and present land uses, ownership and changing livelihood strategies | Focus Group | Group Y – 3 farmers and 3 elders purposefully sampled for oil palm cultivation and historical knowledge |
| Create a map of past land use | PRA – Past land use map | Group Y |
| Identify stakeholders, gain a better understanding of how the oil palm value chain functions in a local context, investigate confounding issues to selling oil palm fruit, and past land uses. | KII | Mill Representative |
| | | Extension Service Agent |
| | | Headman |
| Identify local soil classifications. | Soil Transect Walk | Key informant from group X |
| Investigate soil properties of oil palm plantations at different ages | Soil Sampling | Group X |

# Methods

To investigate the objective and defined research questions a number of methods have been determined to be relevant. In the following those methods will shortly be introduced.

## *Questionnaire*

A structured, formal questionnaire, with pre-determined questions, is a method of interviewing people to collect information (Casley et al. 1988). The main advantage of this approach is that it is a relatively easy tool used to gather comparable, quantitative data that helps to plan and decide about further interviews and analysis such as mapping exercises, focus groups or key informant interviews (KII) (Babbie 2015). The main purpose of conducting a questionnaire in Serubah Ulu is to get a general overview of the community and to identify key informants for future activities. The questionnaire will elicit information about the households, its members and age structures as well as general livelihood activities and agricultural practices used within the community. Furthermore, the gathered information can help to identify suitable field sites for the collection of soil samples.

### *Key Informant Interview (KII)*

According to Mikkelsen, semi-structured interviews (SSI) are a method used to ask open-ended questions, and thus leaves space for discovering new aspects or perspectives in relation to the problem being investigated (Mikkelsen 2005). When a semi-structured interview is conducted with a key informant, it becomes a key informant interview (KII). The strength of this method is that it allows for gathering of information that is not easily accessible in the academic literature (Casley et al. 1988). It will be used in Serubah Ulu to investigate the oil palm value chain and gather data on past and present land use.

## *Focus Groups*

A focus group is defined as an in depth discussion with a small number of people (Hancock et al. 1998; Elmendorf & Luloff 2001; Mack et al. 2005; Gill et al. 2008b). In a focus group, participants are selected on the basis of social or economic criteria that apply to most participants so they can share and discuss issues (Gill et al. 2008a). This method is effective in gathering views on specific topics which are not personal or socially sensitive (Mack et al. 2005). Focus groups will be used to understand the views and perceptions of the villagers in regards to their participation in off-farm activities and past land use practices.

## *Participatory Rural Appraisal*

Participatory Rural Appraisal (PRA) methods will be applied in several different ways. The participatory approach enables researchers to gather local knowledge and interpretations about activities and practices, as well as local perceptions, which can help to gaining a better understanding of the area (Selener et al. 1999). PRA methods are often visual techniques that ensure that all villagers, literate or not, can participate in the activities (Selener et al. 1999). The chosen methods are selected to enhance the knowledge and understanding of the local setting and livelihood activities, as well as current and past land use.

## *Participant Observation and Informal Conversations*

While working and living in the community, observations and informal conversations enable the understanding of relationships and processes within the community (Mack et al. 2005). This method will be advantageous in collecting valid information from the field, improved understanding of social interaction and an exposure to new things not included in the methodology (Mack et al. 2005). While all the methods are being conducted, the researchers will engage in participant observation and informal conversations.

## Soil Sampling

Changing properties of soils, which can lead to soil degradation, are often highlighted as some of the most important environmental impacts of oil palm cultivation (Lord and Clay, n.d., Bruun, 2013, Tanaka, 2009, Sahlia et al.). Therefore, there is an interest in examining how soil properties of oil palm plantations of differing ages have changed in Serubah Ulu. In order to study sites of differing ages, but also of the same landscape, a space-for-time substitution (SFT) method will be utilized (Molnár, Zs, and Z. Botta-Dukát 1998).

Soil samples will be collected using horizontal and volume specific measurements on three different oil palm fields, as well as one site in the secondary forest, which acts as a reference sample. The objective is to investigate changes in soil properties and soil fertility occurring in fields that have been used for oil palm cultivation. In the field, the profile, texture and color will be investigated while pH, total N, and Pox – C will be measured in the laboratory at the University of Copenhagen. The strategy for soil sampling will be random, once the fields of different ages have been identified.

## Additional Methods and Collaborations

We have made contact with our counterparts in Malaysia. Thus far we have shared our ideas about research questions and methods via e-mail. We are pleased to find that many of our research topics are overlapping, and those that are not should enhance the others work. The current plan is to work in collaboration with our counterparts on investigating biodiversity and water quality (which will round out the environmental impact study) and tourism (which will round out the economic impact study) in the field. These collaborations should therefore lead to our participation in additional methods, such as biodiversity assessments, water quality analyses, and an examination of tourism.

## References

Angelsen, A. & Wunder, S., 2003. Exploring the forest—poverty link. *CIFOR occasional paper*. Available at: http://www.cifor.org/publications/pdf_files/occpapers/op-40.pdf [Accessed February 13, 2015].

Babbie, E., 2015. *The Practice of Social Research*, Cengage Learning. Available at: https://books.google.com/books?hl=en&lr=&id=bS9BBAAAQBAJ&pgis=1 [Accessed February 15, 2015].

Bruun, T.B. et al., 2013. Improved sampling methods document decline in soil organic carbon stocks and concentrations of permanganate oxidizable carbon after transition from swidden to oil palm cultivation. *Agriculture, Ecosystems & Environment*, 178, pp.127–134. Available at: http://www.sciencedirect.com/science/article/pii/S0167880913002235 [Accessed January 12, 2015].

Casley, D., Kumar, K. & Mundial, B., 1988. Collection, analysis and use of monitoring and evaluation data. *… monitoring and evaluation data*. Available at: http://bases.bireme.br/cgi-bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&src=google&base=REPIDISCA&lang=p&nextAction=lnk&exprSearch=103171&indexSearch=ID [Accessed February 15, 2015].

Cramb, R. & Sujang, P.S., 2011. "Shifting ground": Renegotiating land rights and rural livelihoods in Sarawak, Malaysia. *Asia Pacific Viewpoint*, 52(2), pp.136–147. Available at: http://doi.wiley.com/10.1111/j.1467-8373.2011.01446.x [Accessed February 4, 2015].

Doolittle, A.A., 2009. Native land tenure, conservation, and development in a pseudo-democracy: Sabah, Malaysia. *The Journal of Peasant Studies*, 34(3-4), pp.474–497. Available at: http://www.tandfonline.com/doi/full/10.1080/03066150701802793#.VN3kh_nF9ag [Accessed January 22, 2015].

Ellis, F., 2000. *Rural Livelihoods and Diversity in Developing Countries*, Oxford University Press. Available at: http://books.google.com.et/books/about/Rural_Livelihoods_and_Diversity_in_Devel.html?id=9LSqQgAACAAJ&pgis=1 [Accessed January 18, 2015].

Elmendorf, W. & Luloff, A., 2001. Using qualitative data collection methods when planning for community forests. *Journal of Arboriculture*. Available at: http://archive.treelink.org/joa/2001/may/04_QUALITATIVE_DATA_COLLECTION_FOR_COMMUNITY_FORESTS_elmendorf.pdf [Accessed February 16, 2015].

Geist, H.J. & Lmbin, E.F., 2002. Proximate Causes and Underlying Driving Forces of Tropical Deforestation. *BioScience*, 52(2), p.143. Available at: http://bioscience.oxfordjournals.org/content/52/2/143.full [Accessed January 18, 2015].

Gill, P. et al., 2008a. Methods of data collection in qualitative research: interviews and focus groups. *British dental journal*. Available at: http://www.nature.com/bdj/journal/v204/n6/abs/bdj.2008.192.html [Accessed February 16, 2015].

Gill, P. et al., 2008b. Methods of data collection in qualitative research: interviews and focus groups. *British dental journal*, 204(6), pp.291–5. Available at: http://www.ncbi.nlm.nih.gov/pubmed/18356873 [Accessed July 11, 2014].

Hancock, B., Ockleford, E. & Windridge, K., 1998. An introduction to qualitative research. Available at: http://www.rds-yh.nihr.ac.uk/wp-content/uploads/2013/05/5_Introduction-to-qualitative-research-2009.pdf [Accessed February 16, 2015].

Lord, S. & Clay, J., nd. Environmental Impacts of Oil Palm: Practical Considerations in Defining Sustainability for Impacts on the Air, Land and Water. Available at: https://scholar.google.com/scholar?q=lord+and+clay+Environmental+impact+of+oil+palm&btnG=&hl=en&as_sdt=0%2C5#2 [Accessed February 15, 2015].

Mack, N., Woodsong, C. & MacQueen, K., 2005. Qualitative research methods: a data collectors field guide. Available at: http://www.popline.org/node/263032 [Accessed February 16, 2015].

Majid Cooke, F., 2012. In the name of poverty alleviation: Experiments with oil palm smallholders and customary land in Sabah, Malaysia. *Asia Pacific Viewpoint*, 53(3), pp.240–253. Available at: http://doi.wiley.com/10.1111/j.1467-8373.2012.01490.x [Accessed February 13, 2015].

Mikkelsen, B., 2005. *Methods for Development Work and Research: A New Guide for Practitioners*,

SAGE Publications. Available at: https://books.google.com/books?hl=en&lr=&id=awz996kY5UYC&pgis=1 [Accessed February 15, 2015].

Molnár, Zs, and Z. Botta-Dukát. "Improved space-for-time substitution for hypothesis generation: secondary grasslands with documented site history in SE-Hungary." Phytocoenologia 28.1 (1998): 1-29.

Ngidang, D., 2002. Contradictions in land development schemes: the case of joint ventures in Sarawak, Malaysia. *Asia Pacific Viewpoint*, 43(2), pp.157–180. Available at: http://doi.wiley.com/10.1111/1467-8373.00171 [Accessed February 13, 2015].

Sayer, J. et al., 2012. Oil palm expansion transforms tropical landscapes and livelihoods. *Global Food Security*, 1(2), pp.114–119. Available at: http://www.sciencedirect.com/science/article/pii/S2211912412000181 [Accessed October 29, 2014].

Selener, D., Endara, N. & Carvajal, J., 1999. *Participatory rural appraisal and planning workbook.*, Available at: http://www.cabdirect.org/abstracts/19991805632.html [Accessed February 15, 2015].

Tanaka, S., Tachibe, S. & Wasli, M., 2009. Soil characteristics under cash crop farming in upland areas of Sarawak, Malaysia. *Agriculture, ecosystems …*. Available at: http://www.sciencedirect.com/science/article/pii/S016788090800265X [Accessed February 15, 2015].

APPENDIX 11: Updated timeline for fieldwork

| Field Work Activities | | | February | | | March | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Social and other activities | Fieldwork, application of methods | Data analysis | 26 | 27 | 28 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Arrive at hotel - debriefing | | | | | | | | | | | | | | | |
| Discuss field collaboration with Malaysian counterparts | | | | | | | | | | | | | | | |
| Arrival and welcome in Serubah Ulu | | | | | | | | | | | | | | | |
| Informal conversations (Headman and other villagers) | | | | | | | | | | | | | | | |
| Transect Walks with GPS tool | | | | | | | | | | | | | | | |
| Informal Interview with Women | | | | | | | | | | | | | | | |
| KII with Headman | | | | | | | | | | | | | | | |
| PRA (historical timeline with Headman) | | | | | | | | | | | | | | | |
| PRA (family tree) | | | | | | | | | | | | | | | |
| PRA (village map) | | | | | | | | | | | | | | | |
| KII with agricultural extension service agent | | | | | | | | | | | | | | | |
| Proposal presentation | | | | | | | | | | | | | | | |
| HH Questionnaire | | | | | | | | | | | | | | | |
| Questionnaire analysis | | | | | | | | | | | | | | | |
| Focus Group (past and present land use) | | | | | | | | | | | | | | | |
| PRA (land use map) | | | | | | | | | | | | | | | |
| Informal Interview with a travel agent | | | | | | | | | | | | | | | |
| Focus groups (Men and Women, Theme: tourism) | | | | | | | | | | | | | | | |
| SSI Interviews | | | | | | | | | | | | | | | |
| Soil sampling | | | | | | | | | | | | | | | |
| Forest Inventory | | | | | | | | | | | | | | | |
| Participant observation and field notes | | | | | | | | | | | | | | | |
| Transcription and data analysis | | | | | | | | | | | | | | | |
| Final presentation | | | | | | | | | | | | | | | |
| Departing | | | | | | | | | | | | | | | |