



ILUNRM REPORT

LIVELIHOOD AND ADA(P)TATION STRATEGIES OF
VILLAGERS UNDER LAND USE TRANSITIONS

- THE CASE OF KRANGAN TRUSAN & KRANGAN ENKATAK



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Abstract

The Malaysian state of Sarawak, Borneo, undergoes major land use transitions with the introduction of oil palm plantations being the most prevalent. This is also true for the two villages of Krangan Trusan and Krangan Engkatak. The aim of this study is to investigate how different dynamics of transitions interlink and affect these villagers' choices of livelihood strategies, land use changes, and flexibility in terms of adapting to changes caused by these dynamics. The major findings are as follows: I) Villagers draw on rationales from both their cultural tradition (adat) and modern capitalism for their decision-making. II) Cultural traditions are challenged by the generational changes characterized by lacking transfer of tacit knowledge such as with traditional farming practices due to educational goals for the younger generation. III) Oil palm production (smallholder as well as large-scale estate owned) result in decreased soil fertility measured by Pox-C, total C and total N compared to field with pepper, rubber and primary forest. IV) Villagers are increasingly diversifying their income sources by cash crop production and by engaging in oil palm schemes, but are simultaneously exposed to higher dependency of global market prices on foods as well as agrochemicals. V) Although a decrease in sharing-tradition or soil fertility might impose limitations to future livelihood flexibility, villagers express high willingness and perceived ability to adapt to the changes in both the economic and natural landscape. Present study shows how modernization in a community is a constant process that involves reinterpretation rather than replacement.

Keywords: land use changes, oil palm schemes, livelihood strategies, adaptation, Sarawak

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List of abbreviations

JVC	Joint Venture Company
K.E.	Krangan Engkatak
K.T.	Krangan Trusan
LUC	Land use change
NCR	Native Customary Rights
OP	Oil palm
P.O.	Participant Observation
Pox-C	Permanganate Oxidizable Carbon
PRA	Participatory Rural Appraisal (method)
RISDA	Rubber Industry Smallholders Development Authority
S/H	Smallholder, Smallholding
S&B	Slash and burn
SALCRA	Sarawak Land Consolidation and Rehabilitation Authority
SLC	Sarawak Land Code
SOC	Soil Organic Carbon
SSI	Semi-structured Interview
USI	Unstructured Interview

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1. Introduction

“(…) look carefully at individual cases-not in the hope of proving anything, but rather in the hope of learning something” (Hans Eysenck in Flyvbjerg 2006:224).

During our intensive preparation for our field trip and during the even more intensive field course our academic and personal horizons have been expanded by new knowledge and friendships. We have learned much more than what is and what could be present in the following case study of the two villages Krangan Trusan and Krangan Engkatak (Malaysia) conducted as part of the 2016 SLUSE field course.

1.1 The history and political context of Sarawak, Malaysia

The country of Malaysia is constituted by 13 states, 11 of them in the western part of the country, Peninsular, and two located in Borneo – Sarawak and Sabah. The island of Borneo, which is the biggest in Asia, has a big variety in biodiversity and is amongst other things home for some of the oldest rainforests in the world.



Fig. 1.1 Map of Sarawak on Borneo (Straight 2013)

In 1839, James Brooke arrived to Sarawak (fig. 1.1), and the English colonization of the Malaysian part of Borneo began. In 1957, Peninsular Malaysia gained independence, but it was not until 1962 before Sarawak, Sabah and Brunei became independent (Bulan, 2006). With the inclusion of Sarawak and Sabah, the indigenous people of Sarawak, the so-called Dayaks, were included in the national commitment. The Dayak’s largest sub-group is the Iban, who make up around 30% of the population (The Malaysia Site, 2016). Their adat (culture) is traditionally build upon farming, which through history has comprised a large part of their livelihood - and still is today. Traditionally, the Iban people have practised swidden cultivation, where different plots of land are cultivated temporarily. Many Asian governments have condemned this practise, as it is associated with low productivity, deforestation, soil degradation and high amounts of CO₂ emissions, even though it might provide social and ecological benefits (Bruun *et al.* 2013). The stagnation of swidden cultivation has been replaced by an increased expansion of commercial oil palm plantations (*ibid.*), but also cash crops are common cultivation methods, and include among others pepper, rubber, and

smallholding oil palm plantations (app. 2). Land rights in Sarawak are based on a system of complex traditional laws (or adat), of which some are recognised in the Sarawak Land Code (SLC) of 1958, referred to as Native Customary Rights (NCR), while others are only applied and held in the collective memories of local communities (Cooke *et al.* 2011). This system is still practised, but today land titles are acknowledged in order to secure land rights. Concurrently with the land availability decreasing, the land titles become more and more crucial for villagers (app. 4, app. 5).

In the southern part of Sarawak there is a general tendency to rent out land for oil palm production to development schemes such as SALCRA (Sarawak Land Consolidation and Rehabilitation Authority) or JVCs (joint venture companies). The governmental development plans for Sarawak encourage an expansion of oil palm production through schemes as SALCRA. The main objective of the state government agency SALCRA is to improve the overall well-being of the rural communities through development of lands for plantation agriculture, by converting idle native land (often NCR-land) into productive agricultural land (oil palm plantations). This aims to enhance rural development and poverty eradication by among other things enhancing infrastructure and increasing job opportunities and income (SALCRA, 2012). These characteristics of land use in Sarawak also apply to our two case villages, the land use changes of which will be introduced in the following.

1.2 A case study of Krangan Trusan and Krangan Engkatak - Sarawak, Malaysia

Our case study is centered around the Krangan area, more specific the two Iban communities Krangan Trusan (K.T.) and Krangan Engkatak (K.E.). These are located around 95 kilometres from Kuching, whereas K.T. is made up by 46 households, and K.E. of 17 households with each of their headman to manage the villages. K.T. was established in the 1930s, whereas K.E. was established later in the 1970s primarily by former K.T. villagers. Common for both areas is a diverse source of cash income, both relying on development schemes, but many also cultivate cash crops, such as rubber, pepper, and swamp rice.

The land surrounding and belonging to villagers of K.T. and K.E. has undergone major transitions throughout the last half century both in terms of land cover, land management and cropping systems. Prior to the introduction of commercialized cash cropping systems and development schemes, these Iban villagers performed agriculture through shifting cultivation based on slash and burn practices (Bruun *et al.* 2009). Forest was cut down and residues

burned in order to create space for new crop cultivation, which after a certain period of time was then left abandoned (fallow) to restore soil fertility. Land tenure was based on a system where those who first cultivated new land had the rights to that land in accordance with the common *adat* and the native customary land (NCR) system (Cooke *et al.* 2011).

From combining most of the data collected we found that the shifting cultivation era came to an end due to several circumstances. Firstly of all the population pressure and the following land scarcity put certain limits on the new land to explore. Secondly, agrochemicals (mainly fertilizers and pesticides) was introduced and made it possible to sustain continuous crop production on the same land. Thirdly, an amendment in 1988 to the Sarawak Land Code of 1958 introduced a fine if “land improvements” are not implemented within a three year period (Cooke *et al.* 2011). This amendment effectively disregards shifting cultivation systems.

The making of a timeline with elder farmers from KT (app. 2) showed that the villagers in the 1960s depended much on natural resources for food sources, e.g. fishing, hunting wild game and frogs, collecting honey and fruits. During the process of agricultural modernization, natural resources became both less available by loss of biodiversity due to over extraction and deforestation and somehow less important for the livelihood of the household due to the availability of cash generating income sources and infrastructure; factors which made trading of food more prevalent.

The changes in the prevalent crops cultivated over time are presented in table 1.1 below. The region has a long history of engaging in governmental (development) schemes for production of high-value crops: previously with the RISDA (Rubber Industry Smallholders Development Authority) and currently with SALCRA and a newly started JVC.

Table 1.1. Overview of main cash crops or forest products (app. 2)

	1960s	1970s	1980s	1995	2005
Main cash crops/forest product	Rubber, Sugarcane, Timber	Rubber, Cocoa, Pepper	Oil palm, Rubber, Cocoa, Pepper	SALCRA plantations, JVC, Rubber, Pepper	Smallholder plantations, SALCRA, JVC, Pepper

1.3 Research objective and research questions

On the basis of the above-mentioned circumstances, it is interesting to understand how a village, which is highly dependent on agriculture as an income source, are adapting to the present land use transitions. A general tendency is the entry into the global market entailing a focus on global market prices and introduces aspects of ‘modern’ life. At the same time it is interesting to investigate how the present development and land use changes of the villages introduces new ways of living, but also how far away the past lies and how/if adat is taking form also in a new way. In this report we use the word “development” as the structural changes wished for by actors such as the Malaysian state, stemming from a wider global context. On the basis of all this, the aim of this report is to investigate how different dynamics of transitions interlink and affect the villagers of Krangan Trusan and Krangan Engkatak's choices of livelihood strategies, land use changes, and flexibility in terms of adapting to changes caused by these dynamics. We have identified the following research questions:

- What are the major land use changes and how goes villagers adapt to these?
- What are the key rationales influencing decision-making in relation to livelihood strategies?
- What are the impacts of different land uses on soil quality and how does it relate to future livelihood flexibility?
- How are local cultural traditions preserved and challenged in the dynamics of current development processes?
- In what way are current livelihood strategy decisions potentially affecting future generations?

The structure of this report is built upon three interrelated themes that contribute to answer the objective of the report. As the two villages to a large extent are similar, and as the headmen from K.T. and K.E. are collaborating (app. 10, app. 11), the aim is not to compare the two villages, but instead unite them in a joint analysis and discussion.

2. Theory of science: Latour and ANT

We refer to ANT (Actor Network Theory) as our theory of science. The framework will be used to create an underlying understanding of elements that are important to incorporate in our analysis. The following is a brief presentation of the ontological assumption related to ANT.

The name ANT refers to the ontological understanding of actors and networks as two elements constituting each other in a phenomenon. It is the relations between some actors that constitute the 'social' and that appoint ANT's analytical focus. An actor is not inherently social. Its sociality should be understood in the relation to the network it is a part of. Vice versa a network is the sum of the relations created by actors it inhabits (Latour 2005:9). The following picture (fig. 2.1) of soybean roots will be used to exemplify this point. The knobs of the root can be seen as actors and the root strings as the network. The knobs on the root strings are both *constituting* the root network, but the knobs are also *constituted by* the root strings.



Fig. 2.1 Soy bean roots visualizing actors and networks of ANT

This definition of the 'social', as being the associations between actors, opens up the definition of an actor. The term 'actentz' makes no distinction between a human or non-human actor (Latour 2005:8ff.)

If 'social' is not an inherent attribution prescribed to an actor, then the actor does not have to be a human actor before it is relevant to incorporate in the analysis of a social phenomenon (Latour 2005:8ff). That opens up the inclusion of a range of actors relevant for social science. As a result nature and culture is not viewed as two analytical separated elements of life for ANT, it is a distinction that has been created through the hybrid of modernity which ANT tries to make visible and to move away from in their analysis (Blok & Jensen 2011:78). We see this perception as highly relevant for the aim of SLUSE and our report.

In our analysis of the Krangan villages we will refer to human and non-human actors simultaneously to try to understand the 'social' phenomenon that is being created by humans and non-humans alike. Here SALCRA or soil organic matter are viewed as actors just as the villagers of Krangan are actors; together with other relevant actors they are constituted by and constituting the network of our case study.

3. Methodology

This chapter gives an overview of the different methods we applied in our fieldwork, and explains some of the reflections, we have made on how our methodological approach has influenced both data generation and analyses. In order to investigate our research objective and answer our research questions we applied an interdisciplinary methodological approach, combining qualitative and quantitative methods from social sciences and natural sciences.

3.1 Methods applied

Our overall approach was more or less divided into two major phases, one exploratory and one more in-depth, as described in table 3.1.

Table 3.1. Methods divided by phase

Exploratory phase	In-depth phase
Baseline survey	PRA-sessions
Transect walks	Focus groups
PRA-session: Land use history timeline	Land use history questionnaires
Semi-structured interviews	Soil sampling
Unstructured interviews	Semi-structured interviews
	Unstructured interviews
	Ethnobotany studies

In order to get a general overview of the field, we first conducted a baseline survey (Casley & Kumar, 1988:55) based on questionnaires with 18 households selected from random sampling. The questionnaires focused on general household demographic, land use and relations to SALCRA. This survey also served as basis for identifying key informants in relation to our planned PRA-sessions, and identifying plots that would fit the criteria of our soil sampling strategy. In this more exploratory phase we also conducted a transect walk of

both K.T. and K.E. with local guides, giving us a chance to learn more about the immediate environment of the villages. Furthermore, we conducted a PRA-session with elders from K.E., establishing a timeline of land use history since the 1960s. Combined with SSIs of key informants such as the headman of K.T., the results and observations from these methods led us to the next more in-depth phase of data collection. This exploratory phase enabled us to specify, which questions we should ask to whom in order to answer our research questions. The more narrow and focused data collection phase mainly consisted of five different categories of methods: PRA-sessions investigating livelihood strategy preferences and perceptions of soil; focus groups discussing challenges regarding making a living and perceptions of the future; semi- and unstructured interviews with several informants; soil sampling with appertaining land use history questionnaires; ethnobotanical studies investigating the villagers' utilization of forest resources, and what they would lose by converting the forest to oil palm plantations. We often intentionally overlapped the themes that these different methods addressed, using methodological triangulation (Mikkelsen, 2005:97) as an overlying method of ensuring valid and representational data.

Our interdisciplinary combination of social and natural science methods especially helped us utilize discipline triangulation (Mikkelsen, 2005:97), and thereby gain a deeper understanding of differences in agricultural management. Especially, the transition from swidden cultivation to oil palm plantations, is affecting soil fertility, which subsequently enabled us to discuss the implications for the villagers' future livelihood flexibility. Using the space-for-time substitution approach, we rely on the assumption that the soil status has been the same prior to the differentiation of management. In order to ensure this, we held a PRA session (app. 3) with farmers; first of all to reveal and map their perceptions of good, medium and poor soil; second to reveal the common management (fertilizer and pesticide use, soil preparation, etc.) for different crops; third to locate fields of the prevalent cash crops, i.e. oil palm, pepper and rubber; fourth and finally to discuss the land use history for fields and identify different palm oil plantations with oil palms of certain ages. Subsequently, we made interviews with landowners of several oil palm, rubber, and pepper fields to ensure similar cropping history and corresponding management. For further detailed methodological reflections on our soil sampling strategy, see app. 24.

For an elaboration of the methods applied, and the rationales behind them including advantages, disadvantages and implications to the report, see app. 25.

3.2 Data creation

Throughout the fieldwork we tried our best to let our own assumptions bias the application of abovementioned methods in the smallest way possible, but we are however still aware that no data collection is free from the bias of the researcher's own perception of the world. Researchers do not merely collect data, but are actively involved in the process of *creating* data (Whyte & Whyte, 1989:147-148). Data is defined through interaction as well as the standards and categories that the researcher brings with him or her to the field (ibid.). In the same way we also brought with us understandings and categories that affected and shaped not only the questions we asked, but also the different answers and phenomena we paid special attention to in our notes. Our theoretical approach of actor network theory (ANT) does however help us in a methodological sense here. One of our main reasons for even using ANT as an underlying theoretical approach is to have open minds regarding assumed differences in ontological understandings of nature and environment between the villagers and us. This helped us to not neglect the significance of the relations non-human actors may have to human actors as found in the accounts given by the villagers. This was also the reasoning behind our focus on applying different kinds of PRA-methods, which emphasize letting the knowledge of “ordinary”, local people play a central part in data creation (Mikkelsen, 2005:97). This was for instance operationalized in the way we organized a PRA ranking exercise, where the villagers compared different livelihood activities’ ability to obtain certain objectives (e.g. food security, preserving adat, etc.). Both the listed activities as well as objectives were defined from previous interviews with villagers, thus letting the villagers’ descriptions become the base for further data creation.

ANT thus functioned as an underlying approach that led us to investigate the network of relations that the households function within to make a living, without being a direct point of reference in our final analyses. Using ANT inductively in this way enables our analyses to focus on letting the data speak for itself, but we recognize that the ANT-approach brings along certain argumentative foci that would not be manifested the same way with a different approach. We for instance chose to disregard using the Sustainable Livelihood Framework (DFID 1999, Clark & Carney 2008) deductively as a way of analyzing the livelihood strategies of the local households, although we share some of the frameworks’ focus on livelihood strategies.

3.3 Lost in translation

We were fortunate enough to have a Malaysian group member that could speak the local language of Iban, as well as two translators. Although it seems they did an amazing job, this still adds an extra layer to the aforementioned process of data creation, making the translators significant middlemen in the interpretation of both our questions and the respondents' answers. This created different parameters for generating data, based on which interpreter you were with during the particular method. We sometimes experienced receiving translated answers that clearly was based on a mistranslation or misunderstanding of the question asked. As the following quote shows, this was often related to time.

Interviewer: when do you think this knowledge will be passed on to you?

Informant: once i moved here, my grandparents learned me little about tapioka planting, eggplant, chili and other vegetables”

(Young villager, app. 12)

Where the question is posed in relation to the future, the answer clearly regards the past. One of our Malaysian counterparts explained that there is only one verb tense in the Iban language, making the indication of time a matter of using the words past, present or future in a given statement. In a case like this where the interviewer didn't ask a followup question to clarify this misunderstanding we have to be critical of if or how to use the information. If a overall assessment of the interview and internally triangulation of the data and in this case triangulation with or knowledge of the grammatically implication can point towards a clarification. In other cases where triangulation doesn't clarify the misunderstanding we have to disregard the data.

In order to prevent misunderstandings as much as possible, we for instance had both translators work together on a single translation of our questionnaires into Iban, ensuring that they used the same translated phrases during our survey data collection. We furthermore highly emphasized letting our translators be a part of many of the group work sessions, allowing them to get an understanding of our research objectives. This could have led the translators to only translate the specific parts of respondents' answers they deemed relevant for us, thus making it harder for us to get a holistic understanding of the respondents'

perceptions. This being said, we still deemed it more rewarding that they had some sort of understanding of what kind of data we were looking for, making it easier for them to know what might be the correct as well as most understandable translation of our questions.

Their translation skills were further put to the test by our frequent use of methods such as PRA-sessions or focus groups, where conversation among the respondents often began to flow freely at some point during the sessions. This could sometimes result in certain quotes being translated differently or the translations being noted differently, thus having consequences for our subsequent analysis. Our best weapon against these differences was applying immediate and thorough debriefing after each session, discussing and merging notes and experiences.

3.4 A case of?

“A case is an edited chunk of empirical reality where certain features are marked out, emphasized and privileged while others recede into the background. As such, a case is not ‘natural’ but, but a mental or analytical, construct aimed at organizing knowledge about reality in a manageable way” (Lund 2014:224). As the quote above shows our entire report and the empirical arguments we present during our analysis is an analytical construction made in a cross disciplinary group discussion and reflections of our above mentioned produced data. To the question Lund asks: “of what is this a case?” (Lund 2014) our point of departure is the LUC present as a general tendency for the region of Sarawak. We try to understand and unfold the implications these LUCs have in a delimited and “manageable way”. This has enabled us to understand some of the microdynamics and relations taking place in a much broader and bigger network.

4. Adat - “a part of who we are”

“Bejalai betungkat ke adat, Tinduk bepanggal ke peningat”

“You sleep with memories and walk with your adat.”

(Iban saying, farmer, App. 5)

In our initial understanding and translation of the word ‘adat’ we referred to it as culture or tradition. With our western relation to culture and tradition, we understood adat as being a practice saved for special cultural events. Even though adat is also part of cultural rituals, it is much more than that. Adat can be defined as: “*‘Rules and expectations’ that govern ‘every aspect of existence’*” (Schiller in Chua 2012:62). It is the villagers’ ontological understanding guiding life’s many aspects. As the Iban saying illustrates, “adat is something you walk with in your waking hours, and sleep with the memories of, in your sleeping hours” - making adat ever present. Adat is in this understanding ‘everything’, and for us to be able to understand, what we are specifically interested in; the villager’s livelihood strategies, we have to incorporate a little bit of this ‘everything’.

The following section is an introduction to how adat influences some of the themes this paper touches upon. More specifically this section connects adat to farming and unfolds how, changes in livelihood strategies such as applying cash crops and education, both changes adat and is an attempt to save the adat.

4.1 Adat and farming

In the villagers’ understanding of life, nature and culture are not two separated spheres, but rather interlinked making adat relevant when addressing land use and livelihood strategies. In the women’s PRA livelihood preference matrix exercise, they were asked to divide 20 stones between different livelihood activities, symbolizing which activities they preferred to use in order to achieve a given objective. They divided all their stones between cash crops and subsistence crops under the objective of ‘preserving adat’. The reason they gave was that farming was the most important in their culture, and part of Iban history as it was something they had always been doing. There are several cultural and traditional practices around farming that is ascribed by adat: during new moon they do not slash the rice field, when they hear the sound of a specific bird while farming they have to leave the field, and if a villager dies they do not work in the field for three days (app. 6). Another adat is to throw a mix of

different vegetable seeds down with the rice seed, and thus have a hill rice field, intercropped with a few small vegetable plants (app. 3). In the farmers' focus group when presented for the scenario of an ideal farm, the consensus was: "*Paddy is the best, without it we would die*" (Farmer, app. 16). Paddy as a subsistence crop is a means of preserving their livelihood and the adat. In the women's PRA they explained how they wanted to include their children in the paddy field as a way to preserve adat (app. 4). Yet again showing that it is hard to separate whether it is livelihood security, farming knowledge or adat that is passed on by bringing the children to the paddy field, as it is all the above. The women felt it challenging to pass on knowledge about paddy farming as the children was preoccupied with technology such as mobile phones and television. There was a fear of the constantly changing world, and how it could lead to the adat dying out (app. 4). As Iban adat is farming, farming is almost a taken for granted aspect of the young villagers' livelihood strategies. All young people in the youth focus groups had plans of coming back to the village as their retirement plan. They had dreams of going to the city to get educated, but that would not interfere with them also being farmers (app. 14, app 15).

4.2 Adat - How to learn tacit knowledge?

The younger people are eager to preserve the adat, and the older generations want to pass on the adat, but there is a discrepancy between intentions and actions. The farmers are not bringing their children to the fields to pass on the farming knowledge. The following quote highlights why this discrepancy takes place. At the same time it shows how farming, adat and livelihood strategies are closely related, and are undergoing changes in relation to an uncertain future that might need adaptation.

Interviewer: You mentioned you would send your children to farming courses, why?

Informant 1: It is easier for our kids, now we use our own tools, and our hands, in the future they might use a machine

Interviewer: Do you feel you can learn your children how to farm with the knowledge you have today?

Informant 1: Based on the knowledge I have, it might be hard for them to live by in the future, they might have to plant extra crops and sell more.

(Mother USI, App. 7)

Under the women's PRA some expressed that they wanted to bring their children to the paddy fields. The unstructured interview with two mothers, who were also present in the women's PRA, explained how they were brought to the paddy field at the age of seven to learn how to farm by watching their parents (app 7). When asking if the same was the case with their children, they said no, because they want a better future for their children, and don't want to disturb the children's time, so they could focus on their schoolwork. As the quote above presents, they felt a lack of knowledge in order to help provide a better future for their children, but this would instead be achieved through education.

We have so far tried to show how knowledge about farming is also adat. From the different conversations with farmers we got the impression that they have a tacit knowledge about farming. When asked to explain how to identify good soil, they explained about a hierarchical system based on e.g. soil color (app. 3). Yet, there is also a big part of farming practices that they explain as 'that is just adat' (p.o.). The knowledge and adat of the parents' generation have been passed on in a 'learning-by-doing' manner, but the quote and other statements indicate, how the future farming of the village will be based on an increasingly academic knowledge (app. 4, 12, 14, 15) as stated in the Women's PRA:

"The world is getting modern, and the children are going to need knowledge for the future, because the world is changing."

(App. 4)

This development is partly recognized due to the presence of oil palm schemes, because remittances received from oil palm is being spent on the children's education (app. 4, 7). In the women's livelihood preference matrix, oil palm (SALCRA and smallholder together) received 12 stones out of 20 under 'securing education for their children' (app. 4). The impacts of oil palm will be elaborated on in section 5.

In the farmers' focus group their children's education and school expenses was a necessity on the same level as basic foods, and could not be compromised even when money was scarce (app 3). This shows how education can be viewed as a livelihood strategy, securing their children's future. The two livelihood strategies of farming and achieving an academical education is to a high extent interrelated, and is not an 'either or'.

For parents and children the optimal education is one where the knowledge gained at university can be applied on farming. There is a preference for natural science, which comes across in choosing subjects for form four (qualifying for university entrance) (p.o.). In a SSI with a 17-year-old boy, he explained, how he aspired to become an chemical engineer, and after retirement he would do research on the village's land area, which could be applied to change the farming methods. As all the other young people we have spoken to, he imagines him-self having dual jobs - working daily in the city and returning to the village in his weekends and holidays to do farming. When asked if he had any knowledge about farming, and how he would learn, he referred to his grandparents even though planning on a career as a chemical engineer.

Informant: It [agricultural knowledge] is very little, because I seldom follow my grandmother.

Interviewer: Then how would you learn?

Informant: Even though I do not know, I want to learn.

Interviewer: But how would you learn, from where?

Informant: My grandparents, they know a lot.

(SSI young, App. 12)

The youth are eager to learn about farming and to preserve the adat (app. 14). However, it seems like the process of passing on knowledge between parents and the youth has not begun. Adat is not only farming knowledge, but a life perception, which might be easier to give a child rather than an adult, who has had time and experiences to form their own life understandings. A relevant difference of getting farming knowledge from the university or the elders is that adat does not distinguish between nature and culture. This is exemplified by the untouched island in a vast oil palm plantation, because the land is inhabited by a spirit (p.o.). A disturbance of that land would create an unbalance with consequences for the land and people (p.o.), and would not be a part of the agenda in modern agricultural academia. Academic knowledge in non-western worlds still lies under a western hegemony of defining academia (Sardar 1999:50), in which the two spheres are separated (Blok & Jensen 2011:78). Farming knowledge gained from adat or the university can affect the future villagers' general life perception and land use differently. In the chapter 'Back to the Future' we will discuss

the implications of the lack of farming knowledge being passed on to the youth by the older generations.

In this section we have opened our understanding of adat to incorporate many aspects of the villager's life, including changes in farming practices, livelihood strategies and economy which will be analysed and discussed in the forthcoming chapters Cash & Crops and Back to the Future.

5. Cash & Crops

Income from cash crops plays a great role in the livelihood strategies of the villages. In the previous section it was shortly touched upon how dividends from SALCRA and JVC secure the children of the village's access to education. This is only one way cash crops impact the life of the villages. In this section, we unfold the many ways the land use changes and cultivation of cash crops, as introduced in the introduction, impacts the two villages.

In '5.1 Money grows on oil palm trees' we discuss the villagers engagement in the most prevailing LUC; the oil palm schemes. '5.2 Consequences of land use changes', as the name indicates, looks at some of the consequences related to land use changes in crops (oil palm, rubber and pepper) and its implications on both soil fertility and dependency on the global market.

5.1 Money grows on oil palm trees

Development schemes, such as SALCRA and JVC, has through the last decades gained greater importance to the villagers in K.T. and K.E., shaping the natural and social landscape of the villages. The majority of the villagers in both villages engage in SALCRA (app. 1), why it is relevant to focus on SALCRA, and how it affects villagers' livelihood and land use change.

The headman of K.E. explained that the villagers' living conditions became better after the introduction of oil palm (app. 2, app. 11). Previous challenges stated by elder farmers e.g. poor infrastructure was bypassed by the building of a road in 1980s, while problems with pests and diseases on crops was partly bypassed by the introduction of pesticides (1970s) and the declining biodiversity (1980s) (app. 2). The perceived high price of fertilizers and chemicals became a novel challenge, but could now be acquired by reinvesting the money from primarily the oil palm plantations.

5.1.1 SALCRA - a way of income diversification

Through the questionnaires and SSI's several benefits from engaging in SALCRA was revealed. The most commonly mentioned benefit is the income and the diversification of income sources that SALCRA enables. Participants are being paid dividends twice a year, depending on the size of fields, the average produce from the field and the global market price on palm oil (app. 1, app. 8). Consequently, if the market price on oil palm decreases, dividends will decrease as well (app. 8). However, leasing land to SALCRA enables farmers to direct more time and/or resources in cultivating other cash crop fields creating a (crop based) diversified source of income. This might make them stand stronger against the fluctuating market prices. Though it is important to emphasize that the size of land each households have varies greatly (app. 1). Another benefit mentioned is when the villagers' land are located too far away for daily access, or if they lack the resources to cultivate their land (seeds, machineries, agrochemicals). In this situation, SALCRA is a reasonable option. As Mr. Nelson from SALCRA stated: "Some farmers do not have cash to manage their land - then SALCRA can help" (app. 8).

With that in mind, another important incentive to join SALCRA is the opportunity to gain land titles (app. 1, app. 3), the requiring of which otherwise would pose a great expense (app. 1, app. 4). In relation to declining land availability and the increasing numbers of actors interested in using land, the importance of land titles has markedly increased. When participating in SALCRA the borders of a farmer's field are determined, and the status will change from NCR-land to privatised native land. This means that people will receive a documented land title, proving their ownership and ensuring their rights for the land (SALCRA, 2012). As previously stated land titles is a newer development of communal land being divided and turned into individual juridical ownership. This tendency is different from the traditional adat, where land was not individual or owned in a juridical sense. The land titles are different from adat, but at the same time it saves adat, and secures the next generation's opportunity to get acquainted with the land so closely related to Iban identity. As SALCRA has a minimum area requirement at 500 ha, the individual villager depends on the rest of the community to also collectively join the scheme (app. 1). It seems genuine when the villagers state that the well-being and consensus of the village is more important than their individual opinion (app. 1). This, which we named 'longhouse mentality', was also present in the PRA-sessions. In the preference matrix villagers gave their "preference" stones to other

farmers, and in other PRA-sessions they for instance expressed that a specific farmer was ‘a good man’ and therefore agreed on whatever he found suitable to answer (app. 3). This ‘longhouse mentality’ is somehow also present in SALCRA. SALCRA, the macro-actor and the symbol of capitalist ‘modernity’, is not without elements of adat. They respect when villagers want “islands” without oil palm in between large-scale plantations, so spirits will not be disturbed. Moreover SALCRA refer their offer and all communication regarding the villagers’ land to the headman (app. 10). This promotes the understanding of the villagers and their land as a community, which prescribed by adat is represented by the headman.

5.1.2 Mind the gap

It has become clear that SALCRA provides several important benefits for the villagers in K.T. and K.E., and especially the attainment of land titles and source of income are of great importance. However, investigating SALCRA and its importance to both villages also revealed some problems. The process of measuring land by SALCRA has caused several conflicts, as some villagers believe that they own more land than the entitled area (app. 4).

A central problem relates to lack of transparency in the calculation of dividends. There are several communication gaps between SALCRA and the farmers. Mr. Nelson, a SALCRA officer stated that villagers are welcome to access the SALCRA office and get documents comprising calculations on the dividends of their specific field (app. 8). However, this information has not reached the villagers, some of whom express frustration with not knowing these details (app. A). A challenge is that many farmers are illiterate, why an access to the documents might not even help them to understand the calculations behind the given dividends.

Farmers, who are satisfied with the dividend they receive from SALCRA, are generally very content with SALCRA, which is shown in our questionnaires where 10 out of 13 were content, and would probably like to continue. Opposite, farmers who feel they receive a low dividend or where the dividend has drastically dropped, are not content, and are more interested in ending the contract with SALCRA (app. 1). The land they get back after ending the 25-year contract with SALCRA, is perceived by the farmers as having lower fertility and involve challenges such as remaining oil palm roots or soil acidity (app. 3, app. 16). This was not known prior to the entrance of the SALCRA scheme, but is a result of observations shared between farmers (app. 16). These gaps might cause consequences for the future livelihood flexibility of the farmers, which will be elaborated on in the following section ‘Consequences of Land Use Changes’ (section 5.2).

SALCRA might provide individual land rights, but the villagers' land is treated as a whole, as SALCRA requests a minimum of 500 ha for a plantation. This forces the villagers to unite and collectively agree upon the lease.

Prolonging the SALCRA-contract means that the individual farmer will go through the 5-year replanting period that are taking place between the oil palm cycles, where no dividend is being paid (app. 8). In the women's PRA, the challenge of this no-income-period was discussed. For some the solution was to join the JVC plantation, which began in 2013 i.e. some years in advance of the ending SALCRA cycle, in order to insure an income during this 5-year period (app. 4). This again highlights the diversifying of income sources, creating a safety net and a continued income.

Overall, SALCRA is contributing with several important benefits to farmers in K.T. and K.E. These have allowed farmers to diversify the sources of income and get land titles on their land. However, farmers are also faced with challenges either way, participating or not.

5.2 Consequences of land use changes

This part consists of several analytical point starting with section 5.2.1 (Changes in land availability and quality), which gives an insight to the villagers' different management practices. In section 5.2.2 (Changes in soil fertility) soil sampling results are presented and analysed to see if and how different management practises impact soil fertility.

'5.2.3 Modernity and dependency on market prices' relates the predominant cultivation of cash crops to an analysis of the villagers' relation to market prices and "modern" rationales influencing their livelihood strategies. The section that follows: '5.2.4 More money, modern problems' describes the presence of market prices and "modern" ideas as a process taking over decisions previously guided by adat. The last section '5.2.5 Relation to and use of the forest' comments on how the LUC has influenced the surrounding forest resources and the villagers relation to the forest as part of Iban identity.

5.2.1 Changes in land availability and management

Changes in land use and land management have led to different consequences for land availability and soil quality. Uniting fields of NCR-land into the large SALCRA and JVC plantations (500 ha and above) means that less land is available to produce foods. However,

this does not seem to curtail the local food security as participation in the scheme generates money to acquire foods from the market (app. 1).

The land use transitions resulted in both new crops and management intensities, which we found to vary between the cultivated crops (table 5.1). E.g. rubber plantations are barely managed subsequent to pre-planting soil preparation while land under oil palm receive, perceived by the farmers, large amounts of external inputs in terms of fertilizers, pesticides, and are modified by mechanical means to insure soil preparation and drainage (app. 3). In these intensified systems without extended fallow periods to regenerate soil properties the farmer cannot rely on the soil fertility alone, but are now dependent on fertilizers, which we found to be almost exclusively commercial and mineral external inputs, rather than organic (e.g. chicken manure) and/or recycled within the farm system. Different land uses and corresponding management affect the landscape and the quality of it on several levels (i.e. biodiversity, biomass, soil fertility, recreational value), and we chose to focus mainly on soil fertility.

Table 5.1. The usual management of different crops (stated during the farmer PRA)

	Oil palm		Rubber		Pepper S/H	Hill pady S/H
	SALCRA	S/H	RISDA	S/H		
Fertilizer	Three times a year. Rises initially, then constant		Yes	No	Much less than OP	Depend on soil
Pesticides	Paraquad for grass		÷	÷	A lot (target insect/fungus)	Small amount
Soil preparation	bulldozer	S&B	machine	S&B	S&B, plow 1 feet	S&B
Drainage	÷	+	÷	÷	parameter drain	÷
Organic input	÷ ¹		÷ ²		÷	÷

¹ The table represents the stated management from the PRA sessions with farmers (app. 3). However, from our observations, there are variations among all oil palm farmers, e.g. pronounced ground cover in the SALCRA plantations (leaves left random) and leaves left in structured rows in the smallholder plantations (app. 17).

² From our observations, living mulch are growing on the rather few rubber fields left (app. 17).

5.2.2 Changes in soil fertility

In table 5.2 below, data of five parameters related to soil fertility is presented. The number represent the mean from three replicates (n=3) and significant tables revealing differences between the plots will be found in app. 19. The section below will go through each parameter supported by a graphic representation.

Table 5.2. Soil fertility parameters (pH, Pox-C, total C, total N, C:N ratio) for different plots.

Field	pH	Pox-C (mg/kg)	Total C %	Total N %	C:N ratio
Palm oil S/H 8y	4.96	270	1.670	0.173	9.77
Palm oil S/H 17y	4.89	180	1.390	0.113	12.33
Palm oil SALCRA 7y	5.26	240	1.333	0.130	10.45
Palm oil SALCRA 18y	4.99	330	1.373	0.130	10.44
Pepper 6y	4.67	930	3.523	0.280	12.80
Rubber 30y+	4.63	720	2.727	0.217	12.57
Primary forest	4.37	1200	3.927	0.340	11.71

Soil organic matter

The graph on the next page (fig. 5.1) presents the permanganate oxidizable carbon Pox-C content of the different fields assessed. Pox-C represents the active carbon fraction of the soil organic carbon (SOC) pool, and the method is commonly used as an early indicator of changes in SOC due to changes in agricultural management. SOC is a widely used representative of soil fertility by being a proxy for both water conservation, nutrient retention and recycling, soil biodiversity and erosion control (Lal, 2008).

From the graph (5.1) and significance tables (app. 19) it is evident that all four fields under oil palm production have a significant lower content of Pox-C than soil under pepper, rubber and primary rainforest. In a review by Bruun et al. (2009), SOC ranked 0-40% lower in palm oil plantations than in traditional swidden cultivation. There is no significant difference between any of the oil palm fields disregarding potential difference in management intensity (between the SALCRA and smallholder plantations) or in the number of years under

cultivation. However, Bruun et al. (2013) have shown declining carbon content with the number of years under oil palm cultivation. The differences that exist, however not significant, could arise from differences in ground cover (highest for SALCRA 18y) and fertilizer use (expressed highest for S/H 17y) (app. 17), having opposite impact on the SOC content.

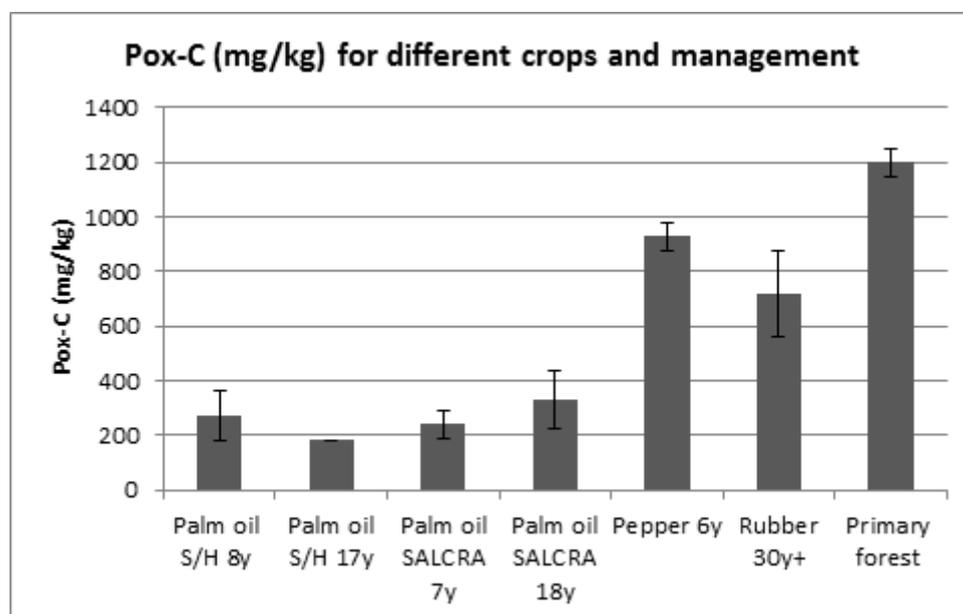


Fig. 5.1: Pox-C (mg/kg) for fields with different crops and management (y = years). Error bars refer to the standard deviation (n =3).

The lowered Pox-C levels under oil palm plantations could be explained by management practices such as soil disturbance exposing former protected SOC or application of mineral fertilizer, both of which stimulate microbial breakdown, and hence result in elevated decomposition rates of organic matter (Bruun et al. 2009).

As expected, the primary rainforest shows the highest content of Pox-C (1200 mg/kg) even though the SOC might be heavily underestimated caused by compaction of the carbon-rich lower-density O-horizon during sampling. As the rubber plantation has been abandoned and left fallow since 2010, we expected this field to have restored carbon stocks and hence perform better than pepper. The inverse difference that we actually see, could be due to the presence of charcoal, which has been a controversial and discussed feature of the Pox-C method – yet, if sensitive to charcoal, the presence of it would have influenced other fields as well (app. 17), which we cannot assess. The Pox-C method is still being developed and recent research point to no clear effects of charcoal (Hepp 2016, personal contact). Regardless the true (multi)factual reason the difference between rubber and pepper is not significant.

Fig. 5.2 shows the total C (%) for the different fields, which most of all can be used to support the Pox-C analysis. While both methods have been proved to positively correlate with soil fertility parameters (Weil *et al.* 2003), authors disagree on which method is the best indicator of soil fertility, stemming most of all from a general lack of understanding of what soil fractions Pox-C most closely reflects (Hepp 2016).

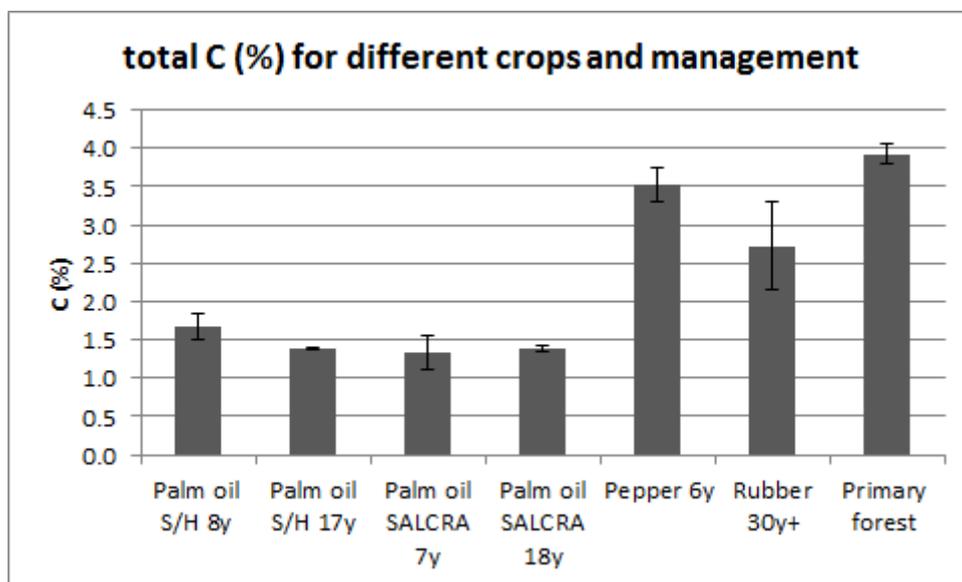


Fig. 5.2: Total C (%) for fields with different crops and management (y = years). Error bars refer to the standard deviation (n =3).

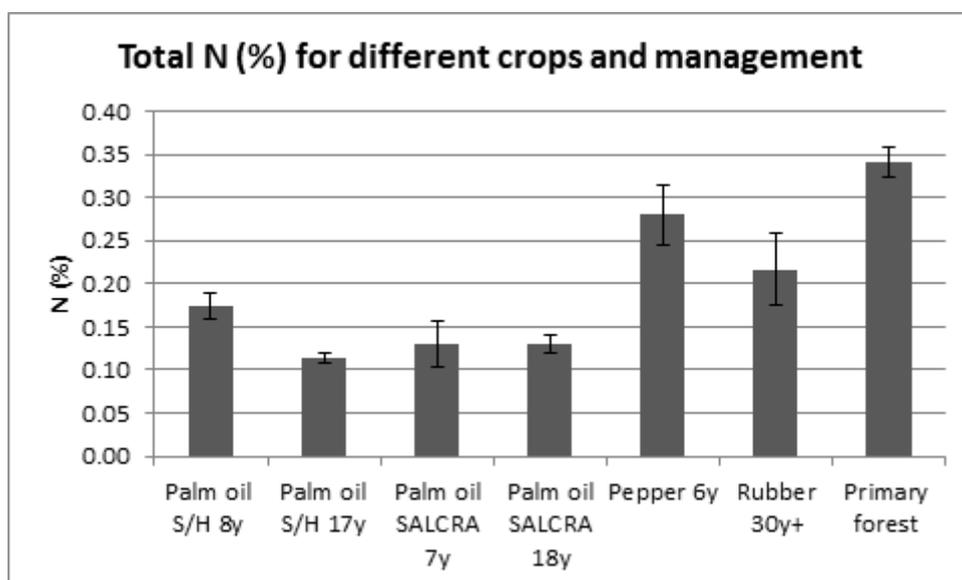


Fig. 5.3: Total N (%) for fields with different crops and management (y = years). Error bars refer to the standard deviation (n =3).

Nitrogen status

The nitrogen status of the soil - as one of the most important macronutrients for plant growth - is also a proxy of soil fertility. However, this parameter commonly varies more in the short-term as a result of recent application of fertilizers and/or the demand and hence nutrient uptake governed by the vegetative stage of plant growth. Interestingly, we see that the pattern for nitrogen highly resembles that for carbon level (compare fig. 5.2 and 5.3). This finding suggests that much of the nitrogen in the soil pool are either chemically bound in organic materials or attached to the soil humus fraction or clay particles (commonly as the positively charged ammonium, NH_4^+). All palm oil fields have significant lower total N (%) than the pepper field and the primary rainforest (app. 19).

Having analyzed both total C and N enables us to calculate the C:N ratio, which is most relevant in terms of the dynamics of soil microbes and their ability to mineralize nutrients for subsequent plant available uptake. Since C and N levels resemble each other, the ratios are similar across the seven fields (fig. 5.4).

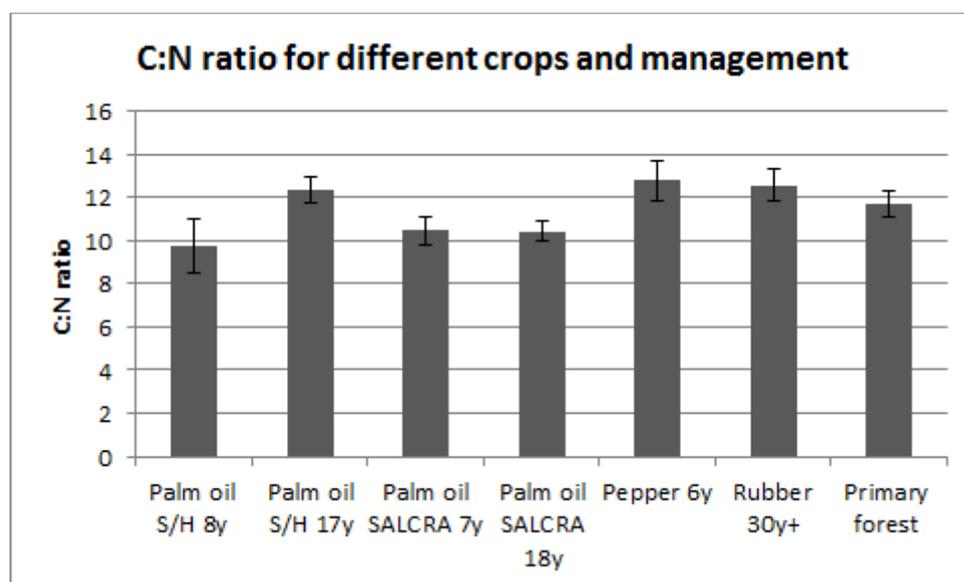


Fig. 5.4: C:N ratio for fields with different crops and management (y = years). Error bars refer to the standard deviation (n = 3).

Acidity

Acidity is another proxy of soil fertility, which determines the plant availability of nutrient in the soil column (Jensen & Husted 2009). As revealed from table 5.2 the soil pH-value range between 4.37 and 5.26 which means that all seven soils can be considered acidic ($\text{pH} < 7$), common to the humid tropics (Bruun 2010). Both high and low pH-values are deleterious to

the plant growth and ideal pH for most nutrients lies around 7 or just below (Jensen & Husted 2009). In figure 5.5 below we see that soil under palm oil shows higher pH-values than for pepper, rubber and primary forest and these findings are supported by Tanaka et al. (2009). Elevated pH-values, although for most fields only significant when compared to the primary forest (app. 19), could be due to the application of either basic cations mixed fertilizers - or pH neutralizer (as the local one used, Dolomite, $\text{CaMg}(\text{CO}_3)_2$) to insure nutrient availability in the plantation. There might have been a need for such an input as certain fertilizer components (such as ammonium, NH_4^+) and pesticides are said to rapidly lower pH in the soil (Bruun 2010).

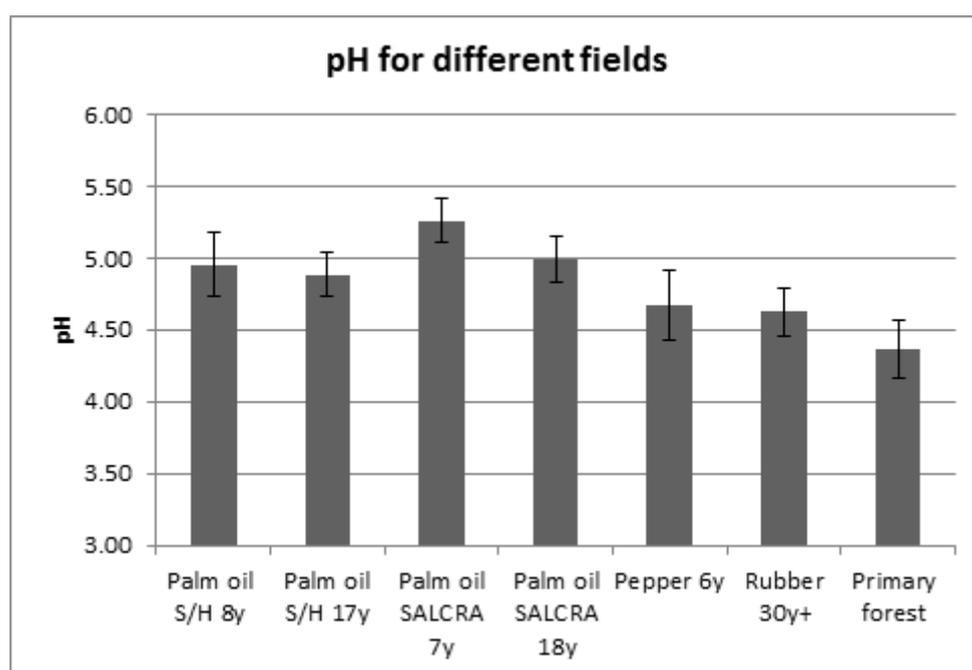


Fig. 5.5: pH for fields with different crops and current management (y = years)
Error bars refer to the standard deviation (n =3).

As for many soil parameters, SOC also has implications for the pH of the soil. Protons from the carboxyl groups present in humus can be exchanged and thereby works as a buffer to changes in pH. This means that the higher the SOC, the better ability of the soil to recover its natural buffer capacity; resulting in a pH increase in acid soils (Bot & Benites 2005) beneficial to nutrient availability.

Summing up

Overall, based on the soil analysis we can conclude that soil fertility is affected by different cash crop farming management, which is supported by Tanaka *et al.* (2009). Oil palm plantations show lower soil fertility in terms of Pox-C (significant differences), total C and

total N compared with pepper, rubber and primary forest. On the contrary the oil palm plantations show lower acidity, expected to arise from some type of external input reflecting the demands of the oil palm. Altogether, the oil palm plantations can be said to be more dependent on external inputs (fertilizer and liming) in order to sustain crop production. The current intensive management might have severe impacts on the soil quality and productivity and may limit farmers' range of land use options in future (Bruun *et al.* 2009).

5.2.3 Modernity and dependency on market prices

Having been subject to development schemes since the 1970s (RISDA, 2014), the inhabitants in the Krangan communities have long been influenced by global and "modern" ideas of how to increase their standard of living. In this report we use the term "modern" as a description of ideas not originated in the local context of the villages and stemming from larger actants such as global tendencies or the Malaysian state. The "modern" ideas can be seen in many different aspects of village life, for instance through the spread of television and subsequent mass media exposure (cf. Postill 2006). Due to the limited scope of this report's analytical object, we will however mainly focus on the "modern" influences that seem to have a direct relation to the local villagers' choice of livelihood strategies.

As the land use of K.T and K.E. has transitioned, so has the relation to the market and the market prices. That these highly affect the household economies was underpinned by several of the villagers (app. 5). At the farmers' focus group session, the farmers argued that the fluctuation of the market prices poses a challenge for their way of living. It affects their lives directly when prices on cash crops decrease (app. 16).

At the men's PRA session one farmer said that: "*Village life is hard because you have to change activity after changing market prices*" (farmer, app. 5). A group of them explained how the price of pepper is high at the moment, which made a lot of villagers plant pepper. However, since it takes three years before it is possible to harvest the pepper plants, the price could easily drop before they could utilize the current rise in market prices, leaving them with a field of low-income producing crop. As one elderly farmer grudgingly explained: "*Market prices will stay stable for maximum a year*" (farmer, app. 16).

That the market sales are crucial sources of income is evident from the transition from growing subsistence to growing cash crops. The villagers are still growing many subsistence

crops like rice and vegetables, but from the questionnaires (app. 1) we found that they are increasingly buying food at the market and focusing their agricultural produce on cash crops. Another costly commodity that they need is agrochemicals. There seems to be a consensus that they cannot cultivate their land without fertilizers and pesticides (app. 5). Several villagers articulate that these are often too expensive (app. 16). In one SSI the farmer said that they use more money than they can earn, because they have to buy expensive fertilizers and pesticides (app. 6).

This means that they depend on the market prices on the crops they sell, the food they buy and the agrochemicals they need for their production. This dependency promotes a ‘rational-choice’ approach to their agriculture, which adds to the modernisation of their way of life. This has consequences, which we see in the following.

5.2.4 More money, modern problems

The “modern” influence rears its head in the villages in many different ways. We especially saw this exemplified in the almost omnipresent influence of market prices in the villagers’ descriptions of how they make a living. Some of the farmers even explained how capitalist market thinking had spread to areas where the adat had previously reigned:

Farmer X: (...)This is the generation, in which we need money all the time. The adat food-sharing system is fading out. When the sharing culture comes to an end, it will be just about money. In the old days they could share their produce more. Now they need to charge money for them. (app. 16)

Farmer X: We know how to live day by day, but we cannot save for the future (app. 16)

At the same time they are expressing that their income is just barely enough. This dependency on the market could be an indicator that the villagers’ livelihood rationales are entering in the logic of the capitalist system.

Taking a cue from Latour, we will ‘*follow the connections and the actors themselves*’ (Latour 2005:179), which enables us to look at the relations this capitalist influence have to other aspects of the villagers’ “development”. It seems that this continuous movement from sharing to selling is connected to a different process of “modern” influence, namely that of

individualization. Many of the villagers, who leased out their land to SALCRA, explained that one of their main reasons for doing this besides monetary income was to receive the title to their plot of land after the end of the contract (app. 1, app. 4, app. 5). This illustrates the ongoing process of privatization of lands that has been part of Malaysian development schemes for decades (SALCRA, 2012), where land areas are being utilized more and more for individual household income rather than sharing produce for village subsistence. Following this, the villagers are relying more and more on buying food in local markets, decreasing their dependency on strategies such as subsistence farming alongside hunting and gathering that are embedded in the *adat* sharing system (app. 1). This point will be elaborated on in the following.

5.2.5 Relation to and use of the forest

The members of the two Krangan villages use the forest for collecting wild vegetables such as ferns and bamboo shoots and hunting wild games and catching fish. The villagers have named the close-by forest area where they harvest from ‘The Supermarket’, due to its great amounts and diversity of produce (app. 21). According to a local expert we did the forest walk with, many plants are also used for medicine (Ibid). Additionally to food collecting, they also use the forest as an income source. One farmer knows how to find and cut bamboo shoots from the forest and hence sells to other villagers. One elder woman used to make the traditional Iban handcrafted weaved mats out of the bark of a specific tree and sell them to supplement her income. She claims that there are no more of these trees left in the forest, and thus she does not make them anymore (app. 9). However, the reason they use the forest is more due to the *adat* tradition than actual need. One farmer said: *“It is not because of income problems, but because it’s a part of who we are”* (farmer, app. 16) She also highlighted that the forest food is *supplementary* food, not primary food. The primary, staple food is rice (app. 16). These arguments show how the use of the forest is bound to *adat*.

‘The Supermarket’ produce is quantitatively and qualitatively declining, and the resources are becoming scarcer, especially fish and wild game. Upon the question: ‘Has the food availability/diet changed during the last 5 year?’ 8 out of 12 of the households in K.T. answer that their food availability has changed due to the increasing scarcity of the forest produce (app. 1). One villager said: *“Wild animals are getting scarce, and there is no more forest because the development has ruined wild habitats.”* (villager, app. 1). And another one told us that 5 years ago the jungle produced vegetables, but since then the animals has decreased, and now they are buying their vegetables and meat at markets (Ibid).

There are different explanations to why the forest resources are declining. One is that it results from unsustainable over-exploitation, for example overfishing. Some people are fishing with poison, where they pour poison into the river, which kill the fish, making them easier to collect (app. 16). Another explanation is that it is the result of declining forest area due to the big-scale plantation planting: *“Resources are getting scarce: fish, wild boar, vegetables. This is because of the government exploiting the land and forests, and the big oil palm plantations that cut down forest.”* (respondent, app. 1). Over-harvesting of wild produce and deforestation in order to make room for plantations are both practices within the logic of ‘maximising-of-yield’. This is the logic that is underlying in the practise of the modern capitalist livelihood rationale that seems to influence the villagers. It seems to be expanding at the cost of biodiversity such as wildlife, and cultural tradition, such as the making of the handcrafted mats and being able to harvest food from the forest.

In this chapter we have analysed and discussed the engagement in SALCRA, being a major LUC, and also some of the consequences that these have in terms of soil quality, dependence on market-prices and the forest resource. In the next chapter we will discuss how the villagers cope with these changes, what that reveals about their livelihood rationalising and what implications it has for the future.

6. Back to the future

New challenges are facing the villagers in the aftermath of the recent transitions (in land uses, market dependency, land availability, food sources and soil quality). These diverge from former challenges, which have been mainly due to climatic phenomena such as flooding or pests (app. 2, app. 16). By entering the global market the villagers are now dependent on and part of a new actor creating new network relations connecting the local to the global. In the forthcoming paragraph, we will discuss how the villagers assess these circumstances, and how they might deal with other challenges in the future.

6.1 Post-SALCRA challenges and solutions

One challenge concerns the impacts and duration of the leasing contract with SALCRA. Within the next few years, villagers will be at a parting of the ways: they have to decide whether or not they will continue in the SALCRA scheme. The vast majority of villagers that we spoke to, regardless their current contentedness with SALCRA, planned on continuing

with SALCRA managing their land (app. 1), a decision seemingly based on several rationales. First, several benefits (section 5.1), especially the cash income from the dividend, provides a somewhat certain diversification of their income sources (section 5.1.1). Second, a general confidence exists in the individual farmer that the village as a whole will make the right decision (app. 1, app. 16). Thirdly, there is a general consensus expressed by the landowners that it will require both time and resources to restore the quality of the land for subsequent crop production. Table 6.1 shows the expressed challenges for crop cultivation subsequent to SALCRA.

Table 6.1. Expressed challenges and proposed solutions expressed by villagers

	Farmer PRAs (app. 2, 3)	Farmer FG (app. 16)	Headman K.T. (app. 22)
Soil fertility	<p>“There might be an effect because oil palm takes the water and the nutrients”</p> <p>“This is the same for SALCRA and smallholder oil palm”</p> <p>app. 3</p>	<p>“It will be a problem to grow another crop, because the land has lost its fertility.”</p> <p>“The soil has lost the nutrients.”</p> <p>“Even weeds don’t want to grow on the land”. The soil has expired”.</p>	<p>“Oil palm kills the land – they take all the nutrients”</p>
Soil acidity	<p>Excess (too much) of a agrochemical (cannot explain whether it is fertilizer or pesticides) app. 2</p>	<p>Acid soil stated as a problem.</p>	<p>“Pesticides do not affect the soil”.</p>
Palm roots remaining	<p>“Not possible [to exit SALCRA scheme] because the oil palm root is too big” app. 2</p>	<p>Problem not stated.</p>	<p>Roots stated as a problem.</p>
Solutions?	<p>Not asked about solutions.</p> <p>“If there is problems, we need to work harder” app. 2</p>	<p>“We have many alternatives”, e.g. animal farm, fish pond.</p> <p>Dolomite to neutralize acid soil (1-3 month before soil is ready for new cultivation).</p>	<p>“Use cover crop for the soil to recover – the root will attract nutrients”</p> <p>“It will take 3-4 years”</p> <p>“Apply pesticides to kill the roots – that will take a couple of weeks.”</p>

The soil analysis (section 5.2.2) shows that the land under oil palm cultivation is lower in SOC, and hence can be said to have lower fertility. All soils are acidic and might be dependent on liming to ensure nutrient availability for crop production. These actual and/or expressed challenges can potentially limit the flexibility of a subsequent farming system, e.g. choice of crop in accordance with market price. Also, the system might be dependent on higher amounts of external inputs such as fertilizers and pesticides, due to inhibited nutrient retention and low biodiversity to naturally suppress unwanted and/or invasive species. Again, this suggests an even higher dependency on the market prices for agrochemicals in the future, which further limits the livelihood flexibility of the household.

Whether or not the impacts on soil fertility are reversible is discussed in literature (Hamdan *et al.* 2000, Tanaka *et al.* 2009). However, we cannot predict anything from present soil analysis. Some of the factors that will determine the soil fertility in the future are many and also opposing. There are many indications that the villagers will continue in the SALCRA scheme (app. 1), and it is impossible to say whether the soil can support crop production after another oil palm cycle, adding 25 years of intensive management to the cropping history. However, revealed from the interview with a SALCRA officer (app. 8), the admission of SALCRA in the certification scheme RSPO (Roundtable of Sustainable Palm Oil) has already, and might so in the future, imposed claims towards more sustainable management.

De facto, the participating farmers in the focus group expressed a range of alternative uses of the land, which was not dependent on the fertility of the soil (table 6.1 – solutions). One suggestion was a fishpond and another was an animal farm (app. 16). This shows their extensive willingness and perceived ability to adapt to the changing circumstances. This concerns not only the challenges connected to oil palm production, but several aspects of their livelihood. For instance, when they cannot afford pesticides, a solution is to slash the weed manually. If the forest species get scarce due to deforestation, they will plant the forest species around the house. As a solution to fish scarcity in the river, they will simply make their own pond. Finally, when market prices are low for their produce or high for their commodities, they cut down on all expenses and eat only rice (app. 16). For reasons of economic safety, they already have diversified income sources, for example rubber trees they can tap when the market price is high (app. 5).

“If the problem is small, we solve,
if the problem is big, we adapt.”

Quote from farmer focus group (app. 16).

The villagers are aware (and accept) that some circumstances are governed by factors outside their sphere of influence. However, it seems as if the villagers can overcome every challenge they can think of, either by solving or adapting (see quote above), depending on the scale of the challenge and their possibility to influence the relevant actors.

Choices made in the past might restrict the livelihood flexibility in the future, leaving villagers of K.T. and K.E. more vulnerable to shocks that are either naturally or socially determined, if the required knowledge is not available to overcome the future challenges. Parallel to new challenges induced by structural and land use changes, also new solutions might be present in the future, possessed by the now young generation under education in terms of enhanced knowledge. Many of the young people about to be educated or find jobs in the cities plan to come back to the village (app. 14, app. 15), and when they do so, they bring with them an academic, “modern” toolbox of potential applicable knowledge.

If the tendency of leasing out land to SALCRA increases in the future, the income sources of the households will be even more dependent on the fluctuating market prices rather than subsistence crops. This means that food to a higher extent will be traded on the market; a trend already occurring (app. 1), making the food security reliant on and driven by external factors, on a national and global level. The national economy of Malaysia is highly build upon the palm oil production (The Oil Palm, 2014), and a major decrease in palm oil prices will therefore not only have consequences for the livelihood of villagers, but also affect the whole national economy.

6.2 A foot in both camps: dialectics of development

As shown in the section 5.2.3, the impacts of “modern” ideas are immanent in the villagers’ thoughts about making a living and securing the future of their children. However, it is here important to keep in mind what anthropologist Marshall Sahlins called “the indigenization of modernity” (1999:x). In short, Sahlins argues that indigenous people should not be seen merely as victims of modernization influences. They have a will of their own, where “modern” ideas might be incorporated strategically into their traditional livelihoods, in order to for instance obtain a higher standard of living (ibid.). The influence on the villagers’ choices of livelihood strategies should thus not be seen merely as a one-way street, where only the traditions of adat are yielding space for global, “modern” tendencies.

Here the ideas of economist Karl Polanyi can help us get a better understanding of the drivers behind the villagers’ differing strategies for making a living. Simplified, he argues that the modern capitalistic way of rationalizing economically cannot be universal, since decisions regarding making a living in non-capitalist societies are based on different principles than the monetary maximization of profit reigning within the market (Wilk & Cligget 2007:7). Here we will take advice from Christian Lund (2014:229-230) and concentrate on the *questions* Polanyi raises rather than the *answers* he gives. Following Polanyi’s interest in the guiding rationalities behind different forms of economies, a relevant question to ask would be, how is it possible for the communities of K.T. and K.E. to live in an economy, where both capitalistic and non-capitalistic rationales are in play. It seems that neither capitalism nor adat act as the sole guiding principle in different processes of development, modernization and individualization that are taking place in K.T. and K.E. in recent years. For instance, when probing into the villagers’ reasons for renting out land to SALCRA, the aim of getting land titles was explained both as a way of a monetary income source *as well as* a strategy to assure the villagers rights to what they already perceive to be their land, which also enables them to pass it on to the next generation as a part of the adat. Thereby they attempt to preserve the land distribution within the adat by engaging in the development scheme.

Although globalization might lead the villagers to untraditional, “modern” ways of rationalizing livelihood strategies, this does not imply that the villagers of the Krangan communities are becoming more and more indistinct from the rest of the capitalist parts of the world. Globalization of culture does not entail that everyone becomes similar, but that new types of differences appear in the intersections between the global and the local (Eriksen

2010:294). In the case of K.T. and K.E., the incorporation of “modern” livelihood rationales thus does not seem to preclude adat. Rather it could be argued that the process of development in the case of K.E. and K.T. functions through a dialectic dynamic of adapting and reinterpreting traditional ways, a process that will continually develop as the villagers experience change. We base our understanding of this dialectic dynamic on Bruno Latour’s perception of time:

“Latour imagines time as a kind of whirlwind or spiralling movement. Within this metaphor there is still a past and future, as we move forward in the loop of time. But the past is not bygone. Rather it is "revisited, repeated, surrounded, protected, recombined, reinterpreted and reshuffled.”

(Blok & Jensen 2011:67; Latour in Blok & Jensen 2011:67)

It can be argued that the villagers’ ability to combine rationalities comes across in their ability to adapt. In this case, adapting entails integrating “modern” ways of perceiving natural resources in an adat-based perception of land and nature in a forward moving process of reinterpreting, recombining and reshuffling traditional perceptions of land use and ways of making a living. This comes across for example in relation to the village rules regarding fishing and SALCRA. The villagers are allowed to fish for own consumption and to sell extra captured fish to other fellow villagers, but they are not allowed to sell the fish on the market place (app. 10). However, the fish, which is a decreasing resource, should not be exploited so that one person can gain economically whilst the village loses the resource. This indicates a capitalist rationale, but not without accounting for the collectivism embedded in the villages.

How the dynamics of development will affect the village livelihood rationales in the future, we do not know. The younger generation might consider the natural resources around them differently than older generations. When a young boy was asked how he perceived the forest, he answered that it was important in terms of producing oxygen, but that oil palm plantations have the same function. Further, he believed that there were still other forests to go hunt in (app. 12). On the contrary, elder villagers argue that the decrease of forest areas is changing food availability (app. 1). This shows that there are differences between the generations in how villagers perceive the forest as a natural resource. With the coming generational change, the older generation’s perception might be completely lost in the new generation’s

reinterpretation, which could be inspired by natural science, the ‘modern’ development rationality involving natural resource exploitation for economic development, or maybe a selective version of adat.

Either way there will surely be challenges ahead as development, modernization and more plantations will continue to influence the landscape and livelihoods of the villagers. The Iban villagers have been shown to be flexible in terms of combining new influences with traditional rationales and practices. Whether or not the villagers will be able to successfully adapt to current and future challenges remains to be seen.

7. Conclusion

Throughout this research, we have attempted to uncover some of the major transitions that the two villages are undergoing, as well as investigate how they interpret and cope with these. In order to understand their reality, we have started by establishing analytically that their ontological understanding of life is largely based on the adat. Farming is inherent to adat, which explains the villagers' holistic view of nature and culture, as being one inseparable concept that largely is passed on through tacit knowledge. We found a discrepancy here, between the parents' expressed importance of preserving adat for next generations and the fact that they are not bringing their children to the fields to pass it on. They rather want their children to focus on schoolwork, so they can learn farming academically and come back to manage their inherited lands using technology. This was the first time we encountered the 'modern' rationale influencing the villagers' livelihood strategies, *parallel* to the rationale of preserving adat and the tradition of being farmers.

In the introduction, we presented the main drivers of LUC in the Krangan villages, the most striking one being the introduction of oil palm plantations, mainly through the SALCRA scheme. We found that the majority of villagers had leased their land to the scheme with the primary reasons being the dividends, the land entitlement and easing the workload. We also saw that it is a way for the villagers to diversify their income sources in order to become resilient to fluctuating market prices (see below). Land titles have become important as land is getting scarce, and we see this privatisation as sign of the increasing individualism that influences the community. However, there are drawbacks of the contract; particularly we identify a lack of transparency in terms of the villagers' lack of knowledge on the calculation of their dividend and on the changes in the quality of the soil in the plantations.

This leads us to elaborate on the consequences of the land use changes. We found that soil fertility is affected by different cash crop farming management. Fields of oil palm plantations show lower soil fertility in terms of Pox-C (significant differences), total C and total N compared to fields of pepper, rubber and primary forest, which was in alignment with villagers' perception of the changes in soil quality. Overall, we found that the oil palm plantations can be said to be more dependent on external inputs (fertilizer and liming) in order to sustain crop production. Irrespectively of actual ability to restore the fertility of the soil, following intensive agricultural management, reduced soil fertility might limit farmers' range of land use options in future.

Another effect of the LUCs is that the villagers' are becoming more dependent on the fluctuating market prices, concurrently with cultivating more cash crops. They depend on the market prices on the crops they sell, the food they buy and the agrochemicals they need. This dependency promotes a market-based logic to their agriculture, which adds to the modernisation of their way of life, but lacks elements of their adat; the adat 'food-sharing-system' is fading out, as the villagers' now has to charge money for their vegetables due to the market-dependency. As such, the entering into the capitalistic system promotes are more individualistic livelihood rationale. The possible use and quality of the forest resources, traditionally a big part of Iban identity used for food, medicine and timber, is likewise undergoing changes. The forest produce and magnitude is declining, some say due to over-exploitation and some say due to expansions of large-scale oil palm plantations, both tendencies of a market-based logic.

When investigating how villagers manage the consequences of the changes brought about by modernisation, market entrance and development, we discovered a high willingness and perceived ability to adapt to these changes. As they have been adapting to natural variation in the past they are now adapting to external factors that are societally conditioned. In constructing their livelihood strategies, the villagers are combining rationales of preserving and living in accordance with adat and their cultural identity with rationales of modernity, economic gain and improvement of living standards. The villagers are thus creating a combined livelihood strategy with selected features from each rationale moving them forward into the future. This is a way of adapting their livelihood strategies to the development processes, capitalism and land use transitions influencing their lives.

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Appendix 1 – Questionnaire overview (K.T. and K.E.)

Krangan Trusan (14)

Person in household	0	1	2	3	4	5	6	7	8	9	10	11
Amount of persons	0	1	1	0	1	6	3	1	0	0	1	1

*HH member not staying but contribute	0	1	2	3	4	5
Amount of persons	5	3	2	2	1	1

*HH = Household

Main activity generating income	1	2	3	4		6	7	8	9	10	11
No. 4: Permanant (P)/Temporary (T)	1	8	10	P: 1, T:1	1	1	1	1	1	1	1

Changes food availability?	No	Yes- More	Yes - Less	Yes - Different
Number of households	3	0	8	3

How Satisfied are people with SALCRA	
1. Very content	6
2. Content	4
3. Discontent	1
4. Very discontent	1
5. I don't know	1

Continuing in SALCRA ?	
Yes	7
No	1
I don't know	0

Krangan Engkatak (4)

Person in household	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Amount of persons	0	0	0	0	0	0	1	2	0	0	0	0	0	0	1

*HH member not staying but contribute	0	1	2	3
Amount of persons	2			2

*HH = Household

Main activity generating income	1	2	3
No. 4: Permenant (P)/Temporary (T)	4	1	2

Food availability	No	Yes- more	Yes- less	Yes - Different
	0	4	0	0

How Satisfied are people with SALCRA	
1. Very content	1
2. Content	2
3. Discontent	1
4. Very discontent	0
5. I don't know	0

Continuing in SALCRA ?	
Yes	3
No	0
I don't know	1

Krangan Trusan + Krangan Engkatak (18)

Size of total	[0-10]	[10-20]	[20-30]	[30-40]	[40-50]	[50-60]	[60-70]	[70-80]	[80-90]	[90-100]	[100-110]
	4	4	3	3	1	1	0	1	0	0	1

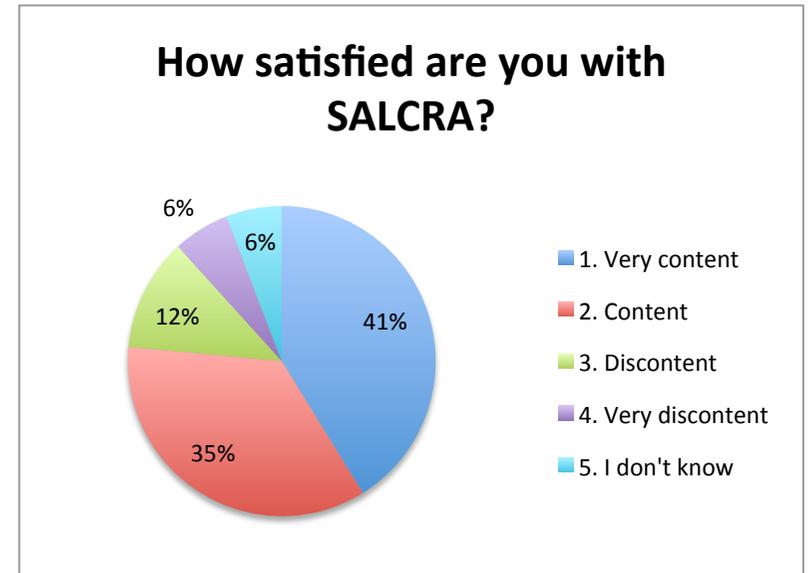
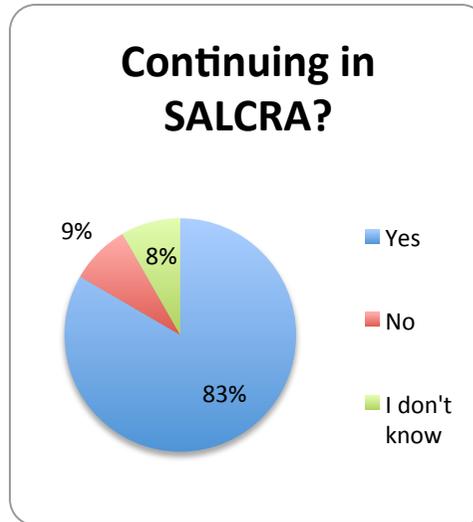
Land size d	[0-5]	[5-10]	[10-15]	[15-20]	[20-25]	[25-30]	[30-35]	[35-40]	[40-45]	[45-50]	[50-55]	[55-60]
Paddy	11	1			1							
Rubber	7	1		1								
Pepper	10											
Smallholder	7	1		1	1	1						
SALCRA	2	2	2									
JVC	2	2			1	1					2	1
Vegetables	4											
Fruits	1											

Continuing in SALCRA ?

Yes	10
No	1
I don't know	1

How Satisfied are people with SALCRA

1. Very content	7
2. Content	6
3. Discontent	2
4. Very discontent	1
5. I don't know	1



This is an overview of most of the qualitative answers derived from the questionnaires.

Question 5: Has the food availability/diet changed during the last 5 year?

Household no.:

44: (no changes) Not changing a lot – they buy at the market.

14: (yes) SALCA provide roads so they can go to the city to buy – more choices now.

10: (yes) In the 80s there was plenty of food. In the 90s it decreased. They are not hunting today – they are buying their food.

27: (no answer) 5 years ago the road connection was bad → hard to go to shops, and therefore no variety in food. Now the road connection is better, because the government provided better roads.

15: (yes) Lesser fish (scarcity) – but they then buy food.

4: (yes) Fish is still available, but the hunting game is scarce, e.g. wild boar, mice, and foxes.

3: (yes) 5 years ago the jungle produced vegetables. Since then the animals has decreased, and now they are buying their vegetables and meat at markets. Their meat intake has decreased.

30: (yes) Because a member of the household work in the city and has more money, they eat more varied compared to 5 years ago. Before the city work, they used to tab rubber in change for other commodities.

35: (yes) Wild animals are getting scarce, and there is no more forest because the development has ruined wild habitats.

11: (no answer) Resources are getting scarce: fish, wild boar, vegetables. This is because of the government exploiting the land and forests, and the big oil palm plantations that cut down forest.

45: (yes) Before they ate food from the forest, now it's more "comfortable", because they buy food at markets, e.g. pork.

9: (yes) Wildlife is decreasing (e.g. wild boar), because oil palm is expanding.

C. Large scale oil palm plantations

Question 9: Why/why not have you lent out your land to SALCRA/other agencies?

44: (no SALCRA) Couldn't do the work himself no more, so now it is the JVC Datuk Tan that takes care of it.

14: (SALCRA) Because: the money, commercial decision, and because everyone else did it.

10: (no SALCRA) If he would do the wise thing, he would join SALCRA. He has already submitted an application – it's on hold right now.

15: (SALCRA) Sister says that they don't want to share with others. They actually wanted to, but SALCRA rejected.

19: (SALCRA) Only SALCRA discovered the land – no other agencies/companies came to the village.

3: (no SALCRA) Even though she has land, she asked if she could have oil palm, but her land is surrounded by other peoples' land, why she cannot. She would like to rent out her land, but she has to wait until the land is ready (the land is located about 20 min from her house).

35: (No SALCRA) Has lent his land because of his land is too small and far from SALCRA.

30: Communal meeting with other landowners who agreed to lease to JVC. She owns an island of a land in a JVC area, so SALCRA is not an option. The decision were made with surrounding land owners and was a "common agreement".

Question 10: How are you being paid for participating in SALCRA or other agencies oil palm schemes?

44: Size of land payed when harvesting (e.g. 1 ton palm oil = RM 300/tonnes).

15: Area – 2 years.

19: Based on land area.

30: No money yet and don't know the basis dividend.

Question 11: How was the piece of land SALCRA or other agencies manage chosen?

44: There was already oil palm on neighbouring plot, and therefore they decided to join.

15: SALCRA choose – it was not fertile, but SALCRA took it.

19: Because of the soil is very fertile, and because the portion of the land area (centre).

30: JVC contacted owners of land and asked if they wanted to make joint venture. The land was chosen by JVC because of the distance to infrastructure.

Question 13: Have you considered what to do with your land after the end of your contract?

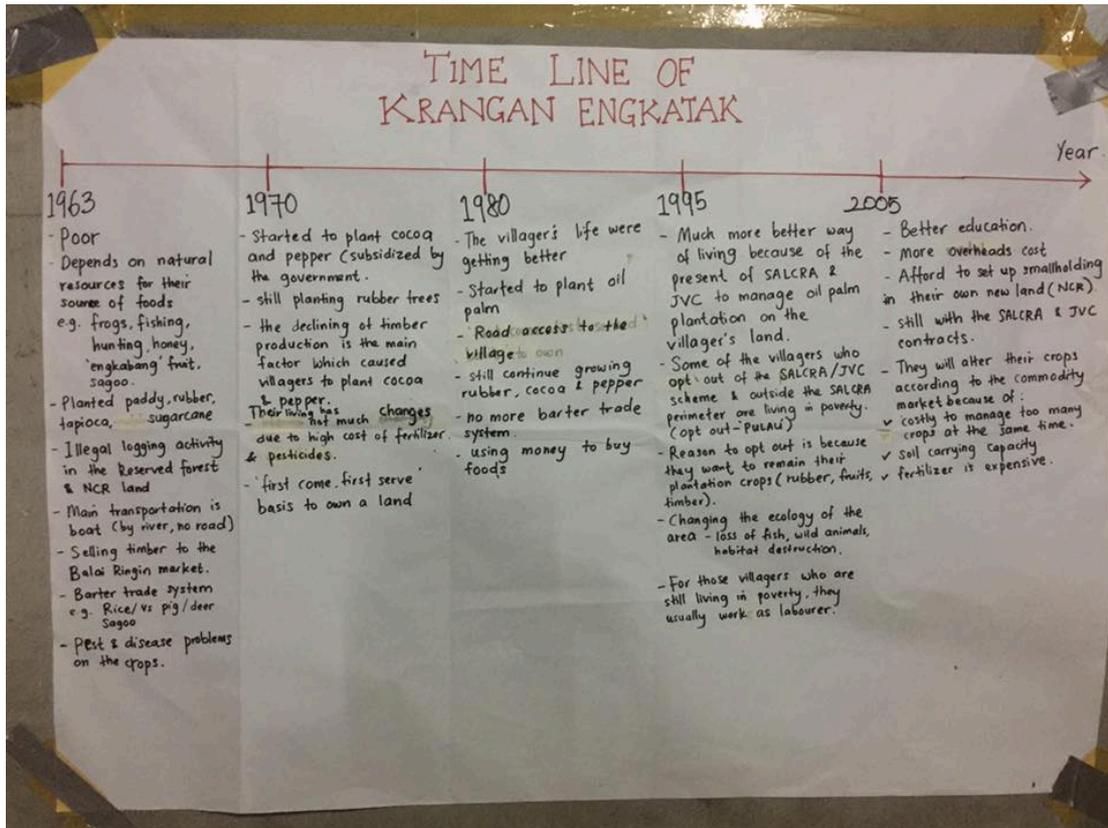
14: (yes) Stay with SALCRA and replant.

15: (yes) The sister is afraid of the fertility of the soil and do not want to continue. The brother means that it depends on the villages – if they continue, he will continue.

19: (no) They get low dividend. They aim to plant oil palm themselves, managed by themselves – no problem with labour workforce. They can afford to build some roads. They had 2000 peppers before SALCRA took the land, which gave them more income at that particular time.

30: Will probably go on because the land won't be suitable for paddy rice after oil palm production, since the produce of other crops after oil palm is low (based on observations of others).

Appendix 2 – Timeline of K.E.



Timeline, notes:

1963

- Poor
- depend on natural resources for their source of foods e.g. frogs, fishing, hunting, honey, 'en gkabang' fruit, sago
- planted rubber, paddy, tapioca, sugarcane
- illegal logging activity in reserved forest and NCR land
- main transportation is by boat (by river, no road)
- selling timber to the Balai Ringin market
- Barter trade system e.g. rice vs. pigs / deer / sago
- pest and disease problems on the crops
- ate frogs as one source of protein

1970

- started to plant cocoa and pepper (subsidized by the government)
- still planting rubber trees
- the declining of timber production is the main factor which caused villagers to plant cocoa and pepper
- their living has not changed much due to the high cost of fertilizer and pesticides (introduced here??)
- first come – first serve (rationale when it comes to ownership of land)

1980

- the villagers' life is getting better
- started to plant oil palm
- road access to the village

- still continue growing rubber, cocoa and pepper
- no more barter trade system
- using money to buy foods (instead of the barter trade system or instead of subsistence farming?)

1995

- much better way of living because of the presence of SALCRA and JVC to manage oil palm plantations on the villagers' land
- some of the villagers who opt out of the SALCRA/JVC scheme and outside SALCRA perimeter are living in poverty (opt out – 'Pulau')
- Reason to opt out is that they want to remain their plantation crops (rubber, fruits, timber)
- changing the ecology of the area – loss of fish, wild animals, habitat destruction
- for those villagers who are still living in poverty, they usually work as labourer

2005

- better education
- more overheads (?) cost
- afford to set up smallholding in their own new land (NCR)
- still with the SALCRA and JVC contracts
- they will alter their crops according to the commodity market because of
- costly to manage too many crops at the same time
- soil carrying capacity
- fertilizer is expensive

Expanded notes:

Keywords mentioned as the themes before session start: land use, management, changes, income
Mainly the headman (K.E.) talking.

1960

- Honey production in the 1960s – but now no more bees because of no trees.

1970

- Low living conditions during the 1970s because of low prices on foods and animal eating the fruits
- No more timber (no more trees)

1980

- "Because of SALCRA their lives are more luxurious now" - Headman K.E.

1990

- Someone has a "rubber-island" (pulau) in the middle of the SALCRA plantation → rejected the scheme. Participants not sure why, but maybe because they have tradition for rubber and don't want to cut the rubber trees down.
- no more fishing because they have money now and because of loss of biodiversity.
- Because of biodiversity loss, there is big consequences for those not part of the scheme (fewer ways of performing livelihood diversification)
- No-SALCRA help others with their land to earn money (now that they don't get the dividends)

Changes brought about:

- education
- capital for starting business
- individual palm oil small holders

2005

- independent small holders
- choose crops based on market price
- if they could choose themselves, they prefer managed by SALCRA - because of the money (start capital → buy machinery)
- but they also grown palm oil themselves for the income (lower risk??)

Scenario

Continue in SALCRA

- YES → better life
- NO → not possible because the oil palm root is too big → no space to replant other crops too much fertilizer (?), (excess fertilizer remains in the soil), a special one for oil palm → not possible to grow other crops like paddy, but ok for rubber production (I think they were talking about pesticides or agrochemicals that are changing the pH of the soil).

If pulau (rubber or other island), SALCRA does not allow them to grow palm oil because they can't tell the difference between theirs and the farmers oil palms – and hence cannot tell if he is stealing from the SALCRA field.

Concerned for the future?

- population increase – the dividend from SALCRA must be divided by more people.
- population increase – land scarcity
- illegal foreign labour and associated social problem

How to overcome these challenges?

- education
- they are planning this for the kids, so they don't rely/depend on the land
- If problems → work harder
- big households ask smaller households for help (because of higher resource distribution)
- complains: work hard, but low wages, high living costs

Choice of crop dependant on prices. If they choose a crop on one field, the other field is ignored. → don't want to have two different crops, because of costs → waisting their time if they are not choosing the one with highest price.

If land is not exploited that is because of low soil fertility → fertilizer expensive.

Headman (K.T.) said that choice of crop dependant on the advice from the government which is based on market price/industry.

Appendix 3 – PRA, farmers

Overview: Community mapping PRA session with farmers (5/3-16) and subsequent informal interview about the map with KT headman

Soil quality:

Good soil:

- yellow/red color with a bit of stones (tanna umbran)
- near the river (especially for oil palm)
- a little slope is good for pepper
- flat area (oil palm)
- swamp/peat soil (paddy)
- Krangan hill has good red soil, very fertile – and have been productive for many years

Bad soil:

- Sandy, stones (roots can't grow well)
- need fertilizer
- makes the paddy yellow
- black/dark
- muddy, too wet
- If the weed Lalang grows, it indicates bad fertility
- Only oil palm and pineapple can grow there (but then palm oil need a high amount of fertilizer)

They base soil quality on the colour of the crop. If the crop is yellow, it's bad.

The status of the crop indicated the status of the soil.

They differentiate what is good soil for specific crops.

The crop does not affect the soil. Except for oil palm, the roots suck out all the nutrients.

Thoughts: Maybe black coloured soil which normally indicate a high content of organic matter/carbon is considered problematic because of a higher water holding capacity, which might actually be a problem during the long rain season where these soils get flooded.

The map:

The farmers drew the Krangan area with associated lands. They wrote on every field which crop was grown on it. Then they rated the soil on the fields as good medium or bad by drawing dots after the statements about good and poor soil. Most fields were good soils. On the medium to bad soil, only palm oil grows. The bad soil on the SALCRA plantation is due the location on a hill side with sandy soils. The water flows downwards which causes retention (too wet soil). This was explained by the headman when we showed him the map. The farmers explained that the one smallholder oil palm that they gave a bad rating, is because it is lying in a valley, so the water flows down and makes the soil muddy. They seem to be aware of the importance of topography.

The forest is more untouched the further away from the village, the closer to the water catchment.

Disclaimer: we didn't get rating on all the fields drawn.

Good soil: 30

- 11 oil palm SH
- 6 oil palm SALCRA

- 7 paddy
- 1 rubber
- 1 pepper
- 3 secondary forest

Medium soil: 4

- 1 oil palm SH
- 1 oil palm JVC Chinese company
- 2 oil palm SALCRA
- 1 oil palm JVC Memaju Jaya
- Bad soil: 3
- 2 oil palm SALCRA (both part of phase 1)
- 1 oil palm SH

The land management matrix:

We asked the farmers to explain about their management practices (use of fertilizer, pesticide, soil preparation, irrigation and drainage, organic input and density of crops), for their different crops (Palm oil smallholder, palm oil plantation, pepper, hill padi, swamp padi, plantation rubber and smallholder rubber).

Palm oil:

For palm oil the same amount of fertilizer is applied by smallholders and plantations. The amount of fertilizer depend on the age of the palm oil and as such rise every year (0.5 kg, 2 kg) until 5 years were it is kept constant at 3.5 kg (3 times a year). The same accounts for pesticides. They use the SOP (standard operation procedure). Both uses the brand Paraquad, which kills the weeds, except for Lalang. Simon has been told that this pesticide was prohibited in 2007. For preparation, the smallholders use the slash and burn method for clearing the field before cultivation whereas the plantation uses a bulldozer and excavator (for roots). The small holders seldom use drainage as the palm oil is often on a hillside. The plantation uses drainage systems. This is especially important on swamp land. They dig lines of rows between the trees to lead the water out of the plantation. The density of the trees in the plantation is 29-30 feet broad, so the cars can drive between the trees to pick up the produce. For smallholders it is only between 26-27 feet as to produce more.

Pepper:

For pepper they use much less fertilizer than for palm oil. They use a lot of pesticides though, to combat a specific insect that lives in the field. They use slash and burn to prepare the field for pepper, and then every season they plow the soil one foot deep. They make a drainage system around the plot so the surrounding roots will not affect the roots of the pepper.

Tine: pepper dies if it gets too much fertilizer, because of too much salt (sodium) in the fertilizer, which affects the roots (contradictory?)

Hill and swamp paddy:

In terms of fertilizer it depends on the quality of the soil whether they apply it. If you have paddy for many years in a row, you have to apply. For an old swamp paddy they apply fertilizer. For hill padi they use only a little pesticide due to fright of crop death, but they use it for swamp padi when its young (Tine: before planting). For hill padi they use slash and burn to get rid of old straw, and for swamp they let it rot. For hill padi they use intercropping with small vegetables as eggplant and pumpkin. They throw the seeds in there together with the rice. This is not due to nutritional benefits, just Iban tradition. It is what their ancestors did.

RISDA and smallholder rubber:

RISDA uses fertilizer, smallholders do not. Neither uses pesticides, smallholders cut grass manually. RISDA prepares the soil using machines, smallholders use slash and burn. Neither uses irrigation or drainage. The density between the plants for both are 7 feet.

Problems:

- Flooding (recently in the oil palm plantation JVC Memaju Jaya)

Government “help”:

- Government advisors from the agricultural department comes to inspect and advise upon the lands, what to grow and such. Before they came once a year but now only seldom as most lands are oil palm, so there’s not much land left to give advice about. The ones specialized in pepper still comes once a year.
- They consider people from the agriculture department to be the experts. They have had a course about soil, where all the farmers at the session except for one had participated
- Before they came once a year to see what they were cultivating
- Note: “advice” can be a strong word, we could have asked “do you share information about the status of your land, how you grow, what you grow...?” to reveal who they would ask for advice in the village.
- Fertilizer for paddy is subsidized, but they don’t apply it.
- They get rubber seedlings from RISDA

Agrochemicals usage:

- They use a specific pesticide that doesn’t kill the crops, only it can’t kill the Lalang.
- They give palm oil fertilizer 3 times a year.
- Fertilizer for oil palm on small-holder plots they buy themselves.

Plantations:

- All SALCRA plantations are 20-25 years old (we learned from the KT headman at the informal interview the next day that that is not true, there is 4 phases, but this is their perception => their lack of knowledge about SALCRA/lack of transparency)
- Headman: phase 1 in 1997, phase 2 in 1998, phase 4 in 2009
- Before the plantations they grew padi and rubber
- There is only one big coherent SALCRA plantation

Observations:

- They are reluctant to draw – from the very beginning, one man having the expected highest status took the initiative to draw the map.
- Primarily one guy drawing and asking questions, but the others say he represents them

Crop history:

- They grew cocoa in the 80’s but stopped due to market prices. The one field we saw with palm oil and cocoa, is not purposely intercropped. The cocoa is a leftover from past times.

Appendix 4 – PRA, women

The matrix was developed after a quick introduction of it, as well as a discussion on who we are and what we are doing here. The main purpose of the matrix is to understand how different objectives (like food security, income, land rights, and so on) is achieved through different livelihood strategies (such as working in the city, cash crops or different oil palm land use).

Before starting the women requested a new category: "remittances", which were added to the matrix.

Food security

One of the women only does sharing and cash crops. Most stones were put on SALCRA, because of greatest income from it. In JVC there is still no income, as they have recently planted it.

Challenges in the future are especially with concern to SALCRA. After 25 years they have to cut it down, and the food source stops, as they are not achieving any dividend until the new palm before the city work trees are ready.

Income

There is more income in smallholders because there is no dividend. There is an interest in continuing as income is now, because joint venture is the future for one of the women. Smallholding to a much larger extent depend on the world's market price.

Remittances are difficult to depend on as the children are also retiring at some point.

Education

Working in the city is the only way to send your children to school – said one of the women. Smallholders have the biggest income source especially because SALCRA contracts soon end, so smallholder is a more staple one. Remittances are a good way of getting money to send your children to school.

Infrastructure

Networking gets all stones, as they are depending on the government. The government is helping making infrastructure, and all the women agree that SALCRA does not play any role in this (though it might!). Villagers meet and decide they are lacking something -> One villager is the representative (Martin Bin from YB) -> government comes and see what is lacking -> then they decide whether it is needed or not -> slow process.

The women also added here, that they feel like the government is taking them for granted, and not e.g. giving them a water tank as Engkatak has. Even their school is using generator, and they have been asking for very long.

Securing children's future

In the future the women believe that JVC is most beneficial. 16 stones on JVC. One woman puts 2 stones on education, as she believes that this is very important because of technology, optimizing land and so on. The world is getting modern, and the children are going to need knowledge for the future, because the world is changing. More technology also brings more of it to the farming. She wants her children to come back and optimize the farming.

The women want the future for their children to be whatever the children want. If they want to work in the city or move back, but they are hoping that their children will continue with JVC.

Land rights

- The women define land rights by NCR. SALCRA helps them securing their land. Through SALCRA it is a hard and long process to secure their land. Though you can also get land rights through smallholding.
- SALCRA comes to the land, measures its size – which is a very slow process.
- There are many situations, where people through SALCRA has received less land than they thought they owned, and maybe another person in the village is receiving more. This has created conflicts in the village.
- When land is past to next generation they lose track of how much land they own, because of no confirmation. The headman does not involve in this, and do not participate or engage in conflicts.

Preserving ‘Adat’

Divided all stones into Cash Crops and Subsistence, because farming and livestock is the most important in their culture. That’s how the Iban history is, and what they always have been doing.

They want to preserve ‘Adat’ – it is their history and tradition – and they hope that the children will pass on the culture and tradition. They want to include their children in the field (e.g. paddy fields) or livestock to teach them the practices and ‘Adat’.

The challenge is that technology makes the children less interested, because the society/world is developing. They are scared that the tradition will die out.

Appendix 5 – PRA, men

Sample chosen based on variety income in the household, 3 men for K.T and 2 men K.E. During the session start, 4 people from K.T. showed up and 2 people from K.E. could not make it.

Table of livelihood preference matrix

	Food Security	Income	Education	Infrastructure	Securing childrens' future	Land rights	Preserving Adat
Working in city	1	1					
Cash Crop		5	11		6	6	
Subsistence	7	2				1	
Oil palm (SM)	3	7	1		5	5	
Oil palm, SALCRA		1	1			3	
Oil palm, JVC						5	
Education	1				9		4
Networking	3						9
Sharing	4						7
Working other job in village		1	6				
Remittance		3					

Food Security

The villagers mainly choose to have rice paddy as a way of securing their food availability.

They prefer the Small holder because of they no need to get the license and they just wan to sell to the big company already have the license. The people do have license will supply the machinery to handle their old palm and the transportation to the mill.

Networking: "Only few people have "it"" , villagers expect headman and village committee (JKKK) to represent them in relations to people with power/authority.

"If JKKK is weak, the villagers are weak"

Not everyone has land available to grow oil palm smallholder, so some send children to work in the city to earn more money. However, living costs are high in the city, so the income they receive from these children is not considered steady, since it depends on the costs of living in the city.

Income

Smallholder oil palm income is more stable than SALCRA oil palm, since SALCRA dividends are only paid twice a year. Smallholder oil palm can generate income every two weeks, and is considered more stable than cash crops due to changing market prices. The villagers explain that they have to have backup crops in order to secure stable income. Here rubber is used as a backup crop, since they can leave it untapped if price is low, and start tapping again if prices rise.

In terms of growing cash crops they follow the market price. If market price is low for one cash crop, they move to a different activity.

The villagers do not like to rely on one source of income, but do different activities at the same time. Category of "other work in the village" (ATM) and "remittances" was added to the activity/strategy list. One old man explained of a way of living: "keranjai manuk" = what you work for/what you earn, you eat/use to buy food the same day (directly translated means like a chicken scratching for food in the ground) "Village life is hard because you have to change activity after changing market prices". They explained that market prices will stay stable for one year at the longest and gave example: pepper price is high now so everybody is planting pepper, but they have to wait 3 years to harvest, and then the price could have dropped again.

Education

"Other work in the village" is used to get "fast money", so for instance when their children studying in the city visit in the weekend, they can work in the village Thursday and Friday, get paid the same day, and give the money to their children when they visit in the weekend to pay for school supplies and the like. They prefer cash crops over smallholder and SALCRA oil palm, since they store the cash crops and can quickly sell them for money when needed to support their children's education. One respondent put five stones on cash crops not to indicate that it was an activity to reach education for his children, but because his children had gone to school, and had now come back to help him grow rubber.

Infrastructure

No stones put on any activities, since the villagers said the infrastructure comes from government allocated money, and that they do not have any influence on the development of this. They roads were made recently, so they rejected that they joined the SALCRA scheme as a way to improve the infrastructure of the village. When they were promised the roads by the government there were 3 villages. However, since the contractors paid to build the road did not make it everywhere, and the government said they had already allocated/paid the money, the villagers argued about this, resulting in dividing into 5 villages. Today, all the roads are made. At one point, things got political: the villagers said that the problem is that they did not get what the government had promised. They talked generally about the elective from Sarawak who is Bidayuh, and were very unhappy with him. "We are the stepsons of this area". "He has eyes but is blind, he has ears but is deaf".

Securing the future of their children

"The new generation is killed by alcohol"
They were worried about the young generation since they drink a lot and marry early while they are still in secondary school. They explained these as the reasons why this area is still not "very developed". Another factor is that some parents spend their money on drinking, and therefore do not have money for school supplies and securing their children's education. The priest explained that he tried to give advice to the young men in church, but they will not listen. They send their children to school to get a good education, but if the children do not perform well in school, the villagers keep their cash crops so that their children can take over their land.

Land rights

They use different kinds of cultivation of their land in order to keep their rights to land. They put stones on SALCRA and JVC to get titles to their land. Stones on cash crops since e.g. rubber lasts long without having to be cultivated, and can act as a backup when prices rise. They spread out their stones on smallholder, SALCRA and JVC in order to represent not only their own opinions, but the entire village's

Preserving Adat

Priest: "I want to keep the good adat and throw away the bad"

Adat is needed to strengthen relationships between villagers and to other Iban groups (mostly during Gawai).

"Other people also have some sort of adat"

The reason they were open to talking to us was because of adat.

Saying: "Bejalai betungkat ke adat, Tinduk bepanggal ke peningat" = the adat is something you can rely on and bring with you everywhere, the most important from baby till grown.

When talking about adat, they explained a lot about respect, e.g. calling elders by title or having respect for your teachers in school.

"If you don't teach them adat it will destroy relationships, because adat will make us closer and stronger, among the villagers, every family, every household".

When asked about whether adat was also in relation to authorities or only among villagers: "it is hard for me to decide because we are talking about the adat of the villagers."

"We also use the adat to the people who are coming to the villages", e.g. in relation to sharing stories and knowledge with our study group.

Appendix 6 – Semi-structured interview: Dahas, Rice paddy woman (K.E.)

Section 1 - Background

Name: Dahas

Age: 56

History: Came here from Indonesia (at the boarder to Sarawak) with her uncle. Married same year to her current husband as 13 years old (been here 43 years).

Children: 5 - The youngest is 21, the oldest 40+.

Occupation: Farmer.

Section 2 – Livelihood Strategies

- Her husband and her are farming smallholder oil palm, paddy, SALCRA, pepper, subsistence vegetables and fruit, and rubber.
- The most common challenges for her farming are to adjust to Adat in different ways. E.g.:
 - During newmoon, they do not slash the paddy fields, because it is against Adat.
 - When they hear the sound from a specific bird, when being in the field, they have to immediately leave the field, because the Adat tells them to.
 - When one villager in the village dies, they are not aloud to work in three days, because the Adat says so.
- Some of her area has a title, and some do not. The ones in SALCRA do. The ones that do not at this point (the smallholding oil palm), she has to pay for getting a title, which she is planning to do soon.
- Food security is never at stake, as she is getting more and more food on her land, as well as being able to go to the market. Climate change that is occurring does not have any effect on food security.
- She do smallholding because her land is nearby.
- To secure her children's future, she is making sure that they get an equal amount of land, except the youngest daughter, who is getting more land, as she is taking care of the her parents (cooking, cleaning and so on).

Section 3 – Land Rights

- Good land = red, worms
- Bad soil = sandy
- She only apply fertilizer to the oil palm, because the other fields don't need it → already fertile
- Relationship to her land: Loves her land very much, and intentionally don't want to join JVC, because her land is giving something back to her (symbiosis)
- JVC: she claims, that people joining JVC has to wait 60 years after planning the palms, before the money shows (dividend is giving). Depending on size of land. People don't talk about it, because people are embarrassed. They probably have a difficult time, because they have rented out their land and can't grow paddy.
- People in KT and KE is selling their land, which she thinks is wrong, because people then don't have land for the next generations. They sell because they don't get money from JVC, and therefore are forced to sell their land, so get money.
- She taught herself to grow paddy, having help/advise from her uncle.
- When moving from Indonesia to Sarawak, people were very good to her, and the acceptance from other villages were good.

- Market prices doesn't affect her much. She has a two-system: when the market prices on palm oil decreases, she keep sell her rice in sacks. The price of each sack does not differ, so she has a secured income.
- They use more money than they can earn, because they have to buy expensive fertilizers/pesticides.
- She will continue to do farming until the children that do not go to school can take over her land. She expects all her children to come back to the village. If they come back she expects them to build new houses.

Section 4 - Sustainability

- Her definition of sustainability is land that is and can be inherited. Paddy is doable, but the outcome decreases the longer time it is being cultivated. She believes that the most sustainable crops are pepper and paddy, as she can do it over and over again, without much shifting.
- She has a lot of land, so she can shift the land (shifting cultivation).
- Government: She feel like the government includes the village during elections, but they do not feel the attention after the election.

Section 5 - Adaptation

- SALCRA: She does not know right now, whether she will continue with SALCRA. If people in the village are going to continue in SALCRA, she will join as well. If people do not want to continue with SALCRA, she probably won't either.
- She claims that the headman does not own any land, but had to sell it. Now they get income from his wife's dividend, because she has rented out her land to JVC. Furthermore, she thinks that the headman keeps the money he receives from the representative to himself – money that should have been giving to the village.

Appendix 7 – Unstructured group interview: Mothers

Informant 1

Informant 2

Interpreter: Bob

Observer: Dash

Interviewer: Atussa

Transcription key:

- The central meaning of each sentence will be written down (not in a word for word account)
- Some actions will be noted if relevant for the interview (e.g., new people entering the room)
- The interpreter's interpretation is the same as what is stated the informant is saying, unless there are passages where it is relevant to highlight the statement of the interpreter independently.

Interviewer: I would like her (informant 1) to explain something she said last time we were here, regarding why they choose to come back to Krangan Engkatak. She explained it was because the school was close to this village, and it was important for her that her children had access to a school.

Informant 1: last time I said it was because of the school, but there is another reason we moved. The old place we used to live didn't have enough infrastructure and some other facilities were lacking in relation the here

Interviewer: And why does infrastructure have an important role in choosing where to live?

Informant 1: Electricity for an example, the place I used to live: called Ulu, very far from here, close to the Indonesian border. it was hard for us to do work at night or to study because we didn't have electricity, we just used oil lamp. here it is far better

Interviewer: in choosing a place with good infrastructure was it because of the children,

or was it also choosing in terms of what was best for farming

Informant 1: because of the children, i don't want them to go away to be able to study, and also here we can charge or cell phone because we have electricity for them to play with.

Interviewer: why is it important for you that your children are able to play with phones?

Informant: It is important for me that my children can explore with ICT (communication technology) - me myself I can not even use the cell-phone or an lap top

Interviewer: why do you think it is important for this generation to be exposed to ICT, whereas you are not able to use a phone or laptop yourself

Informant: now it is an IT world, everything lies at your fingers to search , that is why my children have to learn this modern technology

Interviewer: Okay. I would like to ask a little bit further about the education of your

children. What expectations do you have for their future education

Informant: I have high hopes for my children, I myself only have a secondary school, level 5 education, I have hopes for my children to go to university, and get a higher education than me

Interviewer: what is the reason that you weren't able to get an higher education yourself?

Informant: because my results wasn't so good. I am a science student, I had, Biology, chemistry, physics, but I failed the subjects- I took 12 subjects and failed 6 and passed 6. The education system didn't allow me to go any further, it makes me feel really bad.

Interviewer: Did you choose the subjects yourself?

Informant: the teachers choose for me

Interviewer: If you could have chosen yourself would you also have chosen science?

Informant: Yes I would have, but because of the English language I had difficulties. I couldn't English, and the science subjects were taught in English.

Interviewer: in the school you went to, was it all in English? or did you maybe go to a primary school in another language and then to higher level subjects in English?

Informant 1: During primary school I was taught in Mandarin

Interviewer: wauw okay

Informant 1: From mandarin in primary school i got to the secondary school which was taught in English

Interviewer: And why would you choose science?

Informant: I have an interest in science

Interviewer: What hopes do you then have for the education of your children. what subjects would you like them to read?

Informant 1: It depends on the choices made by my children, If they chose science it would be good

Interviewer: would you let them choose?

Informant: yes

Interviewer 1: why?

Informant 1: If I push them to do science, they might not be able to carry on

Interviewer: how do you think other parents think in this regard?

Informant 1: In my opinion the other parents will push the children based on what the parents like. I would be open and let my children chose for themselves

Interviewer: What education do you think would secure your children's future the most?

Informant 1: In the current world we live in, the world needs more science.

Interviewer: Dash do you have any further questions?

Observer: yes, you just mentioned that English was an obstacle for your, what do you do now to change this for your children ?

Informant: maybe I will ask my husband to send my children to the teaching center- getting extra English classes. It is in the weekends, now they have classes in Serian

Observer: When mentioning that your results wasn't good enough to go to university, others when not able to go to the local university try to go to the private universities. Was this option available for you?

Informant 1: It is too expensive to go to private universities

Observer: okay, as a follow up question, do you know there are scholarships to apply for private universities?

Informant 1: No, At the time I didn't know

Observer: But you know now?

Informant 1: I actually didn't, but maybe you could explain it to me?

Observer: I was actually thinking to that

*** all laughing*

Observer: Companies as Shell and Petronas, Maybank , other agencies or corporations , and even the private universities themselves have scholarships for SPM results. And they will all come up in the newspaper when offering. And can I also ask you how you plan to expand your income, because as your children grow older their expenses also increases?

Informant 1: Me and husband have planned to have an oil palm plantation- maybe that will be able to support us.

Observer: you plan to or already have?

Informant 1: We already have one, it is 3 years old, small holder. We might be able to give our children an education based on the oil palm money.

Interviewer: When you make decisions for your children's future- do you make them on basis of your own experience or how do you make those decisions

Informant 1: based on my own experience. me and my sister had a hard time going to school, that has given us a lesson, that is why me and my husband started to plant oil palm as a source of income.

Interviewer: regarding to decisions about the children or farming, is it something that is being discussed only with her husband or is it something that is being discussed with more people giving their opinions?

Informant: it is only me and my husband no other interferes

Interviewer 1: Okay. Your mother also live here?

Informant 1: my mothers sometimes lives here, and sometimes go back to Ulu to live with her sister

***A friend of informant 1 enters the house with her baby (informant 2) ***

Interviewer: Is it okay if we also ask you some questions? We are interested in knowing

how parents view their children's future and the decisions they make in that regard.

Informant 2: That is okay

Interviewer: how do you see your children's future, the hopes you have for them and the decisions you make for their future

Informant 2: I hope they will be better persons in the future

Interviewer: better than who?

Informant 2: Better than me

Observer: In terms of education?

Informant 2: In terms of life and education

Interviewer: why do you think your life is less better

Informant 2: I live far away from my parents and my family, if faced with any obstacles I have to solve them myself

Interviewer: and that is hard?

Informant 2: It is very hard because I am not from here

Interviewer: But how would an education for four children make it better?

Informant 2: I hope my children can work and help me

Interviewer: In that relation I would like to ask both of you when you see your children's future and you want them to get an education i guess that means they have to move to the city?

Informant 1: it is okay for my kids to move to the city and I still live here. And if they need some money I will send them some. As parents we will help them get an education

Interviewer: Do you have any idea of if they would live permanently in the city?

Informant 1: Yes I have thought of that before- but it depends on how successful they are

Interviewer: Can you elaborate on that, how would the succes make a difference

Informant 1: maybe my kids can work for the government, so of course they would live in the urban areas

Interviewer: So in what scenario would they not live in the city?

Informant 1: Just in case, because we have our own land, the kids can do some business on that land- I have some NCR land.

Interviewer: And you(Informant 2)?

Informant 2: I hope in case my children can't live in the city that my children the same as her children can use our land. But for me i prefer for my children to live in the city, so if that level of education isn't enough i try to push my kids to another level of education.

Interviewer: in relation to both of your families have some land, and you do some farming , how did you learn about farming when you grow up?

Informant 1: If there are some courses about farming I would send my children

Observer: But how did you learn

Informant 1: I learned from my parents

Informant 2: I adapt to the environment of the village

Interviewer: what do you mean you adapt to the environment of the village?

Informant 2: because i learned all this stuff when i was a kid

Interviewer: how did you learn?

Informant 2: I just followed what my parents did

Interviewer: when did you start to notice what your parents did, at what age?

Informant: when i was 7 years a already got used to paddy farming and rubber tapping

Informant 1: For me it was 1998 , when i was 7 years old, by parent brought me to rubber tapping, and whatever they did I just followed

Interviewer: could you (informant 2) give an example of how you adapt to the surrounding area?

Observer: was it something you grew differently in your old kampong she had to change in this new one, or why did you have to change

Informant 2: it is a bit different because in my old village we used water as our main transportation, in this new village we have a new road we can use to move from place to place.

Interviewer: does it make it easier?

Informant 2: yes it makes it easier

Observer: how about crops, is it the same?

Informant 2: it is the same

Observer: is it also the same management style,

Informant 2: last time the way we management to sell crops, is that we carried the crops on our own, with baskets , but now we use different transportation , motorbike

Interviewer: but is that something that has changed from this village from your old village, or is it something that has changed throughout time

Informant 2: Now in my old village they use vehicles, last time they used boats

Interviewer: you (informant 1) mentioned you would send your children to farming courses , why?

informant 1: it is easier for our kids, now we use our own tools, and our hands, in the future they might use a machine

Interviewer: do you feel you can learn your children how to farm with the knowledge you have today?

Informant 1: based on the knowledge I have, it might be hard for them to live by in the future, they might have to plant extra crops and sell more.

Interviewer: you talked about how your parents brought you to the fields to learn how to farm, would you do the same with your children?

Informant 2: I don't bring me children to the paddy no more

Interviewer: why?

Informant 2: because I don't want my children to have the same journey as me, so it is better to bring them to school

Interviewer: have you also consider sending your children to farming courses?

Informant 2: it depends on my kds interest- as long as they have a better future

Interviewer: how important is it for your that your children take over the farming of your NCR land in the future?

Informant 2: For myself, i don't have much land, i just came here, so it isn't that important for me.

Informant 1: It is very important for me because I have the land, so I hope my children come back and do something with the land.

Interviewer: We asked informant 1 before you came about the education of her children, and I would like to ask you the same. What type of education would you like your children to have?

Informant 2: my kids have an interest in science, and are good in science, so I support my kids in their interest and in getting good grades.

Interviewer: there is a point between level 3 and 4 where they have to choose a specialization. how would that decision be made for your children?

Informant 2: it depends on my children's choice

Interviewer: would you let your children chose?

Informant: It depends on my children and what they choose, I support whatever choice they make.

Interviewer: do you (Dash/observer) have any questions to this topic?

Observer: No

Interviewer: Then I would like to know if adat plays a role in the upbringing of your children, and if it does, then how?

Informant 2: Adat is really important, because it teaches our children how to treat others, for example you coming to our village, if we didn't have any adat, we wouldn't have any ceremony to welcome you, we have to teach them

Informant 1: the same, If I come to another state or area, Adat is the first thing being used for welcoming.

Observer: It sound like adat means manners, is that it?

Informant 1: adat, is an attitude, how to respect others , discipline.

Interviewer: you say adat is important, but how do you teach your children?

Informant 1: it is hard to explain, but now you are here and if my children touches your stuff we will teach them not to, because it belongs to you.

Interviewer: Is adat only taught by parents within the house?

Informant 1: It comes from the household the parents and some adat comes from the church, but most importantly it comes from the family.

Interviewer: okay, but how does it come from the church, how does the church learn people about adat?

Informant the priest teaches us: don't make harm to others

Interviewer: is all adat good adat?

Informant 2: adat is all good, adat never tell you a bad thing

Interviewer: okay, is this the adat you have been told, that you are referring to?

Informant 2: it is what my parents taught me, it is the rules

Interviewer: so when you are referring to the adat you are teaching your children you are talking about the adat your parents taught you?

Informant 1+2: yes

Interviewer: is the adat that you were taught by your parents the same as the adat your parents were taught by your grandparents?

Informant 2: the same, what my grandfather taught be father is the same as he taught me, and i will teach the same to my children.

Interviewer: So has the adat of the Iban group never changed?

Informant 2+1: it is the same, it hasn't changed.

Interviewer: do you think that the older generation is satisfied with this new generation?

Informant 1: they are satisfied, because the kids doesn't make any problem.

Interviewer: so when you imagine the best future for your children, do you see any obstacles?

Informant 1: For now i don't see any obstacles yet.

Informant 2: the same for me, but i have high hopes for my children's future.

Appendix 8 – Semi-structured interview: Mr. Nelson, SALCRA officer

Purpose: To get information related to oil palm plantations.

Questions:

- Are there any land use management differences in SALCRA oil palm plantation for the past 15 years?
 - *Answer:* Land management is the same as in the past and now. The amount of fertilizer used also the same.
- Does SALCRA use bulldozer before oil palm plantation?
 - *Answer:* Due to the earth's surface that is not equally even, before planting oil palm, larger machinery are use to open the land before planting oil palm.
- How often does SALCRA take soil samples to analyze the soil parameters?
 - *Answer:* Before SALCRA operate the plantation, Environment Impact Assessment (EIA) had been carried out. It is a common procedure for oil palm plantation larger than 500 hectare. For water inspection, it will be conducted every 4 months. This is a requirement to achieve the standards set by the Malaysian Palm Oil Board (MPOB). Furthermore, every year there will be auditor to check whether the plantation follow the guideline and procedure. Melikin Oil Palm Estate, SALCRA had received Go Agriculture Practice certificate last year.
- Can we get a copy of SALCRA EIA report (before and after the oil palm plantations)?
 - *Answer:* EIA reports are confidential report and have to seek SALCRA headquarters approval for a copy/review.
- If we have any extra question related to SALCRA, who can help to answer our questions?
 - *Answer:* Mr. Nelson himself can answer all the related questions.

Add on conversation

The aim of SALCRA is to develop NCR land and indigenous affairs. “If the land is NCR, SALCRA can come and assess whether the land is suitable”. SALCRA also works on secondary forest (after abandonment of [rubber] fields). Abandoned after use by native people – swidden cultivation. If the secondary forest is NCR it can come under SALCRA. If it is 1958 state-owned it cannot enter the scheme, because it is a development schemes only for the population.

SALCRA are not forcing villagers to sign the agreement, but instead SALCRA help the villager to get the title of NCR land titles. “Some farmers don’t have cash to manage their land – then SALCRA can help”.

Oil palm plantations will expire within 5 – 6 years, SALCRA will seek the villagers to renew the contract or not. However, for villagers who are not involved with SALCRA, they are able to use the facilities such as the oil palm roads.

Seems very open but cannot give us further information (reports or the permissions) without asking ”higher up” in the SALCRA hierarchy. After this meeting we didn’t hear anything from SALCRA.

SALCRA have made an EIL (environmental impact assessment) with an EMR (environmental monitoring report).

SALCRA operates only on combined fields larger than 500 ha.

The quality of the water (main stream of the river) is monitored every four month after new practices have been introduced “Good agricultural practice” from higher up (Malaysian government).

Mr. Nelson tells us, that all fields under SALCRA now are considered sustainable under the RSPO certification scheme – Roundtable of Sustainable Palm Oil. This is after the introduction of good agricultural practice.

He also tells us, that apparently, SALCRA works in close cooperation with UNIMAS which helps analysing samples from the water.

Before: no use of fertilizer, depend on the natural recover.

Now: fertilizer use, subsidized from the government (agricultural department). For paddy.

“Paper [documents] on fields about the dividend is available if they come to the office”

Land development department: calculation of the dividend. \div operation cost, yield / produce (kg) x price per ton. → if prices are going down the dividend will also go down.

Between the oil palm circles (5y) – replanting reserve money. So far they do not get an dividend in these years. But the farmers agreed with the scheme.

Before they did the slash and burn between circles, now they chop the trees and apply to the soil (maybe because of the RSPO scheme?)

Appendix 9 – Semi-structured interview: Older woman, Jenih (K.E.)

No.	Themes	Summary
1.	Background	<ul style="list-style-type: none"> ● A 76 year old woman with one daughter and also a single mother. She had been living in K.E. for more than 40 years. Her first house was in Kg K.T. but was caught in fire and they had to stay in Krangan Tekalong only for temporary until the new house is build. ● Currently, she was not working and only depending on remittance from her daughter. Her daughter was a tailor since she finished her secondary school to support their life. ● Previously, she was a farmer. She used to harvest pepper, and rubber tapping. She really likes to farming as her daily activity while waiting for her daughter to come home and visit her during weekend.
2.	Land Use	<ul style="list-style-type: none"> ● Currently, the old woman had 5-6 hectares land which was still managed by SALCRA and it had been 6 years with them. ● The first 2 years when they were given dividend but not so much because the SALCRA had to invest for buying machineries, tractors and to build road. The amount of SALCRA dividend was not continuously high. ● It was difficult to harvest when the oil palm tree is getting taller. The villagers used to plant rubber before SALCRA had started their oil palm project. ● She refused to join JVC because she did not want to get involved in a conflict between the Penghulu Lebor and villagers. ● She had made her decision to change their crops because most of the villagers had joined SALCRA and she wanted to join too as to gain income from the dividend as like what the others had. ● She had worked as a labor in SALCRA while waiting for the oil palm to produce fruits. ● She planned to continue planting oil palm in her land with SALCRA because according to her, the nutrients content in the soil was not as much as before and not suitable for cultivating other crops than oil palm.

		<ul style="list-style-type: none"> ● The land means a lot to her since that was her only asset that could be inherited by her next generation. ● She wanted to give all of her land to her daughter and son in law. They will be the one who shall managed all her land. ● Challenges that she used to face before joining SALCRA was the prices of the rubber crop was not so high that they could not depend on for living. Then, they started to plant about 100 pepper trees but then the price had declined too. Moreover, they also need some money to buy pesticides and fertilizers for pepper plantation which was too expensive at that time. ● She had also planted about 50 cocoa trees before to gain some income but unfortunately, the crop was mostly destroyed by squirrels. ● The total of land that she owned was about 80 hectares and was NCR land. ● She mentioned that it was quite expensive to pay the land and survey to measure her land and give title. ● Total of the land that she owned was 80 hectares which was covering Batang Sungai Engkatak to Batang Kerang, Batu 12, Batu 13, Kelampai and also in Krangan Engkatak. These are mostly idle land, which was still in her plan to get involved with SALCRA if she get the chance to. ● Some of these areas were used to be paddy field before. ● These lands were given by her parents and also from her late husband.
3.	Livelihood strategies/quality of life	<ul style="list-style-type: none"> ● She started farming since she was a child because her life was so hard at that time. ● She stopped farming 8 years ago when she accidentality broke her wrist during harvesting in the field and was hospitalized more than a week. ● Most of the time, her daughter prepared everything for her such as gave her clothes, foods, money and comfortable house to live. ● The most important for her was her health. Unfortunately, she was not be able to do anything including farming because of

		<p>her unfavorable health condition.</p> <ul style="list-style-type: none"> ● Villagers who were mostly her relatives always came to visit her which made her life quality in everyday life. ● One of the challenges that she faced was the infrastructure of her land. She was so worried thinking of idle land which was still empty and she was afraid that the land might be taken by anyone else easily because it still NCR land. Therefore, her daughter had to visit the land quite often.
4.	Life in a village	<ul style="list-style-type: none"> ● She really loves living in this village. ● Any decision-making was made by her daughter. ● She felt that this village is the only place for her forever.

Appendix 10 – Semi-structured interview: Headman of Krangan Trusan

The 2th of March 2016

Interviewer: Dharshini

Observer: Julie

Translator: Bob

Ethnicity

The origins of Iban Balau

(Balau is originated from Satau). It can be found from Sri Aman to Kt Samarahan. Iban Balau is considered a big ethnicity.

Reason for staying in the Krangan area and time scale

Budan-Kunjau was the first ethnic group to discover the land here (around 1930). They moved from Banting. Budan and Kunjau refer to two brothers, which moved to the land. Later Balau (the brother-in-law to Budan and Kunjau) came. They wanted to discover fertile land with lots of resources – and that is exactly what they found: fruits, different trees, fish, wild boor and deer and so on.

Meaning of the word Krangan

Krangan means stone. There are hills nearby referred to as Bukit Krangan. Trusan refers to small river (canal) – it is a shortcut from one place to another (from the village to the main town).

The reason for the different Krangans

In 1957 the long house burned down in Krangan Trusan, which made a few familie members from Trusan move to Tekalong and Engkatar. Some wanted to discover new land, some stayed back in Trusan. Another one burned (the headman can not remember when) and 7 household burned down (a longhouse), which then made more move out of Trusan. The reason for moving is always fires.

The practising of Adat

The headman has to practise Adat. Christianity is not affecting the adat. Adat is used when managing a divorce or other fights/conflicts. In the past practising adat was very spiritual, but this is not in the same degree the case anymore. Adat Iban is still a tradition. E.g. you have to ask the father for permission to marry his daughter. The adat tradition requires that the man's father has to give presents (dress, food etc.) to the woman's father. Likewise punishment is done the adat way.

Headman Duties

General duties

Besides different administrative duties, the headman also has social duties. Including helping the district officer, assist the government in caring for the villagers' welfare, encourage the villagers to join government programmes, help government officials carry out there official duty, social duties, handle and resolve family conflicts according to Adat, strengthen bond between villagers and government, keep track of birds and the death of them, and lastly, carry out duties for the government.

Any changes in duties from 1988 (where headman took over)

The headman has to do extra work because of the administrative work. He gets an amount of money every month if he does not have enough work. At least once every month he has to have a meeting with his villagers to acknowledge any problems or holidays, which he then makes a report from and send to the district.

Making decisions about the village's land use

If there are no conflicts over land, the decision is easy and the headman decides. If there is a conflict he will have to investigate by interviewing the neighbouring land owners, and find out who the land belongs to.

The headman meets with the government officials and/or SALCRA/JVC and other agencies, which he then talk with his villagers about at a new meeting. The headman will function as a representative for the villagers' wishes.

Village life

Then and now

Before palm oil, they were farmers (paddy, rubber, cocoa and pepper), working for companies or constructor workers in Kuching. In the 1960's the pepper industry was not giving enough profit, so the villagers main focus was mostly rubber and cocoa.

Now there are more jobs as SALCRA and JVC have come into the picture. There is still paddy, as well as becoming drivers, cutting grass and fertilizing for SALCRA – which are only examples of the working opportunities.

Using natural resources in the past

The villagers did not use the resources for building and construction before. They always plant near to their house, as this is easier to use for them and sell everything extra. The villagers had left the land idle, because there was so much untouched land.

The changes in dependency on nature

The 46 households all have cars and bicycles, which makes it easier to get to different locations. The pay for the headman's house is 75 ringgit per month, which demands extra jobs. Therefore it is common that people have several jobs, in order to pay for living. Likewise, they are allowed to fish and sell it to neighbours, but not on the market. The fish size has not changed, though there are a lot less fish and wild animals, than earlier.

Land use

Use of the land in the past and present

The land was not used very much before. For rubber, cocoa, pepper and paddy. Earlier the paddy planting was a shifting cultivation. At that time it was hill rice, but now it is almost entirely switched to swamp. This happens to a large extent for 4 years ago. There is a lot of energy and resources being used for hill rice paddy. Both cutting and burning, which demands extra work. Both seeds from hill and swamp have to be saved in order to plant it again – these has been saved for many generations.

Influence of external agencies

The YB in the area sits in meetings with the headman and the villagers. If the headman holds a meeting about the YB, he has to tell everything the YB says! YB comes if there is a problem in school, with the farmers or something else. The YB emphasizes how important it is to NOT sell your land and to not leave the land idle – but renting out is okay.

Influence on external agencies on land-use decisions

The headman thinks that it is important when renting land out, that the company is well-functioning both financially and socially. It is likewise important how they are approached and introduced to the scheme.

Agriculture

Managing and working on the land

Paddy: The household themselves takes care of it. The men prepares the land (cutting, fertilizing, irrigation). The women plant and harvest.

Oil palm: Mostly men. A foreman is elected among the villagers by SALCRA, which will supervise the foreign (Indonesian (Javanese)) workers.

Pepper: Family helps each other to take care of the pepper if it is fewer than 400. Above 400 they have to bring in helpers from the village.

Rubber and cocoa: No help – on their own.

SALCRA/JVC in the future

The headman thinks SALCRA is good, easy, limited work and maximum income, therefore he wants to continue. The pros is that they get a profit every year, and there is no cons. The headman has a lot of land for children, for if there is a fire again and so on. The land has already been divided out to the children.

Sustainability of livelihood

Roles of youth

The youth has small jobs around the village (without profit) - responsibility. The youth also comes to meetings, but are not allowed to participate in the decision-making process, as this is preserved for the household heads and the elders. A lot of the youth migrate to urban areas, but they often come back, as they have access to a piece of land.

The future

The headman expects that everyone will join SALCRA/JVC, therefore maybe the oil prices will go down, but he hopes not. He hopes that migration to distant areas will not be necessary, and that migration will not lead to drug problems for the young people (especially the girls – his daughter mostly). When the children come back the income should be better (a daily income today is around 15 ringgit). He knows that the youth will come back, as it is “easy life” – everything is around them! No need for buying anything and the children know that.

The life in the village is dependent on what has been planted – this also makes the future generation a focus for the headman and the elder generations.

Appendix 11 – Semi-structured interview: Headman of Krangan Engkatak

1. What is your duty as a headman? (the whole role of Headman)

How do you involve the villager in decisions making? (overview of influence actor)

** regularly talk to when declining with village issues on behalf of the village committee.*

As a headman the main duty is to take care of the villagers welfare and report to the district office (Gov department). Report must be submitted to District Office every 2 week after the village meeting.

As a example, before the Interdisciplinary Field Course start. Headman discussed the request from Unimas with the villagers, after all the villagers agreed, headman will reply the UNIMAS and District Office.

Reporting system:

Tuai kampung	- En. Juty
Penghulu	- En. Rungka @ Jimbai
Sarawak District Office (SDO)	- En. Gerat
District Office	- En. Sindir Muliang

*the report must be reply back within 2 week.

If they have any issue they decline? How is it happen? And what headman have to take action?

So far no issues that the villagers against, they all agreed in the majority. Such as, the government supply the fertilizer to the villagers for the paddy.

How about the land in the village? How the process is made?

Headman have no right to influence the decision of the villagers, headman is just like the middle man to all the process, he gather the villagers to discuss the issues.

As a example of joining SALCA or JVC, normally villagers will agree because of their lack of capability to manage their land, also headman said " if the villagers don't join the scheme, the villagers are more disadvantage during managing his land. Sometime villagers hard to transport out theirs fruits and sometime will get fine if the palm tree at the border die because of the effect by the pesticide use by the villagers.

2. Explain the situation 1st circle of SALCA is coming to end in 6 year time. What will be happen during the meeting of the 5 headman?

** Describe something related to tough decisions making.*

**Venn diagram to know better of the influence of that. (deep and detail of the organization involve)*

Only selected villagers inside the perimeter will be discuss, but not all villagers. After meeting, headman will have the name and signature from who is agree to lent his land to the SALCA and JVC.

The main role of Penghulu is to verify all the document between the developer and villager. Such as, the land of the village, the document of the developer, and keep all the document and agreement.

Penghulu only play his role, if the issues form the village can not be solve at the level of headman.

3. How the headman contact with, and which organization related to any decision making to this situation? (actor, situation and job- starting and detail of the story)

Headman will direct refer to District Office or Elected people representative (YB) office - Tn Martin@ Ben if there have any bigger issues he cannot solve.

Normally, it take 5 to 6 month and also base on annual allocation in their office.

Headman also said " the project can be done by 2 different way, is either the money bank in to the village community account or the office can open tender to appointed contractor to help the village.

4. Do you co operate with other headman with issue of land use? How?

Ya, headman do had a meeting with other headman before relate to the land. Other headmen attend as a witness (Saksi) and refer to Adat UNDANG-UNDANG NATIVE COURTS, 1992 ENGGAU, ADAT NATIVE COURTS, 1993 and SARAWAK ADAT IBAN 1993.

5. Do you do any preparation for those villages who involve the 2nd circle of SALCA?

Headman won't decide and will head a meeting with the villagers to get theirs decision.

6. How you use your headman position to preserving and secure the future of this village?

Headman do give a advise to the villagers to plant rubber, oil palm, paddy, breed pig and chicken to sustain the kids future, especially to earn more money to send their kids to school.

Appendix 12 – Semi-structured interview: Youth

The informant participated in the youth focus groups, number 1. Many of the answers given by the youth in the focus groups were similar. This informant was chosen on the basis of having the same background as the other participants, with similar answers as the rest of the group. This informant was neither a dominant or socially shy participant in the focus group. Some of the other participants seemed to feel uneasy in the focus group situation - and given the time restraints we weren't able to develop a relationship to the more shy informants making them more comfortable doing a personal interview. The more 'dominant' informants, meaning the informants that influenced the discussion in the focus group on their own initiative, was university students. The semi structured interview was intended to get a more in-depth answer to some of the answers given in the focus groups, and the university students wouldn't be representative to that purpose, although we would have liked to do more semi-structured interviews with different youths- but for the purpose of getting more in depth answers to some of the themes of the focus group, this informant was a good choice.

Transcription key:

- The central meaning of each sentence will be written down (not in a word for word account)
- Some actions will be noted if relevant for the interview (e.g. new people entering the room)
- The interpreter's interpretation is the same as what is stated the informant is saying, unless there are passages where it is relevant to highlight the statement of the interpreter independently.

Interviewer: Atussa

Observer: Dharsh

Translator: Bob

Interview:

Interviewer: we want to talk to you because during the focus group yesterday, there were some things in general, where we didn't think there was time enough, or not the place to ask some questions that were more specific or in depth. So this interview is also a chance for you to say what is important and not being constrained by the structure of the conversation, try to see this interview as more informal and casual.

Observer: chit chat

Interviewer: yes. I will ask the questions but Dhash (Malaysian student) will also chip in sometimes. And this time because there are not other people only speaking Iban, if you feel you can express yourself in English, as you sometimes did in the focus group, this time it is okay, because we can all understand English. But sometimes it is easier to express yourself in your mother tongue, that is why Bob (translator ed.) is also here.

So first i would like to hear if you after the focus group, thought further about some of the things we spoke about or if you felt that there were some things you weren't able to say during the focus group?

Observer: do you remember the questions?

Informant: Adat...

Observer: Adat, where do you see yourself in 10 years, city life and village life

Informant: yes I remember

Interviewer: but did you feel like you said what you wanted to say during the focus group or is there anything else?

Observer: after we asked you all these questions did you think more about it?

Informant: there is something regarding where i see myself in 10 years. when I work in the city in 10 years time, I want a better job. I want to find my own house in the city.

Interviewer: okay. What does better job mean?

Informant: I want to be a chemical engineer.

Interviewer: okay. You do not want to be a English teacher?

Informant: I have two choices in my head, which is chemical engineer and teacher.

Interviewer: Do do think chemical engineer is better than teacher?

Informant: yes better

Interviewer: why?

Informant: because i want to do my own research about the chemicals inside the earth.

Interviewer: Why, do you have an interest in that?

Informant: yes

Interviewer: is there a reason?

Informant: When i was kid I was very interested in the chemistry of the earth.

Interviewer: okay. Is there anything that would prevent you from being a chemical engineer

Informant: no

Interviewer: okay. Then what would guide you in making the choice between being a ENGLISH teacher and a chemical engineer

Informant: It is based on my results

Observer: If you do better, you would choose which one?

Informant: chemical engineer

Interviewer: Do you have anything else to this question Dharsh?

Observer: Do you know where you would study chemical engineering, or where you would study to become a teacher?

Informant: Firstly I would go to form 6, and then I would go to the university to get my bachelors degree, and then my master in chemical engineering.

Interviewer: would there be any difficulties in trying to be an english teacher?

Informant: no

Interviewer: it is not based on results?

Informant: It also depends on results- but if my results are better I would choose chemical engineering

Interviewer: Have you thought about what to do if your results isn't good enough for nGLISH teacher, what you would do?

Informant: I want to join the army

Interviewer: why?

Informant: I want to protect the nation, like my father.

Interviewer: so your father was also in the army.

Observer: do you see any differences if you became someone in the army, or became a chemical engineer , or a teacher

Informant: there are a lot of differences

Observer: in which one do you see yourself most suitable for your retirement plan also
The translator tries to get the informant to understand the question

Informant: Chemical engineer

Interviewer: as more suitable

Observer: why is it more suitable for your retirement plan?

Informant: It is still depends on my results, but if I have good results i will choose the army, but if I have better results i will choose chemical engineering.

Observer: but how would that help your retirement plans. Your retirement plan was to come back to the village?

Informant: yes

Observer: But how will the choice of your profession help your retirement plan?

Informant: During my retirement coming back here I would like to do some research in the village.

Interviewer: And what would you do with the results? What would be the purpose of the research?

Informant: the purpose would be about some of the chemical present in the village, and to “generate more knowledge” about the elements inside the soil.

Interviewer: would you use this knowledge to apply a new way of farming in the village= Would you use the results more actively in the village?

Informant: “Firstly” I want the villages to have a development for themselves. I want to have better infrastructures such as from Internet coverage, And I want better roads to connect to the outside world

Interviewer: why?

Informant: the reason of that I see the village is very rural and I want them to be connected to the outside world.

Interviewer: Do you see it as a problem that the village is quite rural?

Informant: For examples for some of the kids here it is hard to go to school, and to find vehicles to go outside

Interviewer: So it is also relates to the villagers ability to get an education? Or part of it is? The roads and so on

Informant: Yes it is an “obstacle”

Interviewer: I will try to ask another question, and Dhash you can always ask something.

You said that you in 10 years would like to own your own house in the city. What does that mean- you don’t want to rent or is that you want to live separately?

Informant: Since i was a kid I have lived in the village, so I would like to have a life in the urban area.

Interviewer: But does that mean you want to live alone, or a life with your parents?

Informant: with my family

Interviewer: You talked about technology, and I would like to know how technology plays a role, not only in your life, but also some of your friends life in the kampong

Informant: Let's say in a study, is it easier to find more information using the internet?

Interviewer: So it is also in relation to education. What about some of your friends in the village, would they also use it for educational purposes?

Informant: yes

Interviewer: would they also use it for other purposes?

Informant: We can communicate with the other family on the other side of the world.

Interviewer: okay, in the focus group you also said you were interested in learning about other cultures. Does access to the internet and technology help in this regard?

Informant: yes- lets say if I want information about the Malays or any other cultures, I can use the internet to find this information.

Interviewer: But do you do that, or is it, that you could do that?

Informant: yeah I use it now, because sometimes our teachers give us assignments about other cultures

Interviewer: okay, Dhash do you have some additional to this topic?

Observer: no

Interviewer: okay, We have in this interview and in the focus group talked about living in the city. But when when you say you want to move to the city, does that mean no villages life?

Observer: That means. do you feel you have to choose one only?

Interviewer: yes exactly

Informant: when I live in the city , I can still go to the villages to see my grandparents

Interviewer: We also talked about adat last time, and I would like to know if he thinks it would be difficult to apply adat when living in the city?

Informant: It is very hard to apply adat in the city

Interviewer: why

Informant: E.g. We will meet different people such as Chinese people, they don't know about our adat.

Interviewer: okay, interesting. In the focus group you said that adat was really important to you, and that living in the city was also important. So now when you say that it will be hard to apply adat in the city, how would you manage that restraints by living in the city and at the same time feeling adat was really important?

Long silence- translator makes sure that he understood the question

Interviewer: maybe I can ask differently. Is there some adat that would be difficult to practice in the city than other adat that would be easy to practice in the city?

Informant: Yes there is a difference

Interviewer: what would that be?

Informant: Mirroring the ritual. because the ritual is specific for this village

Interviewer: would he then when visiting the village still practice the adat?

Informant: yes

Interviewer: Is there some other adat that would be possible to practice in the city?

Informant: yes, the najat, the dance

Informant; yes, and anything else

Informant: yes, marriage can also can be done in the city..... Nothing more.

Interviewer: does he see adat more connected to the rituals?

Informant: yes, mirroring

Interviewer: is there some adat that is not related to rituals?

Informant: no

Interviewer: then we would like to know a little about your knowledge of farming, especially when you want to be a farmer. you are 17- do you know how to farm

Informant: I know little about farming, because i moved to the village a year ago. I Lived in peninsular malaysia in the city.

Interviewer: okay how do you know the little you know

Informant: it is very little, because i seldom follow my grandmother

Interviewer: then how would you learn?

Informant: even though i don't know, i want to learn.

Interviewer: But how would you learn, from where

Informant: my grandparents, they know a lot

Interviewer: when do you think this knowledge will be passed on to you?

Informant: once i moved here, my grandparents learned me little about tapioka planting, eggplant, chili and other vegetables - so more subsistence

interviewer: Do you think the knowledge from your grandparents will be enough?

Informant: yes

Interviewer: how about you wanting to be a chemical engineer?

Informant: when I have become an engineer, maybe in the holidays i will be a part time farmer

Interviewer: how are the knowledge gained from your grandparents and the knowledge you get from being an engineer different or similar.

Translator has to explain the question

Interviewer: are there any relations between these two?

Informant: no

Interviewer: How are they different

Informant: it is very different, engineering is very different, but farming is only about the farm

Interviewer: but i am thinking of that you mentioned you would want to do research on the farm, with the knowledge you gained from being an engineer, and that you also want to gain knowledge from your grandparents. So how are these two knowledges different?

Translator tries to explain

Translator: How would the knowledge be different?

Observer: I don't understand

Interviewer: you don't? He said he would like to be an engineer, and to do some research about chemicals and the farming in the village, and also gain knowledge from his grandparents on farming, and use both knowledges. I would like to know if there is a difference between the two knowledges

Informant: there is not much difference, but there should be some similarities

Interviewer: do you know anything about these?

Translator: he will take some time to arrange his thoughts.

observer: you said something about farming differently , so it could also be the way you farm and if you would do anything different.

Informant: first I would plant tapioka, and apply new system of sprinklers, more fertile for the crop

interviewer: okay interesting, if you had to choose between the knowledge you would gain from the

university and your grandparent's knowledge, which one would you choose?

Informant: my grandparents

Interviewer: why?

Informant: because I can apply my grandparents and it will help us, if have no food, we can go to the farm and get food

Interviewer: but you would prefer both knowledges ?

Informant: yes I want to get both

interviewer: how will his household be different from his parents, when he gets a wife or children

Informant: if i live in the city, i will live in a double story house, i will change my livelihood in relation to my children. i want to teach my children , and better my life.

Observer: now you grandmother farms, and you father has retired from the army and is now farming. how will your life be, will you have your family living near you, and your father is farming. when you become the father how will your family be?

informant. during the holiday i want to bring my grandparents to live in the city with me. I want to give my grandparent a better life.

Observer: but if you take them away who will take care of the farm

informant: it will only be in the holidays

Observer: but you grandmother works nearly everyday on the paddy

informant: My great uncle would take care of the farm

observer: just to confirm i have the right idea. sp you will have you own house i the village and a house in the city where you live with your wife?

informant : yes

observer: where would you spend more time

informant: both

observer: so you would have the liberty of moving back and forth

interviewer: what do you look for in a wife?

observer: knowledge does he have, what background

interviewer: and personality

informant: hard working , and working hard in managing my kids and family

observer: so she is not a working women

informant: i still want my wife working while managing my kids

interviewer: what will she do

informant thinking

interviewer: would you like her to an chemical engineer

informant : no

interviewer + observer: why?

informant: i want us to have different jobs

Interviewer: what is you were an English teacher and she was a chemical engineer?

Informant: i don't want her to be an chemical engineer. teacher is better

Interviewer: is teacher better for a women?

informant: if my teacher doesn't know how to read-she can teach then

observer: can an chemical engineer not teach your children how to read

informant. id it is about science i will teach them science

interviewer: i will like to know a little about your knowledge and relation to the forest. Does you family use the natural environment to fish or hunt or gather plants

informant: only my grandparents, they hunt (monitor lizard, squirrel, fish)

interviewer: would you know how to hunt

informant: no

interviewer: do you feel it is important to know

informant: not important, maybe more as a hobby in my free time

interviewer: do you think the forest is important?

informant: of course!

interviewer: why

informant: creates more oxygen, which is good for the health.

interviewer: anything else?

informant: other than that you can get food from the forest

interviewer: what about in terms of adat?

observer: just a minute. you mentioned it was good for oxygen- here there is a secondary forest close to oil palm plantations , and they are also trees- is there a difference for you

informant: no difference it is the same

observer: sp if we change the forest to a plantation it is just the same

informant: it is just the same

interviewer: in terms of oxygen for the health. but would there be any other differences not just in term of oxygen.

informant: it is also a shelter from the rain and the sun

interviewer: how about for your grandparents- is it more important for them

informant: my grandfather still spends his sunday until 10 pm hunting

observer: but if we change the forest to a plantation now, will that affect you grandfather, or will he still go and hunt in the plantation?

informant: it is no problem because there is more forest

interviewer: have you or your family experienced any changes in the environment

informant: there have been water pollution

interviewer: how do you feel about that

informant: disappointment

interviewer: why

informant: because we use the place to get food but can't do that no more

interviewer: who are you disappointed at?

informant: the corporates

observer: like who

Informant: the excavator

observer: why did the excavate the river

informant: because they wanted to plant crop

interviewer: when your parents make decision about you land, do they involve you

informant: no - because i have no place in this decision making

interviewer: when you take over the land, will you give all the land to a plantation if it was profitable

informant: i want to do my own oil palm. if i have not enough money i can sell the oil palm to the TA factory

interviewer: just make sure you understood the premise. if you get good money, even more money than your own plantation, would you give your land to plantations

informant: no- because like my grandfather i will never lent my land to company- there is a case where my grandfather got exploited from a company.

interviewer: but if you don't lent out your land and you don't know how to farm, who will teach you?

informant: i have my brother take care of it

interviewer: so will you brother not take an education or live in the city

informant: i hope he will

observer: is he more interested in the farm?

informant: he loves to farm and farming- i don't in the same way

Appendix 13 – Semi-structured interview: JKK

The conducted interview was recorded, but because we have not had the time to transcribe it, and have not used the interview in our report, this appendix does not contain information on the interview.

Appendix 14 + 15 - Focus group 1 + 2: young

Focus group discussion became more of a group interview because they participants were really shy.

Focus Group 1	Focus Group 2
Facilitator: Atussa Observer: Astella Translator: Audrey Participants: 2 boys, 3 girls 2 Engkatak, 3 Trusan 1.Eva 2.Marylia 3.Claudia 4.Erieson 5.Douglash 6.Atussa	Facilitator: Dharshini Observer: Emil Translator: Bob Participants: 3 boys, 2 girls 3 Engkatak, 2 Trusan

Question 1:

- Write down what ever you think of when you see the word?

Focus Group 1	Focus Group 2
Culture 1. Referring to the identity of people 2. Referring to something that is 'old ways' 3. Old traditional rule. (6. All of you have mentioned that it is something that should be kept and not changed. But is that the case?) Some adat has been modified to make it easier because it is time consuming or complicated. 4. Iban Miring, offering to God, passed on true time. Hold on, should not be changed or modified. 5. Culture, Gawai festival, Iban tradition. Important not to forget Incorporated in ceremonies Common explanation of a adat event "A villager dreamt of ancestor asking to clean up cemetery, crocodile worship performed before going to graveyard. All Krangan Villages gathered. Bringing together the different communities"	A set of rules that must be followed by each individuals in their lives The most important thing Its our origin past down from generations "No adat, no life" Following the adat will help realise their dreams It must not be forgotten by the coming generation Must know it in order to not break the rules Parents teach them the adat because it is different from one family to the next (mixed families, mixed adat) The current generation is more concerned about technology and modernisation

<p>6. Is it also for Adat festivities that you meet friends or family who you seldom see- because they maybe live in the city. Answer; yes, because it is expected for all to participate.</p> <p>Open question to all: 6. You mention the Gawai festival alot when talking about the Adat. Is it only there you practice adat? Is it only that only time of the year? <i>Answer:</i> it is especially at Gawai but it is not the only time, it can be at weddings, when we go to explore or take use of new land- there are also a ritual</p>	
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Question 2:

- Where do you see yourself in 10 years?
 - Please write down the location, occupation and what you need to make you happy.

Focus Group 1	Focus Group 2
<p>1. living in the city because it is more modern, to be a doctor to be able to treat own parents when they are sick, would like to live in a comfortable house with family and is able to take care of family (buy house and car for family, give parents money); will be in the village if she could be still be a doctor because she wanted to have a different lifestyle than others.</p> <p>2. Live in the city (lives in city now and comes back on weekends with parents) prefers village life but lives in city for job opportunities, to be a teacher, being able to help parents</p> <p>3. Live in city and come back in the weekends because family has land she has to take care of and parents have planned for all siblings to have other lives but also return to the village to take care of land (going back and forth between city and village is depending on where her parents are) - since she was given house and land she always has to keep it, always has to be</p>	<p>D: Kuching as a mechanic and has his own workshop # in the village as a farmer because he has his own land and will open a mechanic workshop in the village</p> <p>C: Sarawak as assistant manager in plantation management and agrotech to help increase Sarawak's economy and farmer's income and she will be really happy if she be this and have her own oil palm plantation #in the village as a farmer planting pepper, oil palm and rubber to increase personal income</p> <p>Sh: West Malaysia as a chef because she loves cooking(her mum has taught her) and will be really have her own money without depending on anyone else #in the village, already a restaurant owner who stays at home and have kids who also want to be chefs and to see them happy</p> <p>J: Kuching as a chef and will be happy to open</p>

that way, electrical engineering, friendship and family because these are the people you can rely on during bad times also knowledge, money

4. city (peninsular) or abroad because it is more secure and stable in the city, an English teacher to educate future generations and develop in every kinds of ways, parents have paid for his education and it will make him happy to repay them, a comfortable life with true friendships, improved life standards and family, buy a car, have a wife

5. city or abroad, in the forces such as police, army , friendship and family,

6. You have all written that in 10 years would like to have a job in the city. Would non of you want to be a farmer

3. I would want to have dual job. I can see myself as a farmer but not full time

4. I would like to spend my free time in the village, but main time/occupation in the city.I would want to be a farmer, but not full time. I want to go to the city and experience other peoples lifestyle, and feel the modern surroundings.

1. When I retire as a doctor i would like to be a full time farmer

2. I would also like to be a full time farmer when i retire

5. The military gives opportunities t travel abroad. I can see myself as a farmer but not full time

6. Is it because you don't want to be a full time farmer , or is it because you want to follow the other professions you have mentioned more than being a farmer.

own restaurant and create own recipe
#in a village as a farmer but keeps both jobs

**St: Kuching for more experience as a chef and he'd be happy to achieve his goal
want to be in the village

**a copy cat answer

#30 yrs

- "see the world before I get old"
- cannot enjoy during village life
- learn more about other countries while living in the city
- can learn new skills

<p>3. My future job is much more stable, that is why. When you are in a big family such as mine, my parents have assigned the land to me and my siblings to take care of. They have taught us that you will do this in the future.</p> <p>1. I want to be a doctor more</p> <p>2. I want to be a teacher more</p> <p>4. Job as a teacher is more important</p> <p>5. Job in the military more important</p> <p>All agreed that parents tell them this is their future, tells them what their life path is</p>	
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Question 3:

- How is city life?

Focus Group 1	Focus Group 2
<p>5. Easier to get a job in the city, access to medical treatments. A lot of different organization that offers jobs. Medical facilities are closer.</p> <p>4. easier to get a job in the city, I want to adapt, and learn about different cultures present in the city. Visit each other during other groups festive season, be present and see. Experience's new ways of life</p> <p>3. It is more modern. Noisy, close to industrial areas, crowded because of modernity and the era. Poor waste management systems.</p>	<ul style="list-style-type: none"> - in the city I can go anywhere, have more freedom - have more friends - more peaceful in the city because of "dogs barking, i can't sleep" (argument that its better to live in village) - high cost of living - difficult to find a job due to high competition (a personal experience) - one person did not have any idea what city life was (he was 14)

<p>2. Much more comfortable, easy to get a job, access to public facilities- more job offerings</p> <p>1. More comfortable. Very busy people, they are not concerned with people around them. They are more concerned with their own life. Hospitals are near. I like that people in the city are easy and not concerned with other peoples life. I don't care about what others do.</p> <p>(6. Is that opposite kampong life?</p> <p>1. Yes, you have more privacy in the city, hear everybody keeps an eye on you.</p> <p>6. Can you others recognize what she is saying, is it like that in the village?</p> <p>All: yes, it is like that always!</p>	
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Question 4:

- How is village life?

Focus Group 1	Focus Group 2
<p>6. No facilities, poor connection, poor access to water and electricity Are there any positive things you can think of?</p> <p>5. it is more peaceful, easier to do revision at night or read a book)</p> <p>4. Meet friends and family, but the medical service not as good as in the city</p> <p>3. It is a easy going lifestyle, not stressful, you can do what you like</p> <p>2. I can see my grand parents and be close to friends and others.</p> <p>1. People around d you helps you a lot, but there is no privacy.</p> <p>Peaceful:</p> <ul style="list-style-type: none"> - easy going lifestyle - happy living here - people here help each other - people always interfere in other people's business 	<ul style="list-style-type: none"> - its a good life - fresh air - lots of friends - free of crime (no crime in the village) - easy food source; plant tapioca for food and collect any jungle produce - cooler in the village - peaceful and bond with villagers - comfortable (despite barking dogs) - pollution-free <p>#in future:</p> <ul style="list-style-type: none"> - more developed with tap water supply, instead of from GFS feed - have restaurants in the village - start a fish farm, cow farm - open a small convenience store - have better farming methods

<ul style="list-style-type: none"> - creates a strong bond - easy life because relatives live nearby - lifestyle is difficult because no facilities such as tap water, internet access - poverty is high - can celebrate with friends and family everyday - difficult to get medical care 	
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Question 5:

- What was the biggest decision you have made in your life?

Focus Group 1	Focus Group 2
<p>1. I have been following what my parents have decided . (6. Have you never made a big decision yourself?)</p> <p>1. I would never disobey my parentd. That would make them frustrated.)</p> <p>2. The same as eva(nr1) (6.how about when you have to choose differnt subjects in school?)</p> <p>2.I would ask my parents first)</p> <p>3. I had to choose my university and what courses I had to follow. (6. How did you do that?)</p> <p>3.I looked at my grades and what opportunities i had.</p> <p>6. Other than what would be available, what guided you in your decision?</p> <p>3. There are some subjects i love)</p> <p>4. I let my parents decide, because they platy an important role in my decison making. And I also consult my family in choosing subjects for school.</p> <p>5. The same with me. If my family don't want me to go abroad I will no move</p>	<ul style="list-style-type: none"> - deciding when and who to get married; difficult to find a girl who can accept his weakness - where and what to work as - in a school environment - weather to study a course offered by the university - on if to go back to school or keep working (been away from school for too long) - if to stay in school because exams are really difficult

Question 6:

- Who do you normally go to make a difficult decision?

Focus Group 1	Focus Group 2
<p>1. My parents, they know more, therefor it is best to listen to them</p> <p>2. The same as Eva (nr.1)</p> <p>3. My friends and family</p> <p>4. Consult my family</p> <p>5. Uncle, ants, close relatives</p> <p>-----</p> <p>6. If by some reason your family or parents weren't available- would you feel yo would know how to make decisions for yourself?</p> <p>5. I would go to my friends for advice</p> <p>3. If there is no one to consult i would make a pros and con list</p> <p>4. I would chose what would benefit me more</p> <p>2. I would think deeply about it and then make a decision</p>	<ul style="list-style-type: none"> - ask God because have most faith in God - parents - teachers - friends - tend to follow advice of parents over friends - tend to follow advice of friends as they are older than me

Appendix 16 (version 1) – Focus group: Farmers

“The hardship of being a farmer”, 10/3-16

Facilitators (F): Sofia and Tine.

Observer: Julie

Participants:

- Mr. Medley:
 - He has 2h paddy. His father taught him how to grow paddy.
 - Smallholder oil palm
 - SALCRA he will inherit from father
 - Pepper
- Mrs. Jenni:
 - Paddy 2h
 - She cannot grow oil palm as her land is too swampy
- Felicia:
 - 4,9h oil palm smallholder
 - 1,5 acre pepper
- Derrik:
 - 1h hill paddy, 2h swamp paddy
 - Oil palm JVC 3 years. Hasn't produced yet

F: Do you feel like you have the possibility to provide food for your family and eat when you're hungry? (challenges of farmer life)

- You have to work to eat. If you work, you can eat. (everyone agrees on this point)

Challenges:

- The field can be far away, and it can take time to get there. (accessibility)
- If it is raining, they cannot go to harvest. If it goes on for a long time, the paddy over-matures.
- They also can't dry the paddy if it's raining.
- Pepper: the pesticides and fertilizers are too expensive.
- The pesticides for oil palm is also too expensive. It doesn't get subsidized.

Solutions:

- Look for alternative incomes. For example, harvesting and selling timber from the forest, and other forest produce.
- “We know how to live day by day, but we can not save for the future”
- As long as you work hard...
- Diversifying income is a solution. One of the women receives money from her husband that lives in Kuching. (remittances)
- They also help each other with the work. For example, with motorcycle transportation if the field is far away.
- When they can't afford the pesticides, a solution is to slash the weed manually. In the older days they had no agrochemicals. The produce was less, now it is far more. They can harvest twice.

F: So why can't you depend just on the fertility on the land (like in the older days) any longer?

Since there is a limited amount of land they have to plant paddy the same place every year which leads to bad fertility. So they need fertilizer.

Before they used shifting cultivation (they can't do that anymore due to land scarcity). Now that they can stay (due to fertilizer), it's easier.

Challenge:

- Land availability is limited.

Solution:

- Renting land that is close to here. But then of course she has to pay some rent.

The forest food source:

- They get ferns, bamboo shoots, medical plants. They go there every day to harvest! But it is supplementary food, not the primary food. The primary, stable food is paddy. Felicia: "It is not because of income problems, but because it's a part of who we are" it's tradition to fish and hunt. (They don't desperately depend on it, but they harvest it because it's a part of their way of life).

Scarcity solution:

- They will plant the forest species by themselves around the house, if they get scarce or is the forest is transformed. So the plants don't extinct.
- The government provide courses in planting ferns and mushrooms.

Challenge:

- Fish availability. The fish stocks are decreasing. It's due to some people fishing with poison, they don't have the patience to fish the regular way. They put poison in the water and the fish turns up dead and are easy to collect. The farmer group wouldn't eat those fish because of the poison, but the people doing it does eat them.

Solution:

- You can make your own pond and put fish in to breed.

F: Can you choose yourself, which crop you want to grow?

- Yes. If there's a surplus product, they sell it. They are selling a bit to each other.
- They choose the crop they want because it's easy.
- "Everything is money". The one who work will get this. In this generation we need money all the time. The adat sharing system is fading out. When the sharing culture comes to an end, it will be just about money. In the older days they could share their produce more. Now they need to charge money for them. A few ringets.
- Mr. Medley knows how to get bamboo shoots from the forest, so he sells them. The others don't know.

F: Can you get the money you want for your crops?

- Yes.
- A "recycle system" with money and food. They make money, they eat, make money, eat. If there's a little surplus in money, they invest in food, for example kitchen equipment.

Challenge:

- Market prices are affecting their lives, when prices decrease.

Solution:

- They have to cut down on all expenses. Food, needs. They only buy basic food and money for kids education, like school books (they can't compromise on that).

F: do you feel secure in your land tenure ship?

- They feel secure even without title. But it is a premise that people respect their NCR rights. "No challenges, hopefully it will stay that way."

F: was tenureship a part of the reason for doing SALCRA?

- Mr. Medley: yes, a big part of it

F: Do you have the possibility to contact/access the government if you want? (democracy/decision-making)

- Yes, we have phones to call them.
- Before they got electricity, the village was more quiet. Less activity, darker. The kids couldn't study in the evening.

F: What would be the ideal farm for you? If you could dream of any farm, regardless the size and cost.

- Paddy is the best. Without paddy they would die.
- Observation: they don't really understand the question. That they're supposed to imagine a dream farm. They are pretty content with what they have. When pushed a little, they finally answer:
- Mr. Medley: Rubber is the best. First he says that he doesn't know how to plant rubber, but than he realizes that he has a rubber field, and that he learned how to manage and cultivate it by himself and by talking to the others.
- Jenni: Watermelon would be the best. But she can't afford the pesticides and herbicides. Budget problem.
- Derrik: pepper plantation. But she doesn't have a specific stick that she needs for it, it's expensive.
- Felicia: Vegetables. But they need love and care/attention. Now she needs to direct her love to her children. When they're older, she'll grow vegetables.

F: Do you feel like there is something you can do to change your situation (the challenges)?

- It's both. Solving and adapting. If the problem is small we solve, if the problem is big, we adapt.
- Problems with price of herbicides: she can only adapt.

F: Do you have the possibility to grow any crop you want after SALCRA, if your contract comes to an end?

- Felicia: No problem. Because I will not use the plant for crops, I will use it for animals.
- Jenni: Yes problem. The soil has lost its nutrients.
- Medley: I will start a pig farm! (now they are actually imagining dream scenarios)
- They also suggest a fish pond as an alternative solution to crops.
- They all know that the palm oil has sucked out the nutrient of the soil, and that it isn't fertile anymore. They only found out after they started the contract, by talking to other villagers about it, some with experience from other communities, and also by observing that the fruits are fewer and that not even weeds will grow there.

F: What if you really really wanted to grow crops there? How would you claim your right to your soil fertility?

- There is no way! The soil is dead (?)
- We would have to apply Dolomite. Neutralizes the pH value, which is now too acidic.

Appendix 16 (version 2) – Focus group: Farmers

Facilitators: Sofia, Tine

Interpreter: Jane

Observer: Julie

Participants (already mentioned in version 1)

Notes:

Mr. Medley: learned to farm paddy from his father. 2 ha of land. Palm oil smallholder. His father has SALCRA.

Ms. Jinny: grows paddy, only 2 ha. cannot do any oil palm because of the swamp.

Ms. Phylissia: Palm oil smallholder. Pepper 1,5 acre. 4.9 ha. Take over SALCRA phase 1 from her father

Ms. Durik: Paddy. Hill + swamp (1 ha + 2 ha). Palm oil JCV (new 3 years).

Ability/possibility to provide buy/grow food to feed your family?

- “if you want to get something to eat, you have to work for it” – saying in Iban
- challenges: far from the field – have to go up early in the morning
- weather: raining → cannot harvest → then paddy over mature. Cannot dry the paddy.
- For pepper: cannot buy the pesticides, so weed grow. Herbicides and pesticides are expensive.

Solutions?

- selling the timber in the forest → income
- Palm oil dividend + pepper → diversification (on purpose)
- can live day by day – but cannot save money
- after 3 days of rain, Jinny brings 2 persons to help her (paid work)
- if cannot buy pesticides → slash and collect → burn → making the insects go away – this was the way before pesticides became available
- fertilizer: use money from palm oil dividend to buy fertilizer
- fertilizer for paddy are given for free (only has to pay for the transport)
- Paddy before the fertilizer → productivity less. now: high production, so they don't have to buy excess rice for consumption
- problem for paddy: grasshoppers
- in the old days, they only depend on the land fertility
- SALCRA use no shifting
- limited land. → have to plant rice at the same plot year over and over again → have to apply fertilizer to make this happen
- less labour needed now: because they don't have to go far to new fields – road access. before more labour were needed for walking, carrying and weeding (modernized agriculture, red.)
- they are helping each other. they can use motorcycles.
- limited land. renting land close to her.
- forest products: every day they go to the forest to collect ferns, bamboo, medical plants, collect food → not because of money problems, but part of how they life (adat).
- hunting, fishing.
- they call the forest the “supermarket”

Problems with no forest in the future?

- We will plant these products ourselves, so they will not be extinct
- the government run courses that learn people how to plant ferns and mushrooms
- some plants can only grow in the wild

..how does this go with limited land availability?

- plant around the house if no forest

Fish?

- fish availability is decreasing. some people are using the “bad” way of fishing: poisoning the river so that the fish will die. this is faster than fishing “manually”. Only these people dare to also eat the fish.
- Basket to trap the fish
- Privat ponds → breeding/cultivate fish

Can you choose yourself which crops you want to grow?

- Yes

Why have you chosen the crops you grow?

- “the easy way”
- everything is about money. this is the generation where we need money all the time. Sharing tradition (adat) is declining → because everybody needs the money for themselves
- each of them sell the things that the others don’t know how to get (specialization, red.)

Do you feel like you can get the right money from the crops?

- Yes
- The marked price is a question for pepper
- marked price affect their life – income low, if prices low

Solutions?

- Cutting everything down (eating, needs, only basic food: coffee, tea, salt, pepper, milo).
- no new clothes
- money for education “it’s a must”. education is a priority. “there is no excuse”.

Land tenure security

- they feel secure, even though they don’t have a title
- they rely on the respect to the land tenureship (adat)
- “hopefully it will stay that way”
- waiting for the government to give titles for the smallholder and salcra palm oil plantations
- the title is a big reason why Mr. Medley chose to grow palm oil

Infrastructure

- good infrastructure, because they were given the road
- electricity for three years only
- before electricity, less activity in the village. Gasoline for the generator, oil lamp was used. Not good that the village is so quiet. Hard for the people to study. Now better life.

Ideal farming system?

- paddy is the best

- they agree on paddy. important to eat.
- “paddy is the most important”
- “it’s not the same without paddy”
- rubber, doesn’t need a big capacity
- without fertilizer and pesticides it is hard to grow watermelon
- Phylissia: love is needed to grow vegetables. but now she has to direct all her love to her children.
- Joking about wanting cattle (all laughs)

Ability to change the situation if there is any obstacles?

- solving and adapting
- if the problem is small enough, she can solve, if it is bigger, she has to adapt (Jinny)

If collaboration with SALCRA comes to an end?

- no problem – Phylissia
- “problem to grow another crop, because the land has lost its fertility” – Durik
- Phylissia has no constraints, because she is planning on opening an animal farm – no specific demands on the soil.
- Mr. Medley want to open a big farm
- the soil has lost the nutrients, not fertile
- they knew before? only after starting the scheme. they know from observation and sharing information
- Mr. Medley: they have a lot of alternatives: fish ponds, etc.
- before salcra, the soil quality was good
- “from what we observed, even weeds don’t want to grow on the land” (talking about salcra)
- “the fruit is smaller” – than it should be
- “the soil has expired” – jinny

If you should plant anything after SALCRA – what then?

- “no such thing”
- Dolomite – to neutralize the acid soil (given by the government)
- apply it already to other land uses (pepper, paddy)
- 1-3 months with dolomite → then soil ready for cultivation or until the weed has grown
- she tried applying to a pond until weed begin to grow (experience)

Final quote:

Jinny: “today you are interviewing us. In ten year our kids will come to Denmark to interview you”.

Appendix 17 – Overview of sampled fields (soil data base for fields)

Field 1 – Palm oil S/H – old (17y), Mr. Samat

Cropping history:

- 2016-2002 only oil palm (high level of management)
- 2002-1999 oil palm and hill paddy (medium level of management)
- 1999-1948 rubber (no management)
- Before 1948 jungle

Perception of soil: Soil fertility has declined since oil palm production started.

Comments from soil sampling: Noticeable topography, chicken manure left in bags for every three palms.

Moss on the ground + small weeds. Mites. Ground cover extensive 7m x 3m x 0.30m (lxbxh).

Soil profile: ½-1 cm O-horizon, 5 cm A horizon (dark brown), B-horizon from 6 cm and below (golden, light brown). Earthworms, insects

Field 2 – Palm oil SALCRA – old (18y), Albert

Cropping history:

- 2016-1998: oil palm (SALCRA phase 1)
- 1998-1992: pepper (high fertilizer input)
- 1992-1980+: rubber (no management)

Perception of soil: before salcra: good, now: less fertile because of the fertilizer and pesticides

Comments from soil sampling: Lots of vegetation, weeds and banana palm, messy and no system for old leaves. Terraces generally. R1 just below 1 terrace (below road). R3B: 2 earthworms, R3D: Many small ants.

Generally: Wet moss where no vegetation. R1B: More red soil. Small black ball said to be fertilizer (Albert).

Soil profile: 7 cm A-horizon (very loamy and moist), B horizon lighter/light brown, more sandy than Mr. Samat, mixet with a little red.

Field 3 – Palm oil SALCRA – young (7y), Alim

Cropping history (general):

- 2016-2009: oil palm (SALCRA phase 4)
- 2009-some years back: pepper
- many years back: rubber (no management)

Perception of soil: Before: medium, too wet. Now: Less good, because of palm oil.

Comments from soil sampling: High variation throughout the plantation. Less stones than the first localization that we wanted to sample from (not possible because of flooding). Samples cannot be said to represent the whole plantation. R1C high content of organic material.

Soil profile:

Terrace 1: 2-3cm A-horizon, B-horizon light brown (darker than F1). No insects, small amount of roots.

Terrace 2: A-horizon non-existing. B horizon more red.

Field 4 – Palm oil S/H – young (8y), Linga

Cropping history:

- 2016-2008: oil palm
- 2008-2006: hill paddy
- 2006-many years back: rubber

Perception of soil: In the past still good soil quality, and still good.

Comments from soil sampling: Moss, structured old palm leaves, mange roots in the soil. Little red soil.

Leaves from rubber threes also present. Variation in the size of the trees → we don't know the exact age of

the trees. Nuts from unknown plant also present on the ground close to replication 3. Charcoal in many of the samples from replicate 1-2, first we tried to avoid it, but that was not possible (we can see from the results, that there is no obvious difference between replicate 1-2 and 3 in terms of charcoal). Charcoal was characteristic for the soil – mainly the topsoil (upper 10 cm).

Soil profiles:

Soil profile 1 (where replicate 3 is from): Compacted soil. No obvious horizons. Very uniform.

Soil profile 2 (where replicate 2 is from): 7-8cm A-horizon slightly darker, B-horizon lighter

Field 5 – Pepper – young (6 years)

Cropping history:

- 2016-2010: Pepper (medium to high level of management)
- 2010-2008: Hill paddy (no management)
- 2008-many years back: Rubber (no management)

Perception of soil: Before: good. Now: bad/poor. Because the soil is getting compacted. The land is exposed to the rain and sun – no more trees to protect.

Comments from soil sampling: Applied herbicides to weeks ago → many dead/bleached weeds. 2 m distance btw pepper plants. Charcoal present from slash and burn. Sampling between 4 pepper plants. Not many insects, one worm.

Soil profile:

Soil profile 1: 10cm A-horizon dark, B-horizon light brown

Soil profile 2: 8-9cm A-horizon dark, B-horizon light brown

Field 6 – Rubber – old (30+) abandoned, 6 years

Cropping history:

- 2016-2010: field abandoned, no management, no clearance
- 2010-1980+: rubber, cleared when planting (slash and burn), stop tapping in 2010
- many years back: hill paddy

Perception of soil: soil quality don't change (→ has not changed?)

Comments from soil sampling: Thick layer of dead organic material partly decomposed. Many roots, especially from rubber. Charcoal also present.

Soil profile:

Soil profile 1: 2-4cm O-horizon, 5-6 A-horizon, B-horizon yellow/light brown (COLOUR?)

From the sampling: high variation in terms of when the B-horizon starts (also high variation in samples).

A-horizon for some samples more greyish than dark brown or black

Field 7 – Primary forest – untouched

Cropping history: Primary forest always, small amount of illegal logging

Perception of soil: same soil type as the other fields, but high amount of humus in the top soil.

Comments from soil sampling: Must remove a lot of organic material to get to the O-horizon. Difficult to distinguish clearly between the two layers. 5-10cm organic material. Fungus present on the surface of some material. Many roots in different sizes. Upper soil less compact → actually getting more than 20 cm in depth → might underestimate percentage of organic material. One sign of illegal logging.

Soil profile:

Soil profile 1: 5-10cm O-horizon humus soil, a gradual transition to the A-horizon

Soil profile 2: 2-5 cm O-horizon, 10 cm darker A-horizon, then B-horizon (difficult to distinguish).

Appendix 18 – Soil data

	Explanation	Pox-C (M/L)	Pox-C (mg/kg)	pH	N (%)	C (%)	C:N ratio
F1.R1	Oil Palm old S/H 17y	0.018	180	4.87	0.11	1.38	12.5312
F1.R2		0.018	180	4.74	0.11	1.39	12.8005
F1.R3		0.018	180	5.05	0.12	1.4	11.6548
F2.R1	Oil Palm old SALCRA 18y	0.017	270	5.00	0.12	1.35	10.9605
F2.R2		0.017	270	4.83	0.13	1.35	10.0944
F2.R3		0.015	450	5.14	0.14	1.42	10.2532
F3.R1	Oil Palm young SALCRA 7y	0.018	180	5.43	0.1	1.08	11.2112
F3.R2		0.017	270	5.14	0.14	1.44	9.9715
F3.R3		0.017	270	5.21	0.15	1.48	10.1704
F4.R1	Oil Palm young S/H 8y	0.016	360	4.76	0.16	1.81	11.1974
F4.R2		0.018	180	4.91	0.17	1.48	8.8478
F4.R3		0.017	270	5.20	0.19	1.72	9.2692
F5.R1	Pepper young 6y	0.009	990	4.41	0.26	3.49	13.6286
F5.R2		0.010	900	4.70	0.32	3.75	11.7881
F5.R3		0.010	900	4.89	0.26	3.33	12.9746
F6.R1	Rubber old 30y + 6y aband.	0.011	810	4.80	0.25	3.27	13.3669
F6.R2		0.014	540	4.47	0.17	2.14	12.3595
F6.R3		0.011	810	4.61	0.23	2.77	11.9857
F7.R1	Primary forest	0.006	1260	4.33	0.33	4.06	12.319
F7.R2		0.007	1170	4.59	0.36	3.94	11.1182
F7.R3		0.007	1170	4.19	0.33	3.78	11.7022

Appendix 19 – Significance tables for Pox-C, pH, total C, total N and C:N ratio

ns = not significant, p-value > 0.05

* = Significant, p-value < 0.05

** = Significant, p-value < 0.01

*** = Significant, p-value < 0.001

**** = Significant, p-value < 0.0001

Significance table – Pox-C

t-test Pox-C	P.O. S/H Y	P.O. S/H O	P.O. SALCRA Y	P.O. SALCRA O	PEPPER S/H Y	RUBBER S/H O	PRI. FOREST
P.O. S/H Y		ns	ns	ns	**	*	***
P.O. S/H O			ns	ns	**	*	***
P.O. SALCRA Y				ns	****	*	****
P.O. SALCRA O					**	*	**
Pepper S/H Y						ns	**
Rubber S/H O							*
Primary forest							

Significance table – pH

t-test pH	P.O. S/H Y	P.O. S/H O	P.O. SALCRA Y	P.O. SALCRA O	PEPPER S/H Y	RUBBER S/H O	PRI. FOREST
P.O. S/H Y		ns	ns	ns	ns	ns	*
P.O. S/H O			*	ns	ns	ns	*
P.O. SALCRA Y				ns	*	**	**
P.O. SALCRA O					ns	ns	*
Pepper S/H Y						ns	ns
Rubber S/H O							ns
Primary forest							

Significance table – Total C (%)

t-test C (%)	P.O. S/H Y	P.O. S/H O	P.O. SALCRA Y	P.O. SALCRA O	PEPPER S/H Y	RUBBER S/H O	PRI. FOREST
P.O. S/H Y		ns	ns	ns	***	ns	****
P.O. S/H O			ns	ns	**	ns	***
P.O. SALCRA Y				ns	***	*	***
P.O. SALCRA O					**	ns	***
Pepper S/H Y						ns	ns
Rubber S/H O							ns
Primary forest							

Significance table – Total N (%)

t-test N (%)	P.O. S/H Y	P.O. S/H O	P.O. SALCRA Y	P.O. SALCRA O	PEPPER S/H Y	RUBBER S/H O	PRI. FOREST
P.O. S/H Y		*	ns	*	*	ns	***
P.O. S/H O			ns	ns	*	*	***
P.O. SALCRA Y				ns	**	*	***
P.O. SALCRA O					*	ns	***
Pepper S/H Y						ns	ns
Rubber S/H O							*
Primary forest							

Significance table – C:N ratio

t-test C:N ratio	P.O. S/H Y	P.O. S/H O	P.O. SALCRA Y	P.O. SALCRA O	PEPPER S/H Y	RUBBER S/H O	PRI. FOREST
P.O. S/H Y		ns	ns	ns	*	*	ns
P.O. S/H O			*	*	ns	ns	ns
P.O. SALCRA Y				ns	*	*	ns
P.O. SALCRA O					*	*	*
Pepper S/H Y						ns	ns
Rubber S/H O							ns
Primary forest							

Appendix 21 – Forest diversity index

Secondary Forest Divesity Index (Kragan)

Local name	Species Name	No. of Individ	Porportion	Diversity
Medang putih	<i>Actinodapne myriantha</i>	1	0,007874016	-0,0381432
Semepak	<i>Adinandra dumosa</i>	1	0,007874016	-0,0381432
Pucuk malau	<i>Agrostistachys borneansis</i>	2	0,015748031	-0,0653707
Jadam	<i>Alangium sp.</i>	2	0,015748031	-0,0653707
Tampoi hutan	<i>Baccaurea sp.</i>	1	0,007874016	-0,0381432
Angkung	<i>Calophyllum macrocarpum</i>	1	0,007874016	-0,0381432
Bintangor	<i>Calophyllum sp.</i>	1	0,007874016	-0,0381432
Kedondong hutan	<i>Canarium sp.</i>	1	0,007874016	-0,0381432
Resak Batu	<i>Cotylelobium sp.</i>	1	0,007874016	-0,0381432
Geronggang	<i>Cratoxirum maingayi</i>	1	0,007874016	-0,0381432
Kayu Malam	<i>Diospyros ebena</i>	1	0,007874016	-0,0381432
KerANJI	<i>Drium indum</i>	1	0,007874016	-0,0381432
Kapur	<i>Dryobalanops baccari</i>	15	0,118110236	-0,2522996
Isu kampung	<i>Durio kutejensis</i>	1	0,007874016	-0,0381432
Songoh	<i>Elaecartus nitudus</i>	1	0,007874016	-0,0381432
Pensi	<i>Elaecartus stipularis</i>	1	0,007874016	-0,0381432
Kandis	<i>Garcinia parvifolia</i>	3	0,023622047	-0,0884781
Medang kasap	<i>Gironniera nervosa</i>	12	0,094488189	-0,2229241
Menyam	<i>Gloichidion sp.</i>	15	0,118110236	-0,2522996
Kumpang merah	<i>Horsfidia sp.</i>	2	0,015748031	-0,0653707
Kerdam	<i>Ilex hypoleleuca</i>	2	0,015748031	-0,0653707
Empenit daun besar	<i>Lithocarpus andersonii</i>	2	0,015748031	-0,0653707
Keraki	<i>Lithocarpus pulcher</i>	10	0,078740157	-0,2001261
Medang paya	<i>Litsea grandis</i>	4	0,031496063	-0,10891
Tibures	<i>Litsea gricillepes</i>	1	0,007874016	-0,0381432
Nyatuh ketiau	<i>Madhuca oblongifolia</i>	1	0,007874016	-0,0381432
Rengas	<i>Melanhoerea sp.</i>	2	0,015748031	-0,0653707
Kumpang	<i>Myristica sp.</i>	2	0,015748031	-0,0653707
Nyatuh rian	<i>Palaquium gutta</i>	1	0,007874016	-0,0381432
Nyatuh	<i>Palaquium sp.</i>	1	0,007874016	-0,0381432
Ngilas	<i>Parastemon sp.</i>	1	0,007874016	-0,0381432
Nyatuh bukit	<i>Peyana sp.</i>	1	0,007874016	-0,0381432
Kasai	<i>Pometia sp.</i>	1	0,007874016	-0,0381432
Seladah	<i>Santiria rubignosa</i>	3	0,023622047	-0,0884781
Bawang hutan	<i>Scorodocarpus borneensis</i>	1	0,007874016	-0,0381432
Meranti merah	<i>Shorea beccariana</i>	1	0,007874016	-0,0381432
Meranti padang	<i>Shorea ovata</i>	3	0,023622047	-0,0884781
Meranti lop	<i>Shorea scabrada</i>	4	0,031496063	-0,10891
Semburok	<i>Stemonurus sp.</i>	3	0,023622047	-0,0884781
Ubah	<i>Syzygium havilandii</i>	3	0,023622047	-0,0884781
Ubah putih	<i>Syzygium pabiflora</i>	1	0,007874016	-0,0381432
Ubah	<i>Syzygium sp.</i>	4	0,031496063	-0,10891
Ubah	<i>Syzygium zeylanica</i>	7	0,05511811	-0,1597475
Resak Tebal	<i>Vatica coricea</i>	3	0,023622047	-0,0884781
Ako	<i>Xylopa ferruginea</i>	1	0,007874016	-0,0381432
		127		1 -3,3180279

Appendix 22 – Informal interview with K.T headman about soil

In general the soil are considered pretty good in the Krangan area.

Sandy soil in one end of SALCRA. Based on experience from hill paddy.

Flood in November, December, January, and February.

Sacred place: jungle with a ghost history at the hill between SALCRA phase 1 and SALCRA phase 4.

Headman worked for SALCRA before.

- Does management affect soil quality?
 - *Answer:* Fertilizer needs to be applied to the plant → affect only crops, not soil.
- Is the soil now better, the same or worse than before SALCRA?
 - *Answer:* First: Same – little different. Crop is the same if you give fertilizer.
 - *Answer:* Then: There is a big difference: palm takes all the nutrients. “*Oil palm kills the land*” – headman K.T.
 - *Answer:* Future: have to cultivate the land even though soil is dying.

Cover crop to soil recover. Grows “over the land” (crawls?) and the root will attract nutrients.

The soil will need 3-4 years to recover. Has experience from Miri (other area) – also after oil palm.

Apply pesticides to the roots of the palm → only a couple of weeks will be needed to remove the roots and then soil will be ready for new crops.

Pesticides does not affect the soil.

When they re-do the oil palm, they level the land with a tractor. Pepper and hill rice and palm oil need terraces. They (SALCRA) also made these on the SALCRA field.

Appendix 23 – Protocol of the soil analysis

Total C and N

Approx. 60 mg of oven-dried soil was mixed with same amount of stone (da: tungsten) and total C and N was measured by Isotope-Ratio Mass Spectrometry (IR-MS) at Department of Plant and Environmental Science.

pH in water

Measurement of pH in a 1:2.5 soil:water solution

1. Weigh 10.0 g of soil in a 50 mL Falcon tube
2. Add 25 mL of milliQ water
3. Shake for 20 minutes
4. Leave for 30 minutes – for the sediment to settle
5. Calibrate the pH meter using the pH 4 and pH 7 buffer solutions (See manual)
6. Clean the electrode with milliQ water between each measurement. Collect the liquid in a glass.

When all samples have been measured the Falcon tubes (with content) and the milliQ water in the glass are collected in a plastic bag.

Permanganate Oxidizable Carbon

Determines how much Carbon is oxidized in a solution of 0.02 M KMnO_4 in 0.1 M CaCl_2 at pH 7.2 by the bleaching of the purple KMnO_4 solution by a handheld spectrometer. The method is based on Weil et al. (2003).

Equipment

Permanganate reagent: 0.2 M KMnO_4 in 0.1 M CaCl_2 at pH 7.2

A glass beaker for the KMnO_4 solution

2 l glass bottles for Milli Q water

25 ml graduated cylinder

Milli Q water

1-5 ml pipette + tips

200-1000 μl pipette + tips

Racks for 50 ml Falcon tubes

Plastic flasks for Milli Q water

Plastic pipettes

Spectrometer

50 ml Falcon tubes

Plastic container for waste

Preparation of stock solution of KMnO_4 (0.2M in 0.1M CaCl_2 at pH 7.2)

1. Weigh 147 g $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ and add to a 1000 ml flask half filled with Milli Q water. Shake. Fill the flask to the 1000 ml mark with Milli Q water

2. Weigh 31,608 g of KMnO_4 and add to a 2l glass beaker that is filled with half of the 1 M CaCl_2 solution. Shake. Fill the same beaker now with almost all of the remaining 1M CaCl_2 solution; leaving about 10%. Adjust pH to 7.2 using NaOH or HCl while stirring. Add 1 M CaCl_2 to the 2l mark and shake. Transfer solution to a capped bottle wrapped in aluminum foil. **Store bottle in the dark.**

Preparations of Standards (0.005, 0.01, 0.02)

Add 1.25 ml (0.005M), 2.5 ml (0.01M) and 5.0 ml (0.02M) of the 0.2M KMnO_4 stock solution to centrifuge tubes and dilute to the 50 ml mark with Milli Q water. These are to be used to calibrate either the handheld spectrometer or lab spectrometer (which will give more precise readings).

Analysis

1. Weigh 2.5 g of crushed soil to 5 Falcon tubes (5 is easiest to handle at a time).
2. Add 18 ml of Milli Q water to each tube and then 2 ml of the permanganate reagent.
3. Shake for 2 minutes.
4. Leave the Falcon tubes to settle for 10 minutes with the lids off.
5. Label 5 new Falcon Tubes for subsampling and add 19 ml of Milli Q water (equal to a 20 fold dilution) – These are the solutions that you will use for measuring KMnO_4 concentrations.
6. When the samples have settled for 10 minutes use an electronic pipette to transfer 1.00 ml of the supernatant to the tubes with 19 ml of Milli Q water
7. Pour about 10 ml of the diluted solutions into the spectrometer glass vial (to the mark). Put on the cap, measure and note the reading. Measure the 5 samples as fast as possible.

*It is very important to maintain consistent procedural timing (pre-shaking, shaking and settling). This means that once you have added the KMnO_4 , you have to be very strict with the time control. Overall consistency in the procedure (i.e. soil moisture content, degree of crushing, etc.) will ensure comparable results.

Waste handling

Pour the permanganate solution into a plastic container and use a plastic bottle to get most of the soil out of the Falcon tubes and into the plastic container. The 'almost empty' Falcon tubes can be disposed of in the normal waste bins. Use a permanent marker to label the plastic container 'O1' + ' KMnO_4 Waste'

Calculation

The bleaching of the purple KMnO_4 (reduction in absorbance) is proportional to the amount of oxidizable C in the soil; the greater the colour loss, the lower the absorbance reading meaning the greater the amount of oxidizable C in the soil. To estimate the amount of oxidized C it is assumed that 1 mol MnO_4^- is consumed (reduced from Mn^{7+} to Mn^{4+}) in the oxidation of 0.75 mol (9000 mg) of C.

$$\text{MnOxC (mg/kg)} = [0.02 \text{ mol/l} - (a \text{ mol/l})] * (9000 \text{ mg C/mol}) * (0.02 \text{ l solution} / 0.002 \text{ kg soil})$$

0.02 mol/l is the initial solution concentration

'a' is the concentration measured in the supernatant

9000 mg is mg C oxidized by 1 mol of MnO_4^-

0.02 l is the volume of KMnO_4 solution reacted

0.025 kg is the weight of the soil being used

Appendix 24 – Methodology behind soil sampling

We wanted to investigate the soil in order to answer how different agricultural management, especially the transition from swidden cultivation to oil palm plantations, are affecting soil fertility and subsequently enable us to discuss the implications for future livelihood flexibility. Using the space-for-time substitution approach, we rely on the assumption that the soil status has been the same prior to the differentiation of management. In order to insure this, we held a PRA session (app. 3) with farmers to 1) reveal perceptions and map good, medium and poor soil, 2) reveal the common management (fertilizer and pesticide use, soil preparation, drainage, organic input, etc.) for different crops, 3) locate fields of the prevalent cash crops, i.e. oil palm, pepper and rubber and 4) discuss the land use history for fields with different years under cultivation. Subsequently, we made interviews with landowners of several palm oil, rubber and pepper fields to insure similar cropping history and corresponding management. Common to all fields (except for the primary forest) sampled was several decades of rubber plantations after clearance of the “jungle” (forest). Except for the abandoned rubber field, the remaining fields was then followed by some years of cash crop cultivation (typically pepper or hill paddy), which for fields except for the pepper field was then replaced by oil palm (app. 17)

The actual soil sampling was carried out with use of a soil auger with a depth of 20 cm. As we did not know the common boundary between the A and B-horizon, we chose the full length of the auger. We chose the soil auger over the volume specific rings to be able to account for infra field variations in matter which could influence the fertility analysis. We do also acknowledge some drawbacks from this choice: as relying on a soil core rather than volume specific sampling, we are not able to assess the soil on a volumetric scale. Also, different soil parts correspond to different densities. For instance the lower-density O-horizon high in organic matter, which is extensive in the primary forest (app. 17) might have been underestimated during the sampling due to compression and hence an actually deeper sample than the chosen 20 cm. In terms of representativeness, the whole field was sampled for smallholder plantations, whereas this was not possible for the 1000+ ha SALCRA plantations. Here, we chose fields with the common cropping history for the area.

Samples were taken between the palms in the rows without extensive ground cover of leaves (fig. x.x). We made three replicates from each site based on topography (replicate 1 from the highest elevation) and each replicate was made up by five composite samples, which was gently mixed and used for a subsample which was air-dried a couple of days before taken home to University of Copenhagen for further analysis.

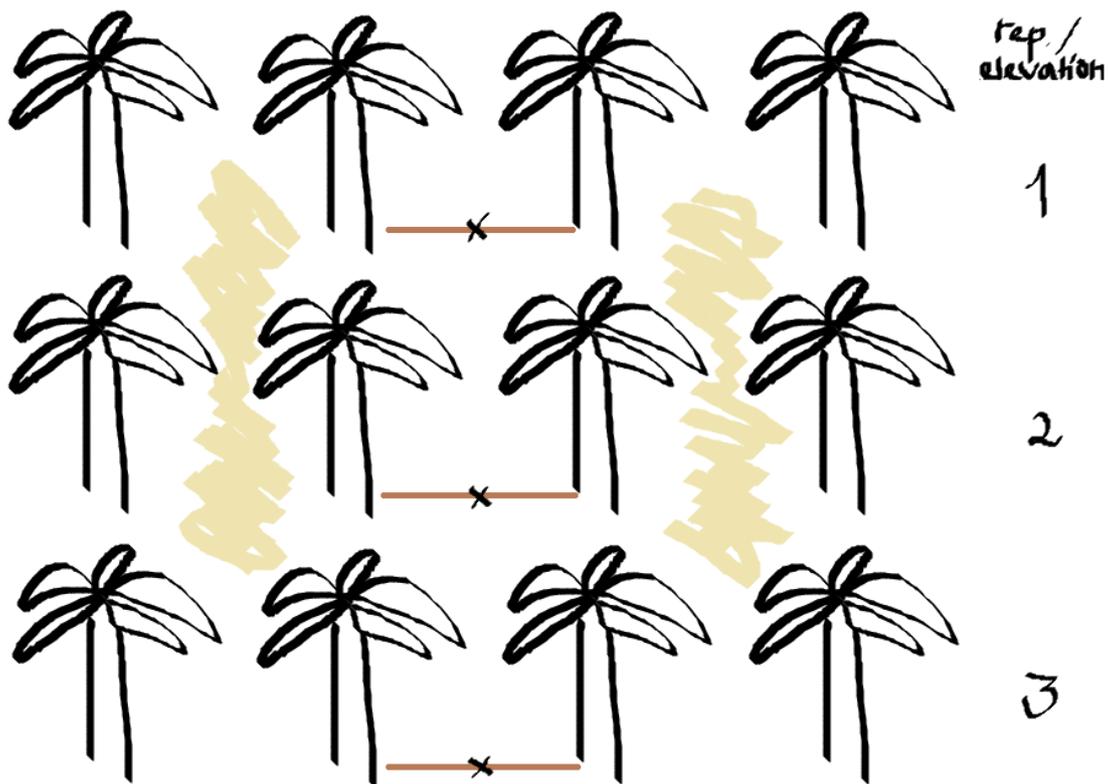


Fig. x.x. Simplified example of sampling strategy. Sampling was done between palms in rows without ground cover. Replicate 1 came from the highest elevation and vice versa.

With support from the Department of Plant- and Environmental science, University of Copenhagen, samples was dried at 65°C for 24 hours before grinded subsampled for analysis of permanganate oxidizable carbon (Pox-C), pH, total C and N. Detailed protocols can be found in (app. 23). Data were analysed by t-tests using the statistical tool R (R-3.1.2), where differences were set to be significant at a p -value of 0.05.

Somehow, it was not possible for us to extract the GPS-files from the 105 composite samplings (5 for each 3 replicates times 7 fields). We are in position of the files and can be shared by request (in the case of anyone else wanting to analyse the soil samples we brought home).

Appendix 25 – Elaboration of applied methods

	Advantages	Disadvantages	Implications for report
Baseline survey	Quantitative representation of the households. Assessment of prevalent themes for other methods. Opportunity to present ourselves. Made later PRA and SSI situations more comfortable.	Whole household was often present (noisy, distracting, might affect answers). Answers stated differently by different household members.	Not used to extract statistical correlations or significance. Indicated relevant themes for later field study. Used in group discussion to make arguments guiding the study forward.
Transect walk	Provided insight to aspects of surrounding areas. Use of GPS gave parameter to localise the size of the village, and general orientation of the village. We got introduced to land uses in the area.	Many participants joined - both group members and villagers. Lack of translator to such big groups.	Overview of land uses in the villages. Different crops identified, used as an introduction to the area. Might have missed certain aspects.
PRA-session	Knowledge from farmers only access to know/understand their practices. Ranking exercise shows us what actors/crops and more are essential. Negotiations during ranking/scoring relevant information.	Affected by social roles within the group of farmers. Some participant more dominating and others passive. Social roles and/or manners challenged new or opposite answers to be stated. Conversation and negotiations: context dependent, different participant/facilitators different knowledge.	Ranking and the conversation leading up to relevant to understand and say something about the ranking. Different PRA sessions not used to compare.
Focus group	The participants taking the lead. Participants relating to other participants' statements opening up for relevant discussions, which only can be accessed in their internal discussion. Indicator of group consensus of individual arguments.	Need of a translator made it challenging to get the conversation flowing. +(Social roles/shyness).	Intended focus group had elements of group interviews- hard to get conversation flowing. Young people FG structured by writing answers down on paper first- prevent adjusting answers to the group.
Semi-structured interviews	In depth data. The informant got the opportunity lead conversation in new directions. Unfold and	Hard to assess the general application of individual statements.	Points from SSI's used with triangulation from rest of data. Used to nuance arguments, that needs explanations.

	nuance the informants perceptions.		
Unstructured interviews	Free-flowing and unstructured talk, cover topics from interesting points made in other interviews. Creates relationships.	Could demand interviewer and informant to have achieved a relationship.	The informal talks were used to further explaining topics in need of elaboration.
Land use history questionnaires	Explaining how the land has been cultivated (crops and management) over the last 30 years for specific plots. Helped identify fields for soil sampling.	Challenge to assess the type and amount of agrochemical application due to lacking knowledge or different ways of expressing amounts. Challenge to reveal management many years back in time as farmers cannot always recall or as the fields have been management by other members of the family.	The soil analysis is based on the space-for-time substitution assumption relying on similar cropping history, why incorrect history will influence conclusions drawn from the analysis.
Soil sampling	The soil sampling was done in order to assess the soil fertility of different fields with the same cropping history but with current different land use and management. Soil fertility parameters analysed was: pH, pox-C, total C and N, and C:N ratio.	Due to choice of sampling equipment (soil auger), it was not possible to assess the fertility based on volume specific means or account for differences in soil horizons between the sampled fields. For the large plantations, it was not possible to sample the whole field, why results might not be representative to the whole field.	Soil analysis made it possible for us to assess the soil fertility status of different land uses and hence the sustainability of different cropping systems, although some measures might be either over- or underestimated due to differences in compactness.
Ethnobotanical studies	Gave an overview of the natural resources present in the forest. Helped to understand how villagers use different species.	The study did not indicate how much they used it in their everyday life, or how dependent they were on it.	Used to show the dependency of the forest. By triangulating different methods, it posed as an argument to this dependency.
Informal talks	Free-flowing and relaxed talk, cover topics not thought of in the beginning. Creates relationships.	Could demand interviewer and informant to have achieved a relationship.	Could demand interviewer and informant to have achieved a relationship.

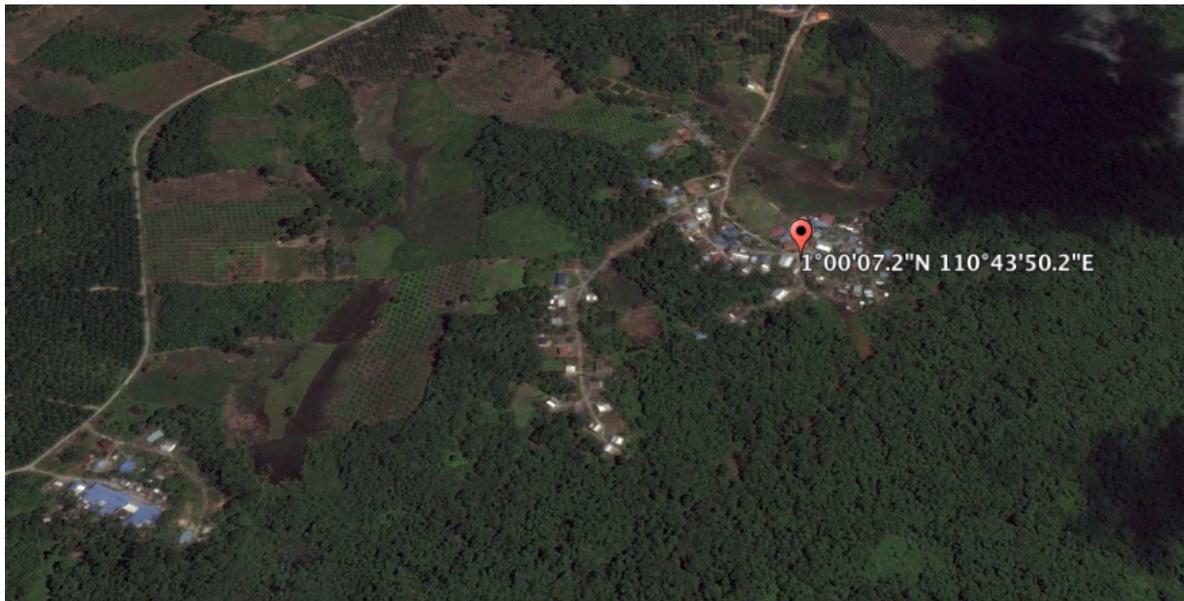
Appendix 26: Table of applied methods

Questionnaires	18
Transect walks	2
PRA-sessions	4
Focus groups	3
Semi-structured interviews	7
Unstructured interviews	2
Soil sampling	21
Land use history questionnaires	10
Ethnobotany studies	2
Informal talks	Throughout

Final Synopsis

Key factors influencing current livelihood strategies in Krangan Trusan

- And the role of land development schemes



Thematic course: Interdisciplinary Land Use and Natural Resource Management (ILUNRM/SLUSE)

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1. Introduction

In Sarawak, Malaysia, shifting cultivation has been the traditional and primary type of agriculture for local farmers. However, during recent decades, palm oil plantations have rapidly expanded at the expense of tropical primary and secondary forest and fields for subsistence farming or other cash crop cultivation (mainly pepper or rubber) (Tanaka et al. 2014). The development of the palm oil industry is driven by an increasing global demand for both edible oils, especially from the developing world, and bio-fuels to meet goals for “sustainable” energy use in the developed world (Sanders et al. 2014).

Sarawak’s legislation and customary laws on land and forests directly affect the status of the Native Customary Right (NCR). Today, the legislation that controls the boundaries of NCR is the *Sarawak Land Code 1958* (Forests Monitor, 2006). Through the Land Classification Ordinance (1948) different areas were defined: Mixed Zone Land, Native Area Land, Native Customary Land, Government Reserves and Interior Land (Bulan, 2006). These different divisions could be assumed to have an impact on land use changes (especially concerning local development schemes) as well as on livelihood strategies. The governmental development plans for Sarawak encourage palm oil production expansion through schemes as SALCRA (Sarawak Land Consolidation and Rehabilitation Authority) and facilitating foreign investment. The main objective of the state government agency SALCRA is to improve the overall well-being of the rural communities through development of lands for plantation agriculture, by converting idle native land (often NCR-land) into productive agriculture land (oil palm plantations), which to a large extent is present in and around Krangan Trusan. This aims to enhance rural development, poverty eradication and the creation of employment opportunities to improve living standards (SALCRA, 2012).

The small village of Krangan Trusan (46 households), 95 km south-east of Kuching in the Serian region, has experienced major land use transitions since 1995 when almost all households in the village decided to lease part of their land to SALCRA (village description). Supposedly within five years, the villagers of Krangan Trusan have to decide whether they will continue or terminate their contract with SALCRA. A large set of factors (i.e. cash income, land availability, food security, (agri)cultural tradition, biophysical resources, crop flexibility and global market

prices) could potentially influence this specific choice as part of the local villagers' overall livelihood strategies. Likewise, it is most likely that had it not been for the palm oil production, the land would be used for other cash crop production with potentially similar cropping intensity. This could be further highlighted as Sarawak has been absorbed in the global commodity production and trade market. In order to emphasize both *local perceptions* of terms as “quality of life”, “sustainability” and “development”, and the *local reality* in a globalized setting, comparisons will to a larger extent be focused on the sustainability of prevailing cash cropping systems, rather than the declining forest area.

As past, present and future decision-making by the local villagers has influenced and will continue to influence land use changes, our objective goes:

We will assess the key factors influencing current livelihood strategies in Krangan Trusan, and how these interlink with socio-economic and environmental impacts of land development schemes in the area.

Research questions:

- What are the key factors influencing current livelihood strategies?
- What are the impacts of the implemented land development schemes concerned with oil palm production in the area?
- How does different land uses and changes in these, influence livelihood flexibility?

In a course such as SLUSE, where a group consists of students with different academic and national backgrounds, a learning goal is how to make a synergy between group members. In that process we treat each other with respect and sincere curiosity on different academic and personal perspectives on our topic. Through mail correspondence with our Malaysian counterparts it has been apparent that they contribute with knowledge which is crucial for our understanding of our case. We have had an enlightening discussion on the research objective and the related methods leading to very similar aims of the study.

In the following sections we will elaborate on our research questions in terms of what we want to investigate, and how we are going to do it methodologically by different types of triangulation (investigator, discipline and methodological triangulation). Prior to this, we will define the scientific theoretical frame of our project work.

2. Actor-network theory

Actor-network theory will guide our overall research framework. Shortly, ANT gives importance to the associations between actors and the specific network they are a part of. The focus of the analysis is neither the actor nor the network, but the interrelation of the two. The two cannot be understood separately as they constitute each other. Furthermore an actor is not only understood as a human actor. Non-humans such as environment, technology and institutions are all of importance in an analysis and are considered as actors. ANT actually ‘forces’ us to be attentive to factors in livelihood strategies that relates to social and natural science, and applies no distinction between the two sciences and their relevance in understanding a given phenomenon. Furthermore, ANT will make it easier for us at a later state to compare our analysis of micro actors (households) to macro actors (SALCRA), as the fundamental understanding of a micro and macro actor is the same (Latour, 2005). All of this and more will be elaborated in the final paper.

3. Research question: What are the key factors influencing current livelihood strategies?

To examine the livelihood strategies and understand factors that affect people’s choices (Chambers & Conway, 1992), the Sustainable Livelihood Framework will be used. The framework will help us identify how and why villagers choose between different livelihood strategies, as well as how different land use changes affect the livelihood flexibility.

Our survey will give an overview of the village demographic and what livelihood strategies are currently present among the villagers (appendix 7, Survey). In terms of sampling strategies, we will give each household a number and randomly select a sample size of 20 households. If we have time we will strive to get around to all 46 households in the village. The surveys will be

conducted in the beginning of our fieldwork as a means to get around and meet the villagers. As mentioned our research questions are broad because we want the villagers' experience and knowledge to be incorporated in our assessment of key factors influencing their current livelihood strategies. This also influences the structure of our survey as we mostly ask open-ended questions. After the questionnaires have been answered we will be able to triangulate key factors in cooperation with other data collected. As the questionnaire includes open-ended questions, relatively few questions that need lengthier explanations, and space for the interviewer to note down relevant information not specifically asked for, the questionnaire has elements of a semi-structured interview. All of the information we gather through the survey will be relevant in pointing us towards relevant questions to ask in a more in-depth interview or in PRA sessions.

In order to investigate the key factors influencing the villagers' choice of livelihood strategy, it is imperative that we also collect data that represent the local villagers' point of view as much as possible, and thus the use of Participatory Rural Appraisal (PRA) methods becomes a helpful tool. Different PRA mapping exercises, and especially ranking and scoring exercises, are relevant for our research project due to their applicability in terms of analyzing difference, unequal relationships, and prioritization (Mikkelsen, 2005). Through a PRA-meeting with 4-6 heads of households, we hope to have them draw sociograms (see appendix 1) or a Venn diagram (Mikkelsen, 2005:92), which will give us the given informants' view of different relevant actors that have an influence on their decision-making process in relation to choice of livelihood strategies. We also plan to do different ranking and scoring exercises with local farmers in order to get their view of the relevant income sources, land uses and ways of prioritizing cash crops, for instance through the use of livelihood matrices (see appendix 2). Furthermore, we hope to have a focus group with other members of the households, which will focus on their understandings of "quality of life", allowing us to investigate the key factors influencing their thoughts about preferred livelihood strategies, and why they choose some instead of others.

4. Research question: What are the impacts of the implemented land development schemes concerned with oil palm production in the area?

According to the village description, almost all the villagers are leasing out land to these schemes. Therefore we find it crucial to investigate how these schemes are affecting the villagers' livelihood, in terms of how they perceive the schemes and the changes they have brought about, ranging from economic to socio-cultural aspects. This includes analyzing the political structures of the tenureship, the income structures of the villagers with a focus on the amount of compensation from the schemes, as well as the labour migration patterns. The research question further involves analyzing the socio-cultural aspects of the implementation of the oil palm schemes in terms of how the villagers describe their relation to SALCRA and JVC, what their reasons are for renting out their lands, and whether they intend to do it again by the end of the lease. Another possible impact of the scheme is on the cultural identity of the community. Traditionally being a farming society, we want to investigate if and how it is affecting them that they are no longer managing their own soils to the same degree.

These questions we will investigate by a set of different methods, primarily PRA methods, semi-structured interviews (appendix 6) and our survey. We will use soil sampling methods as well, and take samples from the plantation fields to compare with a sample from a field that resembles the one of the prior-SALCRA field. This is the space-for-time substitution (appendix 9). The survey can provide a quantitative set of data that can help us identify economic impacts of the development schemes such as tenureship, depending on their answers to our open ended questions. The survey will also help us find key informants to interview and go on walkabouts with, as we will have an overview over the different households' land uses.

We will make use of walkabouts in order to investigate the villagers' perception of the changes brought about by the implementation of the schemes, since this method can be a fruitful way of quickly getting an overview of the different relationships the villagers have to the local environment (Strang, 2010:132). We hope to do walkabouts with local farmers, potentially having them take photos of and explain the importance of different places of interest, marking these with GPS for future analysis. This also generates more concrete data of the farmers' view of the different impacts of land use changes, since we will be able to ask questions related to

specific areas rather than simply interviewing in general terms. Throughout these exercises we aim to utilize the method of participant observation, since the way in which the locals interact with us and each other can be just as rich and relevant data as drawn maps or answers given in interviews.

5. Research question: How does different land uses and changes in these influence livelihood flexibility?

Land use transitions and different land use management have implications for natural resources in terms of land availability and soil quality, and we suspect that changes in these over time will affect livelihood flexibility. With inspiration from the vulnerability conceptual framework known from field of climate change, we define a household's flexibility as the adaptive capacity, i.e. the ability to adjust successfully to change (e.g. price fluctuations or labour availability) (IPPC 2007). We acknowledge that choosing to continue or terminate the contract with SALCRA can potentially influence the household's flexibility in both a positive and a negative manner. Extending the presence of SALCRA palm oil on a field inherently limits flexibility during the given time frame (25+ years), while the cash compensation could be invested in education of the younger generation and thereby open up for another type of flexibility due to change in human capital with reference to the sustainable livelihood framework. On the other hand, if the farmers leave the scheme, their natural capital might be affected in terms of soil quality. This would have impacts for both the potential crop yield and the possibility to change between crops, as there would be restrictions to this if soil fertility has declined significantly. We thereby also plan to focus on the years following this choice, hence future flexibility.

The processes of land use management affecting soil quality will be examined by use of methods from both social and natural science. We will initially identify the prevailing land uses and the changes in these, which we will obtain information on through the survey and PRA community mapping. This community mapping involves different exercises, which will create an overview of land use history as well as future potential land uses. We aim to have village elders make a land use timeline, identifying the different land uses that have been applied through time. Land availability will be assessed through the revealed division of the individual household's

allocation of land (SALCRA palm oil, cash crop production, subsistence farming) from the baseline survey. Also, information about “hungry-periods” in different households will be used to assess local food security.

Furthermore, we plan to bring printed maps of the area and have the local farmers make a soil quality map, pointing out the fertility of different areas and associated land uses, which will be used for our soil samplings. First of all, we will ask the farmers to identify the criterias for a “good” and a “poor” soil and subsequently score the fields with 1-3 bullets according to poor (1), medium (2) or good (3) soil. This information will make it possible for the field team to make a note of specific patterns and elaborate on the subsequent soil sampling strategy, as we assume that the farmers are partly right. A soon-to-be published article by Thilde Bech Bruun (UCPH) shows significant correlation between farmers’ perception of the soil quality and what has been measured through soil sampling.

Soil samples will be obtained from different land use types in order to investigate the soil organic matter content as a representative of soil quality related to different land uses. These will - if possible - be SALCRA palm oil plantations, smallholder palm oil plantations, rubber plantations, and secondary forest. The underlying assumptions are that smallholder plantations might be managed differently (less intensive, less use of agrochemicals) than the large-scale plantations. By investigating the soil under rubber production we will gain information about another cash crop system, keeping in mind that these plantations might not have been intensively cultivated due to low market prices. Samples will be taken from the secondary forests in order establish a baseline and to address carbon emissions from the soil pool associated with deforestation and hence potential contribution of land use changes to climate changes. Results from the land use history will reveal information on whether SALCRA palm oil plantations primarily substitute secondary forested areas, extensively cultivated subsistence farming for annual crops or intensively cultivated fields for cash crops – or a mix of all. Moreover, farmers’ perception of soil in the PRA mapping session will reveal if there is a pattern in perceptions of the soil quality of the fields that have been leased out.

For detailed elaboration on the soil sampling, see appendix 9. The soil test will generate data regarding the active carbon fraction within the soil, changes in which has proven to be an early indicator of changes in land use management (for the detailed test protocol, see appendix 4). GPS coordinates will be noted as to produce geo-referenced data.

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7. Appendix

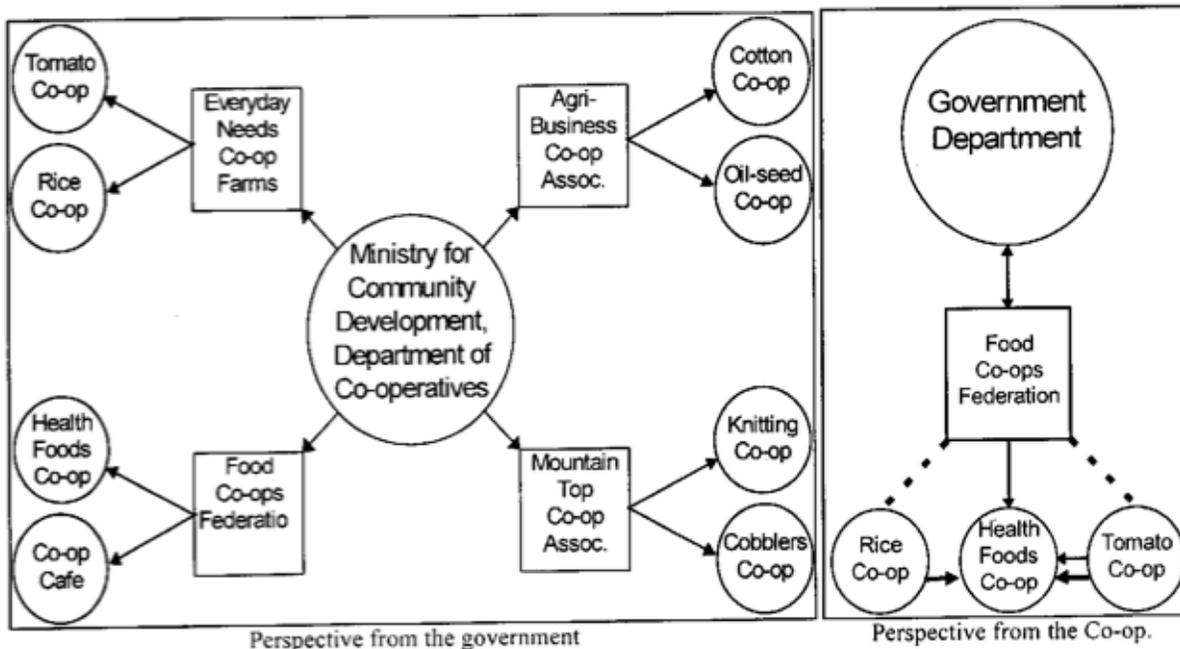
Appendix 1: Sociograms – A PRA Exercise

Background

Sociograms are a visual way of showing how different people or institutions relate to one another. The physical position and size of an organisation may indicate its importance, and lines between organisations their connections. A series of sociograms can be used to examine the perspectives of different subgroups and to understand changes over time and locality.

Example

An association of co-operatives might consist of local co-operatives, regional or activity based groupings and a government department. Different individuals may view the same 'structure' differently, and have various opinions about the lines of communication:



The above diagrams indicate that the government department has information about the whole structure, and sees itself as central and holding greatest power, as indicated by the circle size. The arrows indicate all information originates from the centre and is disseminated outwards. In contrast the Health Foods Co-operative sees itself at the bottom of a pyramid structure. It has indicated only a few other co-operatives, some of which it has shown direct linkages with, showing flow of trade as well as information. Although it shows a two-way flow of information from the government to the regional level, it indicates all other communications to be one-way, towards itself.

Summary

1. Identify people who know and who are willing to share their knowledge.
2. Collectively choose a suitable place and medium: The ground or a floor, and sticks, stones, leaves or chalks; or paper, and pencils, coloured pens.
3. Help people get started by brainstorming for different individual organisations, but **let them do it**.
4. Encourage corrections and additions, for example adding arrow heads onto the lines, or suggesting the possibility of different types of line and box.
5. Record a permanent copy on paper, including the participants' names. Don't forget to note any explanations of the use of different symbols. These may have been discussed but not included on the diagram.
6. It is vital to make notes regarding the process: Who held control or influence? Were there any major changes made to the diagram? Who made them and why? Was there consensus or disagreement? Regarding which points?

Appendix 2: Livelihood Matrices – A PRA Exercise

This is a systematic way of looking at what people need, and where they get it from. It has been used in Nepal to measure the impact of a community forestry project, by comparing the situation now with that five years ago (before the project) and fifteen years ago (before major land reform). It could be done by a group, to get a rough-and-ready consensus, or by individuals from different backgrounds.

Example

Question asked: "Where do you get your from?, Where did you get it from 5 years ago?". For each item, 10 points are allocated over the list of sources.

Time Period (years ago)	Food		Fuel		Building timber		Income / Employment		Farming Tools		Animal fodder		Medicines	
	0	5	0	5	0	5	0	5	0	5	0	5	0	5
Private land	5	7	1	0	1	0	7	8					4	4
Sharecropping, labour	4	2					3	2						
Salary, shop or pension														
State Forest				6	9	9			9	9	9	9	3	4
Other forest			6	4		1			1	1	1	1	1	1
Purchase		1	3										1	1
Steal	1													
Charity													1	
Total	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Method

1. It is particularly important with this exercise that the issue is something people know about from first-hand experience. Information will be misleading if you ask others to imagine what they would do in a particular situation.
2. Copy the outline of the matrix onto flip-chart paper, big enough to write different scores in the same boxes, for different scenarios.
3. Use the same layout for all types of people / scenarios. Agree collectively (maybe by trial and error, or piloting the exercise) on the sources (in the first column) and items (in the first row) which are applicable to the issue.
4. Work down each column, so in the example, ask about all the places food comes from before moving on to fuel. At the end of each column, check the scores add up to 10.
5. Try to carry out each scenario as a group, by consensus. If you fail to reach a consensus, note down why.
6. If you choose to do the exercise individually, keep notes about why the respondent has changed their activities or sources of livelihood over the period.
7. Use different colour pens to score different scenarios.

Appendix 3: Soil colour (McGarry n.d., p. 21)**C 4. Soil colour**

Soil colour indicates many important soil properties.

First and foremost soil colour provides much information on the source material(s) of the soil and the climatic/human factors that have altered the original rocks and sediments to give the current soil condition.

Secondly, soil colour is a strong indicator of current soil water (or aeration) status. Generally, bright colours, and reds and oranges in particular, show good soil aeration and drainage (the iron in the soil is in the ferrous (oxidised) state). Dull and grey colours show reduced aeration and a tendency for low-oxygen status and waterlogging. The dull grey/black colours in a waterlogged soil often occur as mottles, ie a secondary colour within the main soil colour.

Thirdly, soil colour may reflect the organic matter status of the soil, particularly useful when comparing the topsoils of long term cropping land with treelines and fencelines. Generally, the darker the soil the greater the organic matter content.

How do I measure the soil colour?

1. Take a lump of soil from the layer/horizon to be described. Break the lump to expose a fresh face (Fig. 8).
2. If the soil is dry moisten the face by adding water drop by drop.
3. Wait for the water to seep into the soil.
4. Now name the soil colour, eg red, brown, grey, black, white, etc
5. If a soil has more than one colour. Record a maximum of two and indicate (1) the main (dominant) colour and the (2) secondary colour.
6. *If available*, match the soil with a chip on the Munsell Soil Colour Chart. Record the Soil as: Hue/Value/Chroma value and the name of the colour.

Appendix 4: Determination of permanganate oxidizable carbon (Bruun, 2014)**Preparation of stock solution of KMnO_4 (0.2 M in 0.1 M CaCl_2 at pH 7.2**

1 M CaCl_2 : Weigh 147 g of $\text{CaCl}_2 \cdot 2 \text{H}_2\text{O}$ and add to a 1000 ml flask half filled with milli Q water. Add milli Q water to the mark and shake.

0.2 M KMnO_4 in 1 M CaCl_2 at pH 7.2: Weigh 31,608 g of KMnO_4 and add to a 2 l glass beaker that is half filled with 1 M CaCl_2 and shake. Fill the beaker 90% with 1 M CaCl_2 . Adjust pH to 7.2 using NaOH. Add 1 M CaCl_2 to the mark and shake. Transfer the solution to a blue cap bottle wrapped in aluminium foil. **Store the bottle in the dark.**

The above solution is ready and found in the fridge in the soil lab.

Equipment

A glass beaker for the KMnO_4 solution (Glassware room - Section 2)

2 l glass bottles for Milli Q water (Glassware room - Section 2)

25 ml graduated cylinder (Glassware room - Section 2)

Milli Q water (R 342 – Section 2 – or in R338 Section 2)

1-5 ml pipette + tips (Soil lab)

200-1000 μl pipette + tips (Soil lab)

Racks for 50 ml Falcon tubes (Soil lab)

Plastic flasks for Milli Q water (Soil lab)

Plastic pipettes (Soil lab)

0.2 M KMnO_4 solution (Fridge in soil lab)

Spectrometer (One of your closets)

50 ml Falcon tubes (Teknikrum – if not available in the lab)

Plastic container for waste (Svalegang – if not available in the lab)

Preparation of standards (0.005, 0.01 and 0.02)

Add 1.25 ml, 2.5 ml and 5.0 ml of the 0.2 M KMnO_4 stock solution to Falcon tubes and dilute to the 50 ml mark with milli Q water – These can be stored in the fridge and be kept for one week.

- **0.005 Standard:** Add 1 ml of the solution with 1.25 ml KMnO_4 to a Falcon tube and add 19 ml of milli Q water (equal to a 20 fold dilution)
- **0.01 Standard:** Add 1 ml of the solution with 2.5 ml KMnO_4 to a Falcon tube and add 19 ml of milli Q water (equal to a 20 fold dilution)
- **0.02 Standard:** Add 1 ml of the solution with 5.0 ml KMnO_4 to a Falcon tube and add 19 ml of milli Q water (equal to a 20 fold dilution)

Use the standards to test if the spectrometer measures correctly otherwise use the standards to re-calibrate it using the somewhat obscure manual (the calibration procedure is highlighted in the manual).

Analysis

1. Weigh 2.5 g of crushed soil to 8 Falcon tubes.
 2. Add 18 ml of milli Q water to each tube and then 2 ml of the permanganate reagent.
 3. Shake for 2 minutes.
 4. Leave to settle for 10 minutes.
 5. Label 8 new Falcon Tubes for subsampling and add 19 ml of Mili Q water (equal to a 20 fold dilution) – These are the solutions that you will use for measuring KMnO_4 concentrations.
 6. When the samples have settled for 10 minutes use an electronic pipette to transfer 1.00 ml of the supernatant to the tubes with 19 ml of Mili Q water
 7. Pour about 10 ml of the diluted solutions into the spectrometer glass vial (to the mark). Put on the cap, measure and note the reading. Measure the 8 samples as fast as possible.
- *It is very important to maintain consistent procedural timing (pre-shaking, shaking and settling). This means that once you have added the KMnO_4 you have to very strict with the time control.

Waste handling

Pour the permanganate solution into a plastic container and use a plastic bottle to get most of the soil out of the Falcon tubes and into the plastic container. The 'almost empty' Falcon tubes can be disposed of in the normal waste bins. Use a permanent marker to label the plastic container 'O1' + Thilde Bech Bruun.

Practical info

The pipettes are supposed to be in the soil lab but if they are not there try to look in some of the other labs. However, do **NOT** remove anything from the 'Isotope Lab'. The equipment in that lab is slightly radioactive and is not allowed outside the Isotope lab.

If you accidentally push the blue button on the spectrometer then put a vial with Milli Q water in it and push the blue button again – then the spectrometer will reset at a correct 0 value. However, check the calibration using one of the standards if this happens.

Calculation

The bleaching of the purple KMnO_4 (reduction in absorbance) is proportional to the amount of oxidizable C in the soil (the greater the colour loss the lower the absorbance reading) the greater the amount of oxidizable C in the soil. To estimate the amount of oxidized C it is assumed that 1 mol MnO_4 is consumed (reduced from Mn^{7+} to Mn^{4+}) in the oxidation of 0.75 mol (9000 mg) of C.

$$\text{MnoxC (mg/kg)} = [0.02 \text{ mol/l} - (a+b * \text{absorbance})] * (9000\text{mg C/mol}) * (0.02 \text{ l solution}/0,002 \text{ kg soil})$$

0.02 mol/l is the initial solution concentration

a is the intercept of the standard curve

b is the slope of the standard curve

9000 mg is mg C oxidized by 1 mol of MnO_4

0.02 is the volume of KMnO_4 solution reacted

0.02 kg is the weight of the soil being used

Appendix 5: If we have time and resources

If we have the time and resources, we would like to conduct a biodiversity assessment by investigate how different land use systems support biodiversity in terms of habitat constitution, measures by the species richness (total number of species) of vascular plants. Subsequent we will calculate the Shannon index (Shannon's index 'gives more importance' to less common categories). Three subplots (3x3 m) from the three identified land use types (SALCRA palm oil, private palm oil or rubber) will be chosen from random sampling.

Appendix 6: Interviewguide – semi-structured interview with key informants

The Headman

Personal:

- What is your name?
- How old are you?
- Do you have family?
- How long have you lived in the village?

Village structure:

- What is your job in the village?
- How long have you been headman?
- What are your responsibilities as headman?
- What is the organisational structure of the village?
- How do you take decisions in the village?

Village life:

- How is life in the village?
- How are people earning an income in the village?
- Is it changing?
- How is the relation between the old and the young generation?
- How do people cope with ...

Agriculture:

- How are people managing their land in the village?
- Are people cultivating their lands themselves?
- What is your relation to the surrounding nature?
- Is the nature around the village changing?
- How has the entry of the SALCRA and JVC schemes affected the agriculture of the villagers?

Land use change:

- Has the land use changed since the implementation of the schemes? How?

Krangan Trusan household baseline survey (March 2016)

Date:
Household no.:
Name of interviewer and translator:
Respondent:
(Gender and status within household.)

*Thank you for accepting to participate in our survey.
 The questionnaire and your answers will be used in our paper about Krangan Trusan as part of our university course and your answers will be anonymous.
 The questionnaire consists of different questions but will focus on your land use and your household income. Before we start we want to make sure we are speaking with a household member with such an insight. If this is not the case we can come back at another convenient time with a relevant household member present.*

It will take approximately 30-45 minutes to answer all of our questions. If you have some questions along the way feel free to ask.

A. Household income

Important comments

1. How many people does your household consist of- and what is their relation to you? (E.g daughter, husband)

(when identifying household members, please state their age, main occupation, income and their highest level of education)

Member	gender	Age	Main occupation	Income	Highest level of education
1.					
2.					
3.					
4.					
5.					
6.					
7.					

(if more-use comment section to note down)

2. Are any of the stated household members not currently living with you? Yes ___ No ___

(If all members are living together move to question 4)

3. Does the members who are not currently living with you contribute to the economy of the household? Yes ___ No ___

(if yes, please state how much they contribute with and where their current living arrangements)

Member	Contribution each month	Living arrangements

4. Have you experienced Hungry periods during the last 5 years?

Yes___ No___

(If yes, please state when and why)

B. General land use

4. How much land do you own (in X)?

5. What types of crops do you grow? (E.g. vegetables for own consumption, rubber trees, oil palms, SALCRA scheme and more)

(when stating type of crops, please state the area they occupy and the income they generate per X)

Crops	Area	Generated income

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(If respondent doesn't grow oil palm, go on to question 7)

6. Before growing oil palms (grown independently or by SALCRA), what crops did you previously grow on that specific land?

(When stating the change of crops, please give a short explanation as to why you changed, and the approximately difference in income due to the land use change)

Current crop	Previous crop	Reason to change	Difference in income

(If more, use comment section to note down)

C. Large scheme oil palm plantations

7. Why/why not have you lent out your land to SALCRA or other agencies?

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8. How are you being payed for particitaing in SALCRA or other agencies oil palm schemes? (E.g. a set amount on the basis of land area, amount determined by harvest from your land, is the payments per month...)

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9. How was the piece of land SALCRA or other agencies manage chosen?

Objectives	Research questions	Sub questions	Data needed/output	Underlying assumptions	Informants	Methods applied/activities	Equipment	
We will assess the key factors influencing current livelihood strategies in Krangan Trusan, and how these interlink with socio-economic and environmental impacts of land development schemes in the area.	What are the key factors influencing current livelihood strategies?	What are the current livelihood strategies?	Household/village demographic, villagers' view of different livelihood strategies, household income/individual income, SALCRA income	Livelihood strategies are widely diversified in the village. We expect that agriculture is a primary livelihood strategy followed by labour migration to larger cities, especially for the younger generations. In our village description it is stated that many villagers work as government police or military, but we have no idea of how common that is.	Village headman, key informants, heads of households	Questionnaire, semi-structured interviews, PRA Livelihood matrices	Pen, paper, printed survey	
		How do the villagers choose between different livelihood strategies? (decision-making)	Decision-making processes, actors involved, land use, labour migration, socio-economic status, household sustenance needs, institutional/political structure of village	We assume that the decision-making process might be highly politicized, and that this question therefore might reveal relations between different actors, socio-cultural hierarchies. We assume that the decision making process is working through different levels from discussions within a household, between different households within the villagers (community decisions), and might go up to decisions made with other leaders of different villagers (bound together by ethnicity).	Village headman, key informants, heads of households	Questionnaire, semi-structured interviews, PRA livelihood matrices, PRA venn diagram	Pen, paper, printed survey	
		Why do the villagers choose different livelihood strategies? (rationales)	Land use, cash crop cultivation, labour migration, socio-economic status, household sustenance needs, definitions of quality of life, institutional/political structure of village	We assume there might be generational differences in ideas behind choosing different livelihood strategies, and that the younger generation might be more connected to urban livelihood strategies as villagers' choice of strategy might be based on achieving what subjectively is viewed as the best quality of life. Furthermore there might be some restraints on livelihood opportunities that influence the final choices- e.g Dayak lack of rights and opportunities for getting an education, government job security which might result in choosing agriculture or service sector livelihood strategies.	Key informants, heads of households, younger members of households	Semi-structured interviews, PRA livelihood matrices, PRA venn diagram, focus groups about ideas of quality of life.	Pen, paper	
	What are the impacts of the implemented land development schemes concerned with oil palm production in the area?	How are economic and socio-cultural aspects influenced by the development schemes?		Changed patterns in economic and socio-cultural structure, villagers' attitudes and perception towards development schemes	We assume that development schemes have had a big influence on socio-economic relations. The scheme might provide some opportunities not present before such as infrastructure, official land rights. But at the same time the presence of the scheme influences traditional labour distributions, cultural identity as a farmer.	Key informants, villagers	Semi-structured interviews	Pen, paper
			Why do villagers choose to rent out their land to SALCRA and why would/wouldn't they release their land to SALCRA after the current lease is up?	Villagers' relations/attitudes to SALCRA scheme, land tenure	We assume that the date for releasing land to SALCRA is within such a timeframe that the villagers have started to think about whether to release or not. We assume the question of land tenure is of relevance to the villagers' affiliation with SALCRA.	Village headman, village farmers involved in SALCRA scheme.	Semi-structured interviews	Pen, paper
		What are the prevailing changes in land use? How does these changes impact natural resources in terms of land availability and soil quality?	Land cropping history (what have been grown where, when?)	Due to pressures at different spatial scales (local, regional, national and global), mapping land history will reveal some general trends in land use transitions.	Key informants, village elders	Land use timeline drawn by village elders, semi-structured interviews, walkabouts	Pen, paper, GPS, camera	
			Division of households' land into subsistence farming, cash crop farming, oil palm production (smallholder) and land rented out to SALCRA -> land availability. Information about changes in current and past "hungry-periods" -> food security.	Implementation of SALCRA affect local land availability. Allocating an increasing share of the available land for cash crop production for export purposes can potentially affect local food security.	Village headman, head of or representative of household	Questionnaires Semi-structured interviews	Pen, paper, printed survey	
	How does different land uses and changes in these influence livelihood flexibility?	What role does involvement in different land uses (SALCRA, JVC, subsistence cash crop) have for villagers' livelihood flexibility?	Farmers' perceptions of soil quality, field/soil maps, measured soil quality (Pox-C)	a) Farmers perceptions of soil quality correlate well with indicators used in natural science. b) There might be a pattern in perceived soil quality and the fields that are rented out. c) Soil quality is affected by land management practice.	Village farmers	PRA: soil mapping and ranking. Walkabouts. Soil sampling: topsoil samples from different land uses (cash crop, subsistence, SALCRA palm oil).	Pen, paper, pre-printed map of area, GPS	
			Farmers' relations/attitudes towards different development schemes, household income information, socio-economic status, flexibility: changes in cash crop prices	The farmers livelihood flexibility might be affected by the tenureshipperiod an fluxurating palmoil prices. The intense farming of plam oil might lower the soil quality of the land and minimize the farmers opportunities to plant new crops after the tenureship period. But SALCRA might also give some benefits for livelihood flexibility in terms of funding new tools for the farmer to use later(tractors, infrastructure and more).	Village farmers	Questionnaire, semi-structured interviews, PRA livelihood matrices, PRA sociogram	Pen, paper	

Appendix 9: Soil sampling

Before the actual soil sampling, we need to know the soil depth of the O horizon (humus) and A horizon (topsoil) in order to enable strategic soil sampling from the topsoil. Beside this factum the soil profile also offer a visual assessment of soil characteristics (e.g. depth of soil horizons and colour, see appendix 3). A hole of 30 cm deep and 25 cm wide will be dug as recommended by McGarry (n.d.) and photos will supplement the visual assessment.

Having chosen sites from different land use systems where the soils can be assumed to have had the same properties before land use diversification (space-for-time substitution), three replicates of soil samples will be taken from three or four fields (SALCRA palm oil, private palm oil and/or rubber, secondary forest) resulting in nine or twelve soil samples in total. The depth of the top soil samples will be determined by the outcome of the soil profile assessment (typically 0-5cm or 0-10cm). Soil will be air-dried on paper sheets before transported back to Copenhagen, where the samples will be oven-dried for 24 hours at 70°C prior to the execution of a permanganate oxidizable carbon (Pox-C) test, developed by Weil et al. (2003) and revised by Gruver (2004).

