LAND WITHOUT TITLE

A study of consequences related to land use changes in Antayan Keropok, Sarawak

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Abstract

The establishment of large-scale oil palm plantations is a major source of land use change in Malaysian Borneo. This report analyses the impact of large-scale plantations on the environment and everyday life in the Sarawak village of Antayan Keropok and investigates the role of land affiliations in this transition. Through an interdisciplinary approach we show large-scale plantations have had an effect on water quality and soil fertility, and measurements on above ground biomass indicate that there is a significant loss of carbon stocks when converting secondary forest to oil palm plantation. Further, land use change related to the plantations have resulted in the clearing of large forest areas resulting in a loss of biodiversity. This loss contributes to an overall change in village everyday life and villagers' interaction with land. With pressure from the government to adapt and navigate new laws, NCR is shown to no longer be enough for native Sarawakians to protect themselves against land acquisitions. Although, traditions are shown to remain, some are lost in the process. Despite overall living standards being shown to have developed since the village's involvement with government plantation projects, some participants still lack the dividends promised by SALCRA, whilst false assumptions regarding land titles has resulted in wide scale participation with RISDA.

Preface

This report is the final result of an intensive nine-week learning experience within the course "Interdisciplinary Land Use and Natural Resource Management" (ILUNRM), organized by University of Copenhagen and Roskilde University.

The course consisted of three weeks of lectures and study preparation for fieldwork in Copenhagen, a twoweek fieldwork period in Borneo, Sarawak, together with Malaysian students from University Malaysia Sarawak (UNIMAS), and a report writing.

All students from Danish universities have equally contributed on making this report as it is now, whilst Malaysian students have been consulted in topics related to their expertises.

On 8th of April 2016 Copenhagen, Denmark

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Beserakup Nuju Pemansang - Together we stand and move forward. Oha!

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Abbreviations

Above Ground Biomass	
Chemical Oxygen Demand	
Diameter at Breast Height	
Dissolved Oxygen	
Forest Resource Assessment	
Governmental Plantation Project(s) (SALCRA + RISDA)	
Land Use Change(s)	
Native Customary Right	
Permanganate Oxidisable Carbon	
Participatory Rural Appraisal	
Rubber Industry Smallholders Development Authority	
Sarawak Land Consolidation and Rehabilitation Authority	
Soil Organic Carbon	
Semi-structured Interview	
Total Suspended Solids	
University of Copenhagen	
Universiti Malaysia Sarawak	
Water Quality Index	

1 Introduction

Land Use Change (LUC) is a global phenomenon and with pressure from the world's rising population to increase agricultural land, the requirements an ever-developing global economy is at odds with natural land uses, such as tropical rainforest, and the rights of the indigenous peoples inhabiting them. With estimates from LAND matrix indicating that between 0.7 and 1.75 percent of the world's agricultural land in the Global South is subject to large-scale land acquisitions (Anseeuw et al. 2012:3), a major factor behind large-scale LUC.

Those defending large land acquisitions argue that land investments can form mutually advantageous partnerships, targeted at social and economic development in rural areas, by combining investors' key assets (capital, technology, markets) with those of the local communities (land, labor and local knowledge) (The World Bank 2011:34). Opponents argue, that such land acquisitions, in the name of economic development, are subject to corruption and that the associated resource exploitation has severe negative environmental and human consequences, especially for native or indigenous communities.

This study focuses on land rights in the Malaysian state of Sarawak, Borneo. Natives to Sarawak, are colloquially known as Dayak, making up at least 71.2% of the state's population and comprises the main indigenous groups; the Iban, the Bidayuh and the Orang Ulu (Zulkifli et al. 2015:653). Traditionally, Dayaks navigate land rights according to cultural beliefs, social norms and customary practices, a concept known as adat. Both local Sarawak and Malaysian State governments have long respected adat through working to uphold indigenous rights, respecting local customs, and protecting native land from foreign exploitation (Colchester et al. 2007:11).

The acknowledgment of Native Customary Rights (NCR), including adat, accepts that although a community may not have legal title over their land, it retains the right to inhabit and cultivate it in accordance with tradition. (Land Code 1999) Large areas are subject to LUC through government and joint venture schemes, largely through the establishment of oil palm plantations (Colchester et al. 2007:12-13). With a global surge in demand, palm oil has drastically increased the in profitability and Malaysia has become the world's largest exporter (FAO 2011).

Described as the "golden" crop, oil palm (*Elaeis guineensis*) is considered the per-hectare highest yielding oil crop and, being a perennial tree crop, has the additional advantage of a productive life lasting 25 - 30 years (MPOB 2010). Through the introduction of an oil palm plantation initiative by the Malaysian Federal

Land Development Authority (FELDA) in the 1970s, poverty in peninsular Malaysia among participants fell from 30% to almost negligible levels over a 20 year period (Zulkifli et al. 2014). With most land on the peninsula suitable for oil palm already under cultivation, Sarawak, with the lowest population density and among the highest rates of poverty in Malaysia, was the logical next frontier for expansion (FAO 2011).

Usually in the form of large industrialised plantations, commercial oil palm production started in the region in the 1990s, with the total area under cultivation increasing by 1700% from 54,795 ha in 1990 to 919,148 ha in 2010 - a figure expected to reach two million hectares by 2020 (FAO 2011). This rapid expansion comes at a cost for the region's tropical rainforests with forest coverage currently decreasing at an average annual rate of 0.64% (Hon and Shibata 2013).

In order to address conflict with NCR, the Sarawak Land Consolidation and Rehabilitation Authority (SALCRA) was set up in 1976 as a state statutory body to address poverty in rural areas through collaboration with NCR land owners (SALCRA 2012). SALCRA holds the power to develop oil palm plantations on NCR land on behalf of NCR landowners. Participation in the scheme involves leasing land, during which participants receive proceeds based on the performance of the plantation and at the end a land title is issued to the NCR stakeholder (FAO 2011). Land ownership is therefore viewed as a major incentive to join SALCRA projects. As of 2011, SALCRA managed a total of 48,644 hectares and was involved in partnerships with over 21,000 NCR landowners (FAO 2011).

1.1 Antayan Keropok - our home in the field

This study centres on Antayan Keropok, an Iban Remun village about 85km south east of Kuching and 20 km east of Serian. The village is reached by a single track road which winds its way through rice paddies, oil palm plantations and fruit orchards as well as other villages. These villages, including Antayan Keropok, make up the Antayan region as a whole. A small sign reading "Kampung Antayan Keropok" signals your entry to the village where the road branches and houses spring up – rice and pepper being dried outside and dogs and chickens spilling out on to the road.



Figure 1: Sign indicating entering Antayan Keropok

The village comprises 69 households with a total population in 2014 of 376. There is a school of around 100 pupils, a number of small shops and four Christian churches of different denominations. The village is surrounded by hills including 'Mount Antayan' from which three small rivers flow and the villagers receive a gravity fed water supply.

Our host for the duration of the study was the village Headman and we were immediately made to feel at home. He had extended his front veranda to make space for us all to sit, talk and eat. This also served as our makeshift office. We had three cooks, who, under supervision of the Headman's wife, prepared traditional food three meals a day. In addition to what we bought, it was common during an interview or on a walk to be given food to take back with us. We received fruits and vegetables, bunches of jungle fern, snails, fish and even squirrels and snake. Throughout our stay we were treated as guests of honour; on arrival we were treated to a welcome ceremony which included traditional music and dance and personal introductions from the Headman. Tuak, a form of distilled rice wine, flowed in copious amounts (a theme for much of our stay) and on our second day we were invited to watch a cock-fight. Although we entered the village as outsiders, we were made to feel as welcome members of the community from day one.

Land plays a major in the village with life revolving around farming. In total Antayan Keropok land, both cultivated and uncultivated, makes up around 1,200ha; a figure difficult to verify as much land remains

unsurveyed and without title. Every household in the village farms swamp rice for subsistence and during our stay we experienced the harvest. Although each household cultivates their own paddy, harvesting is done communally; you help harvest several fields and the same people will then come and help harvest your field.



Figure 2: It takes a long time to tie up all the lines for the pepper, and the farmers are helping each other out in the field.

Traditional cash crops include pepper, rubber, fruits and vegetables, all of which are still cultivated. Rubber in particular remains a driving force of LUC. In 2015, in conjunction with the Rubber Industry Smallholders Development Authority (RISDA), 55ha of rubber trees were planted on village land with a further 200ha currently under application.

However, In addition to traditional cash crops, oil palm has more recently become a major source of income for many villagers. SALCRA established a plantation in Antayan in 1997, which was then extended in both 2002 and 2006, converting a total of 1,028 hectares (of which, 565 ha belong to Antayan Keropok) of former NCR secondary forest, fallow and fruit orchard to plantation. With such a stark change in land use, we seek to investigate the implications these large-scale plantations hold for land affiliation in the village, and their impact on the local environment.

1.2 Research objective and questions

Research objective:

To assess the impact of large-scale plantations on the environment and everyday life in Antayan Keropok, Sarawak, and to investigate the role of land affiliations in this transition

Research questions:

- 1. What are the environmental impacts of large-scale oil palm plantation for Antayan Keropok?
- 2. How has everyday life changed in Antayan Keropok since the introduction of large-scale plantations?
- 3. In what way is transition in land use in Antayan Keropok related to the farmers' affiliation towards land?

Textbox 1: A note on terminology

In this study, reference to large-scale plantations indicates oil palm (SALCRA) and rubber (RISDA). However, in relation to assessing environmental impacts, the focus is only on oil palm plantation. This is due to the fact that during our time in the village, the rubber plantations were still in establishment.

We define LUC as a *major* change in the way land is used through human intervention. For example, clearing forest for agricultural use or a switch from subsistence based agriculture to monoculture plantations. Seasonal changes or crop rotation are not considered LUC.

In the term *everyday life* we refer to activities and issues in the villagers' life found in the empirical data. The foci has been farming and other work, food security and sovereignty, infrastructure, culture and tradition, preferences. However, it should be stressed that *everyday life* is not a concept as such, but an expression to illustrate these matters.

2 Methodology

Here we describe the methods used in our field work. A table with a further overview can be found in appendix I. As this study was interdisciplinary, we used a combination of social science and natural science methods. The two disciplines supplement each other very well, and each is a part of answering different aspects of our research objective. The fact that we were many people with different expertise working together gave us an opportunity to learn from each other and get insights in other disciplines.

2.1 General reflections on data collection

Before entering Antayan Keropok our major concern with staying with the Headman, was the fact he could potentially interfere with our access to places or people and could bias informants and their responses. He was, however, from the beginning curious and eager to help us in any way. We tried to work with rather than against him, including him when appropriate and asking him for space when not. This proved successful and he was a great help in providing us with maps, locating sampling sites for and setting up an interview with RISDA in Kuching.

Despite our efforts, we are, however, aware that the Headman may have influenced our data collection, though his interference was not as critical as we had assumed beforehand. Throughout our stay, the villagers were very warm and open to us and it seemed from our PRA that overall the Headman was very well liked in the village, which also made it easier to have sessions in his house. It could also be argued that our informants' open attitude towards him was a result of him acting as a gateway to several informants, meaning most of our respondents were his friends or relatives. In many cases this was difficult to avoid as most households in Antayan Keropok are related.

As Antayan Keropok is a fairly small village it was easy for us to interact with the villagers, even in a situations not related to our research. This created some ethical challenges as whilst our relationship with the Headman and the villagers opened up a lot of doors for us we had to be aware of this bias and maintain professionalism in identifying possible conflicts. This awareness is described as *moral positioning*, where transparency in ethical dilemmas can help qualify the data, as the research is then based on a moral attention of the field (Buch 2009:77-78).

We were also aware of our different possible positions in relation to cultural backgrounds and gender. We therefore needed to consider our own position and the villagers' perceptions of our position, as this would help us to bridge our experiences in the village and the final analysis.

The language barrier and our use of interpreters slowed discussion in allowing for translation and clarification. They may also have had implications towards our understanding of the information provided by the informants as many Iban words do not exist in English or in Danish, and therefore cannot be translated directly meaning some words and meanings may be lost in translation. To minimise this risk, before conducting an interview we went through and discussed the interview guides and our objectives with our interpreters. They also helped in subsequently explaining terms and concepts after the interview.

2.2 Establishing the field

Shortly after arriving to Antayan Keropok, the first community walk was done around the village with the Headman and a few other villagers. This offered us the initial impression of the village in terms of its size, diversity of cultivated crops, off-farm activities and general atmosphere, as well as the first feeling of the relationship between Headman and villagers. Another community walk was conducted after the timeline-session (see section 2.4), where we went to see important places that rose from the session.



Figure 3: During a rainy community walk, the Headman pointed out a hill, where RISDA had recently cleared the land to replant rubber.

Informal conversations were a natural part of the stay in the village, which occurred naturally and spontaneously throughout our stay. As Casley and Kumar (1988:11) note, these were more than casual

conversations, as - conscious or subconscious - we had an agenda in mind for each talk and therefore a tendency to steer it a particular direction. Participatory observation was another method for us to interact with the villagers within their natural setting to better understand their everyday life (Brockington and Sullivan 2003:53). One important cultural event was a miring ceremony, *Guna Gayau*, which we experienced on our second day in the village. This was our first contact with many villagers and allowed us to meet future key informants.

2.3 Interviews

Our intent was to conduct an interview with RISDA and SALCRA. The aim was to obtain knowledge of their main goals and mechanisms, and get an understanding of their perspectives towards the current land use development in the area. Despite an effort made by our course teacher's, an interview with SALCRA did not succeed. Through contact with the village's RISDA supervisor, our Headman managed to organise an interview with the regional manager at the region's head office in Kuching. Several interviews were carried out in the field in addition to RISDA interview, and these are elaborated in the following paragraphs. Used guides for each type of interview can be found in appendix II.

Household sketch

During the fieldwork we carried out six semi-structured interviews (SSI) with individual villagers to obtain knowledge about village everyday life; how they make their living, why they chose different crops and how they manage their farm. We were also interested in the importance of land titles and LUC in relation to SALCRA and RISDA. As described in more details in appendix II the selection of respondents was not done in a systematic way although we aimed for having an equal mix of both sexes.



Figure 4: Example of household sketch drawn by interviewees I. Figure 5: Example of household sketch drawn by interviewees II.

The respondent was asked to draw their farm on a piece of paper to give an overview of the land used and crops grown (figure 4+5). The sketch was then used in the interview session, by both the interviewers and interviewee, as an aid throughout the interview - for example how a piece of land was inherited, the market price of a specific crop and the inputs and outputs each crop required and produced. This method turned out to be helpful in giving a visual overview of how the farmers' land often are separated from the household and they have different fields with a variety of crops, which we will elaborate on the analysis in relation to joining the governmental plantation projects (GPP).

Key informant interviews

Whilst almost every household in the village participates in both SALCRA and RISDA, it quickly became clear traditions and beliefs remain important for villagers' affiliation with land and land rights. Five key informant interviews were conducted in order to gain more in-depth knowledge in relation to the influence of GPP on villager's everyday life and the changing role of traditional land rights in relation to the current LUC.

The Headman was a natural choice as key informant as village leader for the past four years and a member in both RISDA committee and regional SALCRA committee. Other key informants were identified and selected through informal conversations (see table 1). SSI guides were designed for each interviewee based on our existing knowledge of their expert area.

Key informant	Reason for the selection	Additional information
1. Headman, Chairman of village's RISDA committee, member of regional SALCRA committee	Headman of the village since 2012, a broad overview of the villagers and current land-use in the area, knowledge about RISDA procedure	One SSI and many informal conversations
2. Pepper farmer in the village, member of the village council	One of our first connections in the village	One SSI and many informal conversations
3. Farmer and fisher in the village, a member of a NGO	Critical view towards state's current land use policy,	Brother of key informant no. 4, Headman's uncle

Table 1: Overview of key informants.

protecting indigenous land rights in Sarawak, key actor in	knowledge and perspectives towards current land right issues	
village	of indigenous people in the area	
4. Farmer in the village, Chairman of regional SALCRA committee	Knowledge about SALCRA procedure, used to work as a government officer	Brother of key informant no. 3, Headman's uncle
5. Farmer and shopkeeper in the village, practising to become a manang (shaman)	Knowledge about the miring ritual that was performed, Insights to the traditional understanding of land	

2.4 Participatory Rural Appraisal

Participatory rural appraisal (PRA) is a way to facilitate discussion on a subject, and to create dialogue, not only between the interviewer and the participants, but also between the participants themselves to gain an in-depth understanding of a certain topic (Mikkelsen 2005). During our time in the field, we conducted a range of PRA methods, which will be described in the following.

Mapping

The first exercise we did in Antayan Keropok was a map-drawing session. The objective of this method was to get an overview of the current land use within the village, to find out how the villagers see their village and to visualise the location and size of the plantations.

Because we saw a gender divide in the village, we decided to conduct separate mapping sessions for men and women. Participants were invited through the Headman and his wife. On finishing the map, we asked each participant to point out the most important places in the village to get an idea of what is central in each individual's life (appendix III). The maps drawn served as a starting point for future conversations regarding LUC as well as a reference in identifying potential FRA, water and soil sampling sites, which we will return to in the analysis chapter.



Figure 6: Women's mapping session. Figure 7: Mapping session.

Timeline

To better understand transitions in land use in Antayan Keropok, we invited the Headman, his mother and some other farmers, to help us construct a timeline of major LUC and events in the village. It was clear from the beginning that the mother felt very emotional talking about the past, as it was a period of greater hardship. The timeline was created from the mother's experiences and we used the map from the mapping session, to make it more visual and easier to explain the LUC.

The next evening we held a follow up session with the Headman and a pepper farmer to elaborate on the transition to palm oil.



Figure 8: Timeline session.

Ranking and Seasonal Calendar

A combined ranking and seasonal calendar session was conducted in order to gain an in depth understanding of the villagers opinion of the different crops, and the villagers' everyday life from season to season (appendix IV).

The ranking focused on the different land uses in the village in relation to own consumption, workload, market value, expenses, income and adat. We wanted all the informants to form their own opinion before filling out the big matrix together, therefore each informant was handed a small ranking matrix to start with. The informants were asked to mark which crop was most related to each term. After the informants had filled out their own matrix, everyone gathered around the big matrix, where everyone told where they had placed their marks.

The seasonal calendar was focused on the significant events happening in the village each month. The participants were asked to list significant events happening in the village, and which crops needed special treatment each month. After the seasonal calendar had been filled out, one of the participants drew how the income and expenses was every month.

2.5 Focus group

After our first week in Antayan Keropok it became evident that there were different perceptions on land ownership and also differences in our own understanding of the term. We needed to get a clearer and more common understanding of the local definition in order to form the right questions in interviews and better understand the answers. According to our interpreter "land ownership" could not be translated directly to Iban. We therefore decided to conduct a focus group and have the villagers discuss Iban terms which could cover what we would translate as land ownership. The goal was not to find a common definition, but to understand different concepts and ideas related to land ownership and see whether there were different understandings of the concept within the village.

We used what Bente Halkier (2009) describes as *snowball sampling* (Halkier 2009:31), where we invited someone we'd interacted with before and knew had lived her whole life in Antayan Keropok to the Headmans house and asked her to bring four to five other people. By letting the first informant choose the other informants, we could insure that the informants were comfortable around each other and more likely to have a flowing discussion.

The session revolved around a piece of paper where we, in collaboration with informants, filled in descriptions of different Iban terms related to land ownership in order to create a visual overview. As these terms are so integrated in their everyday life, they used each other in order to explain the words the best they could.

2.6 Assessing environmental impact

Villagers were not systematically asked about their perceptions on environmental changes due to the plantation, but through informal conversations and interviews we got impressions on decreased biodiversity in the area as well as reduced water quality in the river. The impact on the environment was studied by investigating changes in soil quality, water quality and in biomass combined with biodiversity.

The mapping session determined there was a river running through the plantation and from the map we could identify suitable sample plots. While locating the plots for forest resource assessment (FRA) and soil sampling, we found out that there were some differences between our and the villagers' definitions for primary and secondary forests, which created some confusion. As defined by Brown and Lugo (1990:3), a primary forest refers to a undisturbed virgin forest, where as a secondary forest is a forest with human intervention due to of e.g. collecting fuelwood, grazing, practising logging or having a forest fallow as a result from shifting cultivation. As a difference to this, villagers referred to secondary forest also in a case with planted orchards or rubber trees within the forest. By using maps, we asked the villagers to point areas with forest cover before, for example by asking where they used to go to hunt. From this we finally got an idea of most suitable sample plot locations, where we were then guided by the Headman along with a few guides. GPS coordinates were taken from each sample plot in order to locate the places afterwards (see figures 9, 10 and 11).

Water Analysis

Before entering the field, we had an assumption that large-scale plantations could have an adverse effect on water quality. We therefore wanted to carry out water analysis to test this assumption in the field. The sampling spots was chosen to see the potential impact of the oil palm plantation.



Figure 9: The three water sampling stations - 1. Upstream, 2. Middle, 3. Downstream.

The water sampling was carried out in three stations along a small river running through the oil palm plantation; upstream, within, and downstream of the oil palm plantation. Three water samples were collected from each sampling station to analyse in the laboratory. In-situ measurements included; temperature, dissolved oxygen (DO), conductivity, salinity, and pH and were measured three times at each sampling station in order to minimize measurement errors. Table 2 lists the ex-situ analyses that was carried out in the laboratory, and which method was applied.

Table 2: Ex-situ water analyse	5.
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	Parameters	Methods
TDS (mg/L)	Total Dissolved Solid	Filtration method
TSS (mg/L)	Total Suspended Solid	Filtration method
BOD ₅ (mg/L)	Biochemical Oxygen Demand	Incubation method
COD (mg/L)	Chemical Oxygen Demand	Reactor Digestion method

NH ₃ -N (mg/L)	Ammonia Nitrogen	Powder pillow method
NO ₃ ⁻ -N (mg/L)	Nitrate	Powder pillow method
$NO_2^N (mg/L)$	Nitrite	Powder pillow method
PO_4^{3-} (mg/L)	Phosphate	Powder pillow method
TCC (count)	Total Coliform Count	Membrane filter technique
FCC (count)	Fecal Coliform Count	Membrane filter technique

The oil palm water sample results were evaluated using the Water Quality Index (WQI), an evaluation tool for measuring the quality of river water developed by the Malaysian government. The formula was executed by combining six water quality parameters; DO, BOD₅, COD, NH₃-N, pH, and total suspended solid (TSS). The final WQI data was then compared with the Malaysian National Water Quality Standards (NWQS) to determine the river's status (appendix VII).

Soil Analysis

Through our literature review prior to arrival in Antayan Keropok we became aware that converting secondary forest to oil palm plantation can affect soil properties. We therefore wanted to include soil analysis in our study to see the effects on the local environment. From the first day in the village we were informed that there were two ages of plantation on village land – a 19 year old and a 10 year old. We therefore took soil samples from three sites (see figure 10).



Figure 10: Soil sampling locations - 19 year old, 10 year old oil palm plantation, and a secondary forest used as reference.

Sites within the plantation were chosen to be equi-distant between two palms (about four metres), to avoid piles of palm leaves, away from roads and from any signs of soil disturbance. It was obvious, for example, where a bulldozer had shifted earth to create a terrace. In the forest sites were chosen on the basis of feasibility to avoid roots.

At each site three holes were dug to a depth of around 50cm (although if no horizons were visible the holes were shallower). From each hole we sampled from three depths, starting with the soil surface and continuing down depending on the thickness of the horizon. We took both volume specific samples, using a 100cm³ ring, and non-volume specific.

Each hole therefore gave us six samples which were dried on spare sheets of corrugated iron out of reach from children, cats and chickens. Analysis was conducted ex-situ back in Copenhagen where we weighed each volume specific sample, measured pH, C:N and permanganate oxidisable carbon.

Forest resource assessment and ethnobotanical walk

The introduction of large-scale oil palm plantations in Antayan Keropok has, in many cases, resulted in clearing of secondary forest. With a growing necessity to reduce greenhouse gases (GHG's) and to maintain carbon sinks to mitigate climate change globally (Thompson 2014), it became interesting for us to investigate how conversion to oil palm plantation has affected the carbon sinks in the village area. Since the largest pools of carbon in the tropical forests are stored in the aboveground living biomass of trees (Gibbs et al. 2007:3), we used above ground biomass (AGB) as an indicator to calculate differences between secondary forest and oil palm plantation.

Within the secondary forest, sites were chosen through our guide and through ease of access. Five plots were done, each located 10 meters from the trail to avoid bias in including disturbed forest. Each plot measured 10 x 10 metres, within which the diameter at breast height (DBH) was measured for all the trees with a DBH> 5 cm. FRA was also done in a 19-year old oil palm plantation, where the height of randomly chosen 10 trees was measured. This procedure was less time consuming than in the secondary forest, because the number of trees per hectare is set, and there is only one tree species.



Figure 11: FRA sample plot locations for oil palm plantation and reference forest (secondary forest) (The three dots in the map for oil palm plantation represents the sample plot area from where palms were chosen and measured).

AGB, which is used as an indicator on how much carbon is stored in the trees, was calculated for both of the FRA places by using suitable equations (appendix VI and section 3.3.3). Secondly, biodiversity in tree species was measured and an ethnobotanical walk was done which provided us with knowledge about a variety of uses of the forest resources and people's relationship to the forest now and in the past. According to the AGB, we have put forward the hypothesis that converting secondary forest to oil palm plantation results in a net loss of biomass. This is due to the fact that the density of the oil palm's stem is low (Lim and Gan 2005), and therefore it is most likely that oil palms are lighter and less dense than many trees in a secondary forest. Regarding the biodiversity of trees it is obvious that species are lost in the transition from a diverse forest environment to monocropping of oil palms. Our emphasis here is to show the extent of the loss and the consequences it can have for the environment.

2.7 Structuring the collected data

It was very apparent from an early point that we would have to structure our collected field data in order for us to get a proper overview. The practice of keeping track of all data in the field was for UC and UNIMAS students to meet up every night to discuss the field notes and experiences harvested throughout the day. A document was set up in the field, in which we assigned names and codes to all data (photos, field notes, interview notes, interview guides, contact information), to make sure that everything needed was covered and that at least one person would be responsible for any piece of data. Upon our return from Sarawak, we decided to divide the content of our empirical data based on the overall field work sessions. The fact, that a part of the group are UNIMAS students, and hence stayed in Sarawak to complete a report on their own, required us to keep in contact and throughout the writing share findings and reflections online. Due to our vast amount of data and our very limited time, proper transcription and coding was not an option. Instead we individually read and assigned comments to the data, thereafter we communally decided which topics and which data would shape and support the analysis.

3 Our findings

Here we describe the analytical framework used in the formation of this report and presents and discusses our results. This leads to a chapter regarding changes in everyday life in, cultural identity, dealing with the loss of forest resources and some considerations about changes in living standards. Finally, we examine to role of land affiliation on LUC.

3.1 Analytical Framework

When entering a new field it is important to be aware people's way of organising themselves is based on their relation to each other and from that they bring a meaning to the community, landscape and culture they live in. Informants cannot be placed outside the field, they are part of it and they are the ones forming it (Sjørslev 2015:128). In Antayan Keropok this is best highlighted by their everyday mix of old village traditions and a new transition in their use of land. It has therefore been important to consider the villagers' own interpretation of their everyday life.

From the literature we learned that it can be a sensitive matter for the local farmers to join the governmental schemes, which rely on a common understanding for what the transition contains, but this is not always the case. As Cramb and Wills (1990) indicate; *"Such interventions (changes in land tenure institutions) by the state are frequently disruptive of social order and not conducive to efficiency or equity in land use. In short, they can give rise to a situation of institutional dissonance, where local-level institutions and those of the state, being based on different principles and concepts and serving" (1990:357).* During our fieldwork we experienced, this described "situation of dissonance" when the villagers' idea of the agreement with the GPPs,was not always what was carried out in practice. This made us curious to look into the villagers' affiliations with their land through a focus group aimed at establishing a more common understanding of the local terms related to land rights, which was not something we could learn from the literature.

3.2 Transition in land use

From the timeline session, we got an insight in the history and major events in the village (figure 12) and learned how land use has changed in the village since the establishment of oil palm plantations.



Figure 12: Timeline highlighting the main events in the village's history from timeline session

Before the permanent settlement of Antayan Keropok, the land was used very differently. The villagers described their ancestors as nomads, who had practiced farming, but only when settling down in a specific place did cultivation of the land really began.



Figure 13: Map displaying primary forest, secondary forest and non forest area in 1960 and 2010 - black circle represents Antayan land area. Source: Sarawak Geoportal, 2016 (edited).

As seen in figure 13, Antayan Keropok's land cover in the 1960s was mainly secondary vegetation with some primary forest. When the villagers began to cultivate their land surrounding the village, a conversion from forest to non forest area began. Furthermore, logging before, the oil palm plantation converted much primary forest to secondary forest. Thereafter, the first SALCRA plantation converted large land areas from secondary forest - where people cultivated some of the land with paddy and fruit trees, and used it as hunting ground - to non forest. All this land use gave way for the large-scale oil palm plantation, marking a major transition in the landscape. In the Antayan Keropok area no primary forest, and only a small part of secondary forest, remains. As seen in figure 13, this general trend goes far beyond the boundaries of Antayan Keropok.

A collection of demographic- and land use data in the village had been gathered by the Headman and his wife. Land use data from this collection can be seen in figure 14. Almost half of the village's 1,210 hectares is oil palm plantation. It was mentioned in the timeline session that in 1997, 45 out of the village's 55 joined SALCRA, with the remaining ten joining in 2002. The village has since expanded, and the number of the newcomers who have joined SALCRA is unknown. Although when interviewed the Headman stated all 69 households are now a part of SALCRA and RISDA, according to the interview with RISDA, 65 households are involved with RISDA. This discrepancy could be explained that some individuals are considered part

of a household involved with a GPP. There is no data on how many of the 376¹ individuals are a part of GPP - it is only household data.

Rubber was not included in figure 14, but the land area cultivated with RISDA rubber can be seen in figure 15. It should be stressed that all the RISDA plantations were previously cultivated with rubber, which has now been replanted. The land area cultivated with RISDA rubber in Antayan Keropok is around 55 hectares with, oil palm plantation dominating as largescale plantation.



Land use in Antayan Keropok 2015

(hectare)

Figure 14: Land use in Antayan Keropok 2015.

¹ Demographic data from 2014 (see appendix V)



Figure 15: Current land use and buildings in Antayan Keropok from men's mapping session.

There has been no conversion to oil palm in Antayan Keropok since 2006. Since 2015, the villagers have chosen to cultivate their land with RISDA rubber, which we found interesting as rubber prices rubber have dropped 68 percent from 2011 to 2016 (Indexmundi 2016a).

According to the Headman, the difference between SALCRA and RISDA is that the villagers receive 100 percent of the profit from RISDA whereas you have to share the profit from the oil palms with SALCRA, which is 30 percent of the profit to the villagers. RISDA further elaborated that their involvement with a community goes beyond replanting rubber trees. They subsidise the cost of fertiliser and seedlings, invest in local businesses, provide workshops for good agricultural practices, motorbike maintenance and welding and promote village women's groups. Differences between rubber and oil palm as crops may also be a factor as a rubber plantation can last 50 or more years, compared to oil palm's 25 and rubber can be tapped everyday whereas oil palm is harvested every two weeks.

3.3 Environmental impact

The following sections will present and discuss the main findings of our natural science methods applied in the field. The villagers perspectives on some of these changes will later be phrased in section 3.4.

3.3.1 Soil quality

Conversion of secondary forest to oil-palm plantation is a major land-use change. As SALCRA participants receive a land title at the end of their contract, we wanted to see the effects plantations may have on soil quality which would hold some implications for the stakeholder.

Here we analyse bulk density, pH, Soil Organic Carbon (SOC) and Permanganate Oxidisable Carbon (MnoxC) using the Kruskall-Wallace test to test between all sites followed by a Mann-Whitney U to test for differences between the forest and both plantations as a whole.

Bulk Density

Although there is a trend for increased bulk density from secondary forest to oil palm plantation (figure 16), this was only proved significant at depth C (p<0.004). This is consistent with results from a past study showing a significant increase in bulk density when changing from swidden agriculture to oil palm plantation (Bruun et al. 2013).

pН

pH values for the sites ranged between 3.96 and 5.91 (figure 17). No significant difference was found between any of the sites at any depth, however a trend was found at depth C for site 3 to have a higher pH when compared to both sites 2 and 3.

Soil Organic Carbon

Despite figure 17 showing a clear general trend for decreasing SOC in relation to depth, no significant difference was found between SOC at the different sites At depths A and C, site 3 shows higher SOC than sites 1 and 2. Whilst the difference between sites 1 and 3 is unexpected, an increase in SOC between a 10 year plantation and a 19 year plantation agrees with Tanaka et al. (2009) that despite initial losses in SOC on establishment of an oil palm plantation, these losses are recovered with time. We also observe site 3 to have higher SOC content at all depths although this difference was also proved insignificant.

MnoxC

MnoxC was measured for all samples, however, results for site 2 are missing in figure 18 as there was soil in the colour sample, giving it a darker colour and therefore a higher absorption. We therefore left site 2 out of the results and compared sites 1 and 3. No significant difference was found at any depth although site 3 exhibited consistently higher MnoxC in topsoil (depth a), a trend which corresponds with Bruun et al. (2013) in a similar study in Sarawak.



Figure 16: Average bulk density of the soil at each site and depth where 1,2 and 3 denote the sites 19 year oil palm, 10 year old oil palm and secondary forest, and a,b,c denote the sampling depths of 0-10, 10-25 and 25-40 cm respectively.



Figure 17: Average pH of the soil at each site and depth where 1,2 and 3 denote the sites 19 year old oil palm, 10 year old oil palm and secondary forest, and a,b,c denote the sampling depths of 0-10, 10-25 and 25-40 cm respectively.



Average Total SOC (mg cm⁻³)

Figure 18: Average total SOC of the soil at each site and depth where 1,2 and 3 denote the sites 19 year old oil palm, 10 year old oil palm and secondary forest, and a,b,c denote the sampling depths of 0-10, 10-25 and 25-40 cm respectively.



Figure 19: Average MnoxC of the soil at each site and depth where 1,2 and 3 denote the sites 19 year old oil palm, 10 year old oil palm and secondary forest, and a,b,c denote the sampling depths of 0-10, 10-25 and 25-40 cm respectively.

Very few significant differences were found between our results which may be a result of the low number of sampling sites or errors in choosing the sites. We observe an overall increase in soil bulk density which may hold implications for farmers not wishing to renew their contract with SALCRA after 25 years as a high bulk density may hinder a crops' ability to establish an effective root system.

pH was found to be acidic at all sites which is common across tropical soils, though the significantly low pH at depth C in sites 1 and 2 may be an indicator of the adverse effects large-scale plantations. It is agreed

that a pH of between 5 and 7 is optimal for plant growth, ensuring the highest availability of nutrients (Brady and Weil 2014).

Changes in concentration of SOC is used as a parameter in measuring long term effects of LUC (Bruun et al. 2013). We observe a substantial loss in SOC at depth A between site 3 and sites 1 and 2 figure 17, a finding in line with Bruun et al (2013) who found topsoil SOC stocks to be 50 percent lower after 15 years of oil palm in Malaysia, and with Sommer et al (2000) who reported a 30-43 percent loss under oil palm in the Brazilian Amazon.

Although total SOC is useful in assessing long-term changes to soil carbon stocks, measuring MnoxC levels in topsoil was suggested to us as a more accurate measure of land use induced changes in soil quality and carbon stock. The results mirror those of total C with a substantial loss in MnoxC between site 3 and site 1 and depth A. In future study it would be interesting to assess MnoxC as a percentage of SOC in the three sites to get a better picture of the extent of the loss.

Finally, whilst soil quality can be measured using technical indicators (TISQ), Local Indicators of Soil Quality (LISQ) are useful understanding a farmer's choice in land use (Barrios 2006). Therefore, in a future study, we would assess farmers' perceptions in soil quality with TISQ.

3.3.2 Water quality

The oil palm plantation in Antayan Keropok is maintained by SALCRA + known to use fertiliser and pesticides on oil palm (SALCRA 2016). As such, large-scale plantations can affect water quality through run-off and leaching of nutrients, pesticides, organic matter and sediments (Minnesota Pollution Control Agency 2008).

In our case, the physical changes were clear between sampling spots. Before the plantation water was clear, becoming browner the farther you go into the plantation indicating a decrease in water quality. Figure 20 displays results from the three sampling stations (see chapter 2.6 and appendix VII for further explanation on the used method).



Figure 20: Water quality index and results from Antayan Keropok.

The parameters used to calculate the WQI determine whether water is polluted or unpolluted; an unpolluted river should be Class I, and a heavily polluted river Class V (Tay 2015:12). As seen in the results water quality decreases downstream. Station 1 is Class II whilst station 3 is Class IV. Further indication of a river's water quality include the concentration of heavy metals, pesticides, nutrients and coliforms. However, these parameters are only assessed subjectively to determine the class of river (Tay 2015:12). In appendix VII a table of all the analyzed data can be found with a comment on the changes for each parameter from the three different stations. The most significant changes will be analyzed in the following.

Table 3: Nutrients results from the three water sampling stations in Antayan Keropok.

Nutrients	Station 1 - upstream	Station 2 - middle	Station 3 - downstream
NH ₃ -N (mg/L)	0.02	0.15	0.16
NO_3 -N (mg/L)	0.00	0.00	0.02
NO ₂ ⁻ -N (mg/L)	0.01	0.02	0.03
$PO_4^{3-}(mg/L)$	0.09	0.37	0.00

Water bodies require some nutrients to be healthy, but too much can be harmful (Minnesota Pollution Control Agency 2008:1). As seen in table 3 there is an increase in nutrients from station 1 to 3, associated with the use of fertiliser in the plantation (Cleophas et al. 2013:71). The only exception is phosphate for which there is an increase followed by a decrease. This result is expected to be proportionally lower due to station 3 being a larger area. The result of 0 mg/L can be assumed to be a measurement error. The
ammonical nitrogen goes from a class I to a class II river; water quality is therefore not significantly influenced by nutrient leaching from the plantation, but there is a measurable impact.

Chemical Oxygen Demand (COD) indirectly indicates how much degradable matter is present in the water. The higher reading the more polluted the water (Tay 2015:6). COD goes from 0.00 mg/L at station 1 to 208.5 mg/L at station 3. In relation to the WQI the COD goes from a class I to a class V river, indicating a highly polluted river.

High COD correlates with a low Dissolved Oxygen (DO). The DO drops from 7.03 mg/L at station 1 to 0.15 mg/L at station 3. As algae die and decompose, the process consumes more DO. When levels in DO go below 5.0 mg/L, aquatic life is put under stress, resulting in death of larger fish below 2.0 mg/L (Ji 2007:261). Therefore, the state of the river at station 3 is very poor. COD and DO can also go some way in explaining why the water is more acidic at station 3 than station 1. Decaying of organic matter such as leaves and dead trees releases humic acid into the river stream which decreases the pH of the water (Rim-Rukeh et al. 2006:258).

TSS measures of turbidity whereby solids cause the water to be milky and brown in colour due to light scattering from very small particles in the water, which can be an indicator of soil erosion. TSS rapidly increases from 100 mg/L to 5372 mg/L - means it goes from a class III to a class V – exceeding the scale max of 300 mg/L (appendix VII). This explains the changes in the river's physical appearance.

A major limitation of the present study is that sampling was conducted in one day. Release and entering of nutrients and pesticides into a water body is very dependent on rainfall as it acts as a carrier of the pollutants. Therefore, the major rainfall in the area in the days leading to the sampling may had had to an effect on our results. Furthermore, we do not have any samples from previous years and as such cannot measure change in water quality over time and we did not compare our results with other land uses. Moreover, some of the results show an increase at station 2 and then a decrease at station 3 which may be due to a newly planted field next to the sampling station.

3.3.3 Above ground biomass and biodiversity

An FRA for AGB indicates that secondary forest in Antayan Keropok contains significantly more AGB when compared to oil palm plantation at 179,6 metric t/ha, and 46,5 metric t/ha respectively (see appendix VI). With carbon content typically being 50% of the dry biomass (Gibbs et al. 2007:3), carbon stock amounts to 89,8 tC/ha in secondary forest and 23,3 tC/ha in oil palm plantation.

AGB in secondary forest was calculated by using an allometric equation that has been developed for malaysian forests (Soepadmo 1987). The calculation of AGB for oil palm plantation is based on a study by Khalid et al. (1999).

In addition to AGB assessment, 67 tree species were counted in the secondary forest out of total of 98 trees with a DBH >5 cm. In an oil palm plantation only one tree species is present. So assuming that conditions are similar in the reference place and in the oil palm plantation there is a 100 percent loss of tree biodiversity. As a consequence the ecosystem is completely changed and with this change follows a decrease in wildlife, because their food source and natural habitat disappears (Fitzherbert et al. 2008). This can have the effect that both rare plant- and animal species might reach extinction. For instance we saw a young ironwood tree (*Eusideroxylon zwageri*) on our ethnobotanical walk and was told that this tree is now rare in the region because it takes so long to grow. Logging has played a role in this case but by clearing secondary forest in favour of oil palm plantation the habitat of the tree disappears.

The results from the FRA carried out in the field can only be considered indicators due to several biases that might have influenced the results. Firstly, the topography between the reference place and the oil palm plantation was different, as the sample plots in the secondary forest were located on a slope and the oil palm plantation plot was generally flat. The variance in slope can result in different conditions for plant growth and thereby also biomass. On a slope the spherical area is smaller, which means that the amount of sunshine is smaller per area than on a flat plot, resulting in fewer trees per area (Brofeldt, n.d). This bias will however only drag our result in a direction of a smaller biomass in the reference place than in the oil palm plantation. Another factor related to the topography is that on a slope nutrients in the soil tend to be accumulated at the bottom of the hill (Chapin III 2011), which can lead to less fertile soil on slopes. Again this will lead to a possible lower result in the secondary forest examined in this study, which only strengthens our conclusion that biomass is lost in the transition of LUC from secondary forest to oil palm plantations.

As described in section 3.2, before the oil palm plantation entered Antayan Keropok the large-plantation area was not only covered by secondary forest but some plots were cultivated with paddy rice, fruit orchards or rubber trees. It should be noted, that depending on the previous land use, in some cases the conversion to oil palm plantation might actually result in an increase in AGB (Ziegler et al. 2012). Due to lack of precise information about the size of the cultivated areas in relation to the secondary forest areas, it is not possible to present a number representing how much the AGB has changed from just before the oil palms were planted until the current situation. Our impression was even though the previous land use varied, a

large area was covered with secondary forest. Indicators can thus be given about the impact of conversion from secondary forest to oil palm plantation.

The calculation of oil palm biomass is based on Khalid et al. (1999) where a few palms were cut down and weigh for their water content. Trees measured in the study have very little difference between their dry and wet weight, suggesting that there is little variance in water content between palms. However, this is still a matter that needs to be kept in mind when biases are discussed such as differences in soil type. Lack of literature has in this way been an issue.

To sum up, there is a major loss in tree species, and it can be anticipated that because of this there is a decrease in wildlife. It is also clear that AGB is decreased in the conversion from secondary forest to oil palm plantation. This means, that less carbon is stored to the biomass and more emitted to the atmosphere, contributing to climate change. Due to the lack of knowledge about the size of forest cover prior the plantations, we are not able to present the exact loss of biomass. Furthermore, we have only looked at the AGB rather than the whole biomass (including the below ground biomass), which would have given us more information about the total carbon release. This, however, is discussed in the soil analysis.

3.4 Changes in everyday life

3.4.1 Consequences of forest loss

Through our ethnobotanical walk in the secondary forest we identified several plants with different household uses (table 4).

Scientific Name	Local Name	Uses
(unknown)	Kemedu	Root used for rope
Elateriospermum tapos	Perah	Seeds eaten for protein
Shorea atrinervosa	Pongias	Hardwood used for pepper posts
Alstonia beccarii	Pelai	Soft wood for sculpting (knife handles etc)
Syzygium arcuatinervia	Ubah	Hardwood used for window/door frames

Table 4: Uses of forest resources, identified species from ethnobotanical walk

Tetracera indica	Empelas	Leaf used as natural sandpaper
Gnetum gnemon	Sabong	Vegetable used to make soup
Arenga undulatifolia	Aping	Palm used for food (shoots or 'palm hearts')
Achasma megalocheilos	Tepus	Wild ginger (one of 4 foraged)
Bambusa spp.	Bamboo	Shoots for food, used for traps, snares and alarms and was also used for building the first school.
Ananas comonus	Pineapple	Fruit
Calamus caesius	Takin/Raga	Weaving
Staenchlaena palustris	Midin	Jungle fern, very delicious fried with shrimp paste
Castonopsis foxworthy	Beranga	Tropical chestnut
Eusideroxylon zwageri	(unknown)	Hardwood traditionally used in building of houses, but is still used for example to make toys for kids.

One consequence of clearing forest is the disappearance of these resources, making people more dependent on external inputs and therefore more vulnerable to fluctuating market prices. A further consequence of the removal of forest areas is the loss of local knowledge about flora and fauna. We were told by the Headman, for instance, that techniques for making traps and snares was something he learned from his father and grandfather, but nowadays parents do not teach children these things. We experienced that some villagers still use the forest areas that are left to collect different goods such as vegetables, fruits and materials for handicrafts. Before the oil palm plantation was established villagers used to hunt deer and wild boar, but today they can only hunt smaller animals such as monkeys and squirrels. We therefore know villagers still use the forest for some hunting and gathering, however we cannot say to what extend. Along with materials, forests also provide services. For instance the pepper farmer mentioned that with the disappearance of the forest it had become more difficult to find shade. Forest cover helps to prevent erosion and at the same time provides clean water (Camp and Heath-Camp 2009), as opposed to oil palm plantations as our results suggest. The same farmer noted that whilst the river was previously used for fishing, bathing, and washing clothes, this is no longer the case.

The positive effect natural forest

Textbox 2: Examples from the field

According to the women in Antayan Keropok they traditionally used different plants from the forest to make baskets, but nowadays they are also using a lot of plastic. Shortage of these materials might not be the reason for this. It could just as well be because plastic is more durable and last longer than the former used materials.

A pepper farmer told us that when he was a child, there used to be much more forest and many more animals were present in the area. He then used to go hunting with his father, but today many animals have disappeared along with the forest, and now he does not go hunting in the area anymore. However when we asked if he was sorry about this change, he said that he was not, because he prefer not to be dependent on hunting solely.

vegetation has on water quality was also something that the Headman brought up during the FRA. He said that during the era of the former Headman, the area had been widely logged, which the current Headman claimed had consequences on the water quality. The villagers strongly opposed the logging and fought to stop it. Visibly saddened, the Headman explained how the logging companies "ruined the forest" cutting down large trees for timber and everything else to clear land for roads and camps, leaving "no trees left to hold the rain". The roads became muddy and the mud ran down the hill down to the river, polluting the village's source of drinking water. Further, the Headman and a farmer talked about a more recent change in water quality, describing how the color of the water has changed over the years, becoming more brown the further into the plantation. This visible change may be one of the reasons why people no longer use the river.

Water pollution may not, however, be the sole reason behind a change in use of the river. Before the oil palm plantation people had paddy fields and orchards in the area, and therefore a reason to go there. As the river now flows through a plantation, it may be less convenient to access. Development in the village may also be a factor with the introduction of fish ponds and a gravity fed water system.



Figure 21: These days, the river in Antayan Keropok is not used for fishing and swimming as it used to be. Instead, the villagers establish fish ponds between the houses, in which they can farm and catch fish.

3.4.2 Cultural identity related to the land

"The land is not just a geographical area; it is also a lived experience, and tales and legends, village histories and important events, link the land to the people in a profound way that gives people a sense of belonging to the land, just as the land belongs to them." (Colchester et al. 2007:9).

Rituals and offerings are an integrated part of the everyday life in Antayan Keropok. The tradition is to have a shaman or 'Manang' in the village who takes care of the "mirings" - rituals performed whenever there is a social or land related demand. The importance of land is ever present in Antayan Keropok when interviewed, both the Manang and the Headman described themselves as a farmer, mentioning their other occupations only when asked.

"Land is life" (2007) describes how, in most Iban cultures, land is a fundamental to how the villagers view and understand themselves. This became very clear in our fieldwork from informal conversations, where the villagers built their lives around their fields; it was easy to see how precious their land was to them - land is more than a resource used to make money. Every year there is a ritual where the Manang in Antayan Keropok performs a harvesting miring² to call spirits to increase yield from the rice paddies. In the interview with the Manang, he described that before any crops are planted, the farmers ask the spirits for permission and this was also the case for the oil palm plantation. If the oil palm did not bloom, the villagers would know that was not fully accepted and they would have to do another miring. According to the Manang you will become sick if you do not ask the spirits before planting and only a Manang can cure you. Manang do not receive any salary for performing mirings, however, as an integral part of Iban culture, they sometimes receive gifts from villagers.

Textbox 3: Guna Gayau

During our fieldwork we witnessed a ritual called Guna Gayau1 (a 100 year old tradition), which was last done in 2012 and was done this year because of heavy rain in the area. The Headman from Antayan Keropok and the headmen from four nearby villages decides when it is time for a miring at the Guna Gayau, as they all originated from Antayan Keropok. Guna Gayau is placed just next to the oil palm plantation and has the shape of a crocodile, made from clay. The place is surrounded of forest and the crocodile is placed in a hollow, but even with heavy rain, the tradition tells that the place never floods. The crocodile was made by 17 year old boys for fun, but an old man from the village dreamt about it and saw that the place had a spirit. The crocodile is believed to take care of the villagers, so the villagers would never kill a crocodile entering the village. In the interview with the Manang he explained that the villagers benefit from the Guna Gayau and the old saying is that human originates from the crocodile. Because of the Guna Gayau, there is now a common respect between crocodiles and the villagers.



Figure 22: Villagers re-sculpting the Guna Gayau. Coins and notes were tucked under the wet clay as offerings from the villagers joining the ceremony.

 $^{^{2}}$ For this miring, the Manang calls the spirit through a prayer and spins a chicken seven times around, before he cuts its throat.

The Manang embodies the connection between beliefs, agriculture and nature itself; soil and spirits are equally important in ensuring a good harvest. This connection had been affected by LUC with the Headman on one occasion recalling that when he was young, the forests were full of spirits who would make you lost when you crossed their paths. Now, as he explained, there are much fewer spirits, as much of the forest in which they live has been cut down, to, among other thing. create oil palm plantations.

3.4.3 Living standard in the village

Despite the adverse effects of clearing forest (described earlier), through household interviews and informal conversations we learned that the villagers in general seemed to be glad SALCRA came to Antayan Keropok. They said that it brought along development and a better life.

The key actor in introducing SALCRA to the village spoke of how all the villagers have a better living standard than before because of SALCRA. In the timeline session, it was mentioned how the involvement with SALCRA created an economic boom for the village. This was also a reason for the other villagers joining in 2002. Through many informal conversations people expressed how involvement with SALCRA resulted in better roads in the area, and in this way improvement of infrastructure. However according to the Headman, the roads in Antayan Keropok are damaged because of heavy SALCRA trucks, a statement reiterated in a household interview. During our fieldwork, we visited a few other villages in which SALCRA is not involved, but which however also had increased living standards with electricity, tar sealed roads and better water supply within the last 20 years. A reason for the villagers' perception of SALCRA as the reason for development might be because SALCRA's entrance to the area coincided with a general improvement in living standards.

As a result of being a part of SALCRA, the villagers receive dividends twice a year. Several villagers spoke of how nice it is to get an income without working themselves in the field. An elderly farmer spoke of how SALCRA helps him earn money, cultivate his land and also give him a land title without having to do the hard work himself. In the calendar session the participants marked dividends from SALCRA as a major event. Furthermore, in the two months when the dividend was received, the income line on the calendar went up greatly. It can be assumed from these different experiences the villagers are greatly appreciative of the income they get from their oil palm. Moreover, some of the women spoke of how they had more time to do handicrafts than before, because they do not have to cultivate so much land. The chairman of the regional SALCRA committee and resident in the village told how a lot of villagers in Antayan Keropok have more land than they can cultivate themselves, which makes SALCRA a helping hand. From the

household sketch, we experienced that in some cases farmers could rent out land which before was uncultivated in the form of secondary forest.

According to the Headman and several villagers taking part in the ranking session, income have become higher since joining SALCRA. Participants in SALCRA are now been able to buy scooters and cars, and build better houses. The farmers now also have more time to look after their other fields, which is important in identifying themselves as farmers.

Whilst SALCRA's role in bringing development to the village can be discussed, what is clear is that some participants now receive a higher income. However, as will be discussed in section 3.5.2, some villagers are yet to receive dividend meaning not every participant has seen a change in living standard as a direct result of SALCRA.



Figure 23: Villagers driving around on their scooters and in a car.

3.5 Affiliation towards land

A long time before the first oil palm plantations in Antayan Keropok were planted by SALCRA, the common idea about indigenous land in Sarawak, according both to the government (The Land Code) and the first villagers themselves, was that the land had an intrinsic value connected to history, culture and livelihood. By this virtue, according to the NCR Land Code, the land could be claimed by the natives even if it was fallow, if it hosted burial sites (but was otherwise uncultivated) or if they planted fruit trees (Laws of Sarawak 1999 Part II, Subsection 5.1-2). However, in recent years, a new discourse on ownership of natural resources has gained ground, strongly linked to a free market idea with an ambition of preserving nature by putting an economic value on it. Francis Loh Kok Wah and Joakim Öjendal (2005) criticize how the palm oil industry is geared directly towards global export markets as a response to the demise of the logging industry in Sarawak:

"To ensure that these large plantations have access to secure land, the Sarawak government has proposed a land scheme aimed at transforming 'wasteful and unproductive' Native Customary Rights (NCR) land into economic assets (...) there has been much official pressure put on local natives to allow their lands to be used for large-scale development of commercial oil palm plantations." (Loh and Ojendal 2005:185)

When villagers give up their land for a period of time, they also lose the right to manage it themselves. Once land has been assigned to produce cash crops in a GPP, it becomes a player in the global market, and its assets can be bought and sold (Fairhead et al. 2013:8). It is important to note, that even though NCR land is leased and not sold, it is kept in custody by GPP's for the agreed time. The local communities lose access to the land and we observed that the contracts signed are fundamentally changing the local communities' relation to the land (Barbesgaard 2016:7).

But what happens when nature is no longer regarded to have a value in itself, but only based on the resources it holds? Is this a notion that is shared by the villagers in Antayan Keropok, and what are their thoughts on the transition? Textbox 4 shows how words shape our perception of an environment, and how our work in the field taught us, that perceptions of land affiliations can only be understood in relation to the cultural, historical and social context in which they are defined.

Prior to our visit to Borneo, we had learned land ownership was a sensitive topic, especially in relation to indigenous land rights. Academic literature as well as Bornean news media suggested that the issue in Sarawak is by no means simple. But during our stay, it gradually became clear that it was not enough to

understand general disputes over land, if we did not understand how the local people, who posed the core of our research, contemplated land and their relation to it.

Through our focus group session, we learned that in Iban and Malay language there are very specific terms for different land affiliations. For example, land leased to GPPs would not be considered NCR land, but title land, even though the title was not yet in hand. As there is not a direct translation for land ownership in Iban, we used the Iban term "*Orang ti empu tanah*", which means "*the one who owns land/property*", as a headline to access the focus group and as a term we used to collectively refer to translate types of relationship with land as *land affiliations*.

Textbox 4: Iban concepts of land affiliations, based on villagers' explanations

Orang ti empu tanah

"Land is shared", "It is important to plant something on the land, so no-one will disturb it", "Those who were given the land should protect it in any way they can", "We are not encouraged to sell the land because it is inherited", "A way to protect the land is to plant (...) something that lasts long, so it shows that someone owns it" and "Those who don't have any land can look for land in the forest".

When presented with the task of explaining *Orang ti empu tanah*, it became clear, that the villagers attached historical meaning to the word. The patchwork of statements attached to the concept shows that ownership over land comprises not only legal property, but something very fundamental defining the relationship between nature and people - something that holds the essence of being a person and a community living on and protecting the land.

Adat

"Things you should and shouldn't do", "Miring ceremony", "The land has its own spirit, and if you want to do something to the land, you have to ask the spirit", "You can do anything to the land, as long as you don't leave it empty" and "Adat knowledge is inherited through generations".

We knew adat refers to customs, laws and norms in a community, and can be applied to social, economic, cultural, spiritual and legal life. The focus group revealed something else when we asked how adat could be understood in relation to land. The words and sentences attached to adat disclosed that land laws and rights are not only decided and upheld by legal practice. Instead, adat teaches us that the land has its own transcendental rules and practices, which cannot be negotiated, and that this knowledge is taught on a very early stage in a person's life. Hence, adat is fundamental in Iban society, and it proves that any law or jurisdiction should be aligned to fit adat.

Pemakai menoa

Pemakai menoa can be translated as the people who share the land. Attached to the concept was: "On shared land, everyone in the village can collect resources", "If you have moved out of the village, and sell fruits you have collected [on shared land], you must share the profit [with the villagers]", "Community decisions on what should happen to the land" "If everyone agree, the land can be sold" and "In Antayan Keropok, this type of land has been sold to SALCRA".

From the focus group we learned that the decisions for pemakai menoa, which by definition is communally owned, can only be taken collectively, which all members of the community or village approving. It does not, however explain how the boundaries around such a community is drawn, and it does not explain which land in particular carries the title pemakai menoa - and hence which land was "sold" to SALCRA. Neither does it tell us if and who profits from this agreement. Along these lines, it underscores the trend that we have experiences on several occasions during the field work: That the land leased to SALCRA changes status in the process: It is no longer considered to be pemakai menoa, but instead to be under ownership of SALCRA, even though, legally, the land is still NCR land.

Pulau galau

"You cannot disturb this land, no matter what", "The border land between villages", "The land belongs to no-one", "The knowledge is inherited through generations", "The kampongs [villages] take care of it together", "No disturbance means no cutting down trees, planting trees or disturbing the structure", "Anyone can go here and collect fruits", "The belief is that the first person to disturb the pulau galau will become sick because of the spirits".

From the review of adat, it became clear that spirits are part of the Ibans land affiliations. This became even more evident, when the focus group participants explained the meaning of the Iban concept *pulau galau*. The quotes illustrate that some land is sacred by origin, that there are natural or spiritual sanctions ingrained in these lands. The knowledge about these sacred lands are not subject to a legal document, but to oral tradition. At the same time, pulau galau is the responsibility of no-one and everyone.

NCR land

"The land without a title", "If it's owned by the government, the government can take over the land", "Our grandparents said: This is your land - now do anything you can to get a land title", "Even though it is not officially our land, we believe that the government will tolerate that we use it because we have lived here for so many years", "We just know that we own it [the land]", "Antayan Hill has been sold to the government", "In Antayan [Keropok], there are no land titles on NCR land yet, because the old people didn't know how to get the title", "Iban people are open minded so they let RISDA plant on their land", "The NCR land can be protected by its owner", "It is possible that the government can take over the land", "We are not so afraid of the government - more of companies"

The concept of NCR land has been very present throughout our research, but it was not until letting the villagers explain their perceptions of the concept, that we learned how big an issue, and how many ideas are actually attached to the NCR land. We understand now, that NCR land is a very immaleable legal

term, which on some parameters imitates adat, while still being contingent on a set of more rigid laws and privileges. Some of the perceptions of NCR land are directly opposed to official NCR law (Laws of Sarawak 1999), and our informants in the village were rarely able to explain to us how their rights were protected under the concept. In effect this make them less able to protect and claim these rights if they should be violated.

Land title

"Land is secured from other people", "We need to pay the government to do a land survey in order to get a land title", "Both SALCRA and RISDA promise to give a land title", "Some people in Antayan Keropok who have leased to SALCRA have gotten a land title. But some have not", "Both SALCRA and RISDA are part of the government, and even though we are a little insecure, we believe they won't take the land", "Official title, which can be passed on from generation to generation", "Those who have the money to get the survey will get the title first"

The importance of the land title cannot be overstated, and as we see in the quotes, both from discussions of land title and NCR land, it is a general perception that if possible, one should try to obtain one. It also becomes clear that the villagers idea of the means of obtaining such land title is not consistent with official laws and regulations, which the villagers as native Malaysians are subject to.

The villagers' definitions of the Iban terms related to land illustrate the complexity of the issue. As land is passed on in generations, a lot of tradition and history is related to the land, which according to the villagers and the 1958 Land Code make them entitled to the land. Now, however, for the villagers, it is becoming increasingly important for the villagers to have their land surveyed. It was a challenge for us to capture the essence of this issue, as land affiliations bring out different understandings and reasons for joining GPP. For example, as we learned, the people, signing these GPP contracts often comply because of the prospect of obtaining a legal land title to the land being leased. A farmer in Antayan Keropok, who was former a politician and recently a member of a NGO protecting indigenous land rights, told us villagers participate in GPPs to keep their land as the government stipulates cultivation is essential in order to maintain NCR. For many, communally inherited land, pemakai menoa, covers more than can be cultivated by the people themselves. Therefore, as an elderly farmer also states, the government's offer to rent land for GPPs for extended periods come in handy. The villagers are, in effect, ceding their native lands in order to keep it. A former shopkeeper in the village stated that the only reason he has signed his land over to RISDA is in order to obtain a land title, he had no financial motivation. This was a common opinion in the village which we saw as problematic. Whilst it underscores the importance land titles hold to the villagers in Antayan Keropok, it proves some of the villagers remain unaware RISDA do not provide land titles.

3.5.1 Traditional land rights - a token right?

As mentioned earlier in this report, NCR law should give native Sarawakians legal rights over their land. However, the current policy practised by the government gives a strong signal that having NCR land without a land title is no longer enough for the farmers to legally claim land as theirs. Analysing our empirical data from the field, a pattern appears: Many land owners seem to quietly accept that the land code has been diluted, and that its contents no longer has the legal value it once implied.

Despite the current land policy, the villagers in Antayan Keropok still have no doubt that the ancestral land is theirs - whether it can be legally proved or not. However, the villagers are aware of a change in land policy and acknowledge they cannot fully protect their land without obtaining a title. As described in box xx and expressed by a farmer interviewed about NCR land: "*Our grandparents said: This is your land - now do anything you can to get a land title*".

This appears to be the only possible option for the villagers to finally obtain the sort of legal documentation, as although it is possible to buy a title from the Department of Land and Survey, a farmer member of a NGO dealing with indigenous land rights explained that option is simply unaffordable for most villagers, Therefore, he concluded, getting a title for their NCR land is easiest done by signing a contract with SALCRA.

Despite the shift in interpreting NCR at a governmental level, the traditional way of allocating land rights within village borders remains. The traditional customary law *adat* is used as a guideline, especially in relation to RISDA applications which the Headman has to approve before sending to RISDA officers. The Headman explained that in the case of land dispute problems within the village, which in Antayan Keropok is very common in the form of quarrels between family members, he always refers to *Adat Iban* - the Iban version of adat. For example, when siblings dispute their share of inherited land each, the oldest child is prioritised and given largest amount. Those family members who have put an effort into maintaining land, or those taking care of their parents, are also prioritised in inheriting land.



Figure 24: The traditional customary law Adat Iban, written down in 1993, is used to solve land disputes within the villagers in Antayan Keropok.

Even though villagers in Antayan Keropok still refer to the adat on which the Sarawak Land Code and thereby the NCR was built, it is evident, that the government in Sarawak is no longer satisfied with reference to NCR in claiming ancestral land rights. The clear perception by many farmers in the village, in this regard, is that a land title based on a governmental land survey is the only way the ancestral land can be protected.

3.5.2 An uncertain matter

In Antayan Keropok the GPP have been approved by the villagers in communal meetings. But even so, it is apparent that villagers are having contradicting ideas about the duration and the terms and conditions of the GPP contracts, and especially how they will get a land title. In the previous sections we have seen the importance of getting a land title and this seem to have been one of the main reasons to join the GPP. The villagers' contradictions in understanding their agreements with GPPs presented us with an atmosphere of uncertainty. In our interpretation of their reality, the importance of their affiliation with their land is intrinsically linked with the necessity of their having a definite future with it.

Despite signing a contract with SALCRA ten years ago, some households still have not yet received any dividends, despite their understanding that participation in the programs would pay equal to villagers who signed with SALCRA 19 years ago. Further, when some of the farmers were asked about the land they own,

the informant would not mention the land in collaboration with GPP unless directly asked directly. This could indicate that once the contract has been signed with either SALCRA or RISDA, the landowner has, (at least mentally) waived off the land - at least for the period the land is part of the GPP. Cultivation of land remains a factor in perceived ownership.

Textbox 5: The case of a pepper farmer

In a household sketch interview, a pepper farmer in the village talked highly about his pepper garden which is inherited and shared with his siblings. He also owns rice paddy and a rubber field (also shared with his siblings), which RISDA help to cultivate. According to the pepper farmer, this collaboration will give him a land title and still enable him to farm himself, which is an important part of his life. His main reason in joining RISDA was the land title. There was nothing on the land before, so he joined RISDA to secure the land from outsiders. If he grows rubber, he can tap the tree himself and earn money from it. He does not have any other wealth except the land, so this is the only thing he can pass on to his sons, and if the sons do not want to plant rubber anymore, it is up to them if they want to plant anything else, oil palm, pineapple etc. But this way the land can continue to be inherited in the family. According to the pepper farmer, if he did not ask help from RISDA, the land would probably be taken away from him in the future. Since RISDA is part of the government, the pepper farmer feels that he has already secured his land.

When asked why he is not part of SALCRA, he says; "once you joined oil palm, you won't be able to plant anything else (...) It's our culture to do farming". Later on it turned out, that he actually does have oil palm with SALCRA. He joined in 2006, but have not received any dividends so far. According to the pepper farmer, it is difficult to get in contact with SALCRA, but as far as he has understood it, SALCRA explains the delay in payments with the high maintenance cost of the plantation. The pepper farmer is not pleased with this explanation, and the reason why he did not mention the oil palm he leased to SALCRA in the interview, is that he do not wish to continue the contract. The fact that he did not mention in the interview, could also be due to the fact that he is not farming on it and has neither received dividends nor land title, and therefore he might consider it his land compared to his other fields. He still express that he is pleased with SALCRA in Antayan Keropok, as it has improved the community and other villagers, but not him as an individual.

In the case of textbox 5, the pepper farmer strongly believed he would get a land title through RISDA. Several other informants along with the Headman, the chairman for village's RISDA committee, seemed to share the same perception that RISDA will provide a land title. This misunderstanding is problematic when considering that getting a land title is one of the main reasons for villagers to join the schemes. Furthermore, in the village, perceptions on the duration of SALCRA contracts varied from 25 to 60 years,

and most villagers were not sure at what stage they would get the title. From our perception, this uncertainty was a major concern but did not seem to be a big issue for many of the interviewees. The pepper farmer just shrugged his shoulders when confronted with his own situation and implified that it was still an ongoing process. Perhaps the fact that some villagers, including the Headman, had received a land title from SALCRA gives confidence others that they will too.

4 Conclusion

In relation to the booming global palm oil market, this study aimed to focus on the local consequences from related LUC when engaging with GPP in Antayan Keropok, Sarawak. In the past 20 years, the village has been subject to major LUC - the biggest being the establishment of SALCRA oil palm plantation. It can be concluded, that the large-scale plantation has had impact on water and soil quality, as well as on aboveground biomass.

Effect on water quality is most likely due to soil erosion rather than nutrient leaching due to the increasing level of TSS. The level of COD indicates that there is a lot of decaying organic matter in the river, with aquatic life at station 3 under so much stress bigger fish are not likely to survive in the water.

Although results from our soil analysis yield few significant differences, general trends with regards to carbon stocks are in line with current literature. Bulk density is seen to increase whilst pH decreases, both of which could have adverse effects for farmers who wish to cultivate their own land once a land title has been granted. Further, we observe a decrease in both SOC and MnoxC in topsoil on conversion of secondary forest to oil palm plantation, showing an overall decrease in soil quality which, combined with measurements on above ground biomass, indicate a significant loss of carbon stocks as a result of this transition. The extent of the area of secondary forest prior the plantation is, however, unknown and therefore the exact loss in carbon stock cannot be calculated.

The large-scale plantation has resulted in the clearing of large forest areas and with this, there has been a loss in biodiversity. This loss has contributed to change in the villagers' everyday life. Although, many traditions are still passed on, this is now done in a different way and the clearing of forest, means a loss of forest spirits. Despite this change, villagers retain an intrinsic link to their land, mirings being a part of that, and they identify themselves as farmers.

Many villagers' living standards have improved since involvement with the large-scale plantations, but this was not shown to be their main motivation in joining GPP. Land title is shown as an important factor in why the villagers collaborate with RISDA or SALCRA as NCR is no longer perceived as enough to secure the land. By virtue of this, the local communities living on inherited NCR land are at risk of losing their land if they cannot provide a land title. We have shown this to incur two major issues; not all villagers leasing land to SALCRA received the promised dividends, and villagers collaborated with RISDA with the false impression of gaining a land title.

Our final observations revealed several paradoxes between villagers' perception towards their involvement with GPPs and what was actually carried out. Participation with the government was perceived to be negative, whilst perception of SALCRA and RISDA was generally positive, despite both having heavy government involvement. GPPs are considered to have had a positive impact on village infrastructure, whilst at the same time damaging the roads. Participation in GPPs has resulted in a better standard of living in the community, despite many villagers yet to receive dividends.

In a further study, it would be interesting to investigate what happens after the five year agreement with RISDA as we were only present for the initial phase. Most interesting for us would be to follow up on finding out how many of the villagers eventually receive dividends and land title from SALCRA and what happens to land leased to SALCRA after the initial contract. It would also be interesting to assess whether changes in the global economy will play an even bigger role in the future.

Whilst global economic development may have had local implications for Antayan Keropok, and despite government changes in land policy, what is clear is that the villagers remain rich in natural resources, knowledge and spirit.

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Appendix I: Overview of applied methods

Method	Samples	Data obtained	
Soil analysis	27 volume and non-volume specific samples. (three holes were dug in three sites, and three samples were taken from each hole).	Data from soil in a secondary forest, a 10 year old oil palm plantation and a 19 year old oil palm plantation. Parametres of soil quality: bulk density, pH, SOC and MnoxC.	
Water analysis Samples conducted in three sites - upstream, middle and downstream (three samples in each location).		Parameters of water quality: In-situ: DO, conductivity, salinity and pH. Ex-situ: TDS, TSS, BOD ₃ , COD, NH ₃ -N, NO ₃ -N, NO ₂ -N, PO ₄ ³ , TCC, FCC.	
Forest Resource Assessment	Five plots in reference place (secondary forest) and one plot in oil palm plantation. Identification of tree species.	Above ground biomass and number of tree species.	
Ethnobotanical walk	One trip (during FRA sampling in secondary forest)	Knowledge about uses of forest resources and villagers relation to spirits.	
Informal conversations & participant observation	Throughout the fieldwork	Mixed	
Key informant interviews	Six interviews	Mixed	
Household sketch interviews	Six interviews	Information about villagers' everyday life and their opinion on SALCRA and RISDA.	
Interview with RISDA	One interview at the region's head office in Kuching with the regional manager.	Information about RISDA's mechanism and vision and clarifying answers related to land titles and villagers involvement in schemes.	
Focus group session	One session	Knowledge about villagers perception to land ownership.	
PRA- Mapping session	Two (one group of female participants and one group of male participants)	Maps of current land use	

PRA - Ranking & seasonal calendar	One session (mix of men and women)	Knowledge about farmers crop preferences & land use with focus on activities and income.
PRA – timeline	A main session and a follow-up session.	Information about major changes related to land use in the village
PRA - Community walks	Two	Mixed (atmosphere, land use, village size etc.)

Appendix II: Interview guides

- GUIDE 1: Key informant interview guide 1
- GUIDE 2: Key informant interview guide 2
- GUIDE 3: Key informant interview guide 3

GUIDE 4: Household sketch

GUIDE 5: RISDA interview guide

<u>GUIDE 1: Key informant interview guide 1</u>

- 1. Introduction and personal info (including education and career)
- 2. Personal land ownership
 - a. Do you own any land? How did you get it?
 - b. Are you planning to pass the land for your kinds?
 - c. What do you cultivate? Are you cooperating with SALCRA (S) or RISDA (R)?
- 3. Major land-use changes
- . What have been the major land use changes in the village in past decades?
- a. What kind of influence the big development schemes (S & R) have had in Antayan Keropok?
 - 4. SALCRA and RISDA
 - What are the main achievement of S and R?
- a. What are the main problems of S and R?
- b. What could be the alternatives for S and R?
- i. Alternative way to do the scheme?
- ii. Alternatives for the schemes?
 - c. What does it mean that S and R are governmental organizations (vs. NGO/having nothing)?
 - d. What can be done at political level to change/improve schemes/land right issues?
 - 5. Current situation
 - . How much influence villagers have on deciding about the schemes (joining the schemes)?
 - a. How many households are part of S or R currently?
 - b. 45 households joined S in 1997. What do you think is the main reason that made almost all of the households at that time join the scheme?
 - 6. Future
 - How do you see Antayan Keropok looking in the future? In 5 years? in 10 years?

a. What do you hope Antayan keropok would be in the future (still mainly farming or going to some other directions)?

<u>GUIDE 2: Key informant interview guide 2</u>

- 1. Introduction: Personal information
- a. What is your name? Occupation?
- b. And you are manang in training? What does it mean?
- c. How long does it take to become a manang?
 - 2. Guna Gayau
- . What is it? (The story)
- a. Why do you have miring at Guna Gayau?
- b. How often is it?
- c. Can you describe the practice/the ritual?
- d. Is the miring always the same?
- e. As a manag do you do any preparation?

(Extra questions during the interview: Who decide when it's time for miring at Guna Gayau?)

- 3. The place
- a. Is it true that the place never floods? Why?
- b. What happened when the oil palm was planted?
- c. Did you have to do a miring?
- 4. Link to the ancestors
- . Can you tell me about the spirits?
- a. Did any of these rituals changed with the introduction to christianity?
- b. Can you tell more about the common respect between human and crocodile?

GUIDE 3: Key informant interview guide 3

- 1. Introduction: Personal information
 - d. What is your name? Occupation?
- e. Can you tell us about your position as headman?
- 5. Village charasteristics
- . How would you describe Antayan Keropok?
- a. What are the main activities in the village?
- b. What is unique about Antayan?
- c. Are there any challenges for the village?
- 1. Historical overview
- . When was the village established?
- a. Can you tell us about some major events that had great importance for the village?
- b. What are the biggest changes the village has experienced the past 10 years?
- 2. Land use
- . Which crops do you grow in the village?
- a. How do the farmers manage their land?
- b. How important is farming to the people in the village?
- c. What have been the major land changes in the past few decades?
- d. How has the land been distributed between the households?
- 3. SALCRA/RISDA
- . Who is involved in the oil palm plantation?
- a. In which ways are Antayan affected by SALCRA/RISDA?
- b. Who negotiates with SALCRA for the oil palm scheme?
- c. When is the completion/end of contract of the oil palm scheme?

- d. How does Antayan benefit from cooperating with SALCRA?
- e. How has the oil palm scheme had an influence on the villagers daily-lives?

GUIDE 4: Household sketch

- 1. Personal information (incl. name, age, education and main occupation)
- a. How big is your household?
- b. Do you own any land? If yes, how did you get it (inherited/bought)?
- c. How long have you been farming?
 - 2. Farm sketch (at this point, ask interviewee if he/she can draw a map over their farm) What are the fields located?
- . Where are the fields located?
- a. How big an area do you cultivate? Distributed on different crops?
- 3. Land-use
- . What crops do you have? How long has it been a (pepper) field? If changes, what was before?
- a. How can you protect/secure your land? Do you e.g. have a document/title?
- b. Are you planning to change the crops?
- c. Do you own any land outside the village?
 - 4. Input-output (input e.g. fertilizer, tools, labour)
- . Which crops do you use in the household?
- a. Which do you sell on the market? The best crop to sell?
- b. What do you "use" for cultivating the different crops? E.g. Types of fertilizer?
 - 5. Daily-life

. Do SALCRA/RISDA help you with farming (in terms of profit, debt and a feeling of being a contract worker on your own land)? Why/ Why not?

a. Besides farming, do you have any other source of income?

GUIDE 5: RISDA interview guide

- 1. General information and background of RISDA
- a. Name and position at RISDA
- b. Mechanism of RISDA how does RISDA work?
- c. Main goal of RISDA
- d. Why are development projects, such as RISDA, a good idea?
- 2. LU and benefits of RISDA
- How does RISDA benefit its participants?
- a. What are the benefits to RISDA itself?
- b. Does RISDA have any effect on land ownership?
- 3. Decision making and communication with village?
- . How is land selected for plantation?
- a. Hows does a community get involved with RISDA initially?
- b. Who manages clearing of land, preparation of terraces and planting of seedlings?
- c. What inputs are required after planting and how are they managed?
- d. Is there a mechanism in place to track feedback from participants?
- e. If so, how has the general response been?
 - 4. Ecological impacts?
 - Does RISDA take any ecological implications into account when planting rubber trees?
- a. If so, what are the ecological implications?

- b. Would RISDA ever refuse a project on for ecological reasons?
 - 5. What is the future vision of RISDA?

Appendix III: Mapping Session

Mapping session (Women)

We wanted to do a mapping session where the villagers could draw a map of their village, especially focusing on the current land-use. We decided to divide the session into two groups; one only consisting of men (3), and another consisting of women (4). The division of gender also applied to the interpreters and facilitators. We prepared a few questions before hand in order to have some information about the different informants. The question was:

- Name round
- What is your occupation? (For how long?)
- How long have you been living in the village? [We forgot to ask this in the beginning, but we came back to it during the conversation]
- Point at the three most important places in the village for each individual.

Facilitators: Marlene & Pernille,

Interpreter: Lesandra

Informants:

I: 1988. Part time cleaner at the school and farmer (Paddy and orchard – sells the fruit at the market).

E: since kid. Housewife and farmer (Pebber, oil palm – small-scale, and hill paddy) B: 2008. Housewife and farmer (Pebber, vegetables and hill paddy). Was the one that mainly drew.

M: 15 years. Housewife, crafting (basket and mats), works at E's oil palm field and farmer (Paddy and vegetables). Was not active during the session

The women was invited by the headman's wife (I) by our request. She mainly invited the women who is cooking for us during our fieldwork. They were very happy for the invitation, and after getting the invitation they worked on drawing a map beforehand because they wanted to do a good job. B was mainly drawing while I and E was helping by discussing where everything is. M was passive during the whole session (she answered questions, but did not join the discussion). At first they were in doubt of what to draw other than their own houses and fields, but we guided them through by asking questions and suggesting what they could draw.

Findings:

Only two fields of hill rice, because there is not many good places in Antayan Keropok for hill rice, but mainly because hill rice is very demanding work (up to 40 people to do clearing and burning). They mentioned that their maintenance and harvesting of the swamp paddy is done by helping each other – each day is different. Sometimes they hire other villagers to help.

Big oil palm field owned by one villager (up to 6 tons twice a month).

The natural environment (forest, river, swamp) they did not place it on the map at first, but did it after our request.

The borders of the village is approximately Kerait River and SALCRA road. But some places the border is not clear, but mixed with the other Antayan villages (the area surrounding the paddy field, which is marked Kpg. Antayan Baru, except the three house where Ina's house is one of them). They mentioned that the housing area and the school has a tittle, but the rest is NCR.

The starting point of the map was their own housing area. They described SALCRA road many times, and used it as an orientation point.

RISDA: They drew three RISDA plots, which is recently planted rubber trees (the biggest is only planted 1 month ago). They told us that the village plans to cultivate the swamp area bordering Kerait River with rubber. They already have an agreement with RISDA, and the land has been surveyed (phase 3). It is NCR land which they want title to.

SALCRA: There is a large area with SALCRA oil palm plantation. Before it became oil palm it was secondary forest and paddy (+pepper). They told us that when SALCRA came Antayan Keropok started developing. "They made a road and life became better" – SALCRA made it better because of the work they did. They said in 1992 or 1997.

"There are a lot of disputes over land". They said if their grandparents were alive there would be no disputes over the land. They are scared of someone from the "outside" would claim their land. They only mentioned one forest area, which is on a hill, and some in the lowland next to it. They collect vegetables and rattan (for mats).

In swamp there are big trees, and there used to be logging.

Important places to the informants:

I: 1) most important is the school, because it is the main income. 2) The orchard, because when there is fruit season it is side income. 3) and her paddy field.

Bi: 1) Her house 2) Paddy field (plans to plant pepper there) 3) Vegetable field – sells it to a middleman

E: 1) Oil palm 2) veggies + pepper field 3) paddy field (plans to plant bananas there)

M: 1) paddy field à nothing else – "I do not have any other land" (Land is very important) – she rents the land (not her own)

Mapping Session (Men)

For the men's mapping session we had three participants. Before starting the session they were all asked some very simple background questions;

- Name
- Profession
- Previous profession (if applicable)
- Time spent living in AK

The session was facilitated by Deebak and Duncan with Churchill as the interpreter

Participants were invited by the Headman as we had only been in the village one night without much chance to form our own relationships with villagers. We explained that we wanted them to draw a map of the village highlighting current land-use without using any aids (satellite images etc). We provided a large sheet of paper but all three wanted a smaller A4 sheet to sketch a first draft which they all did without consulting one another. The headman use the electricity line to get his bearings and drew the rest of the village from there. Once finished, they looked at each other's maps and discussed a little before starting on the larger sheet. The headman took the lead role but the session felt very natural. The participants all commented on the fact that drawing and colouring were activities they hadn't done since perhaps they were at school and they found the session very therapeutic. Other villagers approached during the colour coding phase to help colour and with them they brought cigarettes and rice wine and the session turned into a social event ending around 1am.

Findings:

The group produced a very detailed map for us including every household and building in the village. Having only been there 2 days this was useful for us to get our bearings. All major land uses were mapped and colour coded which helped us get an overall idea of agricultural livelihoods in the village, these included;

- Oil palm (both plantation and small holder)
- RISDA land (both currently in use and cleared for future plantations)
- Swamp paddy
- Vegetable fields
- Pepper
- Fruit orchards

The Headman also an area he referred to as an 'abandoned area' which transpired as a farmer who had decided not to follow the Headman and kept a farm in the middle of the SALCRA plantation. We felt this farmer might be interesting to interview as to why he hadn't leased his land to SALCRA and his reasons for leaving the village.

We also got an idea the religious groups in the village as four different churches were included in the map

- Roman Catholic
- Seventh Day Adventists
- Anglican
- CAN'T REMEMBER!

The group also highlighted some areas which had been left natural, including the area around the crocodile, 'Mount Antayan' from where the village's gravity fed water supply flows.

Appendix IV: Ranking and Seasonal Calendar Session

We wanted to do a ranking and seasonal calendar in one session. The ranking was focused on the different land-uses in the village (oil palm, rubber, hill and swamp paddy, pepper, vegetables, fruit, and fish pond). The seasonal calendar was focused on the significant events happening in the village each month, and how the income and expenses was related to each other every month. We wanted a mixed session with different genders, and different ages present. The informants was invited over two days by walking around the village, and visiting people's houses, and asked them to join our session. We gave them very little information about the session, because we wanted them to not think about the exercise beforehand.

Facilitators: Deebak & Pernille,

Interpreter: Lesandra Informants:

informants:

- 6 men
- 5 women
- 2 children

Ranking:

We started out with the ranking session where we handed out a paper with the ranking matrix to every participant, and asked them to place a mark on the crop they thought applied most for each term – "choose one land-use for each vertical category". The terms was; own consumption, workload, market value, expenses, income and adat. We wanted all to have their own opinion before filling the big matrix out. We told them they could place the mark on crops they did not grow themselves.

There were some implications, because people misunderstood that they should mark all the land uses they thought applied to each term instead of just one – some people decided to do their ranking together, so the point of doing it separate in the beginning was a bit lost. Everything was translated to Iban beforehand, so the participants would have it easier to relate to and understand the exercise. Even though, we had both of the interpreters and the headman to help with the translation of the different terms, it was still difficult for some of the participants to understand what the terms exactly meant, e.g. expenses. The main issue was that translating directly from English to Iban can be difficult, because the words might not have the same meaning as in English, or even have a word for it. We had our interpreter explain to all the informants what the exact meaning of each term was, and after that there was no more confusion. We gathered people around the table with the big ranking and asked each person what they thought, so all had their say. A lot of people had the same opinion, and the children just said what their father said. But other than that, we got some really good results.

Seasonal Calendar:

We replaced the ranking matrix with a beforehand prepared calendar. We asked the participants to say some significant events which was happening in the village, and which crops needed special treatment each month, and one of the facilitators would write them down in the calendar. The participants were really good at adding a lot of different events – sometimes people could not say much about some of the months, then we moved on to another month, so the people had time to think. After the whole event calendar had been filled out, we asked one of the participants to draw how the income and expenses was every month. People had a really good discussion about how the line should be drawn – and the one drawing had to erase a lot of time in order for the line to be "perfect" in the participants' eyes.

Notes:

- The weather has changed – before there was dry and wet season – now it is dry some of the year, and wet/dry season most of the year, because you will never know what the weather will be like.

- They see the income from SALCRA as very significant for their livelihood.

Appendix V: Population information 2014

INFO PENDUDUK (2014) – Population Info 2014

Bilangan Penduduk – No. of people	376 Orang - person
Bilangan Keluarga – <mark>No. of family</mark>	66 Keluarga/Pintu –
	family/household
Jantina – <mark>gender</mark>	
Lelaki - <mark>male</mark>	179 Orang-person
Wanita - female	197 Orang-person
Umur	

60 tahun keatas – years and	Lelaki : 16 Orang	Wanita : 22
above		Orang
49 - 59 tahun	Lelaki: 34 Orang	Wanita : 35
		Orang
18 - 48 tahun	Lelaki : 25 Orang	Wanita : 31
		Orang
13 - 17 tahun	Lelaki : 26 Orang	Wanita : 29
		Orang
07 - 12 tahun	Lelaki : 32 Orang	Wanita : 34
		Orang
05 - 06 tahun	Lelaki: 28 Orang	Wanita : 30
		Orang
00 - 4 tahun	Lelaki : 16 Orang	Wanita : 18
		Orang
Tahap Pendidikan – Level of educ	ation	
Taska - Play school	Lelaki : Tiada -	Wanita : Tiada
	none	
Pra Sekolah – Pre school	Lelaki : 12 Orang	Wanita : 15
<u> </u>		Orang
Sekolah Pondok/Agama –	Lelaki : Tiada	Wanita : Tiada
religious school		
Sekolah Rendah – primary	Lelaki : 60 Orang	Wanita : 64
school		Orang
Sekolah Menengah – secondary	Lelaki : 22 Orang	Wanita : 25
school		Orang
Institut Kemahiran – vocasional	Lelaki: 3 Orang	Wanita : 2 Orang
Institution	T 1 1 . T. 1	
Uniersiti - university	Lelaki: Tiada	Wanita : Tiada
Perkerjaan - occupation	T 1 1 11 0	XX7 1/ 1/
Kerajaan – Civil servant	Lelaki : 11 Orang	Wanita : 16
		Urang
Swasta – private sector	Leiaki : 9 Orang	wanita : 15
Lain Lain athans	Lololit 21 Orona	Urang Warita e 22
Lain-Lain – Others	Leiaki: 51 Orang	Wanita : 22
Dengenggun unemployed	Lolobi 7 Orong	Wanita 4
renganggur - unemployeu	Leiaki : / Oralig	Wallita: 4
Vaum na ca		Oralig
Malayy malay	Loloki · 2 Orora	Wanita . Tiada
Cina abinasa	Leiaki : 5 Orang	Wanita : Tiada
India indian	Leiaki : 4 Uralig	Wanita : Tiada
Inuia – Inuian Kadazan		Wanita : 11a0a
Kauazan	Leiaki : 11ada	Wanita : 11ada
Iban	Leiaki: 167 Urang	wanita : 195
Didamik		Workte C O
Bidayun	Leiaki : 4 Urang	wanita : 6 Orang

Lain-Lain - others	Lelaki : 1 Orang	Wanita : Tiada
Lain-Lain - others		
Bilangan Orang Asli – <mark>no. of</mark>	Lelaki : Tiada	Wanita : Tiada
aboriginal		
Bilangan OKU - handicaped	Lelaki: 1 Orang	Wanita : 1 Orang
Bilangan	Lelaki: 2 Orang	Wanita : 3 Orang
Ibu/Bapa		
Tunggal –		
single parent		

E. INFO KEGUNAAN TANAH – info. on land use

Keluasan Keseluruhan Kampung – entire area of	1210 Hektar -	
the village	hectare	
Keluasan Tanah Yang Diusahakan – <mark>entire area</mark>	565 Hektar	
of cultivated land	(Ladang Sawit	
	SALCRA) – oil	
	plam estate	
	SALCRA	
Tapak IKS/Perniagaan – small and medium scale	Tiada	
site/commercial businesses		
Pertanian - agriculture	60 Hektar	
Denternelsen rench	Tiodo	
r enternakan - ranch	Tlada	
Lain-Lain - others	Penternakan Ikan –	
Lain-Lain - others	Penternakan Ikan – fish farming 5	
Lain-Lain - others	Penternakan Ikan – fish farming 5 Hektar	
Lain-Lain - others Keluasan Tanah Terbiar – idle land area	Penternakan Ikan – fish farming 5 Hektar 580 Hektar	
Lain-Lain - others Keluasan Tanah Terbiar – idle land area Persendirian - private	Penternakan Ikan – fish farming 5 Hektar 580 Hektar Tiada	
Lain-Lain - others Keluasan Tanah Terbiar – idle land area Persendirian - private Syarikat/Koperasi – company/co-operatives	Penternakan Ikan – fish farming 5 Hektar 580 Hektar Tiada Tiada	
Lain-Lain - others Keluasan Tanah Terbiar – idle land area Persendirian - private Syarikat/Koperasi – company/co-operatives Hakmilik Kerajaan – goverment ownership	Penternakan Ikan – fish farming 5 Hektar 580 Hektar Tiada Tiada Tiada	

F. INFO KEGIATAN EKONOMI – info. on economic

activities

1. P	Pertanian - <mark>agriculture</mark>		
Bil. - no	Jenis/Catatan – type/remarks	Bilangan Pengusaha – <mark>No.</mark> of participants	Pendapatan Tahunan (RM) – yearly income
1.	Tanaman Lada Hitam/secara kecil-kecilan – black pepper (smallholder)	23 Orang	Secara purata Rm 4000.00/seorang – Rm 4000.00 per person on average
2.	Kelapa Sawit - Oil palm	8 Orang	Belum Mengeluarkan hasil – no produce yet

3.	Getah Asli - Rubber	18 Orang	Purata Rm 600.00/seorang –	
			Rm 600.00 per person on	
			average	
4.	Sayur-	16 Orang	Purata Rm 8200.00/seorang –	
	sayuran/Timun/Kacang		Rm 8200.00 per person on	
	Panjang dll – <mark>vegetables e.g</mark>		average	
	cucumber, long beans etc.			
2. P	erternakan dan Perikana	an - Poultry and Livestock		
Bil.	Jenis/Catatan	Bilangan Pengusaha	Pendapatan Tahunan (RM)	
1.	Babi/Itik/Ayam – <mark>pigs/ducks/</mark>	36 Orang	Purata Rm 600.00/Untuk	
	chickens		pasaran di Kampung	
			sahaja – <mark>Rm 600.00 per</mark>	
			person on average/to be	
			sold in the village only	
2.	Kolam Ikan – <mark>fish pond</mark>	9 Orang	Purata Rm 600.00/Untuk	
			pasaran di Kampung	
			sahaja – <mark>Rm 600.00 per</mark>	
			person on average/to be	
			sold in the village only	
3. Industri Kecil/Perhidmatan/Perubatan/Pelancongan dll – small scale				
ind	ustry/services/medical/tou	urism etc.		
Bil.	Jenis/Catatan	Bilangan Pengusaha	Pendapatan Tahunan (RM)	
1.	Kraftangan/Anyaman -	30 Orang	Purata Rm 3000.00/seorang	
	Handicrafts		- Rm 3000.00 per person on	
			average	

G. INFO HAKMILIK PENDUDUK – info. On the

villagers' belongings

Bilangan Rumah – <mark>no. of houses</mark>	64 Buah - no
Jenis Rumah	
Rumah Sebuah – <mark>single storey</mark>	54 buah
Rumah Teres - <mark>terrace</mark>	0 buah
Rumah Rakit	0 buah
Rumah Tradisi - <mark>traditional</mark>	0 buah
Rumah Panjang – <mark>long houses</mark>	0 buah
Rumah SPKR- development welfare	2 buah
scheme	
Rumah Berkembar - <mark>semidetached</mark>	9 buah
Kenderaan	
Kereta – cars	36 buah

Motosikal- motorcycle	98	buah
Lori - <mark>lorry</mark>	2	buah
Bas Sekolah – <mark>school bus</mark>	0	buah
Bas Kilang – <mark>factory bus</mark>	0	buah
Basikal - <mark>bicycle</mark>	57	buah
Van – van	2	buah
Motorbot - motorboat	5	buah
Sampan - <mark>boat</mark>	12	buah
Kemudahan Telekomunikasi – <mark>telecom</mark>	nunication	fascilities
Komputer Peribadi – <mark>personal computer</mark>	27	buah
Internet/Jaringan – internet/wifi network	0	buah
ASTRO –satelite tv e.g ASTRO	11	buah

Pusat Pendidikan – education centre							
Taska – <mark>play school</mark>	Tiada						
Tadika - <mark>kidergarten</mark>	1 buah						
Sekolah Rendah – primary school	1 buah						
Sekolah Menengah – secondary school	1 buah						
Sekolah Agama/Pondok – religious school	Tiada						
Pusat Komputer/Makmal Komputer – computer	Tiada						
centre/lab							
Pusat Tuisyen – tuition centre	Tiada						
Kolej/Pusat Kemahiran – <mark>college/ vocasional</mark>	Tiada						
institution							
Kemudahan Asas – basic facilities							
Masjid - <mark>mosque</mark>	Tiada						
Surau – small mosque	Tiada						
Rumah Ibadat(Gereja) - <mark>church</mark>	3 buah						
Bangunan Kerajaan – <mark>goverment building</mark>	3 buah						
Balairaya – community hall	Tiada						
Dewan Orang Ramai - <mark>hall</mark>	Tiada						
Klinik Bergerak – <mark>mobile clinic</mark>	Tiada						
Telefon Awam – public phone	Tiada						
Bas Awam – <mark>public bus</mark>	Tiada						
Hentian Bas – <mark>bus stop</mark>	Tiada						

Pejabat/Wakil/Peti Pos - Office e.g	Tiada
representative, post	
Padang Permainan Kanak-kanak – <mark>children's</mark>	Tiada
playground	
Padang Bola – <mark>football field</mark>	1 buah
Gelanggang Permainan – <mark>play court</mark>	Tiada
Perpustakaan Desa – <mark>rural library</mark>	Tiada
Tapak Perkuburan – <mark>grave yard</mark>	2 buah
Balai/Pondok Polis – police station	Tiada
Lain-Lain – <mark>others</mark>	Tiada

Appendix VI: FRA calculations

Biomass reference forest

The table 1 shows the calculation for AGB in reference forest (calculated as a sum of weight of stems, branches and leaves). The total biomass is calculated to be 8982.07 kg (for the 500 m2, which is the total area of the 5 plots). To get this number in tons pr. ha the following is done:

- $(1 \text{ m}^2 = 8982.07/500, 1 \text{ ha} = 10,000 \text{ m}^2)$
- So 1 ha of forest has (8982.07/ 500)*10,000 kg
- (1 metric ton = 1000 kg)
- So 1 ha = ((8982.07/500)*10,000)/1000
 - \circ = 179.64 metric ton

Table 1. The biomass calculation for reference forest with all identified tree species listed. (1/3)

			-	_		_	
Tree	Species Name	cm (DBH)	BA (sq. cm)	Weight of stem (kg)	Weight of branch (kg)	Weight of leaves (kg)	AGB (kg)
1	Macaranga Caladiifolia	24,40	467,77	157,12	30,44	6,52	194,08
2	Macaranga Caladiifolia	12,20	116,94	40,76	7,19	2,31	50,26
3	Macaranga Caladiifolia	10,00	78,57	27,68	4,75	1,71	34,14
4	Castamopsis borneensis	15,50	188,76	64,96	11,83	3,32	80,11
5	Artocarpus anisophyllus	10,00	78,57	27,68	4,75	1,71	34,14
6	Artocarpus anisophyllus	11,60	105,72	36,95	6,47	2,14	45,56
7	Pentace sp.	10,50	86,62	30,44	5,26	1,84	37,53
8	Diospyros elliptifolia	12,10	115,03	40,11	7,06	2,28	49,46
9	Elateriospermum tapoos	7,20	40,73	14,60	2,40	1,03	18,03
10	Elateriospermum tapoos	16,20	206,20	70,79	12,97	3,55	87,31
11	Elateriospermum tapoos	10,90	93,35	32,73	5,68	1,95	40,36
12	Elateriospermum tapoos	5,00	19,64	7,18	1,12	0,59	8,89
13	Elateriospermum tapoos	17,80	248,94	85,04	15,78	4,08	104,91
14	Elateriospermum tapoos	15,90	198,63	68,26	12,48	3,45	84,19
15	Endospermum diadenum	20,80	339,93	115,16	21,83	5,15	142,14
16	Endospermum diadenum	9,80	75,46	26,61	4,55	1,66	32,82
17	Endospermum diadenum	13,40	141,08	48,93	8,74	2,66	60,33
18	Nephelium mangayii	24,20	460,14	154,62	29,93	6,44	190,99
19	Albizia falcataria	24,00	452,56	152,15	29,41	6,36	187,92
20	Hopea griffithii	37,60	1 110,79	364,59	74,93	12,11	451,64
21	Litsea sp.	13,50	143,19	49,64	8,87	2,69	61,21
22	Androtium astylum	13,40	141,08	48,93	8,74	2,66	60,33
23	Shorea sp.	5,70	25,53	9,27	1,47	0,72	11,46
24	Dillenia excelsa	66,00	3 422,51	1 090,11	241,90	25,48	1 357,48
25	Arthocarpus rigidus	24,50	471,62	158,38	30,71	6,56	195,64
26	Arthocarpus rigidus	16,40	211,32	72,50	13,31	3,61	89,42
27	Anisophyllea ferruginea	5,80	26,43	9,59	1,53	0,74	11,85
28	Anisophyllea ferruginea	6,00	28,29	10,24	1,64	0,78	12,66
29	Dillenia excelsa	11,00	95,07	33,32	5,79	1,97	41,09
30	Dillenia excelsa	13,70	147,47	51,08	9,15	2,75	62,99

Table 1 (2/3)
Trac	Species Name	em (DBH)	DA (an arr)	Weight of	Weight of	Weight of	
1166	Species Name	Cm (DBH)	BA (sq. cm)	stem (kg)	branch (kg)	leaves (kg)	AGB (Kg)
31	Dillenia exceisa	16,00	201,14	69,10	12,64	3,48	85,22
32	Browniowia sp	7,50	44,20	15,81	2,61	1,10	19,52
33	Browniowia sp	13,30	138,98	48,22	8,60	2,63	59,46
34	Browniowia sp	7,60	45,38	16,22	2,68	1,12	20,03
35	Artocarpus integer	11,40	102,11	35,72	6,24	2,09	44,05
36	Dyera costulata	32,50	829,90	274,52	55,31	9,86	339,70
37	Elateriospermum tapoos	13,20	136,90	47,52	8,47	2,60	58,59
38	Kemenyan	20,60	333,42	113,01	21,40	5,08	139,49
39	Litsea sp.	23,00	415,64	140,05	26,92	5,97	172,94
40	Shorea sp.	6,00	28,29	10,24	1,64	0,78	12,66
41	Nephelium maingayii	17,70	246,15	84,11	15,60	4,05	103,76
42	Scorodocarpus borneensis	30,50	730,90	242,60	48,46	9,01	300,06
43	Timonius sp.	12,20	116,94	40,76	7,19	2,31	50,26
44	Baccaurea sp.	5,50	23,77	8,64	1,37	0,68	10,70
45	Baccaurea sp.	7,50	44,20	15,81	2,61	1,10	19,52
46	Brownlowia sp	11,30	100,33	35,11	6,13	2,06	43,30
47	Brownlowia sp.	14,30	160,67	55,53	10,00	2,94	68,47
48	Macaranga triloba	7,80	47,80	17,06	2,83	1,17	21,06
49	Macaranga beccariana	9,00	63,64	22,55	3,81	1,45	27,81
50	Artocarpus elasticus	5,50	23,77	8,64	1,37	0,68	10,70
51	Pentace sp.	17,70	246,15	84,11	15,60	4,05	103,76
52	Flacourtia rukam	5,50	23,77	8,64	1,37	0,68	10,70
53	Cratoxylum glaucum	28,10	620,40	206,82	40,85	8,00	255,68
54	Garcinia parvifolia	15,70	193,67	66,60	12,15	3,38	82,14
55	Dryobalanops beccari	10,00	78,57	27,68	4,75	1,71	34,14
56	Diospyros elliptifolia	5,00	19,64	7,18	1,12	0,59	8,89
57	Elateriospermum tapoos	6,10	29,24	10,57	1,70	0,80	13,07
58	Elateriospermum tapoos	9,10	65,06	23,04	3,90	1,48	28,42
59	Dacryodes costata	5,60	24,64	8,95	1,42	0,70	11,08
60	Pangium edule	17,60	243,38	83,19	15,42	4,02	102,62
61	Pangium edule	7,20	40,73	14,60	2,40	1,03	18,03
62	Pangium edule	6,00	28,29	10,24	1,64	0,78	12,66
63	Mezzettia Leptopoda	8,60	58,11	20,64	3,47	1,36	25,46
64	Knema sp.	8,60	58,11	20,64	3,47	1,36	25,46

				Weight of	Weight of	Weight of	
Tree	Species Name	cm (DBH)	BA (sq. cm)	stem (kg)	branch (kg)	leaves (kg)	AGB (kg)
65	Myristica sp.	15,80	196,14	67,43	12,31	3,42	83,16
66	Fordia sp.	6,50	33,20	11,97	1,94	0,88	14,79
67	Litsea sp.	11,20	98,56	34,51	6,01	2,03	42,55
68	Polyathia insignis	15,00	176,78	60,94	11,05	3,16	75,15
69	Palaquium cochleariifolium	8,90	62,24	22,06	3,73	1,43	27,22
70	Palaquium cochleariifolium	5,70	25,53	9,27	1,47	0,72	11,46
71	Palaquium gutta	7,00	38,50	13,82	2,26	0,99	17,07
72	Sterculia bicolor	7,60	45,38	16,22	2,68	1,12	20,03
73	Parashorea sp.	6,60	34,23	12,33	2,00	0,90	15,23
74	Elateriospermum tapoos	10,00	78,57	27,68	4,75	1,71	34,14
75	Artocarpus kumunis	9,80	75,46	26,61	4,55	1,66	32,82
76	Santiria sp.	6,60	34,23	12,33	2,00	0,90	15,23
77	Nephelium sp.	37,40	1 099,01	360,82	74,10	12,02	446,95
78	Shorea sp.	5,00	19,64	7,18	1,12	0,59	8,89
79	Scorodocarpus borneensis	18,60	271,82	92,64	17,30	4,36	114,29
80	Scorodocarpus borneensis	39,00	1 195,05	391,48	80,86	12,74	485,09
81	Scorodocarpus borneensis	5,40	22,91	8,34	1,32	0,66	10,32
82	Parashorea parvifolia	5,50	23,77	8,64	1,37	0,68	10,70
83	Diospyros hermaphroditica	17,70	246,15	84,11	15,60	4,05	103,76
84	Elateriospermum tapoos	7,00	38,50	13,82	2,26	0,99	17,07
85	Elateriospermum tapoos	14,70	169,78	58,59	10,60	3,06	72,25
86	Elateriospermum tapoos	5,50	23,77	8,64	1,37	0,68	10,70
87	Elateriospermum tapoos	9,70	73,93	26,09	4,46	1,63	32,17
88	Elateriospermum tapoos	8,40	55,44	19,71	3,30	1,31	24,32
89	Elateriospermum tapoos	17,30	235,15	80,45	14,87	3,91	99,24
90	Elateriospermum tapoos	8,00	50,28	17,93	2,98	1,21	22,13
91	Lithocarpus sp.	13,90	151,81	52,55	9,43	2,82	64,79
92	Parastemon sp.	15,90	198,63	68,26	12,48	3,45	84,19
93	Alstonia spatulata	19,30	292,67	99,54	18,68	4,61	122,83
94	Parashorea sp.	5,00	19,64	7,18	1,12	0,59	8,89
95	Artocarpus sarawakensis	32,00	804,56	266,36	53,55	9,65	329,56
96	Calophyllum sp.	10,20	81,74	28,77	4,95	1,76	35,48
97	Syzygium Zeylanica	26,00	531,13	177,80	34,75	7,15	219,70
98	Syzygium densiflora	16,60	216,51	74,23	13,65	3,68	91,56
					Total AGB		8 982,07
					Metric ton	/ ha	179 641,48

Biomass oil palm plantation

The calculation of AGB for oil palm plantation is based on a study by Khalid, Zin and Anderson (1999), where four oil palms have been cut down and weighted where after the biomass has been calculated. In our study, the average of the relationship between wet weight and dry weight is calculated based on the article (see table 2), only excluding the weight of frond bases. The wet-weight for measured ten oil palms is calculated by using a regression function W=175+197H, where W is the fresh weight of oil palm (kg) and H is the palm height (m). The DW/WW value is then multiplied by the wet weight of each palm, and the average of this results the AGB per oil palm (see table 3). To get the AGB per hectare, this number is then multiplied by 115 (115 oil palm trees per hectare). To get the number in ton this number is divided by 1000.

Table 2. Applied wet-weight - dry-weight relationship (excluding frond bases) (edited from Khalid, Zin & Anderson, 1999: 26-27).

Tree	1	2	3	4
WW (kg palm-1)	2386	2175	1972	2337
DW (kg palm-1)	533	488	442	526
DW/WW	0,22338642	0,22436781	0,22413793	0,22507488

Table 3. The AGB calculation for oil palm plantation (10 trees).

			DW/WW Tree 1	DW/WW Tree 2	DW/WW Tree 3	DW/WW Tree 4	
Palm tree no.	Height (m)	WW (kg)	0,22338642	0,22436781	0,22413793	0,22507488	AGB
1	10	2145	479,1638709	481,2689525	480,7758599	482,7856176	480,9985752
2	8,08	1766,8	394,6791269	396,4130467	396,0068947	397,662298	396,1903416
3	9,5	2046,5	457,1603085	459,1687232	458,6982737	460,6157419	458,9107618
4	6,3	1416,1	316,3375094	317,7272557	317,4017227	318,7285376	317,5487563
5	7,28	1609,2	359,4734271	361,0526799	360,682757	362,1904969	360,8498402
6	8	1751	391,1496214	392,8680353	392,4655154	394,1061149	392,6473218
7	6,64	1483,1	331,3043995	332,759899	332,418964	333,8085545	332,5729543
8	9,5	2046,5	457,1603085	459,1687232	458,6982737	460,6157419	458,9107618
9	7,6	1672,2	373,5467715	375,1878519	374,8034465	376,3702143	374,9770711
10	9,81	2107,6	470,8092188	472,8775964	472,3931013	474,3678171	472,6119334
					AVERAGE AGB (kg)		404,6218317
					AGB (kg)/ha (115 tro	ees)	46531,51065
					AGB (metric tons)/h	a (115 trees)	46,53151065

Appendix VII: Water Quality Index

Parameter	Subindex Formula	Condition
DO	SIDO = 0	for $x \le 8$
	SIDO = 100	for $x \ge 92$
	$SIDO = -0.395 + 0.030x^2 - 0.00020x^3$	for 8 < x < 92
BOD	SIBOD = 100.4 - 4.23x	for $x \le 5$
	$SIBOD = 108e^{-0.055x} - 0.1x$	for $x > 5$
COD	SICOD = -1.33x + 99.1	for $x \le 20$
	$SICOD = 103e^{-0.0157x} - 0.04x$	for x > 20
TSS	$SISS = 97.5e^{-0.00676x} + 0.05x$	for $x \le 100$
	$SISS = 71e^{-0.0010x} - 0.015x$	for 100 < x < 1000
	SISS = 0	for $x \ge 1000$
pН	$SIpH = 17.2 - 17.2x + 5.02x^{2}$	for x < 5.5
	$SIpH = -242 + 95.5x - 6.67x^{2}$	for $5.5 \le x < 7.0$
	$SIpH = -181 + 82.4x - 6.05x^2$	for $7 \le x < 8.75$
	$SIpH = 536 - 77.0x + 2.76x^2$	for $x \ge 8.75$
NH ₃ -N	SIAN = 100.5 - 105x	for $x \le 0.3$
	$SIAN = 94e^{-0.573x} - 5 x-2 $	for $0.3 < x \le 4$
	SIAN = 0	for $x \ge 4$

Table 1.1: Best-fit equations for the estimation of subindex values

(Tay 2015, p. 11)

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

	The definition	ı of each	class	of river	is	shown	as	below:
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Class	WQI	Designated Uses
Ι	> 92.7	Excellent quality. Undisturbed.
II	76.5 - 92.6	Class IIA – good water quality, suitable for human use Class IIB – protect sensitive species
III	51.9 - 76.4	Moderate water quality. Protect common and moderately tolerant species. Need extensive treatment for water supply
IV	31.0 - 51.8	Poor water quality. For irrigation purposes.
V	<31.0	Very poor water quality. Not suitable for any use

	DOE W	ATER QUAL	ITY INDEX	CLASSES					
Darameter	Unit	Classes							
Parameter	oiiit	I	п	ш	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 Oksigen	mg/l	>7	5 - 7	3 - 5	1 - 3	<1			
рН	mg/l	> 7.0	6.0 - 7.0	5.0 - 6.0	< 5.0	> 5.0			
Total Suspended Solids	mg/l	< 25	25 - 50	50 - 150	150 - 300	> 300			
Water Quality Index		> 92. 7	76.5 - 92.7	51.9 - 76.5	31.0 - 51.9	< 31.0			

(Tay 2015, p. 12)

Explanation of Results from Water Analy	ses
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	Station 1	Station 2	Station 3	Change	Meaning
рН*	7.34	6.29	5.76	Decrease	Lower pH = more acidic
Conductivity* (μS/cm)	0.04	0.04	0.05	No change	Lower is better
Salinity** (ppt)	0.03	0.02	0.02	No change	How salty the water is
DO** (mg/L)	7.03	4.59	0.15	Decrease	Higher is better
DO** (%)	88.30	60.00	1.90	Decrease	Higher is better
TDS**	23.18	22.32	28.60	Increase	Lower is better
TSS* (mg/L)	100.00	3620.00	5372.00	Increase	Lower is better
BOD,**(mg/L)	1.56	2.21	0.16	Decrease	Lower is better
COD**	0.00	33.00	208.50	Increase	Lower is better
NH₃-N** (mg/L)	0.02	0.15	0.16	Increase	Lower is better
NO₃-N** (mg/L)	0.00	0.00	0.02	Increase	Lower is better
NO ₂ -N** (mg/L)	0.01	0.02	0.03	Increase	Lower is better
PO₄ ^₃ ** (mg/L)	0.09	0.37	0.00	Increase then decrease	Lower is better
TCC*** (count)	833.00	1667.00	1500.00	Increase then decrease	Lower is better
FCC*** (count)	500.00	1000.00	833.00	Increase then decrease	Lower is better

* Physical Parameters **Chemical Parameters ***Biological Parameters

Appendix VIII: Raw data used to calculate soil statistics. Statistical tests were conducted using SPSS

									19	
Site	Weight (g) Bul	k Density (g cm-3)	N%	С%	C:N	Total C (mg cm-3)	PoxC Result (M/L) Mn	oxC (mg/kg)	MnoxC: total C j	H
1.1A	132,01	1,3201	0,07	0,95	14,8308	12,54095	0,016	0,0003024	0,39919824	4,31
1.1B	119,06	1,1906	0,14	2,27	16,1718	27,02662	0,011	0,0006804	0,81008424	4,75
1.1C	119,59	1,1959	0,1	1,4	13,7441	16,7426	0,017	0,0002268	0,27123012	5,29
1.2A	102,14	1,0214	0,36	4,4	12,4416	44,9416	0,01	0,000756	0,7721784	4,86
1.2B	119,78	1,1978	0,14	1,08	7,8413	12,93624	0,018	0,0001512	0,18110736	4,49
1.2C	120,1	1,201	0,12	0,93	7,9295	11,1693	0,018	0,0001512	0,1815912	4,61
1.3A	146,42	1,4642	0,08	0,84	10,0424	12,29928	0,011	0,0006804	0,99624168	5,72
1.3B	147,32	1,4732	0,07	0,65	9,7847	9,5758	0,019	7,56E-05	0,11137392	5,74
1.3C	130,6	1,306	0,08	0,63	8,0195	8,2278	0,016	0,0003024	0,3949344	4,16
2.1A	139,24	1,3924	0,12	1,52	13,0897	21,16448	0,013	0,0005292	0,73685808	5,91
2.1B	183,93	1,8393	0,05	0,39	8,7401	7,17327	0,021	9		5,22
2.1C	152,06	1,5206	0,09	0,33	3,7113	5,01798	0,02			4,69
2.2A	123,98	1,2398	0,14	1,98	13,8082	24,54804	0,009	0,0008316	1,03101768	4,86
2.2B	183,93	1,8393	0,04	0,27	7,0245	4,96611	0,021			4,57
2.2C	152,06	1,5206	0,03	0,06	2,3442	0,91236	0,023			4,59
2.3A	123,98	1,2398	0,1	0,68	6,9847	8,43064	0,015	0,000378	0,4686444	5,16
2.3B	183,78	1,8378	0,08	0,38	4,6636	6,98364	0,02			3,97
2.3C	190,14	1,9014	0,06	0,3	4,7165	5,7042	0,02			3,96
3.1A	66,71	0,6671	0,42	4,59	11,0505	30,61989	0,006	0,0010584	0,70605864	4,73
3.1B	112,17	1,1217	0,28	2,54	9,1666	28,49118	0,013	0,0005292	0,59360364	4,8
3.1C	130,26	1,3026	0,21	1,75	8,2133	22,7955	0,016	0,0003024	0,39390624	4,79
3.2A	71,83	0,7183	0,4	4,22	10,5467	30,31226	0,006	0,0010584	0,76024872	4,56
3.2B	122,32	1,2232	0,09	0,43	4,5615	5,25976	0,019	7,56E-05	0,09247392	4,95
3.2C	136,19	1,3619	0,16	1,17	7,2073	15,93423	0,017	0,0002268	0,30887892	4,87
3.3A	89,39	0,8939	0,31	3,01	9,7533	26,90639	0,01	0,000756	0,6757884	5,07
3.3B	134,47	1,3447	0,14	0,94	6,5049	12,64018	0,018	0,0001512	0,20331864	4,93
3.3C	132,12	1,3212	0,12	0,68	5,9139	8,98416	0,019	7,56E-05	0,09988272	5,36

Appendix IX: Synopsis

Land-ownership perspectives in Antayan Keropok

What drives land-use change in Antayan Keropok, and how is the transition affecting the ecology and the villagers livelihood?

Synopsis



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1. Context for the study

As an introduction to our synopsis, we will shortly present the global, national and local overview of the context for this study. These lead us to the proposed objective and research questions, introduced in section 1.3.

1.1 Global and national overview

For at least the last 10,000 years, agriculture has been key to human survival. With estimates from LAND matrix indicating that between 0.7 and 1.75% of the world's agricultural land in the Global South is subject to large scale land acquisitions (Anseeuw et al. 2012:3), pressure from the world's rising population to increase agricultural land is at odds with natural land uses, such as tropical rainforest, and the rights of those indigenous people who inhabit them. We are faced with the question: how far should we be allowed to go in order to meet the production requirement of the global market economy by acquiring land inhabited or inherited by local populations?

Land rights in Malaysia are complex. Natives to Sarawak, on the island of Borneo, are known as Dayak and constitute at least 71.2% of the population. This comprises the main indigenous groups: the Iban, the Bidayuh and the Orang Ulu (Zulkifli et al., 2015:653). Traditionally, Dayaks navigate land rights according to cultural beliefs, social norms and customary practices, a concept known as *adat*.

The acknowledgment of native customary rights (NCR), including adat, by both local Sarawak and Malaysian State governments, accepts that although a community may not have legal title over their land, it retains the right to inhabit and cultivate it in accordance with tradition. However, with Malaysia holding the vision of achieving 'developed country' status by 2020, NCR land is at risk of being labeled what the State argues is vacant or idle and large areas are being converted through government schemes, largely through the establishment of oil palm plantations (Colchester et al 2007:12-13). The global surge in demand for palm oil has drastically increased the crop's profitability and Malaysia has become the world's largest exporter of palm oil (FAO, 2011).

Oil palm is considered the per-hectare highest yielding oil crop and has the additional advantage of a productive life lasting 25 - 30 years (MPOB, 2010). Through the introduction of an initiative by the Malaysian Federal Land Development Authority (FELDA) in the 1970s, poverty in peninsular Malaysia among participants fell from 30% to almost negligible levels over a 20 year period (Zulkifli *et al.*, 2014).

With most land on the peninsula suitable for oil palm already under cultivation, Sarawak, with the lowest population density and among the highest rates of poverty in Malaysia, was the logical next frontier for oil palm expansion (FAO, 2011).

In order to address conflict with NCR, the Sarawak Land Consolidation and Rehabilitation Authority (SALCRA) was set up in 1976 as a state statutory body to address poverty in rural areas through collaboration with NCR land owners (SALCRA, 2012). SALCRA holds the power to develop oil palm plantations on NCR land on behalf of NCR landowners. Participation in the scheme involves leasing land for one oil palm cycle, during which participants receive proceeds based on the performance of the plantation (FAO, 2011). At the end of the cycle a land grant is issued to the NCR stakeholder. Increased land security, therefore, is a major incentive to join SALCRA projects. As of 2011, SALCRA managed a total of 48,644 hectares and was involved in partnerships with over 21,000 NCR landowners (FAO, 2011).

1.2 Antayan Keropok

Antayan Keropok is an Iban Remun village about 85km south east of Kuching, comprising around 70 households. Most villagers rely on some cultivation of swamp rice for subsistence whilst much of the area traditionally used for hill rice has been converted to fruit orchards and vegetables which some of the villagers sell through a middleman, or at market themselves in nearby Serian. Although traditional cash crops consist of pepper and rubber, oil palm is now a major source of income for many villagers. SALCRA started planting oil palm in the area in the 1990s converting 1,028ha of former NCR secondary forest, fallow and fruit orchard into plantation. More recently, the Rubber Industry Smallholders Development Authority (RISDA) started planting 55ha of rubber trees on Antayan Keropok land with the village currently in the process of applying for a further 200ha to be planted. With such a stark change in land use, this study seeks to investigate how the livelihood strategies within the village are adapting, and to assess any impacts large scale plantations may have on the local ecology.

1.3 Objective and research questions

Objective: What drives land-use change in Antayan Keropok, and how is the transition affecting the local ecology and the villagers livelihood?

Research questions:

1. What are the global, national and local driving factors for the land use changes in Antayan Keropok?

- 2. What role do land rights and land ownership play in changes of land use on village land?
- 3. What are the ecological impacts of the land use change from the previous main land-use to large-scale plantations?
- 4. How has everyday life in Antayan Keropok changed since the village started leasing land for plantations?

2. Methodology

In order to provide answers to the proposed research questions, a wide range of quantitative and qualitative methods will be used on the fieldwork. Initially, field methods will be exploratory in order to gain trust, get an overview of the village and villagers and help in identifying suitable informants for further data collection. These include participatory observation, cultural mapping, farm sketch and walkabouts, and the use of these methods is described in appendix I. The proposed methods for each research question are described below in section 2.1.

2.1 Proposed methods

2.1.1 What are the global, national and local driving factors for the land use changes in Antayan Keropok?

This research question will help us understand the context for the area and the different impacts affecting land use change in the village. We will use the following methods:

- Literature search
- Participatory observation
- Walkabouts & informal conversations
- Semi-structured interview (SSI) with headman and/or village leadership.
- SSI with farmers and/or group interviews.

SSIs will be used during our fieldwork to allow for more in-depth questions concerning relevant and important issues that might occur unexpectedly during the interview (Casley & Kumar, 1988: 14). Because a certain question or topic can be answered by more than one at the same time, the group interview can be helpful in saving time, both for us and for the farmers. This method can be helpful in making the interview seem less formal with the informants able to "lean" on each other when answering. The opposite can also be true with the informants agreeing with whatever other participants may answer despite their personal view. This is hard to predict before being in the field as there can be many factors affecting that need to be

learnt before and during group interviews. Strategy and objectives for SSI's can be found in the appendix VII.

We are aware of the fact that the literature about the global and national drivers are broad and we will not be able to cover all the aspects, but we want to include these perspectives as a way to get an understanding of the context. So in our further analysis we will be careful in identifying the different perceptions of the driving factors related to land use and how these are interlinked, as there might not be a direct causality.

2.1.2 What role does land rights/ land ownership play in changes of land use on village land?

Although relating to the previous research question, this question focuses more on land ownership and rights over land. From our village description, we assume land ownership is a one key factor for LUC, but we would like to know exactly how land ownership is perceived in Antayan and what impact it has on LUC. For this we will be using the methods below:

- Informal conversations
- Walkabouts
- Participatory mapping (see section 2.1.3)
- SSI with farmers with/in process of getting title deeds
- SSI with farmers not part of the development schemes
- SSI with SALCRA and RISDA
- Questionnaire (see section 2.1.4)

As the subject can be sensitive, informal conversations and walkabouts will be used as a gentle way of observing and understanding the villagers perceptions on land ownership. Participatory mapping will also be a tool in gathering information, but on terms of the farmers, as they will be leading the exercise.

For the interview with SALCRA and RISDA we want to use SSIs as well, but, as we won't be able to meet with them beforehand, the question-guide will be more structured than for the aforementioned farmers. Our counterparts might be able to clarify how to approach these institutions in the proper way. To gain a better understanding for the factors that play a role in land rights and ownership we will be carrying out a questionnaire, described in section 2.1.4. The questionnaire will be translated into malay/iban.

2.1.3 What are the ecological impacts of the land use transition from previous main land-use to large-scale plantations?

Both social and natural science methods will be used as a means to investigate the environmental impacts of land use change in Antayan Keropok. The planned methods are as follows:

- SSI with farmers
- Ranking of land areas
- Map-drawing and community mapping
- Walkabouts
- Soil and water sampling
- Forest resource assessment (FRA)
- GPS mapping and picture-taking

Due to the short time-frame of this project it is not possible to map LUC by taking samples from the same site before and after any transition. Instead, samples will have to be carried out on different locations, with one making up the reference point and the other making up the point where land use has changed - in this case a rubber and/or oil palm plantation. In the light of our current knowledge, the reference land use is secondary.

The most suitable and comparable sample plots will be identified by carrying out exercises with local informants. Interviews combined with mapping exercises give visualised information of how large-scale plantations have transformed village land. Results from the mapping exercises can be compared with aerial photographs. What is more, ranking of land areas is to give insights of what type of areas are typically valued highest/lowest by the locals and for what reasons (e.g. soil fertility). This method will be combined with a walkabout and picture taking.

When sample spots are identified, three quantitative methods will be used to measure the ecological impacts of LUC:

1) volume specific soil sampling is carried out to measure changes in soil fertility, pH and carbon stocks 2) water sampling to measure changes in water quality, pH and nutrients

3) forest resource assessment (FRA) to assess what effects the large-scale plantations have on above ground biomass (AGB).

GPS mapping will be used as a part of each method to note the exact sampling locations. The sampling strategies are introduced in more detail in appendices II (soil sampling), III (water sampling) and IV (FRA).

2.1.4 How has the everyday life in Antayan changed since the village started leasing land for plantations matter?

With this research question we have an assumption that LUC has had an impact on everyday life. With the transitions we are interested to get an insight in how it's been affecting the social structures and the economy for the villagers. The methods to be used are:

- SSI with farmers
- Community-mapping and farm sketch
- Questionnaire
- Focus group.

The questionnaire will provide an overview of relevant factors concerning overall everyday life in the village and mostly contribute quantitative data which will be used to show characteristics and statistical patterns within our target group (Babbie, 2002: 270). Further, it will provide information necessary for a more thorough analysis and understanding of the villagers and the society they live in. A draft of the questionnaire is attached in the appendix VIII, but this is to be adjusted with our counterparts and when exploring the village. We are aware of the questionnaires can take a large amount of time, so the purpose and use of it must be deemed essential so as not to waste neither villagers' time, nor our own. The questionnaire can be a good tool to be used to select key informants for the SSI and the focus group.

To get a better insight of the dynamics in the village and to open up for a collective discussion between the villagers, focus group discussion will be used as another method. Through this method we will try to gauge different opinions related to livelihood strategies and engagement with the "development" projects in the community. Focus groups will only be carried out when we feel the informants and the village trust us enough to open up in group discussion about their livelihood, which could be a sensitive topic. The focus group will be facilitated in close collaboration with our counterparts to minimise language confusion during the meeting. Specific topics or questions for the focus group will be formed once we have a greater knowledge about the participants and the context.

2.2 Timetable for the fieldwork

The time schedule for our fieldwork is shown in figure 1 below. Different methods are allocated evenly throughout the fieldwork, where the last two days of the trip are so far left to be a bit looser. This allows us to have a buffer in cases of unpredictable events. A more detailed timetable can be found in appendix IX.



FIELDWORK IN SARAWAK, MALAYSIA 28.2.-12.3., VILLAGE ANTAYAN KEROPOK

Figure 1. Schedule for the fieldwork.

2.3 Collaboration with counterparts

In the preparation for the fieldtrip and throughout the stay in Malaysia our research is done together with three Malaysian students, who will join us in the field working closely together with us in the village. It is therefore important that we agree on our focus, our methods and how those methods should be carried out. To succeed in this, communication is crucial both before arriving in Malaysia and during our stay. Pre-field, communication is done by e-mail correspondence. In the field we want to set aside time for evaluation at the end of each day and involve the malaysian students in the decision making so that we all feel part of the group. We hope to supplement each other, share experiences and learn from each other throughout the fieldwork.

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4. Appendices

Appendix I: Methods at the beginning of the fieldwork

- Participatory observation - cultural mapping - farm sketch - resource flow - walkabouts -

Participatory observations is key for obtaining useful information at the beginning, and the method will be used throughout our entire fieldwork as a way of getting a feeling of the everyday life in the village and as a way to engage with the people. As noted by Brockington and Sullivan (2003: 53), participatory observation allows observation and interaction with the target group within their natural setting and as part of their normal life. The approach will further provide a great deal of insight into cultural and social aspects, which might be difficult to detect through e.g. questionnaires or interviews (Mikkelsen, 2005: 88). The information gathered through participatory observation will be highly informal and unstructured nature, since it is to be obtained through casual conversation and interactions. Therefore, it is important to identify keywords and themes throughout these observations in order to create structure for the findings. Our observations will be collected in the individual field notes, and put together and organized afterwards according to different categories that will be helpful in the further analysis.

Cultural mapping, farm sketch combined with resource flow, and walkabouts will be used as one of the first methods in addition to participatory observation. For us as researchers, cultural mapping as a method is a good way to explore the studied environment according to the people themselves. The main goal is to get an overview of how the community engage with the places they live, and what kind of cultural and ethnical landscapes are in place (Strang 2010: 133). The farm sketch will show results in a map showing the present land use for the household. It gives an overview of the land cultivated by the household, including which crops are cultivated, and a spatial knowledge of the distance between the house and the fields. The farm sketch is thus to show the whole cultivation area, not only the area in the actual farm. Another sketch showing the resource flow of the farm/household will be a part of showing the daily life of the farmers. This session will be combined with semi-structured interview and informal conversation in order to obtain the most information possible.

Walkabouts, where informants are asked to show the most meaningful places within the community, will help to get a basic understanding of what and where the community navigate with and from. Findings from

walkabouts create a baseline for us as researchers, as we are able to get a sense of the importance of certain places according to the villagers, and this will also help our own navigation in the field afterwards. Furthermore, walkabout is a good method to make the informants experts, as they will be in charge and "know best", which creates a more common understanding and respect for each other.

Appendix II: Strategy for volume specific soil sampling

Considerations for deciding the sample locations:

- land use history (PRA mapping of land use in the area, ranking of soil quality and detailed timelines for vegetation cover and cultivation of sample sites have to be done as a part of selecting sampling locations before the actual soil sampling)
- permission from farmers is required
- slope
- distance from sample spots (as close as possible)
- vegetation cover
- remember to take care of perennials

The procedure and used parameters for volume specific soil samplings

- · 30 cm holes
- description of the soil profile (noting colour, horizon thickness, sample depth)
- Soil samples will then be taken with defined depth intervals
- As a minimum soil samples will be carried out in three spots in both the reference field and in the plantation field. This is necessary because that allows statistics to be used in the comparison of the two soils.
- The samples will be put into bags labeled with a code identifying each sample.
- All information will be written down along with location, pictures and GPS cordinates will be taken of the place
- Replication of the procedure in the remaining sample spots that need to be carried out.
- Drying of the soil in undisturbed settings should be done shortly after collection of the samples in the field in order to stop biological transformations in the soil.
- Analyzing of soil samples will be carried out after the field trip

Appendix III: Strategy for water sampling

The procedure and used parameters:

Water samples are taken from upstream (reference spot) and downstream in an suitable river, as close as possible to the large-scale plantations. Water samples from the two places are analyzed and compared after sample taking in the appointed location in Kuching.

Possible parameters to use:

- Water temperature
- Dissolved oxygen
- pH
- Salinity
- Biochemical oxygen demand
- Chemical oxygen demand
- Nutrients
- Chemical pollution from pesticides (is this possible?)

Strategy for water sampling and practicalities will be discussed in more detail with Malaysian counterparts when arriving to Sarawak.

Appendix IV: Strategy for forest resource assessment

Objective

The impacts of large-scale oil palm plantations to the forest biomass can be remarkable due to the volume of these plantations in our case village Antayan Keropok. Forest resource assessment (FRA) will be carried out as a per hectare analysis to assess what effects the plantations have on above ground biomass (AGB) in relation to the previous main land use.

Considerations for deciding the sample locations:

FRA is conducted by establishing sample plots to the forests (5 plots to reference forest, 3 plots to plantations). The sample locations are based on the results from land-use mapping, interviews with farmers and from ranking of land areas. Samples are taken from different locations from in the middle of the forest, such as: hill top, down hill, N slope, S slope, flat.

The procedure and used parameters:

To calculate AGB:

- Size of the sample plots: circular nested plots with 9m and 15m Radius
- Parameters used for plots:
 - 9m R circle (living trees DBH > 10cm (31cm circumference))
 - 15m R circle (living trees DBH >30cm (94cm circumference))
- Tree parameters: height (plantation) and diameter (in reference forest)
- Type of allometric equation, biomass content and model to calculate: To be defined later.
- Equipments: clinometer, relascope, tape measure, paper, pen

Appendix V: Strategy for Crop Ranking

The following is an example of a crop ranking table. The crops are ranked from 0-10 (depending on the number of crops), where 0 is when the farmer does not have the crops at all. The purpose is to get a picture of which crops are most important for market sale and which are important for own consumption in the household. The table is preferably drawn on the spot, to be able to add new crop types that we were not aware of. Two tables will be made for each household, one for the present importance, and one for the past importance.

Сгор Туре	Market	Food consumption in household

Appendix VI: Strategy for Community Mapping

The facilitators (us) do not draw anything on the map, but we will coordinate how the mapping-session will be done. In order to get the best result, the following procedures are followed when doing the map: The participants start by drawing major reference points like the village boundaries, the road, and other important points of orientation. After the major reference points has been drawn, then more details like clusters of households, wells, minor roads or paths can be drawn. That is done with a black pen. Then a manifold is put on top of the first map. On the manifold, major differences in soil are sketched. This is done with a red pen. Then different land uses are classified (we decide on different symbols for oil palms, rice, forest etc.) with a green pen. Where does the drinking water come from, where do you wash clothes etc. will be drawn in blue.

Appendix VII: Interview Guides

Semi-structured interview with headman

Timeframe: 1-2 hours

Participants: 1 interpreter + 2-3 of us

Equipment: Dictaphone, notebook, pen, (map), (timeline)

Objective: To obtain knowledge about the characteristics of the village, and overall introduction to land use and daily life in Antayan Keropok.

What to remember: Introduce yourselves properly before starting the interview.

Ask permission to record the interview.

Say thank you for participating.

Theme	Primary Question	Secondary Questions	Notes
Professional information	Can you tell us about your position as headman?	How did you become headman? And how long? Is it a full-time job?	
		Do you have anything you would like to achieve as a headman?	
Village characteristics	How would you describe Antayan Keropok?		
	What are the main activities in the village?	What are the main income generating activities?	
		What farming activities are taking place?	Can you make a list or draw a map
		Are villagers engaged in farming activities outside their own farm?	inap
		Are they engaged in other activities than farming?	

	What is unique about Antayan? Are there any challenges for the village?	Are there any other activities you would like to add? Poverty, transportation etc.	
Historical information	When was the village established? Can you tell us about some major events that had great importance for the village? What are the biggest changes the village has experienced the past 10 years?	Administration changes? Climate/nature events? Infrastructure? Population? Farm, population, land use?	Begin a timeline from this information
Land-use	Which crops do you grow in the village?How do the farmers manage their land?How important is farming to the people in the village?What have been the major land changes in the past few decades?	Which crop is the most important for selling?Which crop is the most important for your own use/eating?Can you mention some reasons for this change?	(Only residents or perhaps the immigrants from Indonesia?) Add to timeline
	How has the land been distributed between the households?	(Is it equal?)	

SALCRA	Who is involved in the oil palm plantation?	How many farmers lease land out to SALCRA? Can people choose not to be a part of the oil palm plantation and engage in other kinds of land use? Do anyone from the village have jobs in the plantations? Who are administering the cooperation between SALCRA and villagers?	
	In which ways are Antayan affected by SALCRA?	Debt, contract workers, lack of sovereignty?	
	Who negotiates with SALCRA for the oil palm scheme?	What is your role in the negotiations?	
	When is the completion/end of contract of the oil palm scheme?	Is there anyone in the village which contract has ended?	
		How do SALCRA leave the fields afterwards?	
	How does Antayan benefit from cooperating with SALCRA?	Could this be improved?	
	How has the oil palm scheme had an influence on the villagers daily-lives?	Changes in occupation, income, etc.	

Semi-structured interview with farmers and drawing session

Timeframe: ¹/₂-1 hour per farmer (4 hours)

Participants: 1 interpreter + 2 of us (min. 5 farmers)

Equipment: Dictaphone, notebook, paper, pen, colors

Objective: To obtain knowledge about individual farmers' daily lives and land-use through interview and resource- and social-mapping. Interviewees will mainly be elder farmers with knowledge on the past LUC.

What to remember:

Introduce yourselves properly before starting the interview. Ask permission to record the interview and take pictures.

Say thank you for participating.

Theme	Primary Question	Secondary Questions	Notes
Personal information	Name, age, education, main occupation?		
	How big is your family?		
	How did you become involved in farming?		
Farm sketch	Can you please draw a map over your farm and the lands you cultivate?	Where are the fields located? Which crops are on the fields?	Ask who the farm/the land belong to (is it private/communal/gov ernment owned?)
		Where are the good fields in terms of soil quality?	
	What is your main crop?	Has there been any changes, and why?	Crops on good soil, Crops on poor soil
	How big an area do you cultivate? Distributed on different crops?		

Land-use	Why did you choose the crops you have? Which yield is the biggest? Which problems are related with harvest?	Do market prices influence your choice of crop?	
Flow chart	Which crops do you use in the household? Which do you sell on the market? What do you "use" for cultivating the different crops?	Inputs: fertilizer, tools, labour	Draw arrows and boxes to symbolize the flows
Daily life	What is the things you most like about farming? And what don't you like (any challenges?) Do you feel that you get enough income from farming? If the farm is leased to SALCRA: Do you feel that you were well- informed of the process? Are you involved in any off-farm activities?	Is the farming sustainable for you and your family? (In terms of profit, debt and a feeling of being a contract worker on your own land)	

Interview with SALCRA/RISDA

Timeframe: 1 hour

Participants: 1 interpreter + 2-3 of us

Equipment: Dictaphone, notebook, pen

Objective: To obtain knowledge about the interests of governmental authorities.

What to remember: Introduce yourselves properly before starting the interview.

Ask permission to record the interview.

Say thank you for participating.

Theme	Primary Question	Secondary Questions	Notes
SALCRA as a stakeholder	What is the background of SALCRA? What is the main goal(s) of SALCRA?	Why is a development project like SALCRA a good idea?	
NCR	Do you with the development schemes suggest a change away from NCR ownership over land?	Do you recommend farmers to get a title deed? Why?	(can be a sensitive issue)
Procedure in decision-making	Who chooses which land should be used for large- scale oil palm plantations? And with which criteria?	 (both SALCRA people and on village level) Is it land with low soil fertility/"unused" land that is mostly used for "development projects"? What does it require for a farmer/village to be part of the "development project"? (start investment, legal ownership, special kind of soil?, etc) 	
Management of the plantations	Who work in the oil palm plantations and how many?	Do indonesian immigrants play a part? (If yes - why and how big a	

		share?) Do the farmer who "owns" the land?	
	How are the fields left after ended leasing period? (trees left there)	(How) do you secure that the farmer can continue profiting from his/her land?	
Ecological impact	How is the plantations affecting the ecology?		
	Is the impact of the ecology important in the decision-making of which lands to choose?	Do SALCRA take into account how the plantations are affecting soil fertility, carbon stocks, biodiversity etc.? And how is that done? Do SALCRA sometimes choose not to establish oil palm	
		plantations because of a too big ecological impact? (when?)	
Impact on villagers livelihood	What do the farmers gain from participating in the project?	What is the payment to the farmers? Is it a share of the profit? How is it secured, i.e. if the harvest is bad?	
		How are the responses from farmers that have been a part of the project?	
		What is the future vision/mission with the SALCRA projects?	

Appendix VIII: Questionnaire (Draft)

Demographic

1. Gender: Male \Box Female \Box

- 3. Ethnicity: _____
- 4. Role in your family: _____
- 5. Main Occupation: _____
- 6. Total members of household: _____
- 7. Number of children in household: _____
- 8. Number of years living in Antayan Keropok: _____
- 9. Highest level of Education: _____

Land-use

10. Do you own any	land? Yes:	□ No: □
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11. How much land do you have in total?

12. How did you get the land?

Bought: [
-----------	--

Inherited: \Box

Other:	Specify:	
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13. What do you mainly use your land for? (Crops, lease it out, livestock etc.)

14. Have your land-use changed during the years?

5 years: Yes 🗆 No 🗆

10 years: Yes \Box No \Box

25 years: Yes □ No □

If yes, which changes have occurred?

15. What types of crops do you grow?

16. What is the most important crop you grow?

17. Do you own any livestock? (Please list which)

_ __

18. What are your off farm activities?

Large-scale plantations

19. Do you let SALCRA or RISDA lease your land?

Yes:

No:

Both:

20. Why or why not have you agreed to the development of your land?

Yes:

No:

22. How much income do you get per year from SALCRA/RISDA?

^{21.} Do you receive compensation from SALCRA/RISDA for using your land?
Appendix IX: Timetable for fieldwork

Day	Time	Activity	Method	Notes
Sunday 28/02-2016	17.00	Meeting at Singgahsana Lodge		
	20:00	Dinner		
Monday 29/02-2016	11.00-16.00	Group Discussion Prepare an introduction of ourselves to the village		Food shopping
Tuesday 01/03-2016	09.00 11.00 13.00 Afternoon	Departure from Kuching Arrival in Antayan Keropok Welcoming session - Present ourselves Informal conversation with the headman	Participatory observation	Ask headman about village council, elders etc. Identify key- informants
Wednesday 02/03-2016	Morning Afternoon	Walk around in the village for orientation - transect walk Timeline session with the headman/villager(s) Small drawing session (livelihood, everyday life, household, production chain) with villager(s) Prepare mapping session/workshop for tomorrow	Transect walk Timeline Community mapping	Invite people for the drawing session/workshop Identify key- informants Prepare plan for the cameras that are handed out

		Interview with the headman (+ village council)	Semi-structured interview	
Thursday 03/03-2016		Big mapping session (landuse) with 5 villager(s)- Combined with ranking session Walkabout with key informants Interview with farmers Prepare presentation for tomorrow	Community mapping, Ranking Walkabout Semi-structured interview	Hand out cameras
Friday 04/03-2016		Proposal presentation at Ranchan Park (general info about land use change and important events (timeline)) Prepare for mapping session tomorrow and invite people for it. Preparing the questionnaire		Invite people to mapping session Think about questions for the questionnaire
Saturday 05/03-2016		Land-use mapping session (before plantation) with village elders Interview with farmers Testing the questionnaire on key informants	Land use- mapping Semi-structured/ informal interview Questionnaire	Think about questions for the questionnaire
Sunday 06/03-2016	Morning	Church Prepare for soil and water sampling	Be presentable	

	Afternoon	Questionnaire with local villagers	Questionnaire	
Monday 07/03-2016		Soil sampling with GPS Water sampling with GPS	Soil sampling Water sampling	
		Water analysis (driving to Ranchan Park)	GPS	Driving to Ranchan Park (water analysis)
		Prepare focus group meeting, for FRA and for interview with SALCRA/RISDA		
Tuesday 08/03-2016		Forest resource assessment	FRA	Driving to SALCRA/RISDA
		Soil sampling with GPS	Soil sampling	Remember to have
		Focus group	Focus group	group
		Interview with SALCRA/RISDA	Interview	
Wednesday 09/03-2016		Forest resource assessment	FRA	
		Follow-up on focus group	Focus group	
Thursday 10/03-2016		Open for changes :) Prepare for final presentation		
Friday 11/03-2016	08.30-12.00	Final presentation at Ranchan Park		
	Evening	Farewell party at the village		
Saturday 12/03-2016	09.00-12.00 13.00	Cleaning Departure from Serian		
	15.00	Arrival at Singgahsana Lodge		

Appendix X: Data-matrix

Data-matrix (1/3)

Research question	Sub-question	Outputs (how are the findings going to contribute to the analysis?)	Activities/methods	Inputs/Who?	Critical assumptions	Tools
 The context: Which are the driving factors for the land 	a) How come Antayan chose to lease their land to SAI CRA/RISDA - who made		Interview	The headman/village leadership		Pen, paper, dictaphone
use changes in Antayan Keropok?	the decision, when, why, how, what are the benefits etc.? (Was there any pressure to do so?).		Interview/group interview	Local farmers - both farmers who did and did not lease their land		Pen, paper, dictaphone
			(Questionnaire, focus group)	In combination with other questions in the data matrix	In the case of focus groups, the methods reques a basis for discussion (not only fact- based questions).	questionnaires, pen,
 Which role does land rights/ land ownership play in changes of land use on village land? 	a) How do the villagers perceive ownership over land (before and now)?	Information about what does it mean to have title over land and why is i important: are there many cases of stolen land; are there any other ways to get a title deed	Semi-structured interview	Farmers		dictaphone, pen, paper
	b) How has the purpose and perception of the NCR changed since its implementation in Malaysia/Sarawak?	The historical changes in NCR and current structure of it	Semi-structured interview	Headman, key informants, farmers		dictaphone, pen, paper
	d) Who chooses the land for large-scale plantations and with	How is the chosen land for large-scale plantations agreed; is	Interview	Headman/farmers	Sensitive topic, interviews are to be carefully planned	dictaphone, pen, paper
	what criteria ?	mere a critera for the land (e.g. soil type, previous land use); do villagers and governmental authorites have same kind of perceptions over the procedure		SALCRAIRISDA	Sensitive topic, interviews are to be carefully planned	dictaphone, pen, paper
		How farmers qualify different type of land	Ranking	Farmers	1	post-it, pen, large papers, ranking criteria
3) What are the ecological impacts of the land use transition from	a) How has the land use changed spatially?	Land-use now and before large- scale plantations	Land-use mapping	Farmers, 3 persons	Maybe the scale is wrong, farmers might not remember everything, or recall things wrong	Big paper, pen, (satelite foto)
plantations?	b) What are the farmers' perceptions on changes in quality of environment?		Ranking of soil quality	Farmers, 3 persons		Big paper, pen or stones (if drawing on the ground)
			Semi-structured interview	Farmers, 2 - 3 persons		Pen, paper, interviewguide, dictaphone

Data-matrix (2/3)

Plastic bags, pen, paper, shovel, tape measure, 100cm3 soil sampling equipments		clinometer, relascope, tape measure, paper, pen	tap measure, rope, pen, paper	Questionnaire, pen, paper, dictaphone	Interview guide, pen, paper, dictaphone	Interview guide, pen, paper, dictaphone	Pens, color pencils (maybe markers), paper, aerial maps, camera
Finding good and comparable spots, permission from the farmers, weather conditions (too much rain), time-consuming		Finding good and comparable spots, permission from the farmers, time-consuming	Finding a species expert	Maybe not possible to find respondents	Cuestionnaire should be prepared and tested in advance. Cuestioning SALCRA migh be a sensitive issue, and we be a sensitive issue, and we bias, b) informants not visiting to speak and be subject to our research, b) possible creation of possible creation of poss		It is important that the participants are familialized with the maps and the area before beginning the excercise. Therefore, the walk around the village with the map could be a good idea. Regarding mapping of nutrient flows: it might be difficult to cacluse of flows, e.g. because of measurement types.
Guide to show location, 2-3 persons	Malay student (water specialist), 2 persons	Guide/farmers to show the sample locations, min 2 students, species expert	Guide/farmers to show the sample locations (same as FRA), 2 students, species expert	1) farmers, 2) SALCRA/RISDA			
Pre soit sampling: tand use pristory - detailed timelines for vegetation cover and cultivation of sample sites have to be done as a part of selecting sampling (ocations before the actual soil sampling. Actual soil sampling	Water samples	 Pre-work: land use mapping (connected to sub-question a), 2) Forest resource assessment (FRA) 	Biodiversity index	Semi-structured interview	Questionnaire. Semi-structure interviews with farmers energinged in SALCRA ventures interviews with representative from SALCRA form SALCRA form SALCRA semi-structured interviews wi farmers engaged in or thinkin, of engaging in SALCRA Land use mapping session with ventures. Interview with ventures. Interview with representative from SALCRA Land use mapping session with villagers (prefeably with villagers), farmers and other villagers.		Land use mapping session with vilagers (preferably with roductionchain and nutrient flows specified), Ranking of crops (session with vilagers), Sami-structured intervilagers. farmers and other villagers.
Findings should tell what impact the land use change has on the local ecology (soil fertility) and global ecology (CO2 emissions)	Changes in water quality	Findings should tell what impact the land use change has on the global and local ecology (C sinks)	Findings should tell what impact the land use change has on biodiversity	Find out a place where the first leasing period has ended and ask the farmers perceptions of the project, and if thy have experienced any positive or negative environmental effects	How much is the rent-payment from SALCRA? Do he vilage people earm more on being part of the development project than they could have earmed if growing their own crops?	Who carries the risk of i.e. crop failure (The villager, the community, SALCRA, etc.)	Has the introduction of plantations resulted in changes in orf-farm activities and changes in orf-farm outivating remaining fields, and if yes, what kind of changes (eg. more efficient cutivating or monocropping? changes in fertilizer, irrigation etc.)
c) wrate are memors on soil quality, water quality, above ground biomass and diversity of forest areas? d) How are the fields left after ended leasing period? (environmental quality)			a) What are the main strategies in generating cash income (before and now)?				
			 Has the everyday life in Antaryan changed since the village started leasing fund for plantations matter? (Social structure, social navigation, cash income etc.) if so, how? 				

Data-matrix (3/3)