# The Comings and Goings of a Scheme: SALCRA and the Livelihoods of Batu Besai Ulu

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## ABSTRACT

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In recent years, the boom of oil palm and its cultivation practices has garnered attention from a wild variety of interest groups. These groups vary from environmental champions calling for the curtailing of deforestation that makes way for its farming possible, to developers finding opportunity for countries in need of economic stimulus and in possession of ideal plantation sites. Caught between these interests, the small village of Batu Besai Ulu in Sarawak, Malaysia has seen massive changes due to oil palm's advent through the Sarawak Land Consolidation and Rehabilitation Authority (SALCRA). This report investigates how oil palm and cash crop cultivation facilitates community, livelihood, and land use change both historically and looking forward. This investigation found that SALCRA has been vital to the development of the village by bringing road access among other things. Even after SALCRA left the community, its influence remains as the community's farming practices, incomes, and ways of life change over the years. It was found that oil palm has major repercussions on land use as well; it takes years for the land to recover from previous oil palm use. For these reasons, this report concludes that oil palm can both foster and detract from the livelihoods of rural communities like Batu Besai Ulu, creating a dualistic relationship very difficult to untwine.
[Word count: 216]

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# Abbreviations

| | |
|---|---|
| BBU | Batu Besai Ulu |
| IRPA | Priority Area Research Intensification |
| GIS | Geographic information system |
| GPS | Global Positioning System |
| LCDA | Land Consolidation Development Authority |
| LSDS | Land and Survey Department of Sarawak |
| MPB | Malaysian Pepper Board |
| MPOB | Malaysian Palm Oil Board |
| NCL | Native customary land |
| NCR | Native customary rights |
| NWQS | National Water Quality Standards for Malaysia |
| PRA | Participatory Rural Appraisal |
| RISDA | Rubber Industry Smallholders Development Authority |
| SALCRA | Sarawak Land Consolidation and Rehabilitation Authority |
| SSI | Semi-structured interview |
| T.R. | Tuah Rumai |

# 1. Introduction

Change has been the overarching feature of the landscape and lifestyles of the people of Sarawak, Malaysia over recent decades. As one of the less economically successful regions of the country, much attention and effort has been devoted towards its increasing economic productivity (Cramb, 2016). This has meant many changes in land policy and land use, not without controversy and oftentimes with splintering opinions about these changes. Cash generating activities such cultivating cash crops feature as just one of the drivers of change in the state. This report seeks to illuminate such changes and their effects on the village of Batu Besai Ulu (BBU). In particular, it investigates on the one hand *in what ways the presence of the Sarawak Land Consolidation and Rehabilitation Authority (SALCRA) changed livelihood opportunities and land use practices* while at the same time *differentiating household livelihoods*, and on the other hand *how the community changed and may move forward since ending its relationship with SALCRA*.

In order to learn about these issues, we delineated several subcategories of investigation. We first ask *of what livelihoods consist* presently in order to learn of change in these strategies. Addressing this change, we explicitly asked them about *shifts in land use and cash crop cultivation*. We also investigated the *characteristics of soil and water* in and around different land uses to see if there appeared to be apparent land use effects on these resources. We asked *how villagers viewed and experienced the impact of SALCRA*. To further understand decision making regarding cash crops and SALCRA, *community concerns and struggles* were asked about such as crop failures, market price fluctuations, and natural disasters. The information gathered from these subcategories assist us in learning about differing livelihood strategies and how they relate to land use and SALCRA, and we discuss how the community, 15 years post-SALCRA, has changed and is positioned for future participation in cash crop cultivation and community change.

The first section of this report provides background information and context, followed by a section which breaks down the methods used in the research process, after which the results are presented and discussed.

## *1.2 Background and Literature Review*

Located in the north-west part of Borneo, the Malaysian state of Sarawak is regarded as the last frontier for oil palm expansion in Malaysia (Cramb & Ferraro, 2010). In 2018, 27% of the Malaysian area cultivated under oil palm was located in Sarawak (Wong, 2018). Much of the land in Sarawak is Native Customary Land (NCL) and this land has increasingly been the target for further development of oil palm under several land development schemes; one of which is SALCRA. The following sections provide background on the land tenure system and relevant development schemes.

### 1.2.1 Tenure System

The traditional Iban land tenure system is based on a community shared system where property rights in principle are assigned and enforced by the local community (Cramb & Wills, 1990). The tenure system consists of both individual plots of land and shared common areas. Only the longhouse community has the right to access territory shared with the rest of the longhouse members. Land access includes the right to clear forest to cultivate crops, and the farming household holds exclusive rights to cultivate the plot as long as they belong to the community. The Iban tenure system provides access to land resources to its members largely successfully. In most cases, the system maintains an equal distribution of access to land in face of population growth and increasing importance of cash crops (Cramb & Wills, 1990).

During Sarawak's colonial period from 1946 to 1963, development goals to boost the economy were pursued (Cramb & Wills, 1990). Seeking to improve both the national and rural economy, eradicating shifting cultivation and promoting intensive rice farming and cash cropping in the Iban communities became highly supported goals. Community-based land tenure was seen as an obstacle to these goals for development, and the solution was to provide individual titles for the land. This goal is found in the land code from 1957, where the first aim of the land code was to protect the land ownership rights of the Iban and other indigenous groups. This was carried out by classifying land into five groups. One is mixed zone land where there are no restrictions on who could acquire a title to the land. The second type is native area land to which only legally defined native Dayak (Iban) and Malay can hold a title. The third category is NCL under which the traditional Iban tenure system is categorized, and the land is not held under title but subject to communal use and native customary rights (NCR). The fourth and sixth land categories relate to land held by the government called reserved land and interior area land as a residual category (Cramb & Wills, 1990). The second goal of the land code is to transform NCL into titled land.

After Sarawak's independence the postcolonial government continued to pursue the goal to transform community-based tenure to individual land plots, in order to create independent smallholders who could intensify the cultivation of crops (Cramb & Wills, 1990). At the same time, Sarawak experienced growth policies emphasizing the extraction of underutilised surplus land via plantation development, leading the government to experiment with different institutional arrangements for land development (Cramb & Wills, 1990).

### 1.2.2 Land development

Starting in the 1960s, land resettlement schemes to encourage smallholders to participate in cash crop agriculture were introduced by the Sarawak Land Development Board. This involved clearing land for rural farmers and supplying loans to them to cultivate the land, but this scheme essentially failed due to lack of experience on cash crop land management. This lack of experience stemmed from the introduction of crops that required different soil and water management as well as agro-chemical application. This paved the way for the development of SALCRA (1976) to further develop *in situ* agricultural land (Bulan, 2006). After SALCRA, development policies have been driven by the ardent push from the Chief Minister Abdul Taib Mahmud (1981-2014) to not only utilize potential land for development, but also boost rural livelihoods. Taib used his platform to encourage developmental expansion into NCR land in Sarawak, as is outlined above (Cramb, 2016). Alongside SALCRA, the Land Consolidation Development Authority (LCDA) was established in 1981 in order to further facilitate the use of NCL as well as state-controlled land by the state as well as by corporations (Bulan, 2006). The extension into NCR land for oil palm resulted in a massive overhaul of the previous land-use in the region. The land was primarily used for semi-subsistence smallholdings and, later, for cash crops like pepper and rubber. It was not until the introduction of large estate oil palm and, consequently, road access that the rural areas experienced a major shift in their land-use.

The policy-narrative in Sarawak, starting with the appointment of Taib in 1981, has been focused on economic development resulting in a clash between smallholders and large-scale plantations promising increases in income and improved livelihoods (Cramb, 2016). The push has been to unlock land that was tied up under NCR through schemes like SALCRA under which rural land is leased to make way for large scale, primarily oil palm, plantations. There are numerous schemes that are now available to smallholders as well as private companies that manage land on previous NCR land. These schemes and companies, outside of SALCRA also include the

Malaysian Palm Oil Board (MPOB), Malaysian Pepper Board (MPB), Sarawak Oil Palms (SOP), and the Rubber Industry Smallholders Development Authority (RISDA).

### 1.2.3 Agricultural Development Schemes

Under SALCRA directed schemes, landowners who participate gain direct income from oil palm plantation dividends twice a year from their land leased to the authority. The exact dividend amount depends on yields from the oil palm on the leased land and profits from selling palm oil. Land is surveyed in order to determine the size of the farm and also to enable SALCRA to distribute the profits proportionately to the landowners. Additionally, SALCRA projects provide rural people with job opportunities, though these jobs can be high risk and low pay, resulting in many positions being filled by migrant workers willing to accept suboptimal conditions (Colchester & Chao, 2011).

Another institution which assists with oil palm development is the MPOB which was established in 2000 to take over the functions of the Palm Oil Research Institute and the Palm Oil Registration and Licensing Board (MPOB, 2020). This consolidation allowed the MPOB to optimize the experience and expertise of the two organizations and provide more effective service to the oil palm industry (Teoh, 2002). According to Teoh (2002), the MPOB supports the oil palm industry by providing research funds. Development and special research projects are funded by the Priority Area Research Intensification (IRPA) government program (palmoilworld.org). Furthermore, smallholders with fewer than 2.5 hectares of land can access funds and additional service from MPOB every year, thereby encouraging smallholders to plant oil palm. In addition to publicly funded efforts, private companies play a big role in rural development in Sarawak and have driven growth in the development and production of palm oil in the last two decades (Teoh, 2002).

Besides oil palm support, the region and some members of the BBU community also participate in RISDA. In Malaysia rubber smallholders comprise 93% of the production share (Fox and Castella, 2013). Since its inception in 1972, RISDA has been responsible for raising their productivity and income through assistance replanting old, low-yielding rubber with high-yielding varieties of rubber (World Bank, 1989). RISDA distributes subsidies to rubber smallholders i.e. seedlings, fertilizers (Al-Awqati, 2018), in exchange for a relationship that is basically publicly backed contract farming, in that the participants must sell only to RISDA. Likewise, the MPB provides qualifying pepper farmers with assistance through a number of schemes covering various stages of pepper production from planting to processing to selling pepper (mpb.gov.my).

## *1.3 Description of Study Area*

Batu Besai (Figure 1.1) is a community of Iban people in Sri Aman, Sarawak. Batu Besai consists of three communities -- Ulu, Ili, and Tengah. The village sits beside the Dor River, surrounded by secondary forests and plantations of oil palm and rubber and stewards approximately 26 hectares of surrounding land. It is 20 km from the town of Sri Aman with mixed gravel and sealed road access, 24-hour electricity, and an untreated gravity fed water system. The study focused on the households of BBU which consists of one long house and several free-standing houses within close proximity, making some 48 apartments. The longhouse has two headmen with 31 apartments officially under the main headman T.R. Mengga and 17 under T.R. Kedini. The households rely on a variety of cultivated cash crops and agricultural products as well as forest products for income and subsistence.

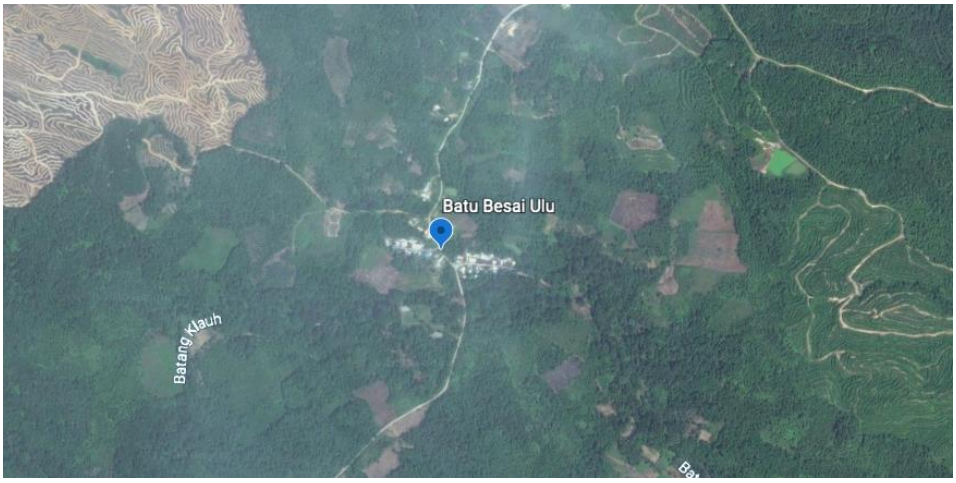


Figure 1.1. Batu Besai Ulu. Adopted from Google maps.

## *1.4 Conceptual Frameworks*

In order to help structure our analysis and interpretation of the field site characteristics and the outcomes of our data collection, we frame our discussion around the livelihood assessment framework. With this we hope to investigate BBU's assets, vulnerabilities, and influences within the community context. By using this framework, we manage to discuss the critical issues and characteristics of the community as such and identify areas of reflection and future implication. This approach is used to look at how SALCRA affected livelihoods and in what ways.

### 1.4.1 The Sustainable Livelihood Framework

Largely coming in vogue within the last 30 years, the sustainable livelihood approach became popular in development literature for its ability to contextualize poverty alleviation efforts and create a more holistic approach than previous less than successful interventionist efforts (le Grand & Zoomers, 2017). In first enumerating the concept, Chambers and Conway (1992) point out that "A livelihood comprises people, their capabilities and their means of living, including food, income, and assets. Tangible assets are resources and stores, and intangible assets are claims and access." In short, livelihoods consist of people, what they do, what they have, and their outputs. Ellis (2000) further articulated the livelihood approach showing that access to assets is modified by social relations, institutions, and organizations in the context of trends and shocks which results in livelihood strategies as Figure 1.2 indicates. We use this point of departure to guide our data gathering approach and analysis of results.

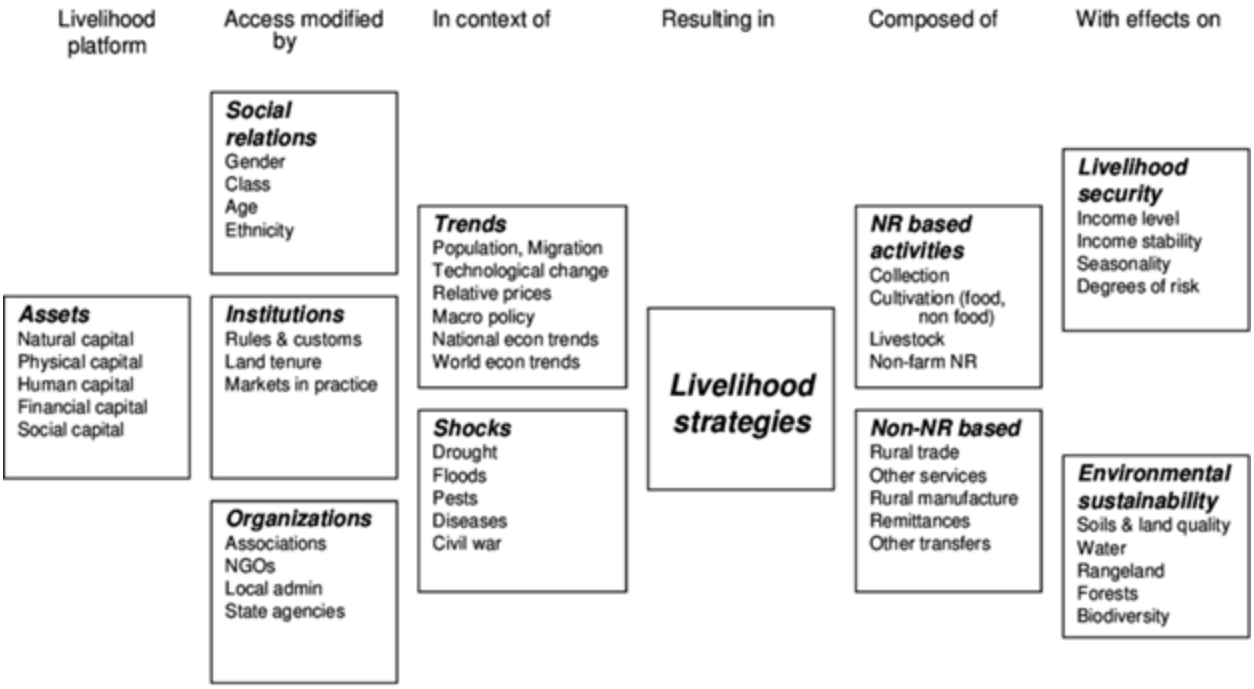


Figure 1.2. Sustainable Livelihood Framework approach (Ellis, 2000, p. 30).

### 1.4.2 Level of Analysis

In development studies, one highly important acknowledgment needs to be made. That is: the level at which livelihoods are assessed and/or generalized. There are strengths and weaknesses to different scopes, and they are good for different things. For example, studying income at a household level, may not differentiate between gender roles and access at the individual level (Chibnik, 2011). On the other hand, creating a broader understanding of a particular people group or country requires the loss of nuance found at the household level through data-driven generalizations. We collected some data at a household level, while some was at the community and individual level. This allows us to combine approaches and make our discussion multidimensional in scope.

# 2. Methodology

The fieldwork occurred between February 25th and March 7th, 2020, using a variety of methods. Each method has its own strengths and weaknesses, but by combining and comparing results from each method, the overall validity of conclusions increases. By using triangulation, it is thereby possible to compensate for weakness of one method by comparing the results with another method to see if the results align or disagree (Chambers, 1994). The methods used are presented in the following sections.

## *2.1 Questionnaire*

Household questionnaires were used to gather a wide range of quantitative and qualitative data related to local livelihoods, including an assessment of households' financial and physical capital and how livelihood strategies were shaped and modified by institutions, trends, and shocks (Appendix C). The sampling strategy was census, but total households that participated ultimately came to 30. Some households either did not want to participate, where not available, or the study

timeframe did not allow for further collection, and not every apartment was occupied. With around 45 occupied apartments, the collected questionnaire represents about 69% of the community.

## *2.2 Participatory Rural Appraisal*

PRA methods are a commonly used form of social science tool for assessing communities. There is a wide variety of PRA methods, but the tools chosen to most effectively corroborate our data and produce valuable information were community mapping, crop ranking, and a seasonal calendar. PRAs generally involve the extraction of information on problems, needs and potentials within a community through a bottom up approach, meaning that information stems directly from members of the community (Cavestro, 2003). PRAs can be both oversimplified as well as over complicated and improper communication between the community members, practitioners, and translators can at times limit the validity of the data collected. Because of this, triangulating results and recognizing potential biases stemming from a lack of diversity in participants or overbearing facilitators is important for PRA data (Chambers, 1994).

### 2.2.1 Community Mapping

The first PRA method was community mapping in which a small group of community members drew the area around the village including roads, crops and boundaries. Community mapping, a method utilized for field work since the 1990s, provides a visual which can be referred to throughout the course of the field work, providing a contextual understanding of where the village is placed in relation to its surroundings. In addition, community mapping helps to substantiate site selection for other methods such as transect walks and soil sampling (Burini, 2012). We determined we wanted the mapping to give us data on which resources were used and where, the location of the land under SALCRA, and an overview of who owned which plots of land. Mapping sessions are used to gain an understanding of the area and the distances to reach used land around the community. It can also be used to initiate a discussion between the community members about past and current land use (Cavestro, 2003).

### 2.2.2 Matrix Ranking

Another PRA method used was matrix ranking which can embody a breadth of information including livelihoods, crop analysis, wealth and income information, food and diet priorities, and more. In general, ranking allows understanding of the deciding factors that community members take into account when choosing the crops they plant and other income generating activities. For the purpose of obtaining information about land-use decision making, a combination of crop and livelihood ranking matrix was prepared with ranking values ranging from 1-5. The values were measured using small stones placed on a large sheet of paper displaying the prepared matrix (Table 3.1). The rows for ranking were the crops and livelihood activities, while the columns included income and food alongside various crop features including stress on land and need for water.

### 2.2.3 Seasonal Calendar

The final PRA method used was the seasonal calendar (see Figure 3.8). Seasonal calendars provide an overview of patterns and trends of income, expenditure, and activities over the course of a year. The trends are demarcated with levels ranging from 1 to 10 with high expenditure/income closer to 10 and low expenditure/income closer to level 1. At the start of the PRA, we asked the community members to list main harvesting activities for each month, after which we had them

rank the trend levels for each month. Seasonal calendars help to highlight key periods of vulnerability or security within a community and the ways they make it through difficult periods.

## *2.3 Semi-structured interview*

In order to gain more details and qualitative knowledge, semi structured interviews (SSI) were carried out throughout the fieldwork. This interview method was chosen to ensure a broad view on the themes while staying flexible if unexpected answers occurred but without letting the informant control the interview (Kvale & Brinkmann, 2015). Key informants were identified in the community as well as from the Land and Survey Department of Sarawak (LSDS) and the Sri Aman Health Clinic.

To avoid generalizing data from a single informant, five SSI were done with community members in BBU. The interviews sought to get nuanced information on the community and individual experience with participation in SALCRA, so informants with a good recall of SALCRA participation were selected for the SSIs (Appendix D). Three of the informants in the community were found through their answers on participation in SALCRA from the questionnaires and invited to do an interview later. One informant was found through snowballing, where another person suggested we speak with the respective informant. The fifth informant was with one of the headmen from the longhouse.

One interview was carried out with the LSDS (Appendix E). The interview sought an understanding of motives and considerations related to the titling process and the tenure system. The information from the LSDS consists of important information related to the decision making and implementation of land development. An interview was requested with SALCRA as well in order to gain perspective from that level, but it could not be arranged. Also, one interview with a nutritionist from the Sri Aman health clinic was conducted in order to learn about health trends with changing land use and livelihood strategies. In addition to the above SSIs, a preliminary open interview with the headlady was conducted at the onset of the study in order to gain a general understanding about the community and its history.

## *2.4 Focus Group Discussion*

One focus group discussion was done with a gathering of the women from the community to shed light on the community's opinions and thoughts on food and health within the community. Since women often oversee cooking and preparing food, it was assumed they would be able to share useful information on changes in diet or health. The agenda of the focus group was to find out if there had been any changes in diet and if these changes occurred due to changes away from subsistence and easier access to markets.

In the focus group discussion participants were free to talk and discuss with each other, thereby a lot of information was collected in a relatively short time from several perspectives. Beforehand questions were prepared for the discussion as a starting point for the conversation and to facilitate the discussion during the group discussion (Appendix F).

## *2.5 Transect Walks*

In order to get an initial understanding of the local land use, transect walks were utilized around BBU, through different fields and forests (Appendix I). Transect walks help us to understand the farming situation of BBU, including local technology and practices and contribute to the design and direction of the questionnaire. Besides, transect walks can serve as a site selection exercise for water and soil sampling. The guides showed fields under a variety of cultivation like

pepper, vegetables, fruit trees, and others. During the transect walk additional information related to land and cultivation was gathered. Things like pesticide use, soil characteristics, natural vegetation, and land ownership were explained by local guides.

## *2.6 Participatory Observation*

The aim of participatory observation is to gain data on local individual's livelihoods and land use methods or even to learn of new areas deserving of investigation. Observation includes daily life activities in the community and interactions among those in the longhouse. It can develop a holistic understanding of livelihoods, learning of practical life strategies from local farmers.

One observation is collecting honey from wild bee nests in the forest and the key informant explained the process of honey collection. Furthermore, rice processing observation and daily chatting observation worked as a supplement to get understanding about agricultural practice and cultural parameters. It contributed to teaching us the manners, taboos and issues that need resolving.

## *2.7 Environmental Assessment*

In order to investigate natural capital and to learn about land use change's effect on natural resources, several techniques were utilized to measure soil and water quality in and around BBU.

### 2.7.1 Soil Sampling

Slope was measured and auger soil samples were taken in four sites with differing primary land use histories. Four to five samples within the sampling site were taken randomly in the area. The samples were taken from the upper eight inches and then from eight to sixteen inches below the surface. Once the samples were collected, the respective sample groups (0-8 inches, 8-16 inches) were homogenized and tested for pH and texture and stored for future testing. The first samples were taken from secondary forests which had been used for cultivating fruit trees with approximately 40 years of growth. The second site had been more freshly cultivated with young fruit and vegetables. The other two sites compared old oil palm (30 years) to new oil palm cultivation (5 years). Old and new cultivation sites were chosen to compare changes in soil characteristics under changing land use. Due to unforeseen circumstances, other soil qualities were not possible to test after collection.

### 2.7.2 Water Sampling

Four water samples were taken to determine water characteristics of the river nearest to the longhouse, the community's water source, and a stream surrounded largely by oil palm cultivation. The Muntik River was chosen for its proximity to oil palm plantation, and the gravity fed water from the longhouse which comes directly from the Nemong River was sampled in order to determine water source quality. The other two samples were both drawn from the Dor River. One sample was taken upstream of the village and one was taken down stream of the village. The Muntik and Dor samples were tested for coliforms, while all four samples were measured for temperature, dissolved oxygen, conductivity, dissolved solids, salinity, pH, Ammonia, phosphorus, and turbidity. These findings were used to classify the water into quality standards from the National Water Quality Standards for Malaysia (NWQS) (Appendix H).[1]

[1] https://environment.com.my/wp-content/uploads/2016/05/River.pdf

### 2.7.3 MiniSass Water Quality Scoring

In addition to water sampling, stream quality was tested using the Stream Assessment Scoring System (MiniSASS) (Appendix G, J). This method uses a sample of invertebrate stream inhabitants to score water quality based on the sensitivity of the species found. Invertebrates were collected by using nets to sieve disturbed riverbeds. This was done in four sites for approximately 30 minutes at each, except for one. These sites included upstream and downstream Dor River, the Rupah River and the Muntik River. The Dor sites were chosen to see if the longhouse runoff affected the river downstream. The Rupah was selected as a site near agricultural cultivation and the Muntik was near oil palm plantation. However, the Muntik collection results were discarded due to incomplete collection of less than 30 minutes, inaccessibility, and only one invertebrate found.

## *2.8 Methodological Limitations*

There were many ways in which these methods could have been improved upon or were limited. For one, the time frame was very short, reducing the amount of planning, number of methods, and testing replications possible. Time ran short for things such as follow up interviews and interview appointments. As we participated in the daily life of BBU, last minute schedule changes were common and often forced us to push back previously planned activities.

Another limitation was setbacks in method availability. We hoped to use GIS data from the LSDS site which turned out to have restricted access. Conflicting understandings of the tenure system and land in BBU obstructed some investigation. GIS data would have provided us a better picture of land plot statuses and land distribution around BBU. We also experienced restricted access to soil lab analysis upon returning to Denmark, since the lab had been closed.[2] Therefore, soil analysis was carried out only in part. Also, soil and water sampling was restricted to the days in which resource people were available, making sampling rushed and unable to be replicated. Not only were samples unreplicated, but the analysis which did take place was done by different students, making even comparison between sample tests difficult.

Additionally, this meant that we could not study actual change over time, but only perceptions of change which can often be skewed. This also means that things can be forgotten. Some of the questions asked for a recall period of 15 years which is a very long period and prone to suffer from faulty memories and hindsight interpretation.

In general, but especially when speaking through a translator, things can get lost in translation between researchers and participants. Proper diffusion of information from the translator to the community members and facilitators is vital for sound data to be collected (Chambers, 1994). To combat this, we structured our methods to ensure that there was always one questioner and one note-taker and both a Malaysian and Danish counterpart present, but at times, things were not clear, and information was not properly diffused to all. With most of our counterparts understanding Iban, sometimes information was not relayed in English or details were lost.

[2] The soil results reflect only the pH and texture of the soils as soil nutrient analysis could not be completed due to the University of Copenhagen laboratory being closed from COVID-19 precautionary measures taken by the Danish Government (https://politi.dk/en/coronavirus-in-denmark).

# 3. Results

Our project aims at discerning the ways in which cash crops and land use contribute to community development and livelihoods in the long and short term in BBU. In this section, a timeline is presented in order to better understand the history of the longhouse in relation to SALCRA's arrival to set the context for future possibilities. The timeline is followed with results analysis on the livelihoods of BBU during and after SALCRA. The environmental results are then presented in order to provide a picture of how soil and water quality as well as land use have changed since oil palm came to the community.

## *3.1 SALCRA and its presence in BBU*

### 3.1.2 During SALCRA

Figure 3.1 shows a timeline from the community. Before SALCRA made its entrance, the community's main activities were subsistence and traditional bedurok cultivation. Bedurok is a system where farmers exchange labour in times of harvest, for example in the harvest of rice, eliminating the need to hire workers. Contact with SALCRA began in 1979 and in 1981 the community started the lease and road access arrived. After a total of 25 years, the lease ended in 2006. The road brought at the beginning of the SALCRA lease offered opportunities to diversify income sources through connection with the town and market. During the same period the community also gained access to gravity fed water and electricity.

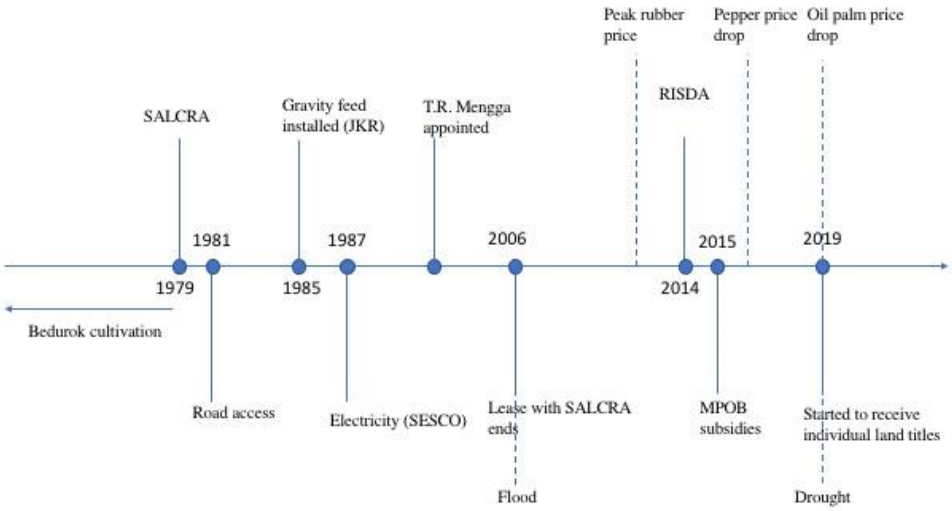


Figure 3.1. Timeline of BBU. Data extracted from SSI with T.R. Kedini, crop data, and questionnaire results.

During SSIs, we inquired about the information provided by SALCRA at the start of the lease. In establishing contact, SALCRA representatives travelled to rural villages to outline the details of the introduction of oil palm. In these presentations, they ensured the community would be given dividends to supplement incomes and gain access to job opportunities. For one SSI informant, the dividends and wage were vital to their overall household income. For all informants, the dividends were described as inconsistent as well as unequal. These inequalities contributed to the decision to end the lease as well as the decision to elect a new headman. Another SSI revealed

that every resident of the longhouse received an equal dividend, regardless of the size of land contributed to cultivation or whether or not they had contributed land at all. Therefore, the residents who contributed a large plot of land when they signed the contract with SALCRA suffered equitable returns. Towards the end of the contract, the community held a vote to terminate the lease, and more than half of the people voted to do so. It was later discovered in a discussion with the LSDS that SALCRA chose not to be involved with BBU as they were unable to resolve dividend and land distribution disputes.

After the SALCRA contract ended, some farmers started small-scale oil palm, using the skills they had learned from time spent working with SALCRA. This was a key positive outcome from SALCRA by providing autonomy and oil palm management skills to the rural communities. Some found the small-scale oil palm cultivation model to be more desirable than the SALCRA scheme. In some SSIs it was revealed that some villagers from BBU would be open to a new scheme like SALCRA, but would prefer to consult with the other community members before making a decision. Community-wide decision making was one key feature of BBU.

### 3.1.2 After the end of the lease with SALCRA

SALCRA has brought about the practice of cash crop cultivation, thus, it has shaped the local land use patterns and the strategies for villagers to make a living. Before SALCRA, most of the land was community shared land and used for rice cultivation. After that apart from producing their own food for subsistence use, they tend to cultivate various kinds of cash crops on their land plots individually and acquire cash income from the market. The road access was provided when SALCRA started the plantation in 1981; the introduction of a road increased their access to the market, and they relied less on rice for subsistence. Although rice is listed as the most important crop for food consumption, the land used for cultivating rice has decreased. By contrast, we could see a significant growth of land used for plantation of oil palm and fruits.

Whether or not to continue the lease with SALCRA reflects the livelihood strategies of local households. SALCRA has diversified the livelihood activities for it provided additional financial resources that are being saved (Wilms-Posen et al., 2014). Therefore, there are villagers who express their concern about the termination of the SALCRA lease, for SALCRA guaranteed work and income. However, among all the households that previously participated in the SALCRA scheme, most agreed with the decision to end the lease in 2006. The most common reasons for this was: (1) They did not receive enough plantation dividends from participating in SALCRA, for the total dividend received per household was not more than RM2000 for the last 25 years; (2) They personally prefer being a smallholder and cultivating crops on their own. Although SALCRA promises to give back land with titles provided, this did not occur in BBU's case because the village had given the land as a whole communal plot rather than in individual household plots; therefore, it was given back to the community without individual land titles, and conflicts have occurred in identifying which plot of land belong to whom, causing many land titles still to be process till today.

### 3.1.3 Land tenure and titling process after SALCRA

As is most land in Sarawak, the land around BBU was under the jurisdiction of NCR. Since land development began, distribution of individual plots has taken place. To the northwest of the village there is an area with mixed zone land which allows non-natives to gain titles for the land (Figure 3.2). However, BBU only has rights to the area, southeast of the village, which is all NCL. East of the village is former land used by SALCRA. According to the LSDS, this land was released

back to the community in 2019 and is still undergoing titling. Members of the longhouse have to distribute the former SALCRA land between them, before the titling process can start. LSDS mentioned the main hindrance to the titling process is land disputes between villagers and longhouses. However, according to the LSDS this is still not a problem they have experienced with BBU, although two informants during SSI explained how conflicts in the community regarding land distribution occurs. Usually the conflicts occur when more than one household claims the land. One informant mentioned that while people usually respect other's land, occasionally some start cultivating on others' land in an attempt to claim the land for themselves. The informant even stated that he had done this since everyone was doing it.

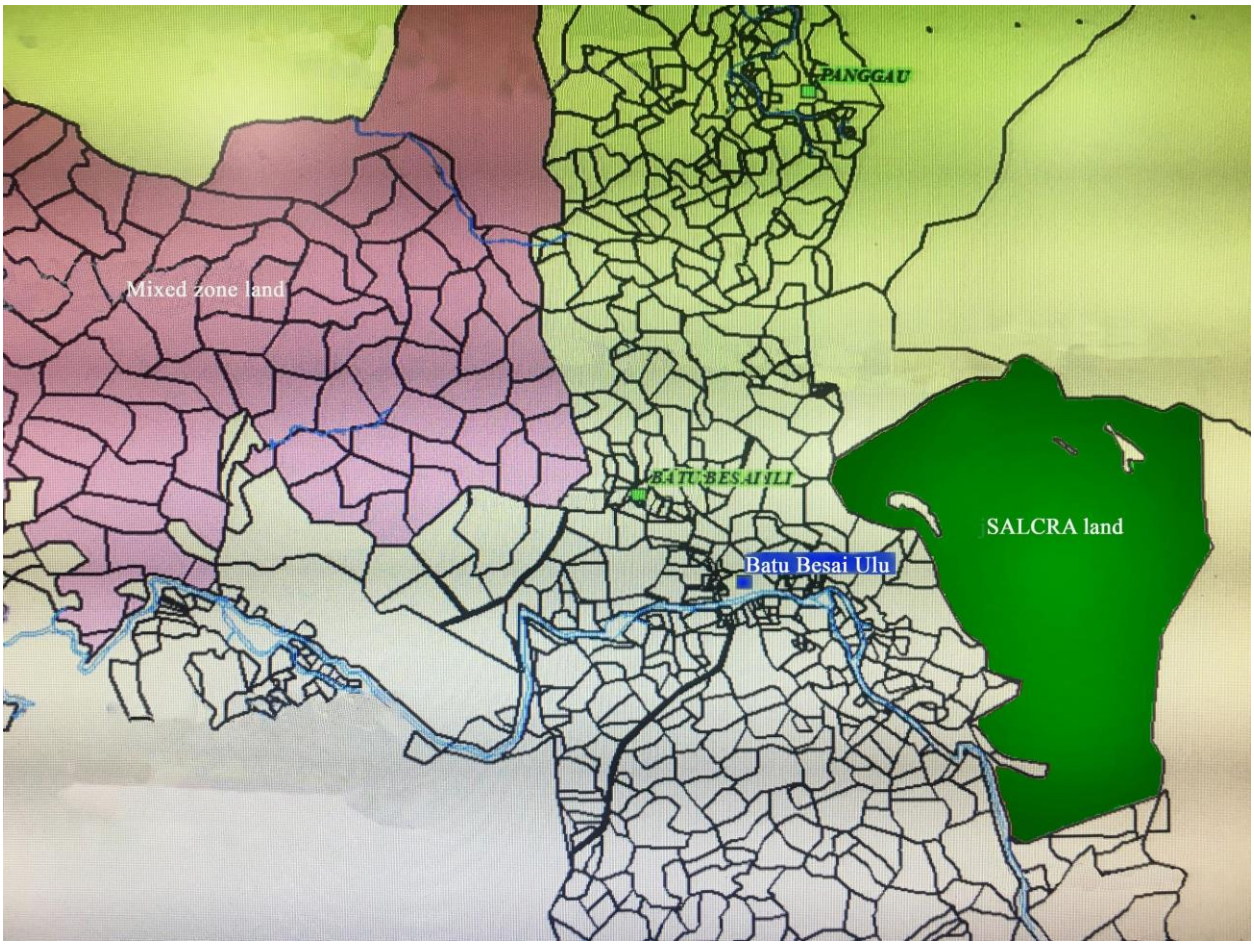


Figure 3.2. Map of Batu Besai in 2019.The map shows the borders between plots of land. The yellow color indicates NCL, pink indicates mixed land. Data: The figure is manipulated from a screenshot from LSDS's office. Highlighting of SALCRA land and Batu Besai are added by the authors.

A lot of the land around BBU is already titled (see Figure 3.2). According to the data collected from the questionnaire, 42% of the land plots are titled currently, while the rest were in process. LSDS states that beside getting ownership and improved land value from a title, it also gives opportunity for the farmers to leave the land, with no risk of others taking over the land. If land is under NCR, it has to be cultivated to prevent others from taking the land. With a title, they can leave the land with no risk of losing it. During the last decades, LSDS has experienced an increasing interest from farmers in getting a title to their land. This was also mentioned in an SSI,

where one informant explained how the villagers have increasingly acknowledged the importance of titles in BBU.

## *3.2 Physical, social and economic infrastructure of BBU*

In order to understand BBU and the challenges residents face, understanding the community's physical, social, and economic infrastructure is important. This is also part of the livelihoods assessment of assets. Even though the community has had road access since 1981, 42% see a lack of road access as a major community constraint. This is because even though a road exists, it is not tar-sealed and has been in very poor condition for the decades. Nonetheless, the road that does exist has a major impact on local livelihoods. It was frequently mentioned that the main benefit from participating in SALCRA was the establishment of the road. Even though poor road access is a major constraint according to villagers, it provides access to Sri Aman town and the ability to sell produce there, not to mention school and medical care in the city, so the road that is there is still viewed as an important piece of infrastructure with major benefits.

Another concern villagers had was a lack of phone reception in BBU. Twenty-three percent of the community mentioned cell phone reception as one the major constraints, while 30% agreed that better phone reception would improve living conditions.

In terms of other community assets, natural capital was mentioned frequently. Natural resources and good soil quality are the most commonly mentioned community strengths. BBU is surrounded by diverse natural resources, including secondary forest and community shared land which makes it possible for the longhouse members to collect the necessary resources in the surrounding area. Because of this, 31% of respondents mentioned natural resources as a community strength. Other assets like water access, BBU being their home, and current development are also seen as some of the strengths of the community.

Several things were also listed as ways in which the community needed improvement. Several mentioned better access to school and clinics as a feature that could improve lives in the community. Currently, the closest school and clinic are located about one hour drive away in Sri Aman. Usually the children stay at hostels in town during the weekdays because the commute to school is so long, only staying in the longhouse on the weekends. Many within the community hope for better educational and vocational opportunities for coming generations.

Overall, the community has abundant natural resources and good quality soil, which makes it possible to farm and find gap-filling resources in the surroundings. However, lack of road access and phone connection may limit the community’s potential.

## *3.3 Household Livelihoods*

### 3.3.1 Demographics

In order to contribute to the research goal of delineating livelihoods, determining human capital and household composition is an important first step. There was an average of five members per household. The community shows a diverse age range from 0 to 80 years old with an average age of 37 (Figure 3.3). This distribution could be interpreted as a strength in social infrastructure and human capital. However, it is important to note that not all of these household members are always present in the community, since some live in town during the week.

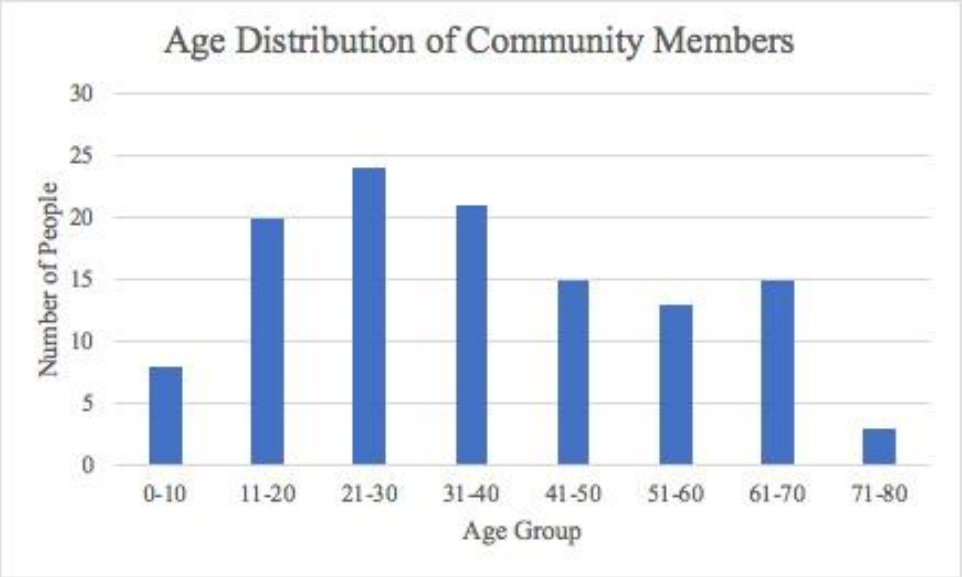


Figure 3.3. Age group distribution of household members listed in the questionnaire.

### 3.3.2 Income and assets

Income is often reported as a key marker in most rural livelihood assessments, and indeed in most societies, income is the key marker of welfare and security. It is also a big part of the land use and development discussion surrounding SALCRA, oil palm, and other cash crop issues. To speak to this, households were asked about income sources and source importance in the questionnaire and further detail was learned during community income ranking discussions.

One stand out source for income is oil palm. Even though not every household grows it, it was the most highly ranked for income in the PRA ranking discussion (Table 3.1, Figure 3.4). Furthermore, the household questionnaire revealed that nearly half of those surveyed viewed it as the most important cash crop for generating income, with the same number ranking it in their top three income sources in general (Figure 3.5, Figure 3.6).

Table 3.1. Results of a community ranking PRA. * indicates the ranking, five being the highest.

| **Activity** | Income | Food | Labour Required | Need for Water | Soil (Ability to grow) | Soil (Degradation) | Fertilizer/ Pesticide/ Herbicide Need | Crop Resistance |
|---|---|---|---|---|---|---|---|---|
| Rubber | ** | | ** | ** | ** | *** | ** | *** |
| Oil Palm | ***** | | ***** | **** | * | ***** | ***** | ***** |
| Pepper | *** | * | **** | *** | ***** | * | ***** | ** |
| Rice | ** | ***** | ***** | *** | *** | * | *** | **** |
| Fruit | *** | **** | ** | *** | *** | ** | ** | **** |
| Vegetables | **** | ***** | ** | **** | ** | * | ***** | **** |
| Wage-Labor | **** | | | | | | | |
| Forest Products | * | ** | * | | | | | |
| Fishing | * | *** | ** | | | | | |
| Hunting | ** | * | ***** | | | | | |
| (Market Food) | | *** | | | | | | |

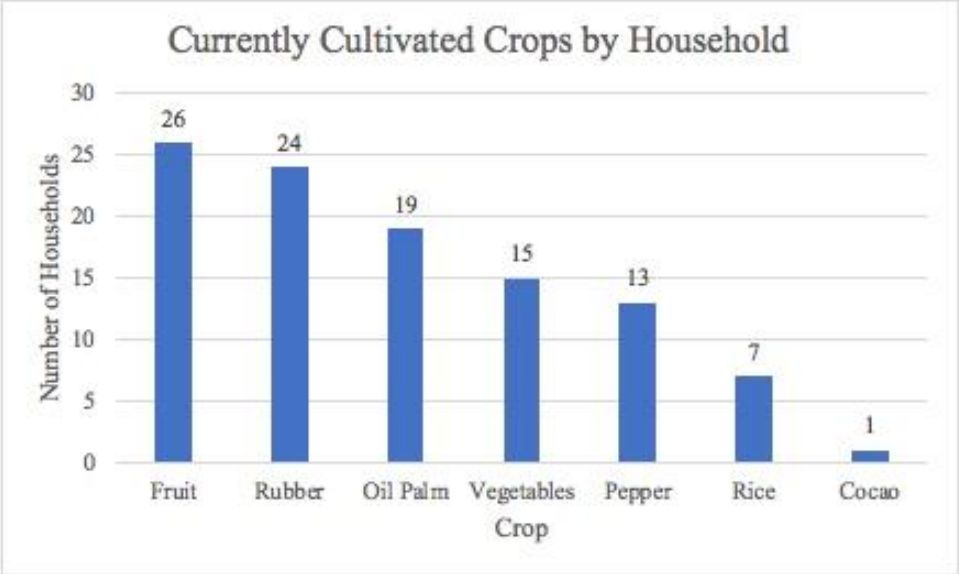


Figure 3.4. The number of households currently cultivating the mentioned crop.

Oil palm is regarded as the most important cash crop for local livelihoods primarily because of relatively high market price, high crop resistance to failure, and adaptability to grow under a wide variety of conditions (Table 3.1). Recent market price drop of pepper and rubber have led to a greater reliance on oil palm for income as well as possibly a lack of job opportunities in the vicinity. Another key finding from the seasonal calendar PRA is that oil palm income is steady all year long. While other sources are highly seasonal, oil palm can be harvested every 21 days throughout the year. This another reason why it is regarded across method outcomes as such an important crop for income.

The questionnaire saw fruit and vegetables coming in close behind oil palm for income. Community members sell these items in the town when fruit is in season and there is an excess of certain vegetables (Figure 3.5, Figure 2.6). Even though vegetables and fruit were both important, the community ranking exercise saw fruit as less important than vegetables and wages as a source (Table 3.1). This may be due in part to the particular seasonality of fruit. By contrast, even though in the community ranking pepper was given the same weight as fruit, in individual responses it was only mentioned by five as being in their top three sources of income. This could be due to the fact that pepper has historically been much more important to income before recent price drops changed that.

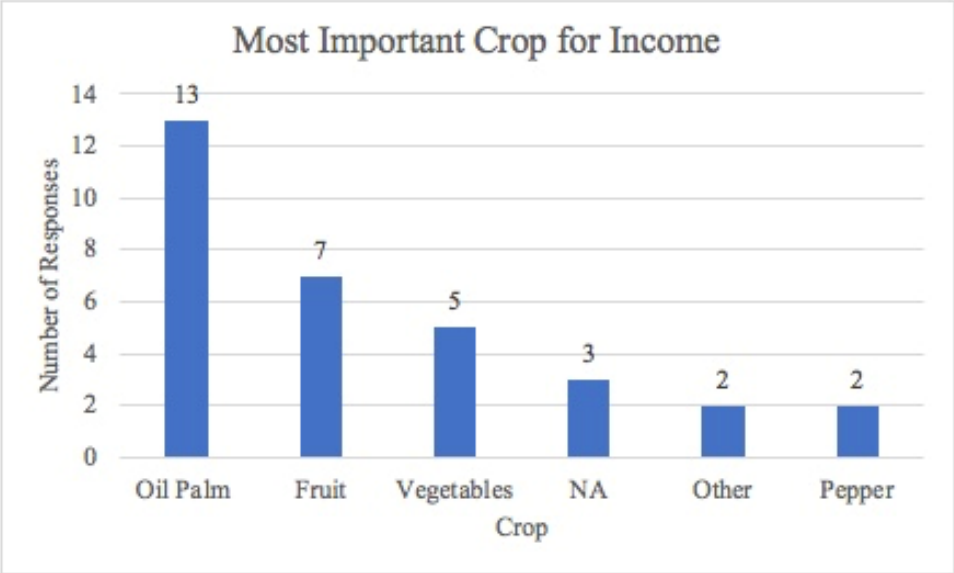


Figure 3.5. Questionnaire answers given about which currently cultivated crop is most important as an income source.

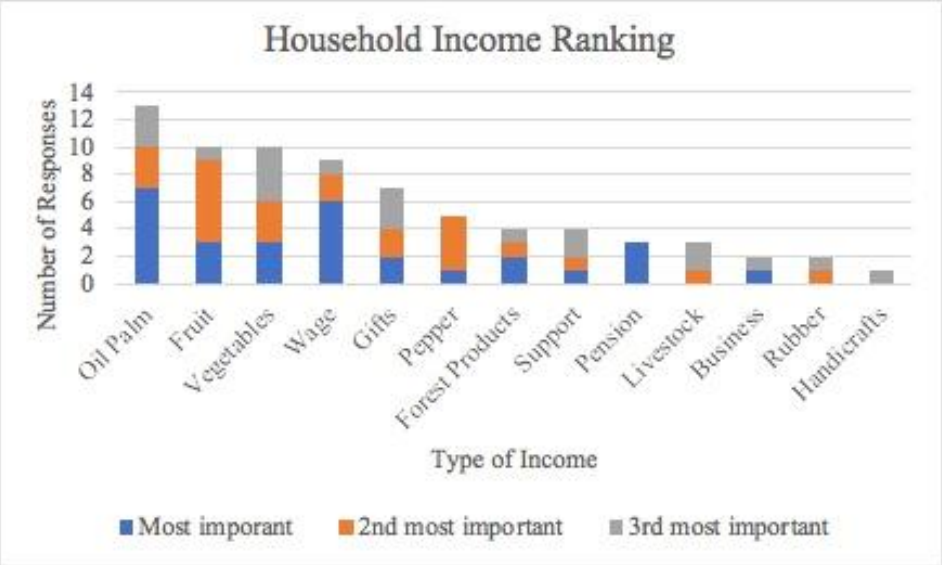


Figure 3.6. Rankings given to income sources for the individual households questioned.

Other income sources listed were wages, gifts from family, forest products, support from the government, pensions, livestock sales, business income, rubber, and handicrafts. Many wage jobs are provided by surrounding oil palm plantations such as SALCRA's and Siang Ga Lau's who is a local landowner. Additionally, the remittances from family members who had moved away and are working in town or other areas were mentioned in several cases. Many houses cultivate rubber, but few are gaining income from them both because groves are too young for harvest and prices are too low to make it worth selling. The business income mentioned by one household was their operation of an in-house convenience store in the long house.

Household assets also can be a helpful way to understand the economic wellbeing of households. Three households had neither a motorcycle or car, while fifteen had both and the rest had either one or the other. Twenty-two of 30 reported having savings which could be an indicator of economic security if further investigated. There was an average of 4.5 plots of land owned per household with 13 being the largest number of plots owned by one household.

All the results regarding income and assets play directly into livelihood assessment. By asking about these factors, we learn about the economic situation of households within the community and are then able to relate these strategies to our research objective of learning how the presence of SALCRA has influenced livelihoods.

### 3.3.3 Household shocks

To enhance the timeline, historical crop data from 2010 onwards can be used to highlight moments in BBU's history where price drops required diversifying income sources (Figure 3.7). One driving force behind decision making on land use is crop market price. Cash crops play an important role in the rural areas of Sarawak by offering an option to boost income through land use diversification. Over time, though, the volatility of these cash crop prices (pepper, rubber, and in some cases oil palm) will change the way that farmers use their current and future land.

Throughout the community history, farmers in BBU have seen significant drops in pepper, rubber, and even oil palm prices. The data from the Malaysian Open Data Portal further inform our data gathered from questionnaires and interviews. As can be seen from Figure 3.7, pepper prices rose steadily, until a dramatic falloff in 2016. This was confirmed by many villagers mentioning the pepper price falling in the years form 2014 through 2019. Rubber can be seen to show a continued decline in value since 2011 with only a small increase in 2017. This was also consistent with questionnaire results with eight households mentioning rubber price drops. By contrast, oil palm prices have historically remained somewhat constant, though speaking with villagers revealed that they may be seeing a decrease in oil palm value in 2019-2020.

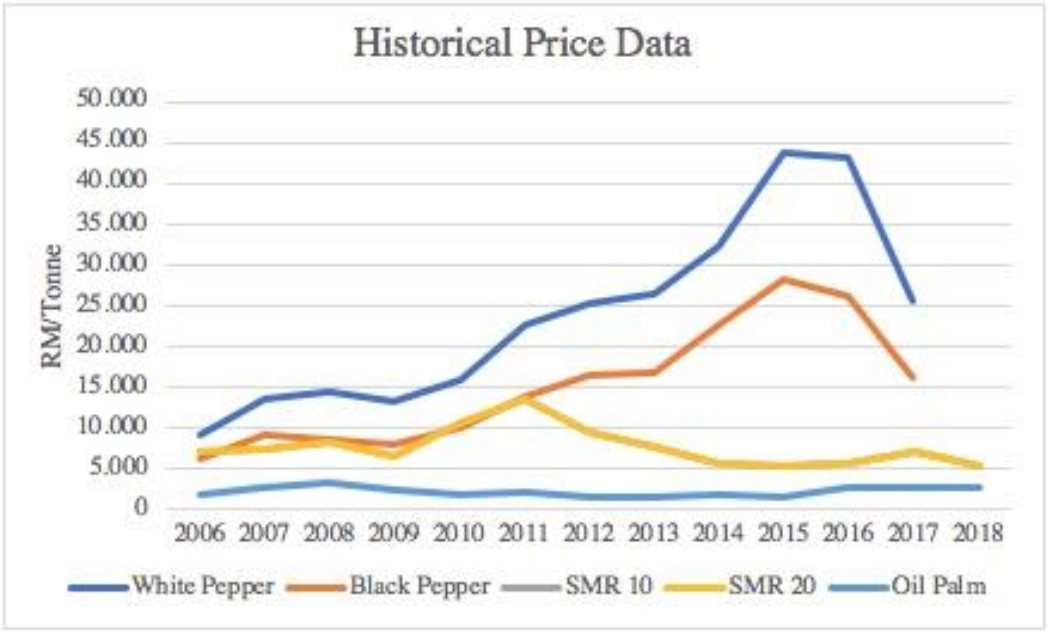


Figure 3.7. Overview of crop price data spanning 2010-2018 including white and black pepper, raw rubber and oil palm. Based on data collected from the Malaysian Open Data Portal.

Based on questionnaire data, 86% of respondents experienced a market price drop on a number of crops, mainly pepper. Respondents referenced pepper price drop as an ongoing occurrence, with several respondents specifically recalling 2016 as the point at which pepper prices started to fall. Respondents also mentioned rubber and oil palm price drops in recent years. 73% of respondents experienced a crop failure, and 53% experienced a natural disaster. The crop failure responses in part mentioned that the failure was due to a natural disaster, while most referred to a failure in pepper due to fungus infecting the roots. Across all responses, the point at which they occurred were recent or ongoing.

The way in which the community copes with these price drops and crop failures is reflected in the adaptations through income diversification. For instance, when asked what is to be done when cash crop prices fluctuate, one interviewee sells vegetables and fruits to make up the difference in income. Questionnaire data show no respondent grows only one type of crop with nearly every respondent growing fruit and naming it as an important source of cash income. The peaks and falls in income happen not only on an annual price-basis, but also month-by-month where changes in land use require different inputs such as additional labour or fertilizer (Figure 3.8).

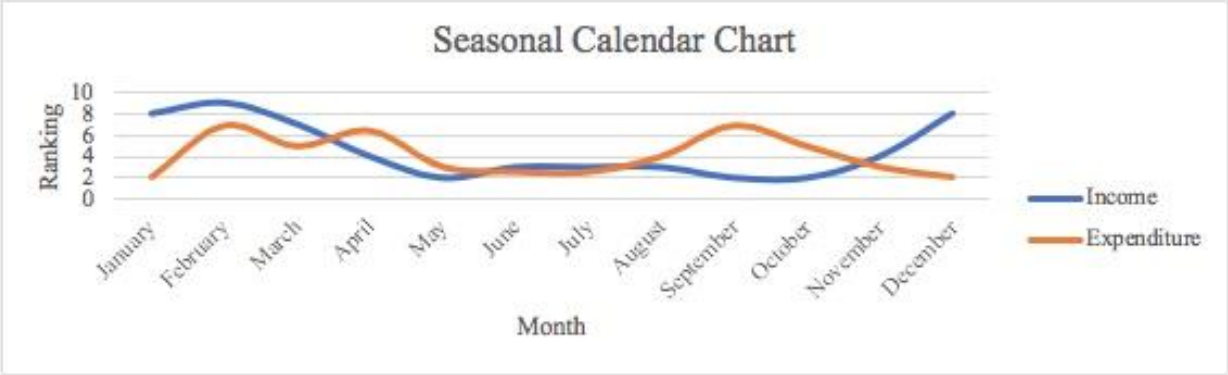


Figure 3.8. Seasonal calendar constructed during a PRA exercise highlights showing dips and peaks in income and expenditure.

Both the seasonal calendar and historical crop price data highlight the points at which BBU is the most vulnerable to external forces. For example, longer drought seasons as a result of climate change can alter the way in which the community members have to adjust their harvesting practices and could cause extra stress on means of making a living at those times.

### 3.3.4 Subsistence activities

In order to gain an understanding of subsistence activities within the community, respondents were asked about things gathered and grown in and around the village and sourcing for food and sustenance. The broad data on this was gathered at the household level with questionnaires but was also substantiated with information gathered from community discussion and PRAs.

Subsistence activities are very important to understanding livelihoods because it is a fundamental part of “means of living, including food, income, and assets" (Chambers & Conway, 1992), The participants utilized all the natural resource-based livelihood activities that Ellis (2000)

mentioned in his framework, including collection, cultivation, livestock, and non-farm natural resources. When asked about food sources during a group discussion, there were only a few vegetables and rice that were mentioned as items bought from the market. The vast majority of fruits, vegetables, and meat eaten is sourced from in and around the village. This activity was further evidenced in the questionnaire results which show most households asked, collected fish, fruit, vegetables, and spices (Figure 3.9). The ranking PRA yielded similar results with vegetables, rice, and fruit ranked as the most important food sources (Table 3.1).

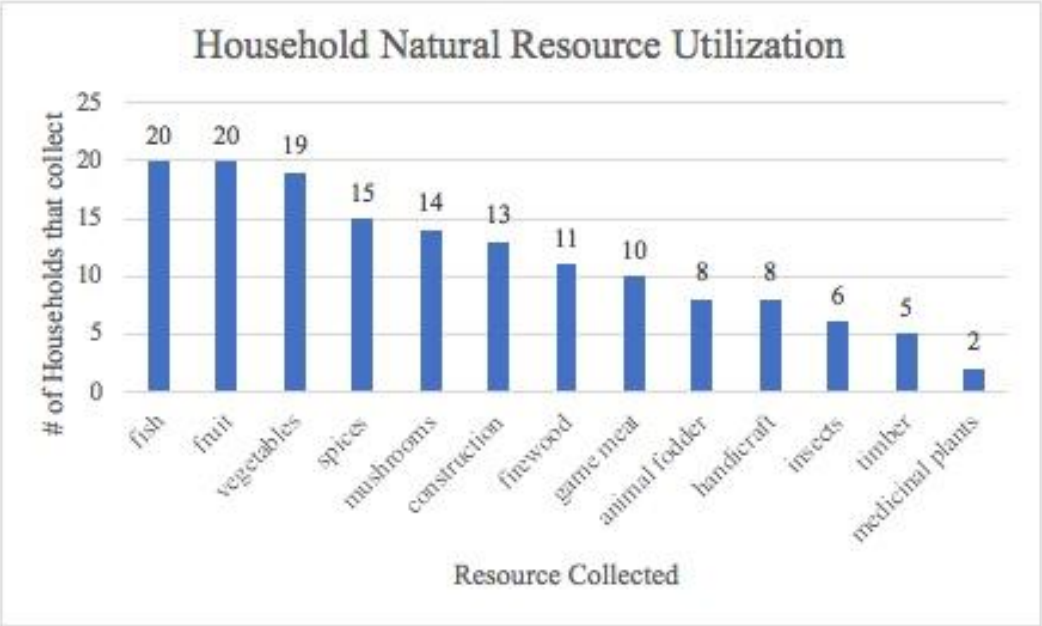


Figure 3.9. The number of households (out of 29) which indicated that they gathered the mentioned natural resources.

Additionally, the results indicate that fishing is common and a very important food source. Even though it is ranked as a less important activity and only a third of villagers mentioned game meat collection, hunting still plays a role in food collection strategy. Hunting parties were also observed on several occasions. People said most creatures in the forest are hunted including wild boar, porcupines, deer, and snakes.

Animal husbandry consisted mostly of households raising chickens, pigs, and ducks for their own consumption. The questionnaire asked about livestock as an income source. While only ten mentioned it provided income, others raise animals for their personal use.

In addition to food subsistence activities, Figure 3.9 also shows that there are a number of other foraging activities in which households participate. Several mentioned bamboo as a construction material for small projects, while transect walk also revealed that there was hardwood used for longhouse construction and species needed for pepper vine poles growing in the neighboring forest. It should be noted however, that even though natural resources remain available for house construction, most modern projects are constructed out of concrete. Mat weaving is still practiced by some, using various materials collected from the forest. Gathering medicinal plants was not practiced commonly according to villagers.

## *3.4 Environmental Context*

The following section presents the results from our soil and water sampling. We hoped to understand the effects oil palm cultivation has on the local environment and thus had our sampling strategy reflect that by sampling from areas close to oil palm cultivation, while sampling from other use areas for comparison of soil samples and using tap water as a baseline to which to compare water samples. Land use effect on soil and water is of importance for livelihoods. Especially, the soil quality influences crop outcomes and is necessary when understanding livelihoods.

### 3.4.1 The soil of BBU

Samples from the secondary forest (S1) were used to determine a baseline of what soil could look like absent of agriculture. The second area (S2), of new produce cultivation was used to understand the characteristics of soil under typical farming practices. The third site (S3) was an oil palm plantation which had been abandoned for over 30 years in order to determine whether the soil changes after recovering after 25 years of intensive oil palm cultivation. Finally, a young oil palm plot (S4) was sampled in an attempt to characterize soil recently disturbed and brought under oil palm growth management.

Soil texture offers insight into management problems with regards to erosion, water, tillage, and fertility management (Fondriest, 1993). Two of the sites were silty loam and the uncared for oil palm was characterized by sandy loam. Loamy soils have high water erosion management, medium water holding capacity along with good percolation. In addition, they are classified as medium with regards to horsepower and tillability management with moderate-low potential nutrient imbalance.

Soil pH influences availability of plant nutrients, solubility of toxic nutrients, soil microbial activity, and physical breakdown of root cells (Fondriest, 1993). In addition, different crops adapt better to different levels of acidity and there can be higher yields from more acidic or more alkaline soils. In general, plants prefer soils that are closer to neutrality. Most nutrient elements are available in the range of 5.5-6.5 (Motsara, 2008). All but two of our sites were within this range, where the final reading of the pH at S2 was 4.54 indicating extremely acidic soil as well as in S3 (Table 3.2). Soils that are formed under conditions of high annual rainfall, as is the case in Sarawak, are generally more acidic, but acidity can also be a result of application of agro-chemicals (Mosaic, 2020). Based on results from the matrix ranking PRA, vegetables and oil palm both had a high need for fertilizers, herbicides and pesticides (Table 3.1).

Table 3.2. pH and texture results from four sampling sites.

| Location | pH Initial | pH Final | Texture |
|---|---|---|---|
| **Secondary forest (S1)** | 5.21 | 5.50 | Silty Loam |
| **New fruit/vegetable garden (S2)** | 5.86 | 4.54 | Silty Clay |
| **Abandoned oil palm plantation (S3)** | 5.85 | 4.28 | Sandy Loam |
| **Oil palm plantation (S4)** | 5.65 | 5.79 | Silty Loam |

### 3.4.2 Water quality of BBU

The primary purpose of water analysis is to understand the quality of the water near the village in order to assess effects of oil palm cultivation. In addition, testing water quality provides insight on livelihoods with regards to fishing and general cleanliness of gravity feed water used in BBU households. The water quality classification outcomes according to the NWQS (Appendix H) can be seen on Table 3.3.

Table 3.3. Overview of water quality indexes for sites sampled for laboratory testing.

| Sub Index & Water Quality Index | Sites | | | |
|---|---|---|---|---|
| | (1) Muntik | (2) Dor River downstream | (3) Dor River upstream | (4) Gravity feed |
| WQI | 74.64 | 80.01 | 84.02 | 75.81 |
| Class | Class III | Class II | Class II | Class III |

The Muntik River and the gravity feed water were both Class III, indicating that they require extensive treatment, while the Dor River requires conventional treatment and can be used for recreational activities. Class II indicates that sensitive aquatic species can survive, while Class III water allows for only tolerant species and is suitable for livestock drinking. According to this, all water samples are considered at least slightly polluted. According to the miniSASS results, the Dor River was determined to be in good condition, while the Rapuh River was determined to be in fair condition.

Although water results can provide certain insight into how cultivation may affect the environment, there were several problems that arose with the sampling and analysis. The biochemical oxygen demand and chemical oxygen demand levels were strangely zero in the Dor River samples, while total suspended solids were unusually high for the Muntik River. These results would need to be replicated to confirm. Although the Dor River downstream from the same source as the gravity feed was Class II, the tap water was valued at Class III, indicating that the water is unable to maintain its quality throughout the pipeline.

Nonetheless, the longhouse community is satisfied with the quality of their water according to questionnaire results which is inconsistent with very high pollution. Additionally, transect walk observation of the Nemong River (gravity feed source) indicated crystal clear water and a visually healthy stream. The Muntik, the most polluted of the streams, was located near oil palm, a possible sign that oil palm cultivation could damage the water bodies around it, but no upstream comparison sample was taken, making such a conclusion impossible to confirm. A better sampling strategy and sample replications would strengthen this analysis.

### 3.4.3 Land use change and its effect on the environment

Over the last 15 years, since the end of the lease with SALCRA, individual households have changed their land use patterns. Before SALCRA entered it is assumed the community had more land to cultivate rice than now since shifting away from subsistence cultivation to cash cropping. Rice for subsistence use, was the most widely planted crop in Sarawak before the

introduction of pepper, rubber and eventually oil palm. According to the questionnaire, since 2006, 73% of the households have decreased their land area used for rice cultivation (Figure 3.10). Also, 63% of households have decreased pepper cultivation since then. Cash crops affect land use by their effects on soil, needs for inputs, and ability to adapt to soil variations (Table 3.1).

The transition from rice to other crops was an easy transition due to the low degradation that rice has on the soil. In comparison, oil palm has major repercussions on future land use because it heavily degrades soil and requires many inputs. The PRA discussion revealed that it can take 6-7 years and burning for land to recover post-oil palm. However, this conflicts with one SSI statement that one year was enough time to recover oil palm land. Additionally, one informant assumed the soil would be more fertile after oil palm, due to fertilizer used in cultivation.

Unfortunately, the soil samples were not analysed after or during oil palm so no conclusions could be made in that regard. The cash crop with the lowest input need (labour, water, agro-chemical application) and high capacity for income was rubber, which needs 7 years after planting to produce a saleable commodity. PRA data found that many villagers plant rubber after pepper plants fail. Pepper crops are subject to fungus, which can in turn infect the entire crop and are therefore a risky investment, especially when prices are not high (3.1 Timeline).

On the other hand, fruit plantations and fallow land seems to have increased on households' land area. Fifty-seven percent of households increased land used for fruit, while 40% increased their fallow land. Even though the tendency has been to decrease rice and pepper and increase fruit cultivation and fallow land, the individual households have made different decisions regarding their land use for oil palm and rubber plantations. As seen in Figure 3.10, there has been a variety of differences between households in their land use patterns. Nevertheless, oil palm has overall taken up more land area during the last years, where 42% of households have increased cultivation of oil palm on their land. According to one informant, they were not allowed to plant oil palm on their own land during SALCRA. When the lease ended some farmers replanted new oil palm for small scale plantations, while most of the former SALCRA land turned to abandoned oil palm plantations.

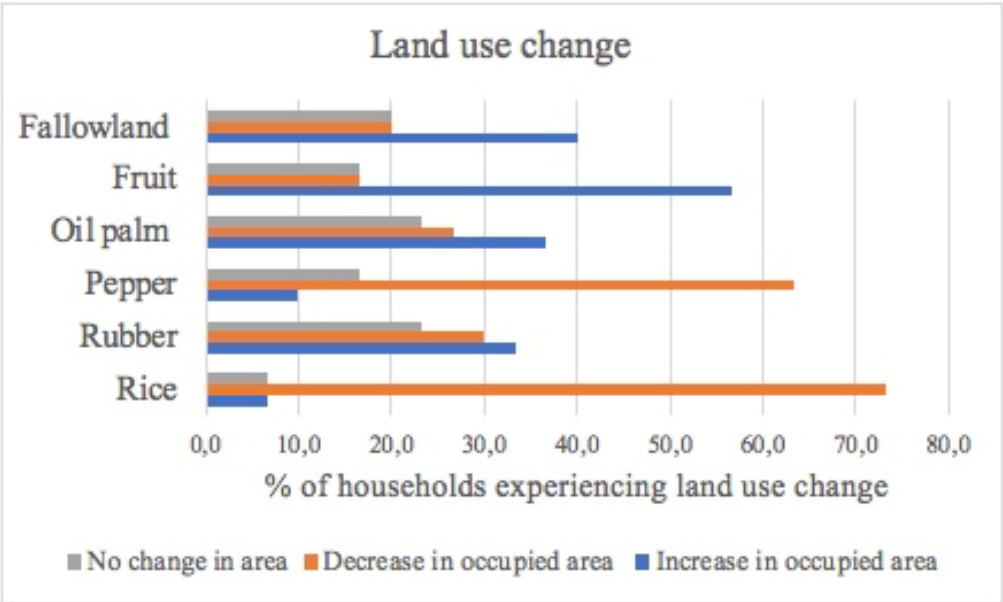


Figure 3.10. Trends in land use change occurring the past 15 years among households based on questionnaire data.

# 4. Discussion

Ultimately the research objective can be broken down into three parts. The first part is how SALCRA changed livelihoods and land use. The second part is how it differentiated household livelihoods, and the last part is an investigation of how the community moves forward post-SALCRA. These three parts are addressed in the following discussion.

## *4.1 SALCRA in BBU*

First, SALCRA's main impacts should be discussed. One major change SALCRA brought to the community was the possibility of applying land titles to the community member's plots of land. This can be seen as having both positive and negative outcomes.

Even though the lease with SALCRA ended 15 years ago, the land was only given back to the community last year at which point the titling process began. The process has been slow as there are differing opinions on how land should be divided and categorized. Some believe that all of the land should be titled to prevent behaviors which result in some benefitting from but not contributing to work done on communal land, while a few believe keeping some communal land is important. Overall though, land titles ensure that land cannot be taken away from community members even if it is not being cultivated which is what can happen if NCL is not being used. In this way the titles resulting from SALCRA participation are a clear benefit with the main drawback being contention among those living in BBU. This benefit may come at a cost however, as some mentioned the difficulty of cultivating on land once used for oil palm.

Secondly, SALCRA was instrumental in establishing some of BBU's infrastructure. In bringing a road, it opened never before accessible possibilities such as market access. Additionally, it appears as though water and electricity closely followed the establishment of the road. This could indicate that without a road, these utilities may not have been established until much later. Some mentioned that they have petitioned the government for years to improve the road, but nothing has ever been done about it. It was only maintained the way it is for use by SALCRA. Now that their lease with SALCRA is over, they are not likely to receive resources to improve the road even from the government. This is and will probably continue to be a major obstacle to the people of BBU.

Besides land titles and road access, SALCRA also brought with it increased community capacity in a number of other ways. Some villagers who are now small-scale oil palm farmers mentioned that they had learned the skills to care for oil palm from SALCRA. So now that the lease is over, there is still increased management knowledge among the farmers of BBU. Another resource SALCRA had was the ability to invest in oil palm inputs. Without SALCRA support, some villagers struggle to maintain old oil palm groves or establish new ones. In 2009, the government supplied some oil palm inputs, but their unequal distribution led to village conflict and division. In the past year, some villagers applied to the MPOB for assistance, but the application was turned down, though the application can be renewed yearly.

SALCRA also brought important wage-earning jobs which have decreased since BBU and SALCRA ended their relationship. While this is true, most mentioned that the salary was exceedingly low and not worth the work to begin with. For this reason, many prefer to operate on a small scale rather than work for a SALCRA plantation with low salaries and dividends. Yet, others have found employment with private oil palm plantations which offer better benefits and salary in comparison to SALCRA.

## *4.2 Livelihoods in BBU*

To fully understand SALCRA's effect on the way of life in BBU we investigated how people make a living and the strengths and weaknesses of those strategies within different households. With most households displaying multiple income strategies, diversity seems to characterize livelihoods strategies in BBU (Figure 4.1). Income diversification is not always the most efficient path, but it has a number of benefits for those living in rural areas and relying on crops for income. Ellis (1999) points out that diversity "contributes to the sustainability of a rural livelihood because it improves its long-run resilience in the face of adverse trends or sudden shocks" (p.4). In BBU, it seems to help villagers survive a multitude of hardships. When crop failure affects one stream of income, there are alternatives on which to fall back.

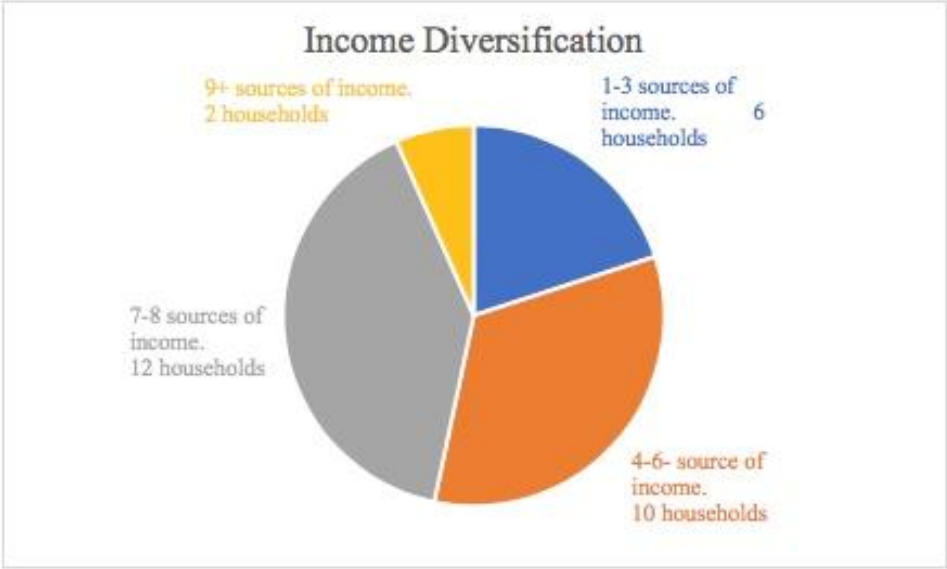


Figure 4.1 This pie chart indicates the number of households with varying numbers of income sources.

If income sources fail to an even greater extent in the face of adversity, the abundant natural resources surrounding BBU acts as a gap filling resource for food and supplies. Wunder et al. (2014) point out that a number of case studies have natural resources acting as a safety net. At least one villager mentioned the forest as a place to find food if other sources ran out, while many mentioned the diversity of natural resources as a key strength the community had. This resource was not necessarily evenly divided between households in part resulting in some households being better off than others. This could continue to be a problem as land is titled and allotted to certain community members, while others may not receive the same assets. The conversion of forest to oil palm or other cash crops could also be seen as a potential threat to this resource.

## *4.3 Moving on Post-SALCRA*

A main goal of land development schemes is the titling of land and intensifying cultivation to boost the rural economy (Cramb & Wills, 1990). Whether or not SALCRA's goals were met may be out of this research scope. However, increasing interest in getting a title is recognized in the community. And in terms of agricultural intensification, overall, the community seems to be relying on cash crops now more than in previous decades. Oil palm is an important part of this income, and the trend after SALCRA has been to continue small-scale oil palm to some extent,

particularly for households with the land and resources to grow it. Still others had abandoned oil palm on their land citing their old age and the heavy workload required as a confounding issue. For some villagers, as they age, this may continue to prove to be an obstacle for future cultivation.

Another possible hurdle was mentioned by LSDS which noted that in 2020 the MPOB introduced a new certification in which farmers cultivating oil palm must meet certain standards to be allowed to grow oil palm. If this certification restricts some people's ability to sell their oil palm or run a profitable plantation, it could work against the people of BBU. If, on the other hand, there could be some type of premium given to certified oil palm, it could be an opportunity.

Beyond these local factors, there are many external forces that can cause a trickle-down effect into rural communities like BBU. These factors are already at play and will continue well into the future. Among these are the increasingly uncertain effects of climate change and unpredictable nature of weather patterns. In Southeast Asia, the temperature has been increasing since the 1960s at .14-.20 degrees C per decade with a decline in cooler weather causing the rainfall patterns to change significantly. Many studies have been done to determine whether there has been an increase in rainfall or dry periods with varying results; even studies devoted to studying these patterns yield unpredictable, inconclusive results (Sa'ad et al., 2017). Changing weather patterns and an increase in the drought season with too much rain in the rainy season causing flooding was mentioned by many villagers in questionnaire responses and PRA discussions.

Oil palm produces more fruit when under the influence of heat stress and suffers when the ground is waterlogged. Such is the case for rubber as well. Both these crops represent highly important sources of income for the people of BBU. Excess rainfall can also wipe away crops with delicate roots. Drought, on the other hand, can result in failure of crops that require a high water input (Table 3.1). Traditional knowledge of ecological systems has prevailed and kept rural farmers afloat for many years, but adaptation is necessary to maintain livelihoods. Without consistent weather patterns, rural communities will likely need to rapidly adjust their crop planting and harvesting routines and methods.

Another external factor that will affect BBU in the future is fluctuations in world market prices of commodities. For one, the perception of "unsustainable" oil palm in the EU has resulted in a recent decrease in its price, which further impacts smallholders like those in BBU. Staggering statistics about the contribution of oil palm to deforestation in Southeast Asia have resulted in a massive shift in the way in which consumers in western countries purchase or view oil palm as a commodity (Velde, 2017). In addition, global events like the COVID-19 pandemic will cause a shift in the demand for rubber products; while some predictions were that rubber prices and demand would increase, there is evidence to suggest the opposite is true (IHSMarkit.com, 2020). Regardless, worldwide events such as climate change and market prices will make their way to the rural parts of Sarawak and places like BBU, causing the way of life there to never stand still for too long.

## *4.4 Conclusion*

Before SALCRA came into BBU, the community was characterized by hill rice for which they walked to the local market to sell. The trip would take hours with heavy baskets carrying as many goods as possible over narrow trails. When representatives from SALCRA visited the village in 1979 with the manpower to plant a brand-new crop, manage the land, provide road access, and wage-income, the decision was easy: no was not an option. In land use change scenarios, the transition of the land from one crop to another requires energy, time and money. In this case, SALCRA would do the hard part for the people in Batu Besai and the surrounding area by covering

these investments. Not to mention, the introduction of the road not only changed the way that BBU cultivated crops, but their diets and access to income diversification; more than ever the community members could reasonably work in Sri Aman without an exhausting commute. With the positive aspects of the road, though, came a shift in local traditions as well as a crop that permanently alters the landscape. After the relationship with SALCRA ended, smallholders took over and discovered on their own the trials of taking care of such an intensive crop. Oil palm has proved to be an important source of income for BBU, but without the proper tools or labour many of the plots have been left to grow out of control and into secondary forest. The dualism between the initial benefits and the costs associated with maintaining oil palm will continue to challenge the people of Batu Besai Ulu well into the future.
[Word Count: 10,930]

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# Appendix A - Final synopsis

**Is Oil Palm Here to Stay? How Land Use Transitions Affect the Livelihoods of the Batu Besai Ulu Community**

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SLUSE 2020, Malaysia

## Introduction

*Study Site Context*

Batu Besai is a longhouse community of Iban people in Sri Aman, Sarawak, the largest Malaysian state on the northwest side of the island of Borneo. Located between 0° 50’ and 5° N and 109° 36’ and 115° 40’ E, the climate is tropical with temperatures varying from 33° C to 22° C with 3,420mm of annual rainfall (Sarawak Government, N.D). Batu Besai consists of two longhouses -- Ulu and Ili. The study site will be Batu Besai Ulu (see figure 1).

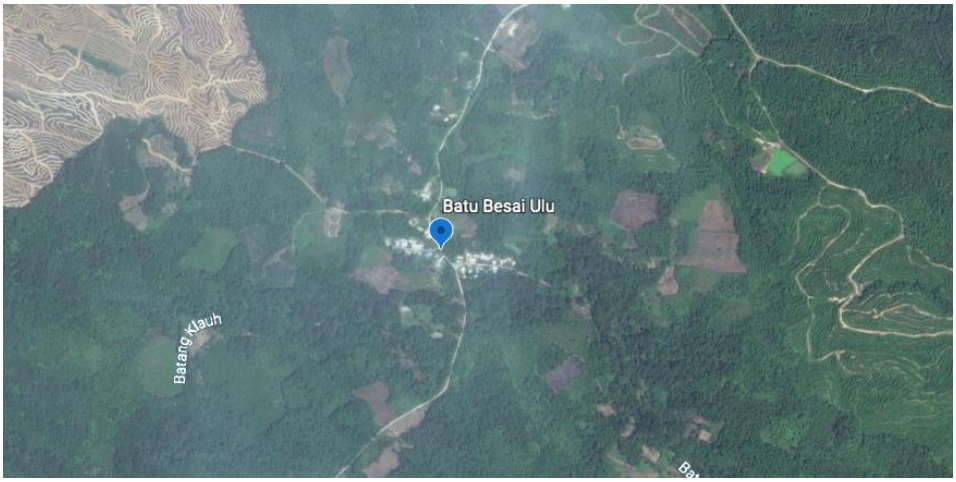


Figure 1. Case study location, Batu Besai Ulu.

*Land Use Change and History*

This region is fraught with land use change and development (Ichikawa, 2007). Ichikawa (2007) examines land use of the Iban near Miri, Sarawak. Over the years, the land went from relatively untouched primary forests to shifting cultivation to logging to cash crop developments. The first major shift came in the late 1800s, when the Iban people began to spread out bringing with them practices of shifting swidden agriculture which requires the felling of forest close to their longhouse settlements. Around the 1960s swidden agriculture began to increase due to an increase in demand for rice, but by the 1990s other products began to overtake rice and land use again shifted to accommodate cash crops such as pepper, rubber, and forest products. Rubber

farming was introduced in the beginning of the 20th century. The crop was adopted by farmers, since it could easily be incorporated into the system of shifting cultivation (Tanaka et al., 2008). Cultivation of pepper began in 1870s on a small scale. Pepper farming requires high labour and agrochemical input, the new availability of which, caused production to first increase after the end of the second world war. Overall, due to increased need of monetary income, cash crop farming has spread leading to a transition from shifting cultivation for rice production to a more diverse farming system, including cultivation of cash crops.

The changes in land use comes with a heavy influence from the chief minister Abdul Taib Mahmd (1981-2014), who had a central focus of developing a more modern agricultural sector (Cramb, 2016). The purpose of the development was to bring the rural native peoples into mainstream economic development, a continuation of the New Economic Plan (NEP) established in the 1970s. To achieve this goal, joint-ventures were used in order to transform small-scale agriculture into large-scale agriculture, with more controlled management and better production practices and skills. However, much land in Sarawak is customary land, subject to native customary rights making it unavailable for large-scale development, due to institutional constraints. Joint ventures were initially created by Taib in order to unlock land for oil palm development through partnerships between landowners, private companies and the central government. One of these oil palm schemes is the Sarawak Land Consolidation and Rehabilitation Authority (SALCRA). SALCRA was established under the Second Malaysia Plan (1971-1975) in order to engage smallholders on Native Customary Land (NCL) land in Sarawak in the oil palm boom by consolidating their land into larger production entities. The communities are then rewarded with the title to the land, which previously had no title according to native customary rights. This can increase tenure rights and land security, further aiding in livelihood development (Cramb, 2016).

SALCRA was part of the NEP in that it was a mechanism used to eradicate poverty within the rural areas of Sarawak through agricultural opportunities. By providing the funds, expertise and management, the exchange from the local community was land and labour, involving long-term leases. In addition, oil palm is not storable so SALCRA must also ensure that a mill is built close enough to the plantation in order to process it on time. By building roads, SALCRA also provides increased market access which may also increase livelihood diversity. The plantations represent a shift away from traditional subsistence farming and indigenous culture that is sheltered from the outside community. The locals are entitled to compensation as well as the opportunity to work on the land, but will not see any profit until after the development costs have been paid back (Polsen et al., 2014). Batu Besai Ulu had a lease with SALCRA lasting from 1980 until 2005 at which point they chose not to renew their lease and take the land back. To this end, we hope to explore the reasons why the community has chosen not to renew their agreement with SALCRA, despite the management support that comes with their involvement.

Just as the Iban of Miri saw many land use changes in their recent history, so too Batu Besai has appeared to follow the trends of market demand and shifting land use demands (Ichikawa, 2007). The 1980s brought a greater reliance of the village on cash crops, increasing income but creating vulnerability to capricious market demand. For many years, rubber has been a reliable source of cash for the households, though the past year saw rubber prices crash and subsequent curtailing of rubber tapping activities in Batu Besai. The same thing happened in 2018 with the price of pepper, thus many households are not relying on these crops any longer. Some households supplement income with fruit and vegetable sales, but a big part of the Batu Besai economy is oil palm due to plantation introduction and establishment through joint ventures and SALCRA support. Now that Batu Besai has chosen not to continue their lease with SALCRA, there may be more ways in which cultivation changes. This exploration of the ways the people of Batu Besai have coped and adapted over the years could be framed in terms of resilience and the adaptive cycle. The adaptive cycle was first coined to describe an ecological process of disruption and reorganization, but was then adapted to describe social evolutions as well (Fath, Dean, & Katzmair, 2015). The concept consists of four stages including growth, equilibrium, collapse, and reorganization. Taking this as a point of departure for interpreting market demands and land use change in Batu Besai, we can learn something about the community's capacity for adaptation and reorganization in face of stresses such as cash crop price falls and other shocks or stresses to their livelihoods. This does not necessarily mean, however, that characterics of the full cycle are to be expected. There may be aspects of livelihood conditions which are in the stage of equilibrium and are not characterized by active adaption. Returning to some of its original intent, this framework can also be used to investigate the adaption of the environment and ecosystem itself around Batu Besai to land use change.

**Environmental Assessment**

With so many shifts in land use and the variety of landscapes available for study, we hope to investigate the causes of land use change and its effect on the environment, livelihood strategies, and local governance to investigate what role SALCRA played on land use and livelihood. To investigate different land uses effects on the environment, soil characteristics and water quality and land use change will be measured.

We want to investigate whether land composition will be affected by the different land use and the cultivation of different crops, for instance: oil palm, rubber and pepper cultivation, and secondary forest. We guess that the different aims of land use can cause a change in carbon stocks as well as nitrogen storage, especially the capability of soil moisture content will be affected by the total N in the soil. Therefore, we will test total C and N content in different selected areas. According to Tanaka et al. (2007), the N availability has a strong impact on the vegetation condition. Besides, the PH also is an important indicator. Although the soil texture will be the critical condition that determines the PH of the soil is under 7 or above, human actions, like overgrowing, will ruin the soil and can be shown on the PH change. Further test bulk density, nitrate and electrical conductivity between different land uses will work as

supplement. The tested areas include oil palm area, pepper area, rice area and abandoned land. 5samples will be taken in the same hole at the same depth from Each test area.

Moverover, land use might change the water quality, so we want to know which of the land use aims or landscape will mostly affect the nearest water quality. We want to make comparisons between different agricultural areas as well as around the longhouses. The methods are taking samples upriver from longhouse near oil palm plantation and downriver near longhouses for comparison. We also prepare to use the MiniSASS-aquatic biomonitoring tool yields as a supplement to get the assessment scores, indicating the water quality in the river or pond near the agriculture areas and living places. These results may yield an exploration of possible pollution factors depending on the outcome.

Furthermore, in order to calculate the exact land use change during the decades, it is necessary to use a GPS machine to collect data and analyze data on Google Earth, showing agricultural land use area change, specifically in different plantation species like oil palm and pepper. This will be done through mapping and use of satellite photos to see earlier land use changes and rapid participatory assessment. Moreover, the local community can help to draw a memory mapping of land use change.

**Livelihood Assessment**

*Objective and Research Questions*

The next research theme to be determined is first of what livelihood strategies consist of in the area and then discovering if there are ways in which land use changes have affected these strategies. In order to make conclusions on this theme we will ask what assets households have, what incomes and subsistence sources they utilize as well as their perception of changes.

*Background*

Livelihood assessment is an essential element of rural and development studies. Though not always an easy task, it is through the measurement of livelihoods that many important factors most essential to the life of rural households can be determined. Livelihood assessments can lead to empirically supported key decisions regarding policy to develop certain livelihood options, lift people out of poverty, and support their way of life. Chambers and Conway (1992) offer a definition of livelihoods as that which "comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living" (p.6). They go further to define a livelihood as "sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base" (p.6). This definition is a good point of departure when considering the livelihood strategies of the community in Batu Besai over years of stresses and environmental transformation.

*Methods*

For the purpose of this study, we will look at livelihood strategies at the household level. This will be accomplished by administering a livelihood questionnaire to a household member from each of the 48 pintu belonging to Batu Besai Ulu. In this way, the sampling scope seeks to

represent every community household. We will consider each pintu and the inhabitants therein as a household unit, but remintences coming from members living abroad will also be included in the household income calculations. Given enough time and resources, we can also carry out the survey for households in Batu Besai Ili. We will collect data on the household income sources and forest product uses and different forms of capital held. These results could also be used to draw conclusions about livelihood strategies at the village level. This will describe current livelihood strategies, but a semi-structured interview technique may be used in order to learn about community members' perceptions of how these have changed over the years with land change and other shocks and trends, addressing issues of tradition and change in ways of life in a qualitative manner. With both the questionnaire and interviews, at least 30 responses will be ideal. Some of the data needed will also be collected via participatory observation and walks.

**Governance and Land Use Assessment**

The last research theme will aim at extracting information about SALCRA and the influence the scheme has had on the community. To do so it is necessary to survey some in the community who have been involved in oil palm in the last 15 years. There is a chance that there could occur a 'recall error,' where the knowledge of those extends too far back for there to be valuable or accurate information about the transition between the large-scale oil palm to current practice. Nevertheless, semi-structured interviews and a questionnaire will be utilized in order to gather information and opinions on how SALCRA has either been detrimental or beneficial to the community overall. The questionnaire will be used to gather an overview on how land use has changed, how land is currently being used and the overall feelings of governance in Sarawak can illuminate key aspects of joint ventures in oil palm. In the semi-structured interviews, open-ended questions will help to gain an understanding of the communities interactions with SALCRA and the Sarawak government, additionally information about the communities experience and land use during and after end of the lease will be collected. Further, PRA will be used in order to assess how the land is currently used and whether there is potential for the land to be used to generate income in the future. Based on the PRA assessment (transect walks, community mapping, etc.) the nature of the land can be determined and soil samples of the areas that are fallow after SALCRA can be taken to test to see the nutrient content of the land, as part of the environmental assessment.

**Conclusion**

This synopsis has explored a brief contextual introduction to the study site and its history. Market demands and development schemes have yielded decades of shifting land uses in the area, -- most recently with oil palm plantations under the management of SALCRA and then the shift to smallholder management. The changes in governance and land use affect both the environment and livelihood strategies, and the purpose of this research is to investigate those effects. In our investigation, we ask questions along three main themes. We explore the issue of

land management, policy, and decision making. We examine how the environment responds to different land use scenarios present in the area, and we consider the livelihoods of community members and how they may be changed by land use changes. We use a variety of methodological tools including surveys, sampling, questionnaires, participatory rapid assessment, and semistructured interviews. Using the gathered data, we will be able to learn about SALCRA's role in the community, decision making of stakeholders, livelihood changes, and environmental impacts.

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**(synopsis) Appendix A**

*Time schedule for field work*

| | Daily tasks: | | |
|---|---|---|---|
| Tuesday, 25 feb | At university of Sarawak | | |
| Wednesday, 26 feb | After arrival: Take a walk in the neighbourhood | Make introductions to key informants and headmen | |
| Thursday, 27 feb | Pilot questionnaires and in collaboration with interpreters edit and modify tools as appropriate | Analyse and get an overview of the questionnaires answers | Plan where to do soil/water samples, GPS mapping |
| Friday, 28 feb | Complete 7 household questionnaires (7) | Review guide for semi-structured interview. Find out and plan who is relevant to talk to | Soil characteristics? Dig a hole (??), GPS mapping |
| Saturday, 29 feb | Complete 7 household questionnaires (14) | Continuous engagement in participatory observation | Take more soil samples, dry soil, GPS mapping |
| Sunday, 1 mar | Complete 7 household questionnaires (21) | Go to church, engage in social activities | Participatory Mapping, timelines |
| Monday, 2 mar | Complete 7 household questionnaires (28) | Carry out semi-structured interviews on SALCRA topic | Perform MiniSASS assessments on water |
| Tuesday, 3 mar | Complete 7 household questionnaires (35) | Carry out semi-structured interviews on SALCRA topic | Carry out semi-structured interviews on foodways and health |
| Wednesday, 4 mar | Complete 7 household questionnaires | Complete unfinished tasks | |

| | | | |
|---|---|---|---|
| | (42+pilots) | | |
| Thursday, 5 mar | Complete final questionnaires as needed | Compile responses and data for presentation | |
| Friday, 6 mar | Prepare presentation of results | | |
| Saturday, 7 mar | Present Results to longhouses | | |
| Sunday, 8 mar | Clean up and Home! | | |

**(synopsis) Appendix B**

## Draft Questionnaire
## Household Level Livelihoods
## Batu Besai Ulu

Introduction:
The purpose of this questionnaire is to assess the assets belonging to the households of Batu Besai Ulu. This is done in order to learn from you the means by which community members make a living and sustain themselves and how these things may be influenced by changing land uses. We are students from the University of Copenhagen located in Denmark as well as from University Malaysia Sarawak located in Kuching and we are working together to produce a final report. The interviews will be used for academic work and are not funded. All of the information provided will be anonymous and the interviewee is not required to answer any questions that they are not comfortable with.

Section 1: General Information

| | |
|---|---|
| Interviewer: | Note taker: |
| Translator: | Household ID: |
| Date/ Time: | Name of respondent: |
| Gender of respondent: | Age of respondent |
| Role in Household: | |

Section 2: Household composition

| Name: | ~ Age: | Gender: | Household relation: | Present in Pintu(time spent)? | Contributes to HH income | Years education: |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Section 3: Assets

Do you own the land that you use/cultivate?

YES NO

If not, who owns the land (government, village, other)

_____

Does the household have?
*(Before asking, look around and fill out relevant check items (TV, fridge, etc.).)*

| | Yes | No |
|---|---|---|
| TV | | |
| Car/Truck/Tractor | | |
| Motorcycle | | |
| Phone/Cell phone | | |

| | | |
|---|---|---|
| Savings | | |
| Refrigerator | | |
| Stockpiled cash crops | | |
| Motor Boat | | |
| Fishing equipment | | |
| Agriculture equipment | | |
| Other. . . | | |

Section 4: Income

From what sources does this household gain income. Check all that apply and rank 1-3, 1 being most important

| Type of Income: | Applies | Rank the top 3 most important sources |
|---|---|---|
| Wage income/salary | | |
| Sale of rubber | | |
| Sale of pepper | | |
| Sale of oil palm | | |
| Sale of fruits | | |
| Sale of other agricultural products | | |
| Sale of forest products | | |
| Sale of handmade items | | |
| Other business income | | |

| | | |
|---|---|---|
| Sale of livestock | | |
| Support from gov, NGO, other org. | | |
| Gifts/support | | |
| Pension | | |
| Plantation dividends | | |
| Rent | | |
| Other, specify | | |

Section 5: Natural Resources

What kind of resources to do you use and gather from the surrounding nonagricultural land and forests? Check all that apply. In general, no specified recall period.

| Product: | Applies: | By whom: | Collected often/rarely/in the past: |
|---|---|---|---|
| Timber | | | |
| Firewood | | | |
| Fish | | | |
| Game meat | | | |
| Fruits | | | |
| Mushrooms | | | |
| Wood | | | |
| Greens | | | |

| | | | |
|---|---|---|---|
| Vegetables | | | |
| Medicinal plants | | | |
| Spices | | | |
| Animal fodder | | | |
| Insects | | | |
| Other construction materials | | | |
| Grasses | | | |
| Other | | | |

Section 6: Shocks

Has the household experienced hardship over the past year? If so, how did they cope with them?

| Event: | When: | What helped the household survive and recover from this stress? (Social support, financial)? |
|---|---|---|
| Crop Market Price Drop | | |
| Crop failure | | |
| Death or Illness | | |
| Natural Disaster | | |
| Costly event | | |
| Other, specify | | |

Section 7: Land Use Change

| What crops are you currently cultivating? (circle if mentioned) | | |
|---|---|---|
| Rice | Rubber | Pepper |
| Palm oil | Fruit | Other, specify |
| If more than one crop, which crop do you view as the most important for cash incomes | | |
| Rice | Rubber | Pepper |
| Palm oil | Fruit | Other, specify |
| If more than one crop, which crop do you view as the most important for food | | |
| Rice | Rubber | Pepper |
| Palm oil | Fruit | Other, specify |
| Have you cultivated crops in the past that you don't cultivate now? YES NO<br>If yes, which once? | | |
| Rice | Rubber | Pepper |
| Palm oil | Fruit | Other, specify |

Did you participate in the oil palm SALCRA scheme?
YES NO Doesn't know about SALCRA

***If they do cultivate oil palms***, do you cultivate on land that was previously under the SALCRA lease prior to 2005?
YES NO

In 2005, this community did not renew the lease with SALCRA. What was the reason for this?

How are the former land under SALCRA used now? (Circle if mentioned)

| | | |
|---|---|---|
| Rice | Rubber | Pepper |
| Palm oil | Fruit | Forest |
| Fallow land | | |

***If they don't cultivate palm oil***, what is the reason that you don't? Please choose one or more of the following reasons:

| | | |
|---|---|---|
| Too costly | Low soil quality | Low market access |
| No labor options | Other, specify | |

Section 8: Household outlook and perception, SWOT

| Do you consider Batu Besai as a good place to live? | | | |
|---|---|---|---|
| very good | somewhat good | neither good nor bad | less good |

| Has income and food availability been adequate for the household within the last year? | | | |
|---|---|---|---|
| Always adequate | Mostly adequate | Inadequate | Always Inadequate |

| In comparison to other households, is your household well-off? | | |
|---|---|---|
| Yes | No | Average |

List three things which make Batu Besai a good place to live.

List three things which could improve life in Batu Besai in the future.

List three things which make you most excited for the future of the community, opportunities.

List three major problems or constraints which affect the community.

With these questions, we hope to understand how different land use changes and cash crop cultivation has affected life in Batu Besai. Is there anything which you feel we should know?

Thank you so much for participating in this interview. Please use the space below to ask us any questions that you have about the study or how we will use the information in the future.

If you are comfortable doing a follow-up interview, please kindly provide us with a phone number so that we may contact you for another appointment.

Thank you kindly again!

Section 9: Researcher Notes

Did the respondent seem to enjoy the interview?

Did the information given seem reliable and accurate?

Other impressions from the researcher?

**(Synopsis) Appendix C**

***Semi-structured interview with Batu Besai - SALCRA/land use informant***

- *It is expected that the informant participated in SALCRA!*

**Participation in SALCRA:**

How did your relation to SALCRA start?

- Who took contact?
- What information did you get about SALCRA before participation?

What did you find attractive for for joining SALCRA

How was your experience of participating in SALCRA while running?

- Did you/the community experience any advantages and disadvantages from participating?

- Did you experience any changes in livelihood or economy, before and after the end of lease?

What were the reasons to end the lease?

- How was the decision taken?

What would you like to use the land for (if not continuing oil palm production)?

**Land use:**

After the end of the lease, did you get a title for the land?

- if yes, how has titling helped improve tenure security?

What are the land formerly under SALCRA used for now?

- Why did you choose this land use?

Do you recall any land use change within the last 15 years? (eg. cultivation of one crop to another, secondary forest to agriculture).

- if yes, which changes?
- When did it occur?
- What were the reasons behind changes in land use?

## (Synopsis) Appendix D

**What**: Semi-Structured Interview Guide. This is meant as a guide for interviewing and participatory observation and not an absolute survey. Note down relevant information including details about the respondent (age, gender, etc.) as the researcher sees fit.

**Where**: Batu Besai Ulu, carried out on walks and while participating in daily activities such as helping prepare and collect food, but can also be a sit down interview if appropriate

**Why**: In order to gain a better understanding of the ways in which SALCRA development efforts, land use change, and shifting access to outside incomes and markets have affected how the people Batu Besai relate to the food they eat, practice cultural agricultural traditions (*adat*), and source their diets.

**Who**: Two interviewers, one translator, and individuals involved in the collecting, preparing, and consuming of food in the community.

**Research Question**: Of what do the diets of Batu Besai consist? Has this changed with land use changes? From their experience, do people feel well nourished and healthy and has this status changed? Are people aware of where their food comes from, how it is made, its content and history?

Interview

*All questions are meant to be a starting point for a conversation about said topics and are not exhaustive. Pose specific questions when relevant to the research scope.*

I. Where does food come from?

From where do community members source their food?

Is food collected from the forest? If yes, what is collected? Who collects it and when? How much time is spent collecting?

Is food grown in personal gardens? If yes, what is grown? Who tends the garden? Is all of if consumed by the household or is it shared with the community or sold at market?

Is food bought in the market? If yes, what is bought? Who does the buying?

II. Of what does food consist?

What dishes are your favorite?

Are there any dishes that are staples of the everyday diet? What does a normal dish consist of?

Are there any foods that are only eaten during certain times of the year? If so, what and when is it eaten?

Are there dishes that are special and reserved for special occasions?

Are there any foods that not everyone in the community eats? (Specific to a certain age group etc.?)

III. Changes in food consumption

Have people always eaten the way that they do nowadays?

If diets have changed, why? When? In what ways?

How have traditional practices in food cultivation and consumption been affected by changes in land use?

Are people healthy and well nourished? Was this always the case? If no/yes, when and how have changes taken place?

Other change key words: refrigerators, freezers, electricity, road, vehicles

## (Synopsis) Appendix E

| **Overall Research Objective: To investigate the causes and effects of land use change on the environment, livelihood strategies, and local governance in the local community** | | | |
|---|---|---|---|
| **Research Questions/Themes** | **Sub Questions** | **Data Required/Output** | **Method** |
| | How does soil content characteristics affected by land use | soil texture (percentage of sand, clay and silt), total C and N, available N, salts in the soil, PH | Difference landscapes comparison between Soil sampling , Density Method, 'feel' Method, Electrical Conductivity tested, Nitrate, PH test |
| Environmental Assessments: In what ways is the environment affected by different land uses | How does land use affect biodiversity and vegetation | Each species density, frequency and evenness, Diversity index, DBH & Tree Height (if necessary) | Herb/shrub diversity plotting -- comparison between oil palm, secondary forest, other ag, etc; diameter tape, clinometers |
| | The current state of land use/How has land use changed | agricultural area change and forest area change showed on Google earth, community drawing | Community (participatory) mapping, GPS data collecting, Google earth analysis. |
| | Water quality affected by surrounding landscape and land use | assessment scores, chemical composition table? | MiniSASS- aquatic biomonitoring tool, physicochemical analyses |
| Livelihoods Assessment: What characterizes livelihood strategies of households in Batu Besai | What assets are available to the community - natural, physical, social, and human capital? | Assets each household and the village in general-- possessions, infrastructure, family unit composition, social wellbeing | Livelihood questionnaire, semi-structured interviews, participatory observation, |
| | Who has access to financial assets? | Who controls funds and money spending, Who works in what areas, Does everyone have the opportunity to use X or work in X field etc, -- financial opportunities and disadvantages, | (questionnaire or interview tbd) |

| | | | |
|---|---|---|---|
| | | gender/status/age differences | |
| | What strategies are used for subsistence and income sources? | knowledge about livelihood strategies -- Income level, subsistence sources | Livelihood Questionnaire:one member from each household, interviewed by two interviewers and one translator |
| | Have dietary habits and food availability shifted with changing livelihood strategies and land use change? How custom practice (adat) affect livelihoods/farming practices | An understanding of the foodways of the inhabitants of Batu Basai --Diet composition, dietary sources, food security | participatory observation, semi structured interview guide |
| | What level of physical assets facilitate access to resource and what physical assets do people have | the distance between longhouse and forest? river? road? marketplace? distance to oil palm mills --Distance in km, maps, distance in time | GPS mapping, participatory rapid assessment and mapping |
| Governance/Political Economy: How has SALCRA impacted livelihood and environment? | What was the idea behind SALCRA and How do households manage their land and its resources that were formerly used for SALCRA oil palm plantation? | Knowledge on land use and effect on livelihood | semi-structured interviews, literature |
| | How the land policy affects the local agricultural land use? | Knowledge about tenure system, land use change | literature, semi-structured interviews |
| | How have the messages from SALCRA changed over time and have they produced the results they promised for the smallholder? | Perceptions of SALCRA and central government | literature, semi-structured interviews |
| | Which external factors influence livelihood strategies, and how do households cope with these factors? | knowledge about market, governmental services, price fluctuation | Questionnaires, semi-structured interviews. |

| | | | |
|---|---|---|---|
| | How does land use change affect their decision making processes? | land ownership (land title) among the community.<br>Do all of the community participate in the decision making process especially involving large project schemes like SALCRA? | preferential ranking, focus group discussion |

# Appendix B - Overview of Methods

| Type of Method | # Times Used |
|---|---|
| Questionnaires | 30 |
| Semi-structured interviews with officials | 2 |
| Semi-structured interviews with key informants | 5 |
| Open interview | 1 |
| Focus group discussion | 1 |
| Community mapping (PRA) | 1 |
| Seasonal calendar (PRA) | 1 |
| Matrix ranking (PRA) | 1 |
| Transect walks/rides | 7 |
| MiniSASS stream assessments | 4 |
| Water quality testing (# of sites) | 4 |
| Soil sampling sites (# of sites) | 4 |
| Natural resource assessment | 1 |
| Participatory observation | Continuous |
| GPS tracking | All excursions |

# Appendix C - Questionnaire

**Final Questionnaire**
**Household Level Livelihoods**
**Batu Besai Ulu**

Introduction:
The purpose of this questionnaire is to assess the assets belonging to the households of Batu Besai Ulu. This is done in order to learn from you the means by which community members make a living and sustain themselves and how these things may be influenced by changing land uses. We are students from the University of Copenhagen located in Denmark as well as from University Malaysia Sarawak located in Kuching and we are working together to produce a final report. The interviews will be used for academic work and are not funded. All the information provided will be anonymous and the interviewee is not required to answer any questions that they are not comfortable with.

Section 1: General Information

| | |
|---|---|
| Interviewer: | Note taker: |
| Translator: | Bilek #: |
| Date/ Time: | Name of respondent: |
| Assumed Gender: M F | Age of respondent: |
| Role in Household: | Level of education: None/ Primary / Secondary/ 6 or Higher |

Section 2: Household composition

| ~ Age: | Household relation: | Do they still live here? | Contributes to HH income |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Section 3: Assets

1. How many plots of land do you have?

2. How many of them do you have a title to?

3. Do you cultivate them? ALL, SOME, NONE

4. Does the household have? (CODE 1 = YES; 0 = NO)

*(Before asking, look around and fill out relevant check items (TV, fridge, etc.).)*

| | |
|---|---|
| TV | |
| Car/Truck/Tractor | |
| Motorcycle | |
| Phone/Cell phone | |
| Savings | |
| Refrigerator | |
| Stockpiled cash crops | |
| Fishing equipment | |
| Other. . . | |

**NOTES*:***

Section 4: Land Use Change

| 1. What crops are you currently cultivating? (circle if mentioned) | | |
|---|---|---|
| Rice | Rubber | Pepper |
| Oil palm | Fruit | Vegetables |
| Other specify | | |
| 2. Which crop do you view as the most important for cash incomes | | |
| Rice | Rubber | Pepper |
| Oil palm | Fruit | Vegetables |
| Other specify: | | |

| 3. Do you recall any land use change on your land since the end of the SALCRA lease? | | | | |
|---|---|---|---|---|
| Rice: | Increased | Decreased | No change | Can't recall |
| Rubber: | Increased | Decreased | No change | Can't recall |
| Pepper: | Increased | Decreased | No change | Can't recall |
| Oil Palm | Increased | Decreased | No change | Can't recall |
| Fruit | Increased | Decreased | No change | Can't recall |
| Fallow land | Increased | Decreased | No change | Can't recall |

4. Did you participate in the oil palm SALCRA scheme?

YES NO Doesn't know about SALCRA

5. ***If they do cultivate oil palms***, do you cultivate on land that was previously under the SALCRA lease prior to 2006?

YES NO

6. In 2006, this community did not renew the lease with SALCRA. Did you agree with this decision at the time? What about currently? Why?

7. How are the former land under SALCRA used now? (Circle if mentioned)

| Rice | Rubber | Pepper |
|---|---|---|
| Oil palm | Fruit | Forest |
| Fallow land | | |

8. ***If they don't cultivate oil palm***, what is the reason that you don't? Please choose one or more of the following reasons:

| Too costly | Low soil quality | Low market access |
|---|---|---|
| No labor options | Age | Health Issues |
| Other specify | | |

Section 5: Income

From what sources does this household gain income. (CODE YES = 1; NO = 0); Rank 1-3, 1 being most important

| Type of Income: | YES (1) /NO (0) | Rank the top 3 most important sources |
|---|---|---|
| Wage income/salary | | |
| Sale of rubber | | |
| Sale of pepper | | |
| Sale of oil palm | | |
| Sale of fruits | | |
| Sale of vegetables/other ag stuff | | |
| Sale of forest products | | |
| Sale of handmade items | | |
| Other business income | | |
| Sale of livestock | | |
| Support from gov, NGO, other org. | | |
| Gifts/support | | |
| Pension | | |
| Plantation dividends | | |
| Other, specify | | |

**NOTES:**

Section 6: Natural Resources

1. What kind of resources to do you use and gather from the surrounding nonagricultural land and forests? Check all that apply. In general, no specified recall period. ? (CODE 1 = YES; 0 = NO)

| Product: | YES (1)/ NO (0) |
|---|---|
| Timber | |
| Firewood | |
| Fish | |
| Game meat | |
| Fruits | |
| Mushrooms | |
| Vegetables | |
| Medicinal plants | |
| Spices | |
| Animal fodder | |
| Insects | |
| Other construction materials | |
| Handicraft materials | |
| Other | |
| | |

Section 7: Shocks

Has the household experienced hardship? When? (CODE 1 = YES; 0 = NO)

| Event: | Yes (1) / No (0) | When: |
|---|---|---|
| Crop Market Price Drop | | |
| Crop failure | | |
| Health Hardship | | |

| | | |
|---|---|---|
| Natural Disaster | | |
| Other, specify | | |

**NOTES:**

Section 8: Household outlook and perception, SWOT

| | | | |
|---|---|---|---|
| 1. Do you consider Batu Besai as a good place to live? | | | |
| very good | somewhat good | neither good nor bad | less good |
| 2. Has income and food availability been adequate for the household within the last year? | | | |
| Always adequate | Mostly adequate | Inadequate | Always Inadequate |
| 3. In comparison to the past, are living conditions getting better? | | | |
| Yes | No | Neither | |
| In what ways: | | | |

4. What is something that makes Batu Besai a good place to live?

5. What could improve life in Batu Besai here?

6. What are you hopes for the next generation and your kids here in Batu Besai Ulu?

7. What is a major problem or constraint which affects the community?

8. With these questions, we hope to understand how different land use changes and cash crop cultivation has affected life in Batu Besai. Is there anything which you feel we should know?

Thank you so much for participating in this interview. Please use the space below to ask us any questions that you have about the study or how we will use the information in the future.

Thank you kindly again!

Section 9: Researcher Notes

1. Did the respondent seem to enjoy the interview?
2. Did the information given seem reliable and accurate?
3. Other impressions from the researcher?

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**NOTES:**

# Appendix D - Interview Guide for SALCRA participants

***Semi-structured interview with Batu Besai - SALCRA/land use informant***

- *It is expected that the informant participated in SALCRA!*

**Participation in SALCRA:**

How did your relation to SALCRA start?

- Who took contact?
- What information did you get about SALCRA before participation?
- how many generation has involved in the SALCRA project (time frame)

Who is involved in the SALCRA project?

Does everyone participate in the decision making process to be involved in the SALCRA project?

- if no, why?

What led you to joining SALCRA?

- What if you have no land?

How was your experience of participating in SALCRA while running?

- Did you/the community experience any advantages and disadvantages from participating?
- Did you experience any changes in livelihood or economy, before and after the end of lease?
- What is your view on SALCRA managing the land?

What were the reasons to end the lease?

- How was the decision taken?

What would you like to use the land for (if not continuing oil palm production)?

What are your thoughts on management that have been done by SALCRA onto your land and resources?

- Do you have control over your land and resources?
- Who decides on the access to the land and resources? SALCRA or villagers

**Land use:**

After the end of the lease, did you get a title for the land?

- if yes, how has titling helped improve tenure security?

What are the land formerly under SALCRA used for now?

- Why did you choose this land use?

Do you recall any land use change within the last 15 years? (eg. cultivation of one crop to another, secondary forest to agriculture).

- if yes, which changes?
- When did it occur?
- What were the reasons behind changes in land use?
- what are the types of crops currently cultivated in the village area?

Did various coping strategies have been developed among the villagers?

- if yes, how they trying to make use the land to increase the level of household income

**Income**

- Was the dividend given by SALCRA enough for their monthly expenses?
- What is the income gap during the SALCRA project and after SALCRA?
-
- After discontinuation of SALCRA from the project, where do they sell their products (oil palm)?
- RISDA(rubber)/MPOB(pepper); do they provide any subsidies (fertilizers, weedicides, herbicides)

# Appendix E - Interview Guide for LSDS

Semi-structured Interview with Land Surveyor

Date: Time:

How long have you been a land surveyor?

Besides SALCRA, what other agencies do you survey for?

Why did SALCRA want to title the land?

What in your experience is the main challenge with working with small/rural communities?

Could you walk us through the process of titling land that has been part of Native Customary Land?

- Do longhouses/villages typically make joint decisions on land leasing?
- What are the main problems if a village decides to lease their land jointly?

How long does the process typically take for titling the land?

- What are the main problems you run into with the process?
- How do you deal with land where multiple claim that it belongs to them?

Is it forbidden to use the land that is still under the process of titling?

- How does it work to sell/lease untitled land?
- Is there a punishment if someone uses land not under title?

What are the future problems you foresee with regards to community land?

- How much of the land is state owned?

# Appendix F - Focus group discussion

**What**: Semi-Structured Interview Guide. This is meant as a guide for interviewing and participatory observation and not an absolute survey. Note down relevant information including details about the respondent (age, gender, etc.) as the researcher sees fit.

**Where**: Batu Besai Ulu, carried out on walks and while participating in daily activities such as helping prepare and collect food, but can also be a sit down interview if appropriate

**Why**: In order to gain a better understanding of the ways in which SALCRA development efforts, land use change, and shifting access to outside incomes and markets have affected how the people Batu Besai relate to the food they eat, practice cultural agricultural traditions (*adat*), and source their diets.

**Who**: Two interviewers, one translator, and individuals involved in the collecting, preparing, and consuming of food in the community.

**Research Question**: Of what do the diets of Batu Besai consist? Has this changed with land use changes? From their experience, do people feel well nourished and healthy and has this status changed? Are people aware of where their food comes from, how it is made, its content and history?

Interview

*All questions are meant to be a starting point for a conversation about said topics and are not exhaustive. Pose specific questions when relevant to the research scope.*

I. Where does food come from?

From where do community members source their food?

Is food collected from the forest? If yes, what is collected? Who collects it and when? How much time is spent collecting?

Is food grown in personal gardens? If yes, what is grown? Who tends the garden? Is all of if consumed by the household or is it shared with the community or sold at market?

Is food bought in the market? If yes, what is bought? Who does the buying?

II. Of what does food consist?

What dishes are your favorite?

Are there any dishes that are staples of the everyday diet? What does a normal dish consist of?

Are there any foods that are only eaten during certain times of the year? If so, what and when is it eaten?

Are there dishes that are special and reserved for special occasions?

Are there any foods that not everyone in the community eats? (Specific to a certain age group etc.?)

## III. Changes in food consumption

Have people always eaten the way that they do nowadays?

If diets have changed, why? When? In what ways?

How have traditional practices in food cultivation and consumption been affected by changes in land use?

Are people healthy and well nourished? Was this always the case? If no/yes, when and how have changes taken place?

Other change key words: refrigerators, freezers, electricity, road, vehicles

# Appendix G - Water sampling

Water Sampling Results
MiniSASS and Quality Test

Station #1 – Muntik River
Station #2 – Dor River (downstream)
Station #3 – Dor River (upstream)
Station #4 – Gravity Feed (tap water)
Station #5 – Rapuh River

MiniSASS Results:

Date: 2/3/2020
Collectors: AJ, Karolina, Mew, Azura
Time Spent per Station: approx.. 30 min

| Station | #2 – Dor River (downstream) | #3 – Dor River (upstream) | #5 – Rapuh River |
|---|---|---|---|
| GPS Co-ord | N 01º04.963' E 111º27.425' | N 01º04.946' E 111º27.884' | N 01º04.946' E 111º27.884' |
| Site description | Section of river about 15 minutes walking down from the longhouse. Wide rocky section and took samples along the side as well as in the middle of the river. | Large section of river slightly flooded from rains. Rushing water. Took samples from a rocky part of the side of the river. 15 minutes walk upstream of longhouse. | Small stream. About 4 feet across with new oil and vegetables and pepper fields as well as forest. |
| Groups found | 6 (Dragonflies, Other Mayflies, Bugs, Minnow mayflies, Shrimp, Damselflies) | 9 (Crabs/Shrimps, Stoneflies, Minnow flies, Other mayflies, Damselflies, Dragonflies, Bugs or Beetles, Caddisflies, True flies, Snails) | 6 (Crabs/Shrimps, Damselflies, Dragonflies, Bugs and Beetles, Caddisflies, Snails) |
| Total Score | 37 | 63 | 34 |
| Average Score | 6.17 | 7.00 | 5.70 |
| Result | Good Condition | Good Condition | Fair Condition |

Notes:

MiniSASS at the Muntik river has inconclusive results as only caddisflies were found. Caddisflies have a score of 9, but no other specimens were collected.

Quality Test:

| Station | #1 – Muntik River | #2 – Dor River (downstream) | #3 – Dor River (upstream) | #4 – Gravity Feed (tap water) |
|---|---|---|---|---|
| Fecal per 100 ml (2 ml) | 850 (Class IIB) | 500 (Class IIB) | 400 (Class IIB) | N/A |
| Fecal per 100 ml (4 ml) | 475 (Class IIB) | 550 (Class IIB) | 100 (Class IIA) | N/A |
| Total Coliform (2 ml) | 11,450 (Class IIB) | 3,500 (Class I) | 4,400 (Class I) | N/A |
| Total Coliform (4 ml) | 8,850 (Class IIB) | 2,750 (Class I) | 1,050 (Class I) | N/A |
| Temperature (Celsius) | 35.4 º | 24.8 º | 25.55 º | 27.7 º |
| DO % | 71.4 % | 91.8 % | 76.6 % | 71.3 % |
| DO (mg/L) | 5.85 (Class IIA and IIB) | 7.62 (Class I) | 6.265 (Class IIA or IIB) | 5.66 (Class IIA or IIB) |
| Conductivity (µ mas/cm) | 0.032 | 0.031 | 0.03 | 0.037 |
| TDS (mg/L) | 21.27 (Class I) | 20.27 (Class I) | 22.8 (Class I) | 23 (Class I) |
| Salinity (ppt) | 0.013 | 0.01 | 0.01 | 0.013 |
| pH* | 6.76 (Class II) | 7.60 (Class I) | 7.8 (Class I) | N/A |
| $N_2$, Ammonia (mg/L) | 0.13 (Class I) | 0.42 (Class IIA or IIB) | 0.11 (Class I) | 0.245 (Class I) |
| Phosphorous | 0.07 | 0.135 | 0.105 | 0.19 |
| Turbidity | 66* | 17.5 (Class I) | 11.5 (Class I) | 2.5 (Class I) |
| TSS(mg/L) | 335.00 (Class I) | 232.50 (Class I) | 107.50 (Class I) | 25.00 (Class I) |
| COD (mg/L) | 5.50 (Class I) | 0.00 | 0.00 | 2.00 (Class I) |
| BOD (mg/L) | 2.75 (Class II) | 0.00 | 0.00 | 1.00 (Class I) |

*Class reaches 50 cannot classify. Most likely too many sediments.

WQI = 0.22SIDO + 0.16SICOD + 0.15SIAN + 0.16SISS + 0.12SIpH + 0.19SIBOD

Notes:

Ammonia reading only had two samples with wide range between the two readings (e.g. Dor River (upstream) had a reading of 0.07 and 0.15). Fecal and Total Coliform count had multiple attempts when the filters were not properly placed inside plastic petri dishes.

# Appendix H - National Water Quality Standards for Malaysia

National Water Quality Standards For Malaysia

| PARAMETER | UNIT | CLASS | | | | |
|---|---|---|---|---|---|---|
| | | I | IIA/IIB | III* | IV | V |
| Al | mg/l | NATURAL LEVELS OR ABSENT | - | (0.06) | 0.5 | LEVELS ABOVE IV |
| As | mg/l | | 0.05 | 0.4 (0.05) | 0.1 | |
| Ba | mg/l | | 1 | - | - | |
| Cd | mg/l | | 0.01 | 0.01* (0.001) | 0.01 | |
| Cr (IV) | mg/l | | 0.05 | 1.4 (0.05) | 0.1 | |
| Cr (III) | mg/l | | - | 2.5 | - | |
| Cu | mg/l | | 0.02 | - | 0.2 | |
| Hardness | mg/l | | 250 | - | - | |
| Ca | mg/l | | - | - | - | |
| Mg | mg/l | | - | - | - | |
| Na | mg/l | | - | - | 3 SAR | |
| K | mg/l | | - | - | - | |
| Fe | mg/l | | 1 | 1 | 1 (Leaf) 5 (Others) | |
| Pb | mg/l | | 0.05 | 0.02* (0.01) | 5 | |
| Mn | mg/l | | 0.1 | 0.1 | 0.2 | |
| Hg | mg/l | | 0.001 | 0.004 (0.0001) | 0.002 | |
| Ni | mg/l | | 0.05 | 0.9* | 0.2 | |
| Se | mg/l | | 0.01 | 0.25 (0.04) | 0.02 | |
| Ag | mg/l | | 0.05 | 0.0002 | - | |
| Sn | mg/l | | - | 0.004 | - | |
| U | mg/l | | - | - | - | |
| Zn | mg/l | | 5 | 0.4* | 2 | |
| B | mg/l | | 1 | (3.4) | 0.8 | |
| Cl | mg/l | | 200 | - | 80 | |
| $Cl_2$ | mg/l | | - | (0.02) | - | |
| CN | mg/l | | 0.02 | 0.06 (0.02) | - | |
| F | mg/l | | 1.5 | 10 | 1 | |
| $NO_2$ | mg/l | | 0.4 | 0.4 (0.03) | - | |
| $NO_3$ | mg/l | | 7 | - | 5 | |
| P | mg/l | | 0.2 | 0.1 | - | |
| Silica | mg/l | | 50 | - | - | |
| $SO_4$ | mg/l | | 250 | - | - | |
| S | mg/l | | 0.05 | (0.001) | - | |
| $CO_2$ | mg/l | | - | - | - | |
| Gross-α | Bq/l | | 0.1 | - | - | |
| Gross-β | Bq/l | | 1 | - | - | |
| Ra-226 | Bq/l | | < 0.1 | - | - | |
| Sr-90 | Bq/l | | < 1 | - | - | |
| CCE | µg/l | | 500 | - | - | - |
| MBAS/BAS | µg/l | | 500 | 5000 (200) | - | - |
| O & G (Mineral) | µg/l | | 40; N | N | - | - |
| O & G (Emulsified Edible) | µg/l | | 7000; N | N | - | - |
| PCB | µg/l | | 0.1 | 6 (0.05) | - | - |
| Phenol | µg/l | | 10 | - | - | - |
| Aldrin/Dieldrin | µg/l | | 0.02 | 0.2 (0.01) | - | - |
| BHC | µg/l | | 2 | 9 (0.1) | - | - |
| Chlordane | µg/l | | 0.08 | 2 (0.02) | - | - |
| t-DDT | µg/l | | 0.1 | (1) | - | - |
| Endosulfan | µg/l | | 10 | - | - | - |
| Heptachlor/Epoxide | µg/l | | 0.05 | 0.9 (0.06) | - | - |
| Lindane | µg/l | | 2 | 3 (0.4) | - | - |
| 2,4-D | µg/l | | 70 | 450 | - | - |
| 2,4,5-T | µg/l | | 10 | 160 | - | - |
| 2,4,5-TP | µg/l | | 4 | 850 | - | - |
| Paraquat | µg/l | | 10 | 1800 | - | - |

Notes :
* = At hardness 50 mg/l $CaCO_3$
# = Maximum (unbracketed) and 24-hour average (bracketed) concentrations
N = Free from visible film sheen, discolouration and deposits

National Water Quality Standards For Malaysia

| PARAMETER | UNIT | CLASS | | | | | |
|---|---|---|---|---|---|---|---|
| | | I | IIA | IIB | III | IV | V |
| Ammoniacal Nitrogen | mg/l | 0.1 | 0.3 | 0.3 | 0.9 | 2.7 | > 2.7 |
| Biochemical Oxygen Demand | mg/l | 1 | 3 | 3 | 6 | 12 | > 12 |
| Chemical Oxygen Demand | mg/l | 10 | 25 | 25 | 50 | 100 | > 100 |
| Dissolved Oxygen | mg/l | 7 | 5 - 7 | 5 - 7 | 3 - 5 | < 3 | < 1 |
| pH | - | 6.5 - 8.5 | 6 - 9 | 6 - 9 | 5 - 9 | 5 - 9 | - |
| Colour | TCU | 15 | 150 | 150 | - | - | - |
| Electrical Conductivity* | µS/cm | 1000 | 1000 | - | - | 6000 | - |
| Floatables | - | N | N | N | - | - | - |
| Odour | - | N | N | N | - | - | - |
| Salinity | % | 0.5 | 1 | - | - | 2 | - |
| Taste | - | N | N | N | - | - | - |
| Total Dissolved Solid | mg/l | 500 | 1000 | - | - | 4000 | - |
| Total Suspended Solid | mg/l | 25 | 50 | 50 | 150 | 300 | 300 |
| Temperature | °C | - | Normal + 2 °C | - | Normal + 2 °C | - | - |
| Turbidity | NTU | 5 | 50 | 50 | - | - | - |
| Faecal Coliform** | count/100 ml | 10 | 100 | 400 | 5000 (20000)a | 5000 (20000)a | - |
| Total Coliform | count/100 ml | 100 | 5000 | 5000 | 50000 | 50000 | > 50000 |

Notes :
N : No visible floatable materials or debris, no objectional odour or no objectional taste
* : Related parameters, only one recommended for use
** : Geometric mean
a : Maximum not to be exceeded

DOE Water Quality Index Classification

| PARAMETER | UNIT | CLASS | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| Ammoniacal Nitrogen | mg/l | < 0.1 | 0.1 – 0.3 | 0.3 – 0.9 | 0.9 – 2.7 | > 2.7 |
| Biochemical Oxygen Demand | mg/l | < 1 | 1 – 3 | 3 – 6 | 6 – 12 | > 12 |
| Chemical Oxygen Demand | mg/l | < 10 | 10 – 25 | 25 – 50 | 50 – 100 | > 100 |
| Dissolved Oxygen | mg/l | > 7 | 5 – 7 | 3 – 5 | 1 – 3 | < 1 |
| pH | - | > 7 | 6 – 7 | 5 – 6 | < 5 | > 5 |
| Total Suspended Solid | mg/l | < 25 | 25 – 50 | 50 – 150 | 150 – 300 | > 300 |
| Water Quality Index (WQI) | | < 92.7 | 76.5 – 92.7 | 51.9 – 76.5 | 31.0 – 51.9 | < 31.0 |

Water Classes And Uses

| CLASS | USES |
|---|---|
| Class I | Conservation of natural environment.<br>Water Supply I – Practically no treatment necessary.<br>Fishery I – Very sensitive aquatic species. |
| Class IIA | Water Supply II – Conventional treatment required.<br>Fishery II – Sensitive aquatic species. |
| Class IIB | Recreational use with body contact. |
| Class III | Water Supply III – Extensive treatment required.<br>Fishery III – Common, of economic value and tolerant species; livestock drinking. |
| Class IV | Irrigation |
| Class V | None of the above. |

DOE Water Quality Classification Based On Water Quality Index

| SUB INDEX & WATER QUALITY INDEX | INDEX RANGE | | |
|---|---|---|---|
| | CLEAN | SLIGHTLY POLLUTED | POLLUTED |
| Biochemical Oxygen Demand (BOD) | 91 - 100 | 80 - 90 | 0 - 79 |
| Ammoniacal Nitrogen ($NH_3$-N) | 92 - 100 | 71 - 91 | 0 - 70 |
| Suspended Solids (SS) | 76 - 100 | 70 - 75 | 0 - 69 |
| Water Quality Index (WQI) | 81 - 100 | 60 - 80 | 0 - 59 |

# Appendix I - GPS Tracks of Transect Walks

# Appendix J - MiniSASS Protocol

| SITE INFORMATION TABLE | | | |
|---|---|---|---|
| River name: | | Date (dd/mm/yr): | |
| Site name: | | Collector's name: | |
| GPS co-ord Lat(S): | Long(E): | School/organisation: | |
| Site description: e.g. downstream of industry | | Notes: e.g. weather, impacts, flow, etc | |
| pH: Water temp: °C Dissolved oxygen: mg/l Water clarity: info at www.minisass.org | | | |

GPS co-ordinates as degrees, minutes, seconds (e.g. 29°30'25" S / 30°45'10" E) OR as decimal degrees (e.g. -29.50694°S / 30.75277°E) If you don't have a GPS, upload your results at www.minisass.org, find your site on the map, click to upload your result and the co-ordinates are saved for you!

## Scoring

1. On the table, circle the sensitivity scores of the identified organisms.
2. Add up all of the sensitivity scores.
3. Divide the total of the sensitivity scores by the number of groups identified.
4. The result is the **average score**, which can be interpreted into an ecological category given below.

**Interpret the miniSASS score:**

Although an ideal sample site has rocky, sandy, and vegetation habitats, not all habitats are always present at a site. If your river had no rocky habitats that were sampled, use the **sandy type** category to interpret your scores.

| GROUPS | SENSITIVITY SCORE |
|---|---|
| Flat worms | 3 |
| Worms | 2 |
| Leeches | 2 |
| Crabs or shrimps | 6 |
| Stoneflies | 17 |
| Minnow mayflies | 5 |
| Other mayflies | 11 |
| Damselflies | 4 |
| Dragonflies | 6 |
| Bugs or beetles | 5 |
| Caddisflies (cased & uncased) | 9 |
| True flies | 2 |
| Snails | 4 |
| TOTAL SCORE | |
| NUMBER OF GROUPS | |
| AVERAGE SCORE (miniSASS score) | |
| Average Score = Total Score ÷ Number of groups | |

| Ecological category (Condition) | River Category | |
|---|---|---|
| | Sandy Type | Rocky Type |
| NATURAL CONDITION (Unchanged/untouched – Blue) | > 6.9 | > 7.2 |
| GOOD CONDITION (Few modifications – Green) | 5.9 to 6.8 | 6.2 to 7.2 |
| FAIR CONDITION (Some modifications – Orange) | 5.4 to 5.8 | 5.7 to 6.1 |
| POOR CONDITION (Lots of modifications – Red) | 4.8 to 5.3 | 5.3 to 5.6 |
| VERY POOR CONDITION (Critically modified – Purple) | < 4.8 | < 5.3 |

*Now, upload your results at www.miniSASS.org or use the miniSASS App (download from the miniSASS website) or send a scan of this page to info@minisass.org!*

**www.minisass.org**
Version 3.0 – September 2015

### Method

The best sites have rocks in moving water (**rocky type** rivers). Not all sites have rocks, but may be largely sandy (**sandy type** rivers).

1. Whilst holding a small net in the current, **disturb** the stones, vegetation, sand etc. with your feet or hands.
2. You can also lift stones out of the current and gently **pick** organisms off with your fingers or forceps.
3. Do this for about **5 minutes** whilst **ranging across the river to different habitats** (biotopes).
4. Rinse the net and turn the contents into a plastic tray. **Identify** each group of organisms using the identification guide (see insert: start with the dichotomous key, then use the identification guide for more information).
5. Fill in the site information and **mark** the identified organisms off on the scoring sheet (back page).
6. **Add up** the sensitivity scores and determine the **average score**.
7. Interpret your miniSASS score.
8. Remember: **WASH** your hands when done!

https://www.youtube.com/channel/UCub24hwrLI52WR9C24uTbaQ

### Equipment list

- Net (see www.minisass.org)
- white container / tray / ice-cream box
- magnifying glass
- pencil
- shoes/gumboots
- hand wash / soap

### Don't have a net? Make your own – it is easy!

Take any piece of wire, for example an old clothes hanger, and bend it into the shape of a net. Then tie the netting (which can be any porous material) to the wire with a piece of string. Alternatively cut the bottom out of an ice cream container and staple netting to the bottom. Now you have a net!!