Land-Use Opportunities and Dependencies in Kumpang Langgir

How do Government Initiatives for Rural Development Affect Land-use Practices in Kumpang Langgir, and with what Outcomes for their Livelihoods?

Thematic Course: Interdisciplinary Land-Use and Natural Resource Management – Copenhagen University

Supervisors: Kristine Juul, Torben Birch-Thomsen and Frauke Tom H Menne.

Dilani Lykke
MSc Environment & Development: Copenhagen University
dilani.lykke@gmail.com

Sara Ruiz De La Hermosa
MSc Environment & Development: Copenhagen University
srdlh593@gmail.com

Kirsten Solgaard Sørensen
BSc Anthropology: Copenhagen University
kirstensolgaard95@gmail.com

Levin Scholl
MSc Environment & Development: Copenhagen University
levin.scholl@gmail.com

Chris Ajemian
MSc Environment & Development: Copenhagen University
cajemia@gmail.com

10,847 Words

Abstract

This study examines '*How do Government Initiatives for Rural Development Affect Land-use Practices in Kumpang Langgir, and with what Outcomes for their Livelihoods'*. This is done to understand the proximate and underlying drivers and consequences of land-use affected by governmental rural development policy and with what outcomes for Iban communities in rural Sarawak, Malaysia. This was done by investigating three key variables that interact with elements of the sustainable livelihood framework elements: (1) government programs, (2) agricultural practices, and (3) livelihood outcomes.

This was done utilizing a mixed-methods approach through a localized geographic case, Kumpang Langgir, a community in Sri Aman district. Collected data included: PRA methods, participant observation, focus groups, semi-structured interviews, empirical natural science testing on soil and water quality as well as a quantitative household survey. Data was captured over ten days with a multidisciplinary team of students inside of Kumpang Langgir.

Overall, data illustrates and discusses how community-members engage their respective livelihood assets with an accessible government structured initiatives to potentially access different types of livelihood assets and form new livelihood strategies. This happens simultaneously at the household level and when faced with internal and external strengths, weaknesses, opportunities, and threats to their current livelihood strategies. These new livelihood outcomes displayed differing pathways: engaging new opportunities, displaying varying dependency on government agricultural outputs and mitigating risks using their various livelihood activities.

10,847 Words

Acknowledgment

The field-based part of the course was a collaboration between the University of Malaysia Sarawak (UNIMAS), Roskilde University and the University of Copenhagen. The inputs and efforts of lecturers from the UNIMAS and University of Copenhagen are highly appreciated.

We would like to graciously and enthusiastically thank all the community members of Kumpang Langgir for their kindness, hospitality, and warm reception of us field researchers - not just as visitors but as friends. We are immensely grateful for their knowledge and assistance to us: not just in describing local land-use systems but also regarding local methods of ethanol distillation and demonstrations of dance. Without the widespread support and acceptance provided by the communal longhouse, headman TR Baying Kadam, and langkau this report would not be possible.

They freely contributed the information in this report, and their contribution and support are acknowledged, and much appreciated. Furthermore, we highly appreciate the work done by our three interpreters: Alfred Keleman, Eva Kristin, and Anna Carmila Anak Billy. We enjoyed working with them and immensely enjoyed working with our new Malaysian counterparts from UNIMAS and newly created dear friends. Terima Kasih!

Picture 1: *students from Copenhagen University and UNIMAS with interpreters*

Acronyms

FGD	Focus Group Discussion
HH	Household
KL	Kumpang Langgir
LH	Longhouse
MPB	Malaysian Pepper Board
MPOB	Malaysian Palm Oil Board
NCR	Native Customary Rights
NTFP	Non-Timber Forest Products
NWQSM	National Water Standard Quality for Malaysia
OP	Oil Palm
PRA	Participatory Rural Appraisal
RISDA	Rubber Smallholders Development Authority
SALCRA	Sarawak Land Consolidation & Rehabilitation Authority
SLF	Sustainable Livelihood Framework
SSI	Semi-structured Interview
USLE	Universal Soil Loss Equation

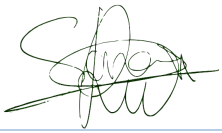
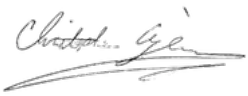
10,847 Words

Author Table

Section	Main Author(s)	Contributing Author(s)
Abstract and Acknowledgement	Chris, Dilani	All
Introduction	Levin, Sara	All
Conceptual & Analytical Framework	Levin	All
Methodology	Kirsten	All
Challenges and Limitations	Kirsten	All
Introduction to KL and Communal Livelihood Assets	Dilani, Chris	All
Agricultural Livelihoods and Rural Development	Dilani, Chris	All
Subsistence Farming and Government Support	Chris	All
Cash Cropping and Government Support	Levin	All
Influences of Socio-Economic System on Agroecology	Sara	Chris
Soil Perception Underlying Soil Fertility	Sara	Chris
Water Quality Assessment	Sara	Chris
Discussion	Kirsten, Sara, Dilani	All
Conclusion	Chris	All

10,847 Words

The authors sign below, affirming that the representations made in the Author Table above are accurate and represent their contributions to this report.

Name	Student ID #	Signature
Kirsten Solgaard Sørensen	**qwv752**	
Dilani Lykke	**qxb845**	
Levin Scholl	**wcj105**	
Sara Ruiz De La Hermosa	**vxk852**	
Chris Ajemian	**gpk166**	

10,847 Words

Table of Contents

10,847 Words

10,847 Words

1. Introduction

The following report provides an empirical and contextualized in-depth case study on the way government initiatives for rural development affect communities, their land-use practices, and their livelihoods. Government initiatives for rural development will be conceptualized in this research as rural development programs that are: (i) organized by the Malaysian or local government; (ii) purposeful in their intention to improve rural livelihoods; and (iii) targeting rural communities. The studied community, Kumpang Langgir (KL), is geographically located in the rural uplands of eastern Malaysia's state of Sarawak on Borneo and will be briefly introduced after an overview of governmental rural development strategies at work in this region (large scale plantations and local smallholder community support). The section will end with a presentation of the research question.

Since its independence in 1957, Malaysia experienced far-reaching and fundamental social change. Similar to other south-east Asian countries: industrialization, globalization, and high economic growth transformed Malaysia from a low-income country with an economy mainly dependent on the primary sector, into an economically diversified upper-middle-income society (Birdsall et.al 1993). Malaysia's so-called 'modernization' and the accompanied rise of a middle class have been associated with strong government planning and strategic economic policy (Embong 2002). In this line, Malaysia has been described as a 'developmental state', a centralized bureaucracy exercising technocratic control over the distribution of resources to optimize macro-economic productivity in capitalist market structures (Jarvis 2017).

In this context, it is particularly interesting and relevant to turn the eye to rural development and rural livelihoods, for at least three reasons: First, while Malaysia's most dramatic changes took place in mainland urban areas, poverty levels have been most persistent in rural areas, in particular in eastern Malaysia **(**Hew 2007**)**. Second, government-led rural development entails drastic land-use changes with implications for local livelihoods and the natural environment. Among the most noticeable land-use changes are the deliberate demise of traditional shifting cultivation and the expansion of large-scale mono-crop plantations (Mertz et al. 2008; Cramb & Sujang 2013). Third, the progressing integration of remote and indigenous communities into state governance and market structures (Cramb 2007), and the commodification of their resources (Nevins & Lee Peluso 2008) is a long-term process which deserves attention for its historical significance.

Cramb has noted that the Malaysian "government [...] pursues two somewhat contradictory strategies of rural development" (Cramb 1997, 39). One approach is to promote central large-scale plantations to increase the productivity of land, foster infrastructure, and create employment opportunities with potential spillover effects for the rural economy (Ibid). This approach depends on the consolidation of land. Since the 1970 New Economic Policy, large agricultural lands held by smallholders have been converted into mono-crop commercial plantations, especially for the state – and privately run – oil palm (OP) cultivation (Mertz et al. 2008; Fold & Hansen 2007). The consolidation and conversion of small-holder land have required the resettlement of small-holders or asked for their partnership as landholders under native customary rights (NCR) in joint venture programs. In eastern Malaysia, the main agency responsible for these processes is the Sarawak Land Consolidation & Rehabilitation Authority (SALCRA) (Ngidang 2002; 2003).

The parallel approach is decentralized as it targets smallholders and aims to support their local economy by developing local infrastructure, particularly through road constructions, and by providing subsidized

inputs; such as seedlings, agrochemicals, and training for the intensification of land use and small scale cash-crop cultivation (Cramb 1997). To receive government-sponsored benefits, farmers have to apply with the respective agency; and upon success follow more or less stringent agricultural instructions. This approach has a long tradition in eastern Malaysia. Already in 1956, the year before independence, the Department of Agriculture introduced the Rubber Planting Scheme in Sarawak. A variety of schemes concerning different crops followed, of which rubber, pepper, and OP, however, remained the most prominent up until today. For these schemes, the government initiated several marketing boards, such as the Rubber Industry Smallholders Development Authority (RISDA), the Malaysian Pepper Board (MPB), or the Malaysian Palm Oil Board (MPOB), which reach out to small-holder communities through a network of extension workers **(**Cramb 2007, 252-274; Hamid et.al 2019**)**. The present research was guided by the following central research question:

"How do Government Initiatives for Rural Development Affect Land-use Practices in Kumpang Langgir, and with what Outcomes for their Livelihoods?

By this, we hope to contribute to a better understanding of rural livelihoods and their dynamics with development programs in the context of a rapidly transforming newly industrialized country.

1.1 Study Site Description

The study site was selected to show how smallholder communities are affected by governmental development programs. As such the community of KL was selected, in Sarawak's Sri Aman district.

Map 1*: Satellite image of the study site. The road is highlighted as a red line and distance to main borders and towns in arrows.*

KL has direct road access, is 52km from the district capital Sri Aman and about 15km from the nearest town, Engkililli. The population is Iban, and permanent residents account for 23 households with roughly 92 individuals (Questionnaire). The average household size is four and ranged from one to eight

members. Although 40% of households had children below schooling age, KL's population is aging. Three-quarters of respondents are above 50 years old, reflecting a long-term trend of rural-urban migration. Previously, Ibans have sustained their livelihoods by fishing, hunting, foraging, livestock keeping, and subsistence agriculture (Cramb 2007). These activities are still in practice but shifting cultivation has been replaced by permanent intensified agriculture of short-term rotational crops in mixed cash cropping agroforestry systems. The local area, roughly 300 hectares, encircling the longhouse is administered locally under native customary rights (NCR).

KL's tropical climate and the surrounding ever-wet dipterocarp forest is suitable for a wide array of agroforestry practices. Inhabitants grow a wide assortment of both woody perennials and short rotational crops in this climate using rainfed irrigation (Transect walk-1, Transect walk-2). Annually, KL receives around 3331 mm of precipitation and has a relatively static temperature averaging around 22°C (Climate-data.org 2020). Most rain is received from November till March (Ibid; Crop-Calendar). Figure 2 below depicts secondary historical data from a nearby weather station.

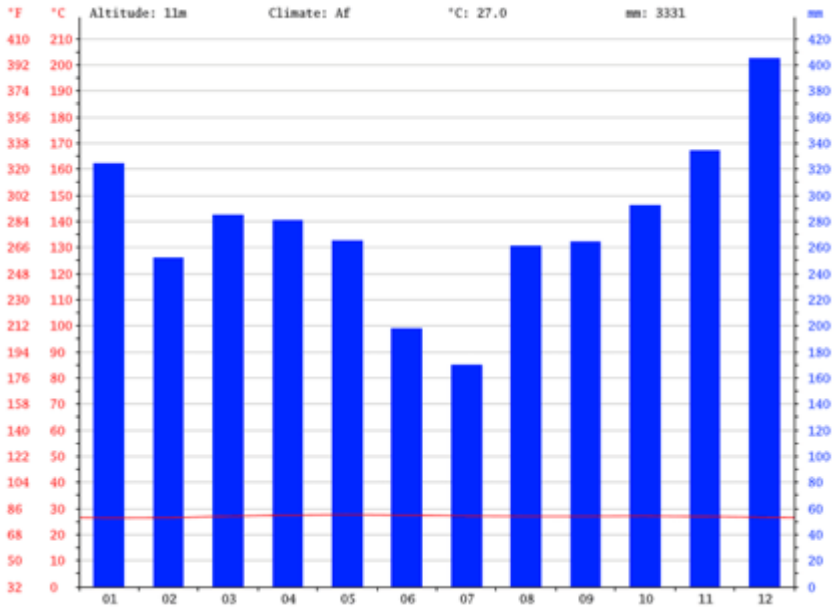


Figure 1*: Sri Aman Average Temperature and Precipitation: temperature shown in red, precipitation variations shown in blue* (Climate.org 2020)

1.2 Conceptual and Analytical Framework

The Sustainable Livelihood Framework (SLF) was taken as an analytical point of departure. The advantage of this framework is its holistic and exhaustive perspective on livelihood dynamics, with the capacity to take structural factors as well as an individual agency into account. The SLF provides the following basic structure for analyses: Given a particular context (e.g. history, global markets, etc.), a combination of different types of assets (human, natural, financial, physical, and social), mediated through transforming structures and processes (e.g. private sector, policies, culture), enables certain livelihood strategies (e.g. diversification, agricultural intensification), leading to observable livelihood outcomes (e.g. increased well-being) (Scoones 1998).

Figure 3 represents the use of the SLF which is elaborated in the following paragraph. Given our research question, government programs for rural development are conceptualized as transforming structures and processes with the capability of affecting individual and communal access to livelihood assets and influencing livelihood strategies. Our research question focuses on forms of land-use activities as a category of livelihood strategies and investigates their general livelihood outcomes. One perspective on livelihood outcomes is to look at the effects of government programs and land-use activities on livelihood assets. It is important to note; however, that the SLF represents an endogenous cyclical flow in which elements are causally intertwined by feedback loops. The government promoted land-use changes, for example, might result in livelihood outcomes by affecting the quality of agricultural soil, which constitutes a natural asset for local livelihoods, while the way government initiatives are utilized by recipients will also depend on their access to assets, such as access to suitable land.

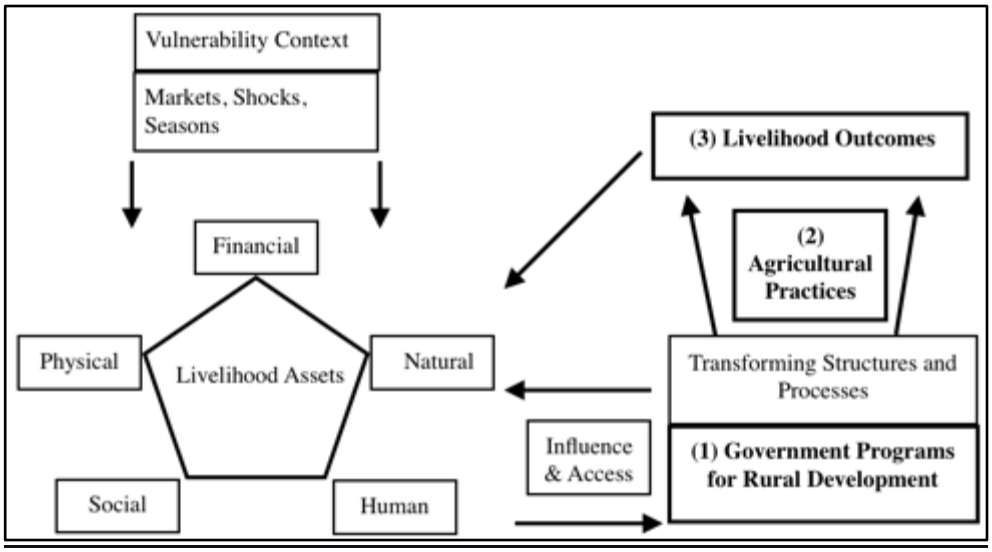


Figure 2: *The SLF as employed here. The numbers refer to the numbering in the paragraph below. The key variables are in bold. Arrows depict the flow of influence.*

Following the above, our investigation has three interrelated key variables that reflect SLF elements: (1) government programs, (2) agricultural practices, and (3) livelihood outcomes. Each of these variables required our investigation leading to three general sub-questions to our main research question:

1. *What government initiatives does KL experience?*
2. *What are local agricultural practices and how are they influenced by government initiatives?*
3. *What are the consequences for local livelihoods?*

Findings will be discussed by analyzing the general strengths and weaknesses of KL's farming system and by assessing opportunities and threats arising from government programs for rural development. This categorization was inspired by the SWOT analysis tool for strategic management, although it is not followed closely (Hill & Westbrook 1997). The subsequent section discusses the methods employed to answer these questions.

2. Methodology

The following chapter shows how different data collection methods contributed to answering our research question. Since this research is interdisciplinary, both quantitative and qualitative methods were selected. This approach is chosen since, while researching resource management or sustainable land-use, a mono-disciplinary point of view is not adequate to understand the multi-facet, nuanced issues in these fields (Birch-thomsen et al. 2005,5). Our interdisciplinary approach enabled us to triangulate and validate our observations, enriching our work by bridging and complementing the different strengths and weaknesses of the methods used (Mikkelsen 2005,96).

2.1 Participant Observation and Unstructured Interviews

In our fieldwork, we strived to be inductive. To do this participant observations and unstructured interviews (POUI) play a central key since they demand that the researcher follow the informant's lead. Also, when the interviews become less formal it tends to relax the informants, and they speak more freely, allowing for discussion and about more sensitive topics (Bernard 2011, 156-157, 256-261). The unstructured interviews contributed to our research by providing us with context for our research, and by enabling discussions of some of the negative consequences of the government initiatives.

2.2 Semi-Structured Interviews

Seven semi-structured interviews (SSI) provided data on different forms of information: how households craft distinct livelihood strategies, how these strategies translate into different agricultural or land-use practices, and what role government initiatives play in these livelihoods. An overview of the interview topics and the reason for each participant’s selection are listed below in

Date	**Criteria for Selection**	**Identifier Code**
27.02.2020	In the beginning of the field investigation, the Headman was consulted since he was able to provide an informed overview to the community to inform our initial research strategy. He could explain any protocols or social etiquette required during the data collection period.	**SSI-1**
01.03.2020	The interviewee was selected since he is experienced in the cultivation of both rice and rubber. This perspective was helpful in understanding the role and nature of rice and rubber cultivation.	**SSI-2**
01.03.2020	This interviewee is an OP producer whose land has road access. His perspective was able to illustrate some of the changes and benefits associated with both OP cultivation and the road extension that was constructed into Kumpang Langgir.	**SSI-3**
01.03.2020	This informant has a unique perspective on the connections and opportunities available to Kumpang Langgir since he is not only a producer of OP, but also runs a transportation business shipping agricultural products grown by other members of the community to nearby towns and cities.	**SSI-4**
01.03.2020	The interviewee was selected due to his extensive experiences with pepper cultivation. This perspective was helpful in understanding the role and nature of pepper cultivation among producers in Kumpang Langgir	**SSI-5**
01.03.2020	Our informant receives assistance from MPOB, MPB, and PELADANG so he was a good informant to discuss the difference between government initiatives.	**SSI-6**

Table 1: *Short description of criteria of selection on key participants in semi-structured interviews with identifier code for each.*

2.3 Transect walks

Two transect walks were completed at the beginning of our fieldwork. The first transect walk was done around farming activities near the longhouse (Transect walk-1), the second was further away from the longhouse uphill in Rubber and rice fields (Transect walk-2). The transect walks enabled us to see and understand local lands and ask questions to villagers who manage them simultaneously. Land-use activities that were described could then be physically observed and participatorily analyzed in the same transect walk. This method contributed to understanding land-use practices and the causal linkages behind how natural and physical assets are used.

Figure 2: *Transect walk-in OP field*

2.4 Focus Group Discussion

Three focus group discussions (FGD) were completed during fieldwork. The first (FGD-1) was a mixed group of three females of different ages. By making a mixed group we were able to gain insight into knowledge and attitudes related to land-use practices and experience with government development initiatives and compare data against responses from the men (Mikkelsen 2005:89).

The second focus group (FGD-2) was with a group of three experienced farmers, to get an in-depth understanding of their soil perceptions (Mikkelsen 2005:89). Primarily, the FGD provided knowledge

about how soil perceptions and what influences its quality. Secondly, how fertilizers, pesticides, and herbicides from government initiatives affect their land-use practices and long-term soil fertility.

The third focus group (FGD-3) was with participants who received MPOB support. We designed this FGD so it would give us detailed and precise information about what assets they received from the MPOB and how it has affected their land-use practices. This enabled for a better understanding of how the MPOB affects livelihood strategies.

2.5 PRA Exercises

Three participatory appraisal methods were selected: participatory mappings (MAP-1 & MAP-2), a seasonal calendar and a matrix scoring with crops. These are ideal since they allow participants to analyze and assess their own situation alongside researchers to get a clear conceptualization of information. (Narayanasamy 2009,43)

Two PRA maps were made: one by the headman and another by an elderly community-member. These maps provided an overview of various physical and natural assets but also showed how government initiatives either facilitate access or control these livelihood assets surrounding LH. The maps played a role in our findings, illustrating what role government initiatives play into KL's physical and natural assets. Additionally, they showed what livelihood strategies and land-use practices occur.

Figure 3: *Picture of TR Baying participating in a PRA map-1.*

In the seasonal calendar PRA exercise, the participants filled in information about rain, temperature, pest, and disease changes over the year. They also gave information about when to plant and harvest (i) hill rice (ii) OP (iii) pepper (iv) root and tuber crops and (v) vegetables. Additionally, they ranked these crops' respective vulnerability to temperature change, precipitation, disease, weeds, and pests. The

seasonal calendar was chosen for its capability to provide a seasonal overview that is much needed since the field is so short, and a setting for discussion of farming practices, where correlations between different land-use practices and natural assets could be made. For our analysis, we especially focused on what challenges they face during the different seasons, and how government initiatives and material inputs interact with these challenges.

A scoring matrix for crops was designed by the field researchers and scored by seven female participants. The X-axis labeled various crops: rubber, OP, rice, pepper, and vegetables. These were chosen due to their importance as indicated in initial interviews and household surveys. The Y-axis listed different criteria to rank the crops against in order of greatest to least value, by the number of stones they were assigned: five stones were ranked the highest, followed by four stones for the second-highest, and continuing to the least value being assigned a single stone. The criteria on the y-axis were: Physical Effort; Knowledge Required; Fertilizer, Pest- and Herbicide; Startup Cost; Continued Cost; Income; Predictable; Enjoyment; Tradition; Priority.

The scoring matrix provided valuable information about how the women perceive, prioritize, and consider the relative advantages and disadvantages of their crops. This information is used in the report to compare and validate our analysis surrounding choices of land-use practices. The results of the matrix can be found in Appendix 5.

Figure 4: *Interpreter preparing the participants for the crop scoring matrix PRA exercise.*

2.6 Household Questionnaire

Questionnaires from all 23 households currently living in KL were collected. A copy can be found in Appendix-4. They provided data regarding the extent of physical, human, financial, natural assets in

each household. Moreover, the questionnaire captured additional livelihood assets captured by government initiatives and the current livelihood strategies of the household. Since questions were closed response (yes/no, multiple-choice questions) results from the questionnaire provided mostly descriptive information that can be further inferred or connected to qualitative findings from other data sources.

The questionnaire was piloted, revised, and shortened to include data on 162 variables with a completion time of around 30-40 minutes. The questionnaire was completed by a household member who felt confident answering questions regarding that particular household's economy and land-use.

The strength of the questionnaire data is its ability to complement qualitative data with statistical information. This enabled researchers to identify and analyze clusters of livelihood strategies, assets, and household demographics: allowing us to understand the interplay between different parts of the SLF and purposefully find participants to sample (i.e. SSI's, FGDs).

2.7 Soil Sampling

Six plots were sampled based on crops cultivated (OP, pepper, and rice) and topography (uphill and lowland). All soil samples were collected at two depths: the first layer between 0-6 inches and a second layer 6-below inches. Soil profile and texture as well as soil color, pH and steepness of the slope were noted.

The purpose of this method was to supplement and triangulate information gained from social science methods. This method requires further analysis using laboratory facilities. Due to the impossibility of completing these laboratory tests - as mentioned in 2.3.5 under Challenges and Limitations - data from soil sampling was greatly reduced in this report. Only, surface-level information regarding soil erosion characteristics and ph could be referenced. This limited triangulation between soil perception, interview data concerning land-use activities and empirical data on soil physicochemical properties.

Figure 5: *Gathering soil sampling from a pepper field*

2.8 Water Quality Assessment

Water analysis added information regarding the potential detriment fertilizers, pesticides, and herbicides may have had on the condition of main water sources in terms of watershed quality and its portability. This showed information about how various land-use practices may indirectly influence natural assets to inhabitants of KL. We hypothesized a detrimental effect on water streams conditions nearby agricultural fields compared to more distant ones. Several qualitative and quantitative tests were carried out to validate this hypothesis.

First, a Stream Assessment Scoring System test (MiniSASS) was conducted in a middle-stream of the Kumpang River, recorded the overall 'health' of a waterway based on the presence/absence of 13 specific taxa of macroinvertebrates (i.e.; dragonflies) that are sensitive to water quality changes. The average value of this sensitivity score correlates with a specific ecological condition. A higher water quality average score indicates less human influence on the water system - indicating better water quality (Table 2). A strainer, a magnifying glass, and a container were required to perform this test.

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

Table 2: *Ecological River Category based on miniSASS sensitivity score average (MiniSASS 2015). Kumpang river was characterized as Rocky Type.*

Although this method is useful, it only provides an imprecise assessment of water quality and does not inform researchers about possible pollutants or microorganisms (bacteria): defining factors of potable water.

To support this methodology, a more detailed examination of the watershed condition was relevant since physical, chemical and biological parameters determine the quality of surface and groundwater (Al-Badaii et al. 2013). Furthermore, despite the authors acknowledging the difficulty of identifying pollutant sources in water streams, the anthropogenic interference of agricultural land due to runoff is commonly related to pollution in nearby watershed areas.

Therefore, it is relevant to our study case to determine a possible depletion in the quality of water sources used by the KL community related to their land-use management. Three different stations were tested for eight specific water tests. More detailed information is gathered in Table 3. To discuss the results obtained, the values from the National Water Quality Standard of Malaysia (NWQS) would serve us as criteria of analysis.

Physical Parameter	
Parameter	Unit
Turbidity	NTU
pH	-
Chemical Parameter	
Chemical Oxygen Demand (COD)	mg/l
Ammoniacal nitrogen (NH3-N)	mg/l
Phosphoprus (P)	mg/l
Biological Parameter	
Total Coliform Count (TCC)	count/100ml
Fecal Coliform Count (FCC)	count/100ml

Table 3: *Physical, chemical and biological parameters analyzed in the Longhouse - with equipment and guidance from UNIMAS experts. Corresponding units are shown above.*

3. Challenges & Methodological Limitations

The limitations and challenges related to the methods, language barrier, and accessibility to informants will be discussed in relation to how they may have affected our data collection and following analysis, and how we attempted to compensate. While these challenges did not alter the conclusions of the research, they may have altered the nature of data collection or required changes in how the analysis was conducted.

3.1 Language

A language barrier existed between field researchers speaking English and the community speaking Iban. The research team had two translators, as well as an Iban speaking student. This minimized miscommunication. The language barrier especially affects our ability to conduct POUIs by informal and inductive questioning while socializing with villagers. This is because these require listening while minimizing influence in the conversation (Bernard 2011, 156-157).

3.2 Access Filters

The headman of KL facilitated access during the field visit. He provided extensive assistance and was beneficial for accessing the community and locating research participants. This meant that he could influence the sampling strategy unintentionally. This may have pressured participants to speak on the record or only wish to interview men as informants. The Headman decided to divide the work so that men would assist in interviews, FGD and guided tours, etc. and the women would cook. This resulted in very few interviews with the women compared to the men. To compensate we decided to conduct an FGD, more participatory activities and unstructured interviews with the women. Nevertheless, as a consequence, gender imbalance is present in sampling selection.

3.3 Diplomatic Bias and Time limitation

Due to the extensive use of self-reported data, there is a risk of ‘diplomatic bias’ (Chambers 2008,38). Visiting researchers may not be shown intra-community conflicts, inequalities from wealth and gender since they are easy to hide during a short visit (Ibid). Moreover, some community members believed that our research was meant to provide consultation for their household’s land management. Participants may have felt that they could receive support as a result of collaboration with this research. The origins of these sentiments are not understood. But regardless, before each activity, researchers stated the objectives of each activity to the participants and verified that they fully understood that their collaboration was entirely voluntary.

The data collection in KL was only possible for a brief time. Certain variables (i.e perceptions of crop attributes, soil quality, water quality, or household perceptions) may differ throughout various seasons. Insights regarding land-use over a longer period are therefore dependent upon the memories of participants.

3.4 Unforeseen Challenges

Firstly, for two days data collection was not possible due to a spiritual ceremony in the community. To compensate for this, scheduled interviews were moved to alternative days and some additional follow up interviews with government institutions or community members were not completed. However, written interview questions were sent out to the officials through electronic mail but were not responded to.

Secondly, after the data collection, both Danish and Malaysian universities were closed and students subject to self-quarantining due to the COVID-19 pandemic. Due to these highly irregular circumstances many library resources, and all laboratory equipment, were no longer available for this analysis. This limited the capacity and availability of the authors to collaborate in person, use paper records in the university facilities and prevented examination of soil variables: CEC, N/C, NPK, soil organic carbon (SOC) and permanganate oxidizable carbon (PoxC).

Due to the impossibility to analyze the soil samples in the Department of Plant and Environmental Science laboratory, a whole perspective on soil findings is not possible - creating difficulties implementing the research strategy but not affecting the overall conclusion of findings.

4.Findings

4.1 Introduction to KL and Communal Livelihood Assets

To fully discuss findings that are relevant to the research question, a concise overview of some common physical, natural, financial and human assets referenced in the SLF should be elucidated first. As presented in the Study Site description, the forest surrounding KL provides a communal natural asset that is administered through NCR. Furthermore, public infrastructure such as a gravity-fed water system, the road, and longhouse construction materials all constitute physical assets under the SLF while financial savings on generator fuel enabled by the electric grid make alternative pathways and livelihood strategies possible (Map-1).

This is especially relevant considering KL's aging population. Public services such as a primary school and a public health clinic are key forms of human assets. When combined – all of these assets with road access, the population is enabled to access livelihood assets and opportunities outside of KL. The time where these communal assets were created is within the previous decade. Additionally, with the construction of infrastructure such as the road - other rural development initiatives have expanded into the community. Community members appear to be aware of this, awaiting further communal infrastructure and physical assets such as telecommunication networks, rights to nearby granite deposits for mining and increased routes in the forest for tourism (Map-1). The nature of how initiatives are engaged by inhabitants in KL under the SLF will be discussed in the upcoming sections of this report. Later sections will also subdivide findings between (i) agricultural livelihoods and rural development; (ii) subsistence farming and government support; (iii) cash cropping and government support; and (iv) influences of socio-economic activities on KL's agroecology. Before proceeding to the conclusion, the SLF will be re-discussed showing examples of real case-studies presenting combinations of dependency, access to government initiatives, and opportunity (Crop calendar; Questionnaire).

4.2 Agricultural Livelihoods & Rural Development

This section describes how agricultural livelihoods and rural development policies manifest inside KL. This is necessary to understand the research question and objectives since knowing '*how do Government initiatives for rural development affect land-use practices in Kumpang Langgir, and with what outcomes for their livelihoods,*' requires understanding the homologous linkages between agricultural land-use systems and livelihood strategies. Additionally, this allows us to thematically discuss the relationship between our research variables rather than simply describing them. This section addresses: (i) firstly, how the local economy is dualistic - based on subsistence and cash crop-based agriculture livelihood strategies in a dual-economy. (ii) Secondarily, how this dual economic system actively engages the development strategy and initiatives to create new livelihood strategies and outcomes to utilize their changing livelihood assets. To present these relationships and linkages, the SLF framework will be quickly introduced to show the collected data from KL.

Households encounter varying micro-level strategies and results when engaging with these development policies, institutions, livelihood assets, and contextual factors (transect walk-1; crop calendar; SSI-5; questionnaire). KL community members seek to participate in different connections, opportunities; which in some cases, accelerate mechanisms of dependency from these initiatives. For example, higher integration of agricultural commodities with opportunities for cash incomes have

pushed people to readapt areas using older mixed subsistence shifting cultivation systems (Mertz et al. 2013). Smallholders in KL are no exception to this trend as Southeast Asia, adapting their land systems to population growth and new government intervention policies (Ibid). This combination of subsistence rice, vegetable and fruit cultivation diversified with cash incomes effectively creates a two-sided 'dual-economy'. This was emphasized in the questionnaire, stored rice, and cash crop production (i.e. pepper and rubber) as well as other subsistence livelihood activities such as foraging (NTFP), livestock, and hunting mitigate potential risks for food security and are a key component of livelihood strategies. 91% of questionnaires indicated that households had at least one or more years' rice stock stored for consumption and a substantial amount also engaged in a significant amount of their time on other livelihood practices such as foraging, and livestock (questionnaire). While almost two thirds (57%) also received remittances. These are illustrated below in Figure 7.

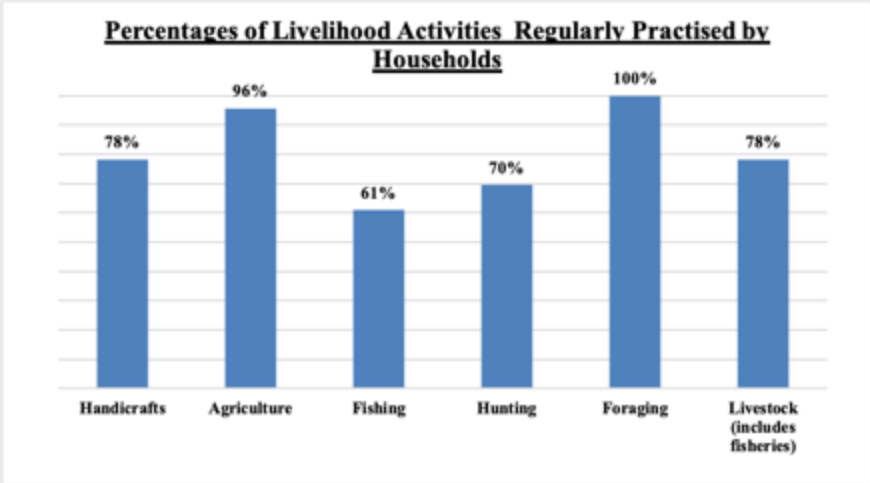


Figure 6: *Regular Livelihood Activities Practiced by Surveyed Households*

This 'dual economy' brings a diversified safety net for KL's economy. Any shocks to other income sources (off-farm wages, seasonal shocks, remittances), can be mitigated by selling stored pepper or rubber production and small-scale cultivation of vegetables (i.e. eggplant and ginger) and provide shorter-term cash opportunities (Seasonal Calendar).

Furthermore, the dual economy allows market integration on small and large scales, as a combination of subsistence and cash-based agricultural systems allow farmers to cultivate crops with higher start-up costs (i.e.OP) and to re-invest their livelihood assets differently under the SLF. If the market price fluctuation negatively affects cash crops (Pepper, rubber, OP) then financial buffers still exist through other subsistence crops and livelihood activities (vegetables, NTFP, and hunting. etc.). As different government interventions (Peladang, MPOB) interact with producers, productivity increases through soil fertility improvements, and crop diversification to assist subsistence and cash incomes are also possible (SSI-1, FGD-3). The tropical agricultural climate also makes it possible for the community to grow different crops all year round i.e. with intercropping vegetables with rice or pepper with a fair amount of rain received during the monsoon.

Figure 8 below shows the SLF with information that will be discussed in the later sections of this report and given a brief introduction here. Access to government initiatives, dependency, and opportunity are shown on a three-directional spectrum illustrating how livelihood outcomes and strategies are affected by the context, livelihood assets, and varying mechanisms of participation by community-members in KL.

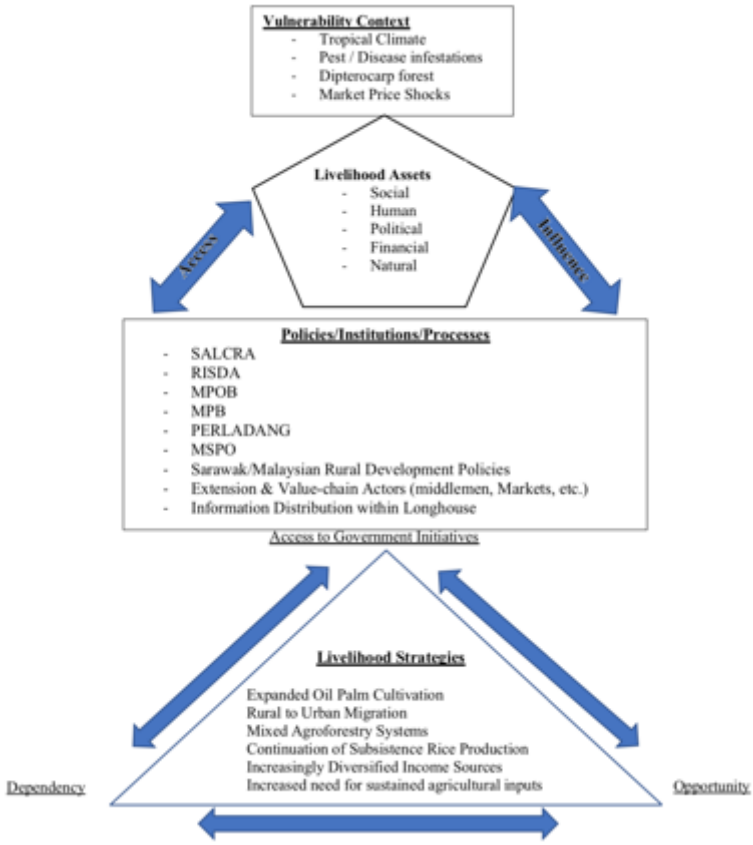


***Figure** 7 - Revised SLF Illustration with information from Kumpang Langgir*

4.2.1 Subsistence Farming and Government Support

Rice holds a fundamental role in the agricultural system of KL (SSI-1). It is grown by all producers, remains a central part in local food security - providing most of the calories consumed, and also is the main crop produced in the community apart from cash crops (SSI-1; Scoring Matrix). Its value as a basis for communal life should not be understated. In the final interview with a member of the community made it clear that "*regardless of the future of OP or cash crop production, they will always grow rice.*" For land management, many producers center their crop rotations around seasons of rice production (Crop calendar). Local fast-yielding varieties are favored for their quick maturation (SSI-1). The land is prepared during the dry season in June to July with collecting and burning the previous harvest's crop residues. The rice is being harvested from March to May and often not left fallow (Crop calendar, Transect walk-2).

Some of the most widely cultivated crops include hill rice, vegetables, fruit trees, root and tuber crops for largely self-consumption (Crop calendar; Questionnaire). Most rice production is also destined for self-consumption; although some minor amounts of excess vegetable and rice production are sold in nearby markets (predominantly *Solanum lasiocarpum* and *Zingiber officinale*) (Crop calendar, Scoring Matrix). This is different from other neighboring communities that predominantly sell rice then purchase other varieties on the market for a financial surplus (SSI-1; Crop calendar). Although possible all year round, much of the local vegetable production occurs around the cultivation period for rice with sowing either after the rice harvest (April/May) or after rice planting (October) (Ibid). Considerable land inside KL is managed intergenerationally: mature fruit or rubber trees, roots, and tuber crops are intercropped with rice (transect walk-1, questionnaire, crop calendar). A common rotation is to have

fruit trees or rubber as a border crop, with vegetables, root and tuber crops rotated on the land parcel annually with rice and pepper. OP is an exception to this. It is often cultivated on separate parcels of land - requiring non-sloping lands with road access (Transect walk-1, Transect walk-2). Many common crops that are also cultivated in KL are also outlined below in table 4 (Questionnaire).

Crop Type	Crop Common & Scientific Name	Percentage of Households Reporting Cultivation
Cash Crop	Rubber (Hevea brasiliensis)	95%
Cash Crop	Oil palm (Elaeis guineensis)	68%
Cash Crop	Pepper (Piper nigrum)	77%
Cash Crop	Sugar palm (Borassus flabillifera)	0%
Cash Crop	Cacao (Theobroma cacao)	9%
Cereal/Energy Crop	Maize (Zea mays)	68%
Cereal/Energy Crop	Hill Rice (Oryza sativa)	95%
Energy Crop	Swamp Rice (Oryza sativa)	14%
Energy Crop	Sago palm (Eugissonia utilis)	45%
Fruit	Sugarcane (Sacharum offinarum)	23%
Fruit	Mangosteen (Garcinia mangostana)	18%
Fruit	Banana (Musa spp)	91%
Fruit	Durian (Durio zibethius)	68%
Fruit	Crystal Fruit (Pometia pinnata)	14%
Fruit	Soapberry (Sapindus saponaria)	9%
Fruit	Rambi (Baccaurea motleyana)	41%
Fruit	Pineapple (Ananas comosus)	77%
Fruit/Legume	Langsat (Lansium parasiticum)	55%
Legume	Bitter Bean (Parkia speciosa)	73%
Legume	Longbean (Vigna sinesis)	55%
Root/Tuber	Taro (Colocasia esculenta)	86%
Root/Tuber	Sweet potato (Ipomea batatas)	36%
Root/Tuber	Cassava (Manihot Esculenta)	95%
Root/Tuber	Ginger (Zingiber officinale)	95%
Root/Tuber	Chillie pepper (Capsicum annuum)	86%
Spices	Chives (Allium schoenoprasum)	45%
Vegetable	Wax gourd (Benincasa hispida)	9%
Vegetable	Mustard Greens (Brassica juncea)	50%
Vegetable	Cucumber (Cucumis sativus)	64%
Vegetable	Bottle gourd (Lagenaria siceraria)	23%
Vegetable	Loofah (Luffa cylindrica)	45%
Vegetable	Eggplant (Solanum melongena)	95%
Vegetable	Pumpkin (Cucurbita maxima)	50%
Vegetables	Okra (Hisbiscus esculentus)	36%
Vegetables	Bitter gourd (Momordica charantia)	50%
Vegetables	Winged beans (Psophocarpus tetragonolobus	41%

Table 4: *Questionnaire Household Data Regarding Crop Selection - The most cultivated species appear in red (top 10%):*

The tropical agricultural climate also makes it possible for the community to grow different perennial and short rotational crops at different times of the year. With regard to the use of inputs, some interesting findings were noted. Fertilization and pesticide application are often shared between crops (transect walk-2; Crop Calendar; questionnaire). (i) Pepper, (ii) vegetables and (iii) rice were consistently mentioned as crops with the most difficulties with pest management (Crop Scoring Matrix; Crop Calendar). A brief explanation for rice's pest and disease management system is needed since it is communal across all agricultural producers.

Most households (17 out of 23) receive free fertilizer once a year from Lembaga Pertubuhan Peladang (hereafter Peladang) under the administration of the Ministry of Agriculture and Agro-Based Industry (FGD-1; SSI-2; SSI-3; SSI-6). Peladang is a governmental umbrella organization for agricultural

organizations and their development (Hamid et.al 2019). Upon a membership of RM70, farmers receive pesticide, herbicide and 40, 25 Kg sacks fertilizer for their hill-rice cultivation, which reportedly increased the productivity of rice farming. This input serves mainly subsistence purposes, is easily accessible, and is provided unconditionally to rice farmers (transect walk-1; FGD-1). The amount of input is more than sufficient, and households from focus group one reported that their surpluses are bigger than what they need, most only use 2-3 of their 40 bags for their rice fields (FGD-1). This steady supply facilitates the subsistence rice cultivation as a steady activity with reliable incomes within the community.

Moreover, the supply of agricultural inputs may have facilitated the demise of shifting cultivation. Nutrition which was originally available through shifting cultivation can now be obtained from subsidized fertilizers with different environmental detriments (Nair 1993, 55-56; Erni 2015). The system was no longer found in practice (SSI-2). In general terms, this practice is found to be reduced by several drivers. More than a matter of land scarcity, secondary literature exists which discusses how engagement through commodity markets, the expansion of infrastructures, and subsidies allowed for a sustained replacement for shifting cultivation (Ibid).

Simultaneously, the effectiveness of both fertilizers and pesticides may be reduced since the ratio of fertilizers provided are dosed to different crops and pesticide application provided for cash crops may not mitigate potential pests for common species of vegetables such as eggplant or ginger (Crop calendar; Questionnaire). Some species of pests or diseases found to be particularly concerning to participants (FGD; Crop matrix) in their pepper vines (i.e. Root-Knot - *Meloidogyne incognita*) and rice fields are not treated since provided inputs do not target these pests or diseases (Appendix-3). For example, some infections of the bacteria *Xanthomonas oryzae*, responsible for significant yield reductions were seen in several rice plots (Kumar et al. 2013). This infection could only be treated efficiently with antibiotics while instead mostly Peladang insecticide was applied (Ibid).

Similar results were found with fertilization. While the nutritional requirements for subsistence crops such as rice and pepper are covered by the specific input applied, doses for surrounding subsistence crops may differ. An example can be seen with bananas - one of the most common crops (Appendix 3: below), which requires Potassium in high quantities. By creating competition for this nutrient between the rice and banana trees, less nutritional uptake will be available for uptake among both plants (Jensen & Husted 2009).

4.2.2 Cash Cropping and Government Support

<u>Rubber & Pepper</u>

The following section will discuss how rubber and pepper, livelihood assets provided by the government, enable specific livelihood strategies even when prices for rubber and pepper are low. Although rubber and pepper cultivation in Sarawak is much older than government support for it (Cramb 2007), households in KL have started rubber and pepper cultivation with the help of the Rubber Smallholders Development Authority (RISDA) under the administration of the Ministry of Rural Development and the Malaysian Pepper Board (MPB) under the administration of the Ministry of Primary Industries, respectively (SSI-2-6; Hamid et.al 2019). Both perennials have been cultivated long before the arrival of OP and are widely common within the community: all but two households cultivate rubber, and 18 out of 23 households cultivate pepper (Questionnaire).

RISDA provides smallholders with free rubber seedlings, which take from five to seven years to mature. RISDA also provides training, basic equipment for tapping (shown in Figure 9), and machines to process rubber sheets for further sale. RISDA further provides fertilizer, pesticides, and herbicides, although to a small extent, given the low input requirements (SSI-2-6). Out of 11 households applying fertilizer, pesticides, or herbicides to rubber, five indicated that they have received some or all of these inputs from RISDA. It is interesting to note that these five households have planted their rubber trees a long time ago, on average 20 years (or longer than they can remember), in contrast to an overall average of roughly 13 years (Questionnaire). This could indicate a policy shift by the Ministry of Rural Development which deemphasized agrochemical support for rubber in the past.

Figure 8: *A rubber tree being tapped with equipment provided by RISDA.*

Rubber trees were often inherited and do not require much care or maintenance, which explains why all, but two households continue to have rubber trees, although most households neglect rubber tapping since market prices for rubber sheets are low, as price indices in *Figure 10* indicate. Moreover, rubber tapping appears to be a back-up livelihood strategy. As long as prices are low, rubber is only being tapped occasionally as a source of ad-hoc income if extra cash is required. Rubber trees are also used as border crops and to keep land under cultivation, as uncultivated land might be redistributed to other households (Transect walk-2; SSI-2; POUI). Accordingly, rubber trees are natural livelihood assets, although they currently do not accumulate wealth nor receive much attention.

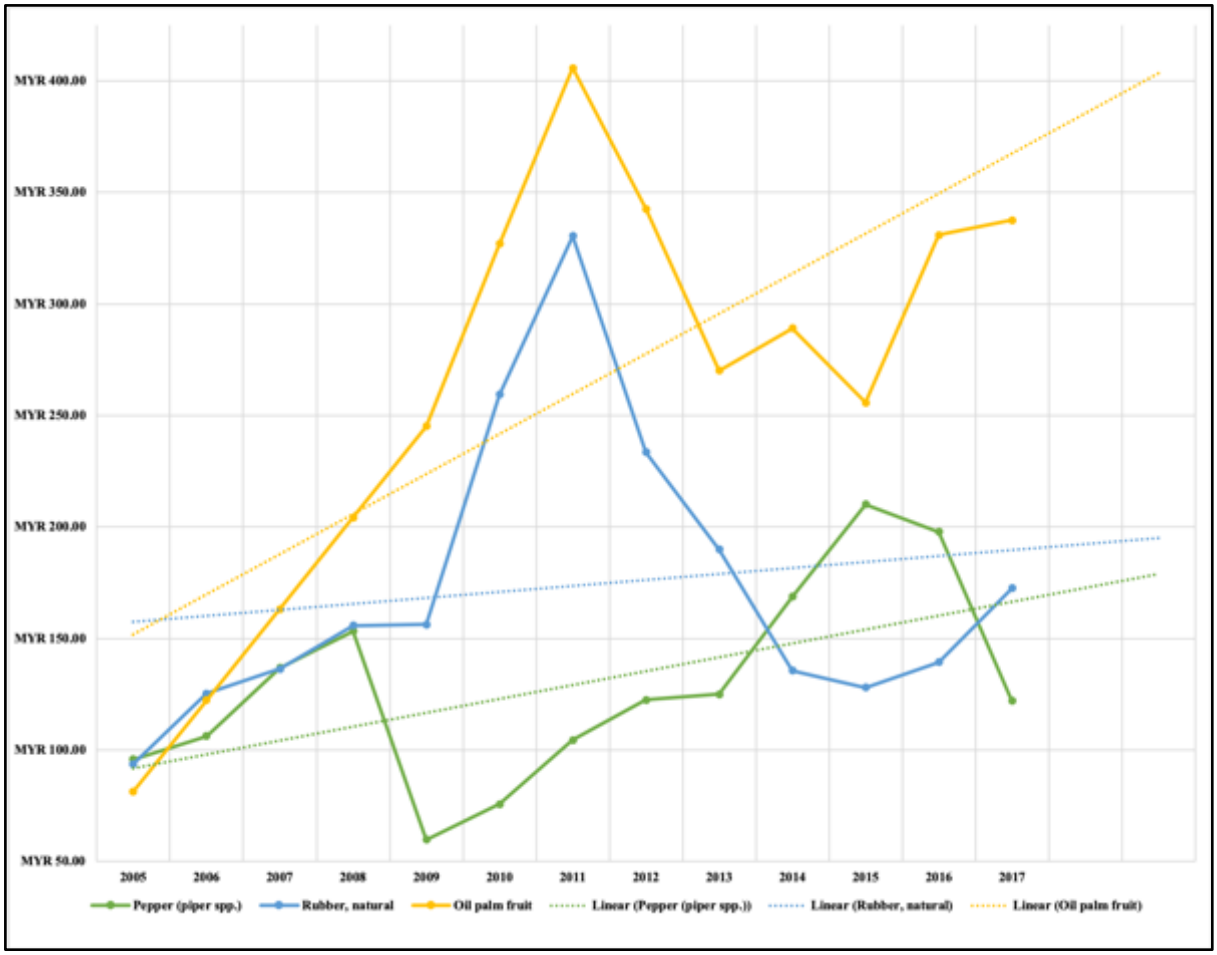


Figure 9. *Producer Price Indexes for OP (yellow), Rubber (blue), and Pepper (green), equalized for Malaysian Ringgit and weight unit, 2005-2017* (FAOSTAT 2020).

Similarly, the MPB provides seedlings, hardwoods, and training for pepper vines of different optimized varieties. Additionally, they provide fertilizer, pesticides, and herbicides for the start-up phase of three years. They also provided a machine to process white pepper, which is currently not being used because of low prices (SSI-2-6; Transect walk-2). Out of the 18 households applying fertilizer, pesticides, or herbicides to pepper, only three indicated that they have received some or all of these inputs from the MPB. These households have been growing pepper for the shortest amount of time (two years), which reflects the temporary start-up support provided by the MPB (Questionnaire).

Pepper has no specific season to cultivate and is harvested every nine months once the tree is mature. In contrast to rubber, pepper does require significant inputs in terms of labor, fertilizer, and pest control (Crop Calendar, Scoring Matrix). Therefore, one could assume that pepper harvest is partly being neglected since pepper prices have been low at the time of our presence (see Figure 10) and the ongoing rice harvest competes for labor. However, pepper can be stored and sold spontaneously at times of higher prices, or when additional cash income is required ad-hoc (POUI, Transect walk-2). Given its liquidity, stored pepper could be regarded as a financial asset that can buffer sudden liquidity pressures. Additionally, pepper cultivation receives a lot of priority as a skillful and traditional activity which brings enjoyment (Scoring Matrix). Accordingly, pepper appears to hold a firm position in KL livelihoods strategies, even though farmers complained about low prices and highlighted the high costs of its cultivation (Scoring Matrix, POUI).

Text Box 2

"I had to pay my electricity bill and was short of cash, so I decided to sell some of my stored pepper. That is why I continue to grow pepper despite the low market price, it is my savings"
(Transect walk-1)

In both cases, the demand for agrochemical inputs is not fully covered by the government. Farmers largely use surplus rice fertilizer provided by Peladang or have to purchase products themselves (SSI-1-6). Nevertheless, the support appears to be fairly accessible as nobody in our semi-structured interviews expressed difficulties in receiving seedlings or start-up help. Although the crops do not generate considerable incomes or drive a vibrant rural economy, as it might have been in the past, they are assets for KL livelihoods: to mark landholdings (rubber), as a joyful traditional activity (pepper), and as buffers to ease sudden liquidity pressures (rubber, pepper). The government support schemes might currently not be highly successful from a pure macro-economic policy perspective, but their outcomes are strategically being used by households to support their dynamic livelihoods.

Oil Palm

The following section will discuss how government programs facilitate OP cultivation as a relatively new livelihood strategy. Particular focus is spent on the way by which access to livelihood assets and transforming structures and processes condition and affect livelihood outcomes from this strategy. OP is currently the only crop generating considerable incomes with rising prices (Figure 10) and the capacity to accumulate wealth: a field with 300 trees, a common size in KL, generates around RM800-1200/month, depending on quality and market price. However, OP cultivation is labor intensive, bears high start up-costs, and requires non-sloping fields with road access, due to the bulkiness of OP fruits (FDG-3; Scoring Matrix; SSI-2-6).

Incentivized by the new income opportunity and by the MPOB smallholder support scheme which they have been granted, the first four households started OP cultivation in 2009 and 2010 while the road construction was being finalized. The MPOB, under the administration of the Ministry of Primary Industries, opened up applications for smallholder support in forms of seedlings, agrochemical inputs, work equipment, and the improvement of field road access in some cases. Additionally, extension workers assist when problems such as pests arise, provide regular training on the different stages of the crop cycle, and control the compliance of land management standards. In principle, this support is similar to the one offered by RISDA and the MPB, but is significantly more substantive. The beneficiaries reported the provision of resources worth RM9000 for each farmer. A further difference is the application, which took three years to result in actual benefits, and was perceived as complicated

and not very accessible. Nevertheless, all recipients of these benefits expressed their happiness about the received support and could not list any disadvantages (FDG-3).

Figure 10: *Picture of OP plantation near the LH*

MPOB support is much desired but not accessible to all households. After the success of the first four pioneers, others in the community applied for MPOB support. However, no household has received any support from the MPOB after that, although most households apply every year. The reason for this is unknown. Some hypothesized that updated requirements demand formal land titles, others think the MPOB is underfunded, and yet others assume patronage-based distribution of MPOB resources (FDG-3; SSI-7; SSI-1; SSI-3). MPOB officials have not answered a written interview concerning this observation. In any case, the lack of transparency of the transforming structures and processes at work, and the individualized access to this program limits the MPOB's ability to support the community as a whole.

Evidence suggests that social livelihood assets could have been decisive for MPOB support. The four

MPOB beneficiaries assured that everyone was invited to join their application in 2009 but back then only they were willing to take the risks being first movers and carry the heavy labor of OP cultivation (FGD-3). Others, however, told us they never knew about the application and were not asked to participate (SSI-3; FGD-1). According to our informants it is the formal responsibility of the headman to share such information equally among the community (SSI-1, POUI). However, a former leader of the community had to leave the longhouse as he allegedly underpaid community members for their labor on his MPOB subsidized OP field, while not revealing the profitability of OP to the rest of the community (POUI). If only certain households were informed about the MPOB scheme and others not, social assets, such as a distinct relation to the person being aware of such opportunities, were decisive

to receive relevant information. The same holds if MPOB officials distribute resources based on patronage. Which of the narratives is more accurate is unclear, but they do indicate that access to MPOB support created privileges that could have contributed to a divide inside the community?

Text Box 3
"I apply every year [for the MPOB] *and never receive it and I don't know why… They take your application and shove it somewhere under a pile. It is like this; and then it just depends on who you know"* (SSI-7)

Nevertheless, all other 11 households with road access launched their small-scale cultivation of OP. Either households obtained OP seeds from friends or relatives or they bought them from certified nurseries (Questionnaire). Buying from certified nurseries is expensive (RM15/seedling) but provides the required license to be formally allowed to transport and sell OP fruits (FGD-3; SSI-7). Households who do not have the necessary financial assets for certified seedlings are disadvantaged because they have to sell their fruits to an informal middleman at a 20% lowered rate (SSI-3). Most households without road access cannot enjoy benefits from OP cultivation at all. Another potentially limiting factor is labor. In KL's aging population a shrinking labor availability might hamper the future of OP.

OP holds the potential to generate substantial incomes, drive the rural economy, and secure and improve rural livelihoods of small holders. However, it has been repeatedly confirmed that the expansion of this livelihood strategy will depend on further road development and MPOB support because of high start-up costs (POUI; FGD-3; SSI-7). The uncertainty about MPOB support and about the reasons for its absence has resulted in frustration (see Text Box 3) and increased the perceived inequality within the community (SSI-7; FGD-3). Access to the benefits from OP depends on the availability of physical, human, and potentially social livelihood assets. This could increase inequality and potentially erode community cohesion, although we did not experience any conflicts during our stay.

Refusal of SALCRA Joint Ventures

The subsequent section will discuss how KL made the strategic decision to refuse joint venture programs to keep autonomy over their livelihood assets. The community of KL has repeatedly been offered to participate in joint venture programs for the large-scale plantation of oil palm with SALCRA (SSI-7).

Text Box 4
The purpose of joint venture programs is generally to pool complementary resources from different shareholders for the development of an enterprise. In the case of SALCRA brokered joint ventures, landholders under NCR contribute resources in the form of their land and their labor, while government institutions broker and manage land consolidations, and private investors provide financial capital. In other words, small-holders surrender their land to the government agency, which consolidates the land, transforms it into a mono-crop plantation, and leases it to private investors who then hire the small-holders as their labor force. Smallholders receive a 30% equity share in return. After two crop cycles (60 years), the community can either extend the agreement or terminate it, upon which they are given back their land, not under NCR, but as individualized plots with private land titles (Ngidang 2002).

An informant strongly indicated that the community stands united behind the decision not to participate in any joint venture programs as they are described in Text Box 4. The reason for this decision is a deep mistrust against joint ventures programs and government agencies aiming to consolidate land under their management, which has been confirmed in informal talks with other community members (POUI). Apparent joint venture experiences from other communities, which have never fully received their profit shares nor sought-after land titles, as well as the low wages as plantation employees discouraged KL to engage in any joint ventures (SSI-7).

Although it was indicated in the FGD-3 and in informal talks that private individualized land titles are desired (POUI), it is notable that the NCR provides the community with autonomy over their land. This empowers the community to reject the consolidation of their land, based on their own judgement and the information at their disposal. Given the significance of land for their livelihoods, it is little surprising that the community is not interested in risking this autonomy. Land is not only the basis of their subsistence but also holds cultural and spiritual value. The PRA mapping and interviews showed that certain river and forest patches are considered sacred and individuals have repeatedly expressed their strong emotional connection to the surrounding landscape.

4.3. Influences of Socio-Economic System on Agroecology

This section will illustrate how different government interventions (referred to as structures and institutions under the SLF) indirectly influence and alter natural assets' physicochemical properties. This can be seen not just in the influences on land-use as described above but also in soil, water characteristics. A demonstration of some influences that government initiatives have had on agroecology vis-a-vis natural and physical livelihood assets will be outlined below.

10,847 Words

4.3.1 Soil Perception Underlying Soil Fertility

The suitability of the land is the limiting factor for the development of agricultural practices. To find information regarding this, soil perceptions of smallholders were meant to be compared with specific physio-chemical results in the laboratory (FGD-2). However, due to the lack of analytical soil information, the following section can only be discussed in theoretical terms without laboratory analysis.

Map 2: *Depiction of the areas considered as the most and least fertile. Soil samples collected in the areas with similar characteristics.*

The main difference between a 'good' and 'bad' soil for farmers were the texture and the topography of the land (FGD-2). Fertile areas were perceived as the darker in colour located usually further up in the mountains, where less sandy soils with rocks at the bottom can be found. Contrary, less fertile soils are characterized as yellowish-red soils with higher content of sand, but still suitable for performing agriculture (Ibid). This led researchers to believe possible differences between uphill and lower areas, and in consequence a differential response to soil quality loss.

Based on their descriptions, soil samples analysed in KL theoretically fit into the 'bad'-soil perception and can be characterized as Ultisols **(**Bruun et al., 2013; Chapin III et al., (2011), Coulter, 1998; Sarawak Department of Agriculture, 1968). Weathered soils with conditions of deep moisture that have been developed on sedimentary, acid igneous and metamorphic rocks (Ibid). The horizon A, topsoil layer, presents a brownish yellow to yellow colour in the horizon B, subsoil layer (Figure 12). Organic matter in the topsoil layer contributes to darker colour and is found to be sensitive to management, but relevant to perform proper plant growth (Culman et al. ,2012). Again, more detailed distinctions could have been made with specific laboratory analysis.

Figure 11: *Horizon A and B from Ultisols soils, with proper differentiation of colour between layers. Soil from uphill rice fields.*

The agricultural capability associated with KL specific geographic areas appear to be strongly influenced by the nature of the parent materials (referred to as *Melugu* and *Bugunan* series), topography, but also the human activities in terms of the degree of agricultural intensification (Sarawak Department of Agriculture, 1968). Soil series, heavy rainfalls in combination with fertilizers are the primary cause of nutrient leaching and acidification of soils (Harter, 2002). The pH results from Table 5 b), are found to be lower than expected in all the cases, indicating effects in acidification (Suseela et al., 2010). Based on the Universal Soil Loss Erosion Equation (Wischmeier, 1984), OP presents the highest erosion risk among all crops studied (Table 5 a.). For the rest, pepper presents the higher increase in erosion rate when increasing steepness of slope. Rice, in contrast, maintains similar values. These results highlight the importance of the topography in crop selection.

UNIVERSAL SOIL LOSS EROSION EQUATION RESULT		
CROPS	LOCATIONS	
	Uphill	Low-land
Oil Palm	-	60.31
Secondary Forest	21.25	-
Pepper	16.08	10.78
Paddy	19.67	18.64

pH RESULTS		
CROPS	LOCATIONS	
	Uphill	Low-land
Oil Palm	-	4.28
Secondary Forest	5.49	-
Pepper	4.41	4.715
Rice	5.89	5.61

Table 5. *Data output from in situ soil sampling test from: a) Soil Loss Erosion Equation b) pH results from same crops and sample sites. (Wischmeier, 1984).*

KL agricultural system appears to be suitable for rubber, upland rice and pepper under conservation practices (Sarawak Department of Agriculture, 1968). The mentioned crops favour agriculture due to

its root system in deeper zones in the B horizon, supplying carbon and nitrogen to the soils (Shaliha et al, 2012). Conversely, OP is found to show a high C/N ratio in the A horizon because of root system distribution about 0-30 cm (fibrous root), which translates into higher plant activity. The latter combine with the high activity ratio of Al and Fe characterizing soils in tropical regions, could cause difficulties for plant nutrient uptake due to precipitation of some chemical forms after a 'competitive' interaction among nutrients, decreasing soil fertility (Jensen & Husted, 2009; Shaliha et al, 2012). Therefore, placing the OP in lowland areas and the crops causing less erosion in uphill fields (pepper and rice) is interpreted as a sustainable agricultural practice followed for KL smallholders.

In relation to subsidised agricultural inputs use, rice receives the highest amount overall (Figure 13). Acting as the base for food security and its constant requirement for management (Crop calendar) this situation is explained. At various degrees, the rest of cash crops also receive noticeable subsidised inputs. This continuous application is a requirement of the KL agricultural system as described above, and through either the subsidized inputs or bought, smallholders would decrease their vulnerability context.

In contrast, a constant fertilization, might not only cause erosion and leaching of nutrients, but inappropriate distribution on inputs due to cross fertilization in intercropped fields, which account for almost every rice field. Lower yields than potentially expected could be found for this situation, but generally , securying food at household level is the main output found in this strategy.

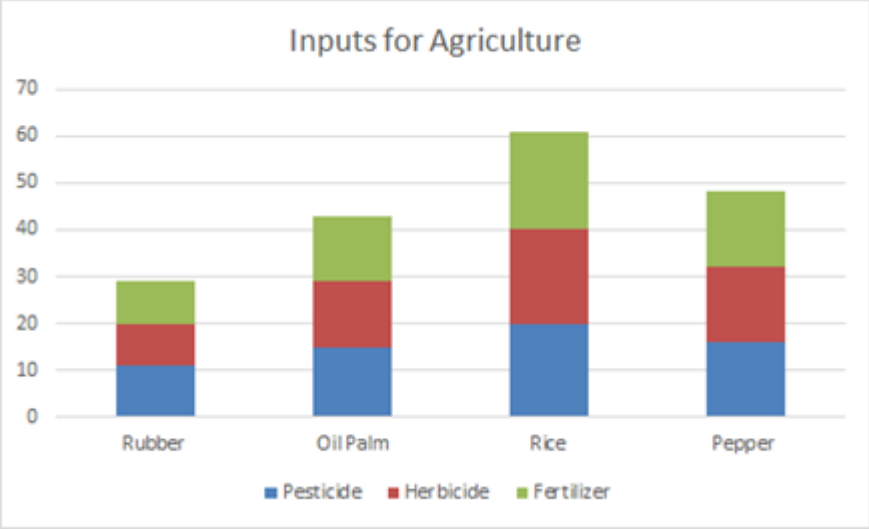


Figure 12: *Distribution of subsidised pesticide, herbicide and fertilizer for three cash crops (rubber, OP and pepper) and rice among households (n=21: seholds practicing agriculture).*

At a proper extent, smallholders succeed to overcome the disadvantages in working on KL agricultural systems mentioned above, leading to a profitable strategy in terms of maintaining capitals (i.e financial) while avoiding significant detriment in the natural capital.

Even though the literature describes similar phenomenon and soil systems for the same region and occurring in agricultural lands, it is relevant to mention the difficulty to argue soil repercussions in the natural capital due to the lack of empirical output from this precise station.

4.3.3 Water Quality Assessment

The water streams are of relevance as a natural resource for the KL community, acting in combination with soil, as the natural capital under KL livelihood strategies. Water quality could be affected by agricultural practices, whether watershed is placed nearby cultivars or not, mainly by leaching, as crops are unable to absorb the total percentage of applied fertilizer and other chemical compounds (Kumar, 2019).

Samples were collected both, at their main source of drinking water and at different streams in Kumpang River, where fishing and leisure activities are commonly practiced. In order to investigate the effect of the livelihood strategies might have, sample sites are as follows:

ST-1: Upstream: no crops nearby. Main source of gravity fed potable water network.

ST-2: Middle-stream. Kumpang river, bordering rice paddy and pepper fields

ST-3: Downstream. A steady water storage next to an OP plantation (Certified by MPOB). Not a water stream.

The results from the data collection from water sampling gathered in Table 6. These parameters would be compared to the National Water Quality Standards for Malaysia (NWQSM) with the different classes (Table 7):

Stations				
Parameter		ST1	ST2	ST3
Physical	**Turbidity (NTU)**	8	6.5	46
	pH	7.33	7.1	6.6
Chemical	**COD (mg/l)**	0	3	7
	NH3-N (mg/l)	0.025	0	0.11
	P (mg/l)	0.1	0.095	0.15
Biological	**FCC (count/100ml)**	255	300	500
	TCC (count/100ml)	350	730	1275

Table 6: *Results from the three different stations analyses with specific test performed.*

a)

National Water Standars For Malaysia					
Classes					
I	IIA	IIB	III	IV	V
<5	<50	<50	-	-	
6.5-8,5	6.5-8,5	6 - 9	6 -9	<5	>5
<10	10-25	10-25	25-50	50-100	>100
<0.1	0.1-0.3	0.3	0.3-0.9	0.9-2.7	>2.7
<0.1**	0.2	0.2	0.1	-	#
<10	<100	<400	<5000	<5000	-
<100	<5000	5000	50000	50000	50000
**natural level or absent					
# level above IV					

b)

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

Table 7: *a) Standard values from NWQSM with b) description of the classes.*

Values from ST-1 and ST-2 are associated either to classes I or IIA of the NWQSM. That means water quality[11] is under general good conditions and represents no or little threat for human consumption under adequate treatment (i.e.; boil water). For the ST-3 site, surrounded by oil palm plantations, values for the pH and Fecal Coliform Count (FCC) are deviated from the normality in natural conditions. These findings could not be associated with leaching after poor management practices regarding fertilizer use range due to the naturalness of detection of the test does not allow. Yet no extrapolations can be made. Hence, high values associated with FCC indicate presence of non-treated contaminated sewage water with presence of human or animal excreta.

Results from miniSASS support these findings. MiniSASS was performed next to an OP plantation and relatively close to the LH and several crops fields. With a sensitivity average score of 6.6, Kumpang River is classified under the 'good condition' category.

Therefore, overall, water sources in the community of KL, present little or no influence of adverse effects from agricultural practices in terms of water detriment. Water is secured for the community members and the agricultural practices they are engaged seem to not cause significant detriment in water quality. It is important to mention that results might fluctuate between different time periods when land-use will be more intensified (i.e. during winter rice fertilization) finding different results.

5.Discussion

The following section discusses our findings in respect to the research question. Overall our data supports that the combination of KLs agricultural system and access to various external government initiatives have provided varying degrees of both opportunities as well as threats to local livelihood strategies. This section will discuss and illustrate this by presenting three case examples from KL, exemplifying these opportunities, threats and dependencies in practice.

[1] Water ''quality'' is going to be referred to in this report as ''The suitability of water to sustain various uses or processes. Any particular use will have certain requirements for the physical, chemical or biological characteristics of water. Consequently, water quality can be defined by a range of variables which limit water use'' (Bartram and Balance, 1996)

Figure 14 below illustrates how different factors and effects interplay when households make decisions about how to utilize livelihood's assets, structures, processes within their particular context. By viewing the subcomponents of the SLF through this model through a SWOT analysis, one can see what factors may influence individuals or household decisions to take part in different pathways of livelihood strategies. Additionally, that effects from interventions materialize as internal and external factors: strengths, weaknesses, opportunities and threats emerge. When these strengths, weaknesses, opportunities and threats are navigated, new livelihood outcomes are created.

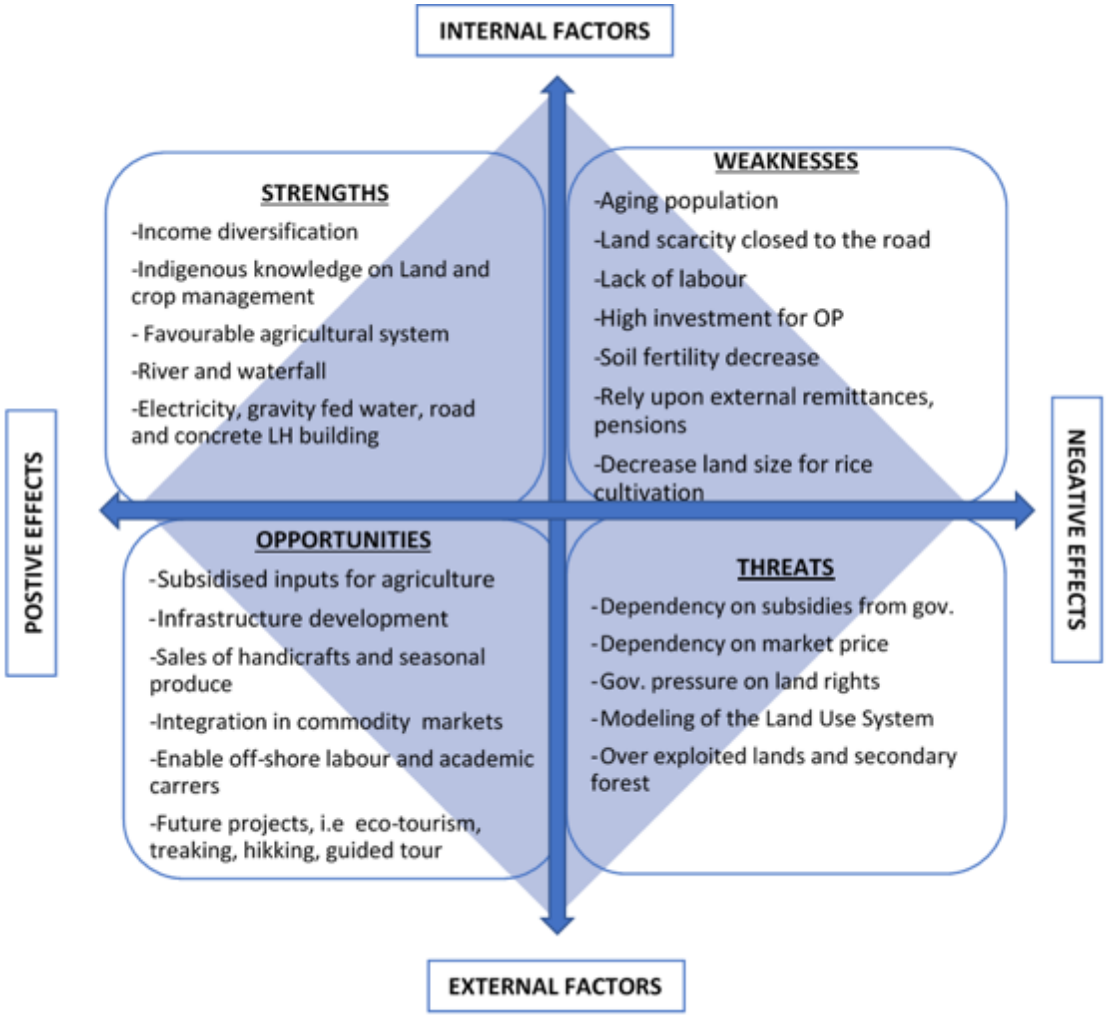


Figure 13: *KL SLF's Opportunities and Dependency interpreted into a SWOT diagram.*

In practice, the culmination of these livelihood outcomes in the community have enabled a 'dual economy' which almost every inhabitant of KL participates in: combining subsistence rice, vegetable, and fruits, with income from different cash crops (Questionnaire). This strategy is considered sustainable by Cramb (1993) and Wadley & Mertz (2005). While Malaysian government initiatives incentivize and engage smallholders into monocropping systems, diversification through a dual-economy regarding land-use practice and livelihood outcomes remains an adequate strategy for rural communities. Higher degrees of diversification are found among the most prosperous households and is possible due to an intensified agricultural system. Nevertheless, weaknesses in the agricultural system and new indirect dependencies from natural assets such as fertilization, pest management, and threats to soil and water conditions remain for the longer term.

Intensification to the rural agricultural system is facilitated by providing government-based assets and initiatives but leave producers in an ambiguous position of depending on subsidized inputs. Differing responses to this occur between households. High-income households are less vulnerable than lower-income households to this issue since they can buy additional inputs. However, weaknesses inherent to the agricultural system and exposure to soil erosion remain, leaving producers in a land system with continuous soil, water, and pest/disease management demands. In the future, if erosion becomes exacerbated, households with more suitable land-use practices and more diversified livelihood strategies would be less vulnerable.

Similarly, our findings show that external factors can significantly affect livelihood strategies. Road access allowed for additional access to agricultural commodity markets, but price fluctuations accompany these new opportunities. If the price fluctuations negatively affect main cash crops (Pepper, rubber, OP) then different livelihood activities (foraging, subsistence vegetables, NTFP, and hunting. etc.) buffer these shocks but this leads to a paradox. KL's dual-economy continues to be pulled by drivers such as urban migration and pushed by other drivers like an aging population and cash cropping incentives. These drivers could alter the sustainability of the dual economy as a center of KL's socio-economy in the long-run. As long as this is avoided KL livelihood strategies are sustainable both in terms of income and food security, as stated by Cramb (2013).

5.1 Case studies

Ultimately, each household will navigate their future differently. The specific cases below illustrate how a different combination of livelihood assets and varying access to different government initiatives alter livelihood outcomes of each particular household. Before continuing further, a short introductory description of the cases can be seen in Table 7 below:

Case Studies (ID/age/income group)	Household Description	Opportunities	Dependencies
HH2 (40-49) High income	HH size: 7 Income: Agriculture (Large OP plantation) Secondary income: vegetable sale and transport provider Land Arrangement: Land title + NCR Road Access: Yes Government initiatives accessible: MPOB certification	-More diversified source of income-through the road -Large economic benefits for involvement in OP market -Possibility to apply to development programs -Benefits from selling to mills	-Price market fluctuations -Road Access -Own provided inputs for agriculture -Strong reliance on those inputs to maintain yields - a larger amount of manual labor
HH4 (60-69) Middle-income	HH size: 2 Income: Agriculture Secondary income: None Land Arrangement: NCR Road Access: No Government initiatives accessible: None	-Possibility to apply to development programs -Economic benefits for involvement in OP market	-Own provided inputs for agriculture -Strong reliance on those inputs to maintain yields -No access to mills; rely upon price markets and intermediaries for selling
HH16 (70-79) Low income	HH size: 2 Income: Welfare from Government Secondary income: None Land Arrangement: NCR Road Access: No Government initiatives accessible: None	None: insufficient human capital makes labor difficult. The HH consists of one elderly woman taking care of her middle-age blind son	Fully reliant on Social Security Organization of Malaysia (SOCSO)

Table 7: ***Informants for study cases representing three different households.*** *The main characteristics of the household are described in relation to opportunities and dependencies provided by Government Initiatives.*

These cases represent three clear examples where applicable livelihood assets differ resulting in different livelihood strategies. Furthermore, these assets can be altered by either changing access or changing the implementation of policies, institutions, and processes.

When comparing HH4 and HH2: both rely on agriculture. But, a higher degree of involvement in OP plantations made possible by different government initiatives, road access and MPOB certification resulted in a more profitable economic situation for HH2 than HH4. Additionally, HH2 also has a younger and larger household size allowing him more human assets (labor) within the SLF model - minimizing an internal weakness of the agricultural system (see Figure 14).

HH2's higher-income also allows him more livelihood assets which were then used to access other sources of income (transportation, vegetable sale). These act as a buffer during market fluctuations - thus decreasing the household's vulnerability context. In contrast, HH16 served as an example of a household with few accessible assets. Human capital is very low, an aging and physically disabled member of the household prevents labor inclusion in agriculture - forcing them to be fully reliant upon either remittances or government assistance. In this example, the household's only income source was accessible through the SOCSO.

5.2 Framing Dependency

This section will discuss whether the villagers in KL should be perceived as dependent on outside support in the form of agricultural services from the government. As shown throughout this report and in the above examples, people of KL receive support from government initiatives for rural development in various amounts. Most of KL's population receive so much that it has an effect on what livelihood strategies they pursue, and how they decide to use their land. In this sense the long house community has made a livelihood that is dependent on the support from the government, which can be perceived as a threat to the people of KL's way of life, because there is no guarantee that the support will continue.

This view of the farmers as dependent on the government, is challenged by sociologist Saskia Sassen in her theory of 'the global city'. Here she describes the globalized world as made of centers and peripheries (Sassen 2007,177). The centers are characterized by a high level of specialization, capability of global control and with enormous profits, examples of this are large cities such as New York, London and Tokyo (Ibid.) The peripheries are where the poorer workers live, who have little political power and who live mostly in rural areas (Sassen 1991, 4-10,102;Sassen 2017,177). In her model she describes that because of globalization the cities will become more interdependent and the centers will increasingly depend on the peripheries (Sassen 1991,11,166). Her theory argues that in our global world we are all interdependent on each other, not only the poorer workers on the rich city dwellers, but actually even more the other way around.

In the case of KL this theory suggests that even though farmers do receive a lot of government support, they are not more dependent on the government, than the government is on them. The economy of Sarawak depends on farmers to get products for export. In this line of thought the agricultural support KL receives provided by the government is not necessarily just funding their livelihoods, but the support can be perceived as funding a governmental investment in their farmers.

6. Conclusion

This report sought to answer, "*How do government initiatives for rural development affect land-use practices in Kumpang Langgir, and with what outcomes for their livelihoods??*" The community of KL has a specific context where community-members engage their respective livelihood assets with accessible government structured initiatives to potentially access different types of livelihood assets and form new livelihood strategies. This happens simultaneously at the household level and when faced with internal and external strengths, weaknesses, opportunities, and threats to their current livelihood strategies. The collective information presented above attempted to show this: presenting case examples and showing how the SLF interacts with varying themes related to KL's dual-economy and agricultural system. As rural development continues, this dynamic will continue. If we look at this more abstractedly, interesting questions for future research emerge; although some points should be noted beforehand.

Readers may conclude that while communities like KL have an agricultural system where subsistence plays a large role, the community is not self-reliant. Their agricultural system has various forms of dependence on government subsidies and their livelihoods also depend on remittances. If rubber and pepper prices decrease compared to other cash crops, further development opportunities seem to depend on MPOB support and expansion of road access to fields. The future of both these initiatives is uncertain. Living standards have increased in KL and different opportunities are available as livelihood

strategies; but these opportunities are not reliable in the longer term if KL's economic structure is to remain. Urban migration and an aging population reflect this.

Regardless, it is important to consider that households in KL are not simply acted upon. They chose to participate and engage with structures and institutions through a range of creative means: with new land-use practices to reinvest their use of natural assets or by forging new livelihood strategies. Assuming that the nature of interactions with external factors and their responses will be static rather than dynamic over time is simplistic at best. Furthermore, while dependency is inherent in KL's livelihood strategies and interactions, the very nature of development and globalization is one of mutual interdependence. As mentioned in the discussion, as development occurs urban areas become interdependent on rural peripheral communities, such as KL, just as rural peripheries become more dependent upon connections and opportunities from cities. Regardless, the trends seen in rural development raise interesting questions. On an abstract level, future themes of investigation could include: the redefinition of the communal Iban longhouse community according to agricultural commodities or individualistic entrepreneurialism. Or on a more practical level, thematic research regarding the effectiveness of government agricultural inputs, potential for livestock improvements and tourism, cash crops which require less labor. Researching these themes would assist in answering the research question and elucidate the significance of the findings presented here.

To conclude, the rural development of Sarawak is complex and positive and negative aspects exist. Although the model presented in this report attempts to highlight the relationship of these complexities, statements from KL community members themselves paint a good holistic picture of being aware, yet optimistic of this dynamic.

They are grateful for the new opportunities that they have been presented with and eagerly look forward to future opportunities (i.e. telecommunication tower, tourist routes in the forest, potential granite mining). They are aware of the changes brought by infrastructure and the OP business and confidently reject initiatives when they do not suit the community (i.e. SALCRA joint-venture). Rather than expressing dismay at the dependencies they now face; participants wish to connect more. This repeated sentiment indicates that development is successful at integrating rural communities in a participatory manner improving their livelihoods.

7. References

Al-Badaii, F., Shuhaimi-Othman, M., & Gasim, M. B. 2013. *Water quality assessment of the Semenyih river, Selangor, Malaysia*. Journal of chemistry.

Bartram, J., Balance, R., 1996. *Water Quality Monitoring – A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Program*s. UNEP/WHO.

Birdsall, N.M.; Campos, J. E. L.; Kim, C.; Corden, W. M.; MacDonald, L. [editor]; Pack, H.; Page, J.; Sabor, R.; Stiglitz, J. E. 1993. *The East Asian miracle : economic growth and public policy : Main report (English)*. A World Bank policy research report. New York, New York: Oxford University Press.

Bruun, T. B., Egay, K., Mertz, O., & Magid, J. (2013). Improved sampling methods document decline in soil organic carbon stocks and concentrations of permanganate oxidizable carbon after transition from swidden to oil palm cultivation. Agriculture, Ecosystems & Environment, 178, 127-134.

CABI Crop Protection Compendium. (2010). *Solanum melongena Datasheet.* Available at: http://www.cabi.org/cpc/datasheet/50536. [Accessed 2 April 20]

CABI Crop Protection Compendium. (2019). *Musa acuminata (wild banana) Datasheet.* Available at: https://www.cabi.org/isc/datasheet/35125#topests [Accessed 2 April 20]

Chambers, R. 2008. *Revolutions in development inquiry*. Earthscan.

Chapin III, F. S., Matson, P. A., & Vitousek, P. (2011). Principles of terrestrial ecosystem ecology. Springer Science & Business Media.

Coulter, J. K. (1998) Tropical soils. In: Webster, C. C., & Wilson, P. N. (1998). Agriculture in the tropics (No. Ed. 3). Longman Group Ltd.

Cramb R.A. 1997. *Remoteness and rural development: economic impacts of rural roads on upland farmers in Sarawak, Malaysia.* Asia Pacific Viewpoint 38(1): 37–53.

Cramb R.A. 2007. *Land and Longhouse - Agrarian Transformation in the Uplands of Sarawak*. Copenhagen, Denmark: Paperback.

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

Embong J. 2002. *State-led Modernization and the New Middle Class in Malaysia. New York, US: Pelgrave.*

Erni, C. 2015. *Shifting Cultivation, Livelihood and Food Security.* Food and Agriculture Organization of the United Nations and International Work Group For Indigenous Affairs and Asia Indigenous Peoples Pact, Bangkok.

FAO. 2006. *Nutrient management guidelines for some major field crops.* Rome, Italy: Food and Agricultural Organization of the United Nations: 237-240.

Fold, N & Hansen, TS. 2004. *Oil palm expansion in Sarawak. Lessons learned by a latecomer.* In Connell J, Waddell E, editors.*The Local and the Global: Environment, Development and Change in Rural Asia-Pacific*. University of Hawaii Press,Honolulu. p. 147–66.

Climate-data.org. 2020. *Sri Aman climate: Average Temperature, weather by month, Sri Aman weather averages.* Climate-Data.org. [online] available at *https://en.climate-data.org/asia/malaysia/sri-aman/sri-aman-976530/#climate-graph*

Hamid, M. S., Mohamed, S.B., & Abdullah, A. A. 2019. *Profiling of Manufacturing Industries Bumiputera Entrepreneurs (MIBE) Government Related Agencies.* International Journal of Academic Research in Business and Social Sciences, 9(7), 1212–1262.

Harter RD. 2002. A*cid soils of the tropics. An Echo Technical Note*. Available from http://echonet.org/tropicalag/technotes/ Acidsoil.pdf.

Hew, C. (Ed.). 2007. *Village Mothers, City Daughters: Women and Urbanization in Sarawak*. ISEAS–Yusof Ishak Institute.

Hill, T. & Westbrook, R. 1997. S*WOT analysis: It's time for a product recall*. Long Range Planning 30(1): 46-52.

Hughes & Salathé, 2020. *Eggplant | Diseases and Pests, Description, Uses, Propagation*. Retrieved 2 April 2020, from https://plantvillage.psu.edu/topics/eggplant/infos

Idio, A., & Adinya, I. 2017. *Analysis of different rates of N.P.K. (15:15:15) fertilizer on yield of eggplant (Solanum melongena) in Cross River University of Technology Teaching and Research Farm,* Obubra Campus, Cross River State, Nigeria. Net Journal Of Agricultural Science, *5*(4), 121-125. doi: 10.30918/njas.54.17.046

Jarvis D.S.L. 2017. 8 - *The State and Development in Malaysia.* In T. Caroll Editored *Asia after the Developmental State* (pp. 201-236). Cambridge, England: Cambridge University Press.

Jensen, L.S. & Husted, S., 2009: Applied plant nutrition. Faculty of Life Science. 4 edition.

Kumar A, Guha A, Bimolata W, Reddy AR, Laha GS, Sundaram RM, Pandey MK, Ghazi IA. 2013. L*eaf gas exchange physiology in rice genotypes infected with bacterial blight: an attempt to link photosynthesis with disease severity and rice yield.* Aust J Crop Sci 7(1):32–39

Limsrivilai, P., Likitakaraj, S., & Surin, P. 1980. *Oil palm diseases [crown diseases; spear rot] in Thailand. In 2. Southeast Asian Symposium on Plant Diseases in the Tropics*, Bangkok (Thailand), 20-26 Oct 1980.

Mertz O.; Reenberg A.; Bech Bruun T.; & Birch-Thomsen T. 2008. *Land use decisions in smallholder rural communities in developing countries.* Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 3(204): 3-11.

Mertz, Ole, Kelvin Egay, Thilde Bech Bruun, Tina Svan Colding 2013. *The Last Swiddens of Sarawak, Malaysia*. Human Ecology 41.

10,847 Words

Mikkelsen, Britha. 2005. *Methods for Development Work and Research: A New Guide for Practitioners.* SAGE Publications India Pvt Ltd.

Nagaraja, K., Praveen, J., & Reddy RL, R. 2019. *Standardization of fertilizer adjustment equations in banana cv. Ney Poovan (AB) following Targeted yield concept*. Retrieved 1 April 2020

Nair PKR. 1993. *An introduction to agroforestry*. Kluwer, Dordrecht, The Netherlands, p 55-56.

Narayanasamy, N. 2009. *Participatory rural appraisal: Principles, Methods and Application* New Delhi: SAGE Publications India Pvt Ltd

Nevins J. & Peluso N. (Eds.) 2008. *Taking South-East Asia to Market*. Ithaca, US & London, UK: Cornell University Press.

Ngidang D. 2003. *Transformation of the Iban Land Use System in Post Independence Sarawak*. Borneo Research Bulletin 34: 62- 78.

Ngidang D. 2002 *Contradictions in land development schemes: the case of joint ventures in Sarawak, Malaysia.* Asia Pacific Viewpoint 43(2): 157–180.

Orwa C, Mutua A, Kindt R, Jamnadass R, Simons A. 2009. *Agroforestree Database: a tree reference and selection guide version 4.0.* World Agroforestry Centre, Kenya. http://old.worldagroforestry.org/treedb/AFTPDFS/Elaeis_guineensis.PDF [Accessed 2 April, 2020]

Ravindran, P., & BABU, K. 2004. *Ginger: The Genus Zingiber.* Boca Raton: CRC Press LLC.pp.305-391

R. A. Cramb & Patrick S. Sujang. 2013. *The mouse deer and the crocodile: oil palm smallholders and livelihood strategies in Sarawak, Malaysia*. The Journal of Peasant Studies,40:1, 129-154, DOI: 10.1080/03066150.2012.750241.

Sarawak Department of Agriculture. 1968. Soil map of Sarawak.

Sassen, Saskia. [1991] 2002. *The Global City, New York, London, Tokyo.* Princeton University Press.

Sassen, Saskia. 2007. *The Global City.* In *A Companion to the Anthropology of Politics,* edited by David Nugent and Joan Vincent, 168.78. BlackwellPublishing Ltd.

Scoones, I. 1998. *Sustainable rural livelihoods - a framework for analysis*. IDS WorkPaper 72.

Shaliha, J. A., Arifin, A., Hazandy, A. H., Abdul-Latib, S., Majid, N. M., & Shamshuddin, J. (2012).Emphasizing the properties of soils occurring in different land use types of tropical rainforest inSarawak, Malaysia. African Journal of Agricultural Research, 7(48), 6479-6487.

Suseela, B., Sithara, R. & Kumar, A. 2010. *Influences of soil pH and moisture on the biocontrol potential of Trichoderme harzianum on phytophthora capsici-black pepper system*. Journal of Biological Control 24 (2): 153-157.

Wadley, R., & Mertz, O. 2005. *Pepper in a time of crisis: Smallholder buffering strategies in Sarawak, Malaysia and West Kalimantan, Indonesia.* Agricultural Systems, 85(3), 289-305. doi: 10.1016/j.agsy.2005.06.012.

Wischmeier, W. H. 1984. *The USLE: some reflections.* Journal of Soil and Water Conservation, 39(2), 105-107.

8.Appendices

Appendix 1: Overview of applied methods

Method	**Amount**
Semi-structured Interviews	8
Unstructured Interviews	8
Transects Walk	2
Focus Group Discussions	3
PRA: Mapping	2
PRA: Seasonal Calendar	1
PRA: Scoring Matrix	1
Surveys	23
Soil Samples	12
Water Samples Sites	3
Mini Sass	1

Appendix 2: Synopsis

Kumpang Langgir

Agricultural Practices and Livelihoods in Upland Sarawak

Course Synopsis: Interdisciplinary Land Use and Natural Resource Management

Dilani Lykke, Sara Ruiz de la Hermosa, Chris Ajemian,
Levin Scholl and Kirsten Solgaard Sørensen

10,847 Words

Table of Contents

10,847 Words

1. Introduction

This synopsis presents methodological considerations for an upcoming fieldwork on agricultural practices and livelihood in rural Sarawak, Malaysia. Since its independence in 1957, Malaysia experienced far-reaching and fundamental social change. As for other south-east asian countries: industrialization, globalization, and high economic growth transformed Malaysia from a mainly primary sector economy into an economically diversified upper-middle-income society (World Bank 2019, Birdsall et.al 1993). For more than half a century, this transformation has provided the broader context of dynamically changing livelihoods marked by urbanization, market integration, and rising living standards.

Social change of this magnitude, however, is rarely a straight forward process. This becomes evident by looking at rural Malaysia, in particular eastern Malaysia's Sarawak. Here, the Iban, Sarawak's largest ethnicity, have adopted a diverse spectrum of livelihood strategies and agricultural activities to cope with- and gain benefits from Malaysia's social transformation (Cramb 2007). In this light, it is interesting to note that some Iban communities have not entirely replaced swidden cultivation of rice and subsistence agriculture with cash cropping, agricultural intensification, or rural-urban migration, as it has happened with other communities over th
e past decades (Mertz et al 2012). Such communities provide an excellent subject to study the impacts of modernization, dynamic livelihoods, and small-holder and community decision making, confronting the transforming rural environment of a newly industrialized country.

The upland Iban community of Kumpang Langgir (KL), 52km from Sri Aman, exemplifies such a case. While some of the 26 households in this community engage in small scale perennial cultivation of oil palm, pepper, and rubber. The community largely depends on shifting cultivation of hill rice, fishing, and handicrafts for subsistence, with comparatively little external input (TR Baying Kasam). Their reliance on subsistence agriculture and shifting cultivation, their previously noted agricultural intensification, and simultaneous market integration via cash crops, make KL a particular case that may showcase the role of different agricultural practices, such as cash cropping and subsistence farming, for rural livelihoods in the upland-Sarawak context.

1.2 Overall Objective & Research Questions:

The overall objective research is to gain knowledge on the role and strategic use of different agricultural practices for the management of livelihoods in KL. Based on this objective our research is guided by a central research question: How do different agricultural practices affect Iban livelihoods in KL? From this question four distinct but related sub questions derive:

1. What are different agricultural activities among inhabitants in KL and how are they used?
2. What are the largest perceived livelihood changes the local community of KL experienced and how are they related to agricultural practices?
3. How do different agricultural practices in KL affect the local ecology?
4. How does the local community of KL interact with agricultural private and public institutions and with what livelihood outcomes?

2. Methods

The following quantitative and qualitative methods describe the data collection of our main outputs. For more information about how these methods will be utilized with the research plan – please see Appendix A – Data Matrix

2.1 Quantitative Methods:

2.1.1 **Structured Questionnaire**: A survey tool with closed and/or open-ended questions, designed to collect information for a statistical study. We will perform questionnaires to collect information about several sub questions where the unit of analysis will be at household level (sample size : all households). We seek for possible correlations between social factors within the community members and local crops systems and its adoption in relation to income generation (Sub Questions 1.1; 1.3 and 2.1).

2.1.2 **Soil Sampling**: The method will be used to investigate potential variations in physical and chemical soil characteristics of agricultural lands. Quantitative data collection pertaining to soil typology and nutrient uptake are essential to understand heterogeneity and consequent management of agricultural soils (Heil and Schmidhalter 2017). Subquestion 2.2 regarding trends in relevant types of cultivars could be assessed with collected comparative data, as well as research outputs of dependence on fertilizers and crop yields. Soil samples will be collected for the following types of examination:

2.1.2.1: Soil Texture Profile: Sampling for defined textural and content classifications. An in-situ analysis of three different locations related to two different aged-cultivars: three samples/recent cultivar; three samples/oldest cultivar.
2.1.2.2: pH Measurement: Nutrient uptake depends directly on pH values and therefore determines yield production. By means of dissolving soil particles in a water solution, pH results will outline the effectiveness of agricultural systems. This technique will require 2 series of 10 replicates each (5:5 sample at 30 and 15cm underground respectively) from one subsistence and one cash crop.
2.1.2.3: NPK Nutritional Sampling: Nitrogen, Phosphorus and Potassium estimation to determine nutrients and investigation into various forms of crop requirements as well as nutrient budgeting of the community farmland system.

2.1.3. Water Sampling: quantitative data collection regarding water fertility and composition is vital to understanding natural assets involved in livelihood activities. The output from this will be information regarding potential determinants in ecological systems surrounding agricultural lands (i.e erosion and leaching). This could be linked to a long-term detriment in farmland areas affecting livelihood strategies. Water samples will be collected for the following types of examination:

2.1.3.1: Biochemical oxygen demand (BOD): The amount of oxygen presence necessary to degrade organic matter in a fixed volume of water.
2.1.3.2: Chemical oxygen demand (COD): The amount of oxygen required to oxidize organic compounds in a fixed volume of water.
2.1.3.3: Total suspended solids (TSS): The total amount of suspended materials in a fixed volume of water.
2.2.3.4 Stream Assessment Scoring System (SASS): A simple tool that utilizes observations of macroinvertebrates to monitor the general health or water quality of a river or stream.

10,847 Words

All samples sizes and replicates belonging to types of examination mentioned before will be defined with the water test technical expert upon arrival to KL.

2.2 Qualitative Methods:

2.2.1 **Semi-structured interviews (SSI)**: 1on1 interviews with individuals, identified by the headman for their knowledge, or understanding of either agricultural activity or Iban livelihoods. The selection by the headman might produce a bias which will require additional control. This method uses interview guides with 8-10 framed open questions, using subtle follow-up probing techniques (Mikkelsen 2005). An example can be seen in Appendix B – Interview Guide for Farmer. The purpose is to provide in-depth contextualized information on, important crop types, current agricultural trends, significant livelihood changes in the past, and the interaction with outside institutions.

2.2.2 **Participatory Rural Appraisal (PRA)**: PRA helps to understand perceptions of land use and active livelihood strategies in a format where participant(s) can analyze and interpret their own conditions with the assistance of a researcher (Chambers 1994). The PRA method of a group or individual discussions collects qualitative information regarding common changes perceived by the community's inhabitants in relation to agricultural activities over time.

2.2.2.1 Most Significant Change Technique (MSC): A qualitative narrative transect walk. This technique explores important perceived changes in the details of community member's stories by letting them sketch rough graphs of changing broad qualities. This information will help answering questions regarding the interaction with outside institutions, changing local values, and changes in livelihoods.

2.2.2.2 Geographical Mapping: Geographic coordinates of relevant waypoints and tracks will be compiled into a map of different crops, secondary forests, road access and households, with the ability to analyze geographic distribution of livelihoods assets pertaining to each subquestion.

2.2.2.3 Free Pile Sorts: This method will take cards with names of individuals from the social structure you want to examine, for example longhouse or actors related to agriculture. Then ask the interviewee to sort the names according to her/his own criteria. Then ask why people appear in the same pile (Bernard 2011:233).

2.2.2.4 Ranking: Ask the informant to rank people from the longhouse, occupations or crops after prestige. Put the words in before and ask the interviewee to put numbers next to the words, for example 1 being the most prestigious and 20 being the least (Bernard 2011:235).

2.2.2.5 Free Listing: Ask the informant to list all the X they can think of. X could be crops that can be grown in KL, ways you can earn money or things you do when you don't work (Bernard 2011:224). The three last methods are explorative and will deepen our understanding and guide our research, without necessarily but potentially producing tangible research outputs. These outputs will help us to broaden our perspective on the research subjects and identify critical elements we cannot identify from home.

2.2.3 **Semi-Structured Focus Group Discussions (FGD):** Less than 5 participants, talk freely with each other about a particular issue and belong to the same homogeneous group. Issues for FGD will be identified by a cluster analysis of questionnaire results. identified clusters of agricultural practices in relation to livelihood experiences will identify and determine FGD topics. The

researcher's role is only to introduce the topic and keep the recorded discussion going. We aim to gain knowledge into the factors determining the adoption of certain agricultural practice, the contribution of the main crops to livelihoods, changing community values, significant livelihood changes in the past, and interactions with external institutions.

2.2.4 **Participant Observation:** These are direct observational methods used to find crucial elements within the community not captured under self-reported semi-structured qualitative methods. Field researchers will carry notepads on their person and informally document notes of any qualitative observations that they find in the field which are relevant to the research outputs. If possible we would like to observe agricultural extension workers at their work in KL.

3. Sampling

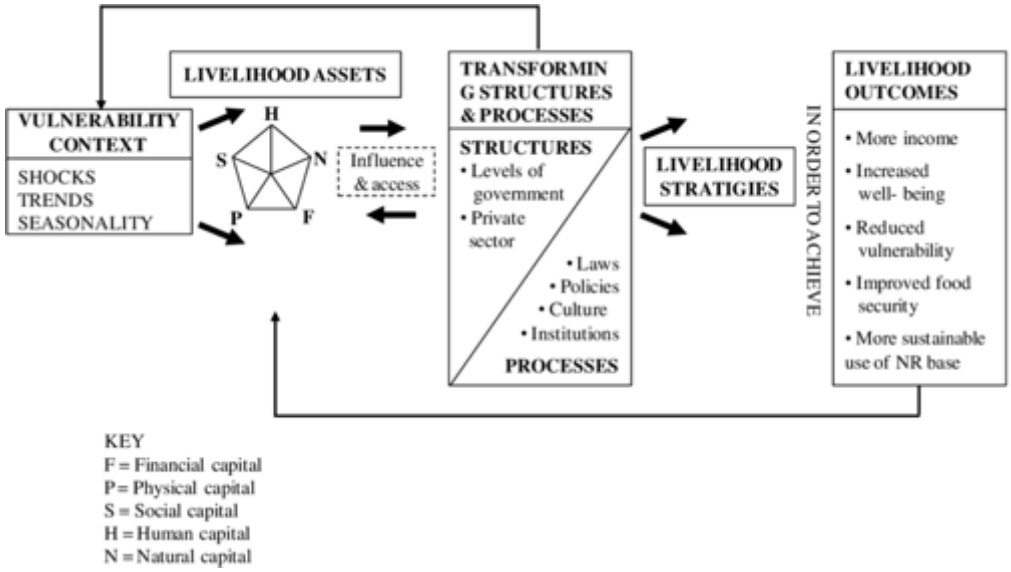
Questionnaires will be assessed on the household level: all 26 households will be sampled for 1 adult representative from each 'bilek'. While we aim at a fairly representative picture, interviewees, participants for focus group discussions or participant observation or MSC, will be sampled by snowball or convenience sampling. Further, qualitative information will be sampled using randomized homogeneous cluster sampling. These clusters will be derived from self-reported quantitative data. This mixed-methods approach will improve confidence in the collected information.

4. Analytical Framework

4.1 Sustainable Livelihoods Framework

Collected data will be analyzed through the Sustainable Livelihoods Framework (SLF). The SLF provides a conceptual framework to analyze combinations of available livelihood assets (financial, physical, social, human, natural), which enable observable combinations of livelihood strategies mediated through social structures, and with measurable outcomes, in a given particular context (Scoones 1998). The circular nature of the SLF allows all elements within the framework as a starting point of investigation. As our research questions asks for the effects of agricultural practices, our starting point is agricultural practices, which we conceptualize as a subcategory of livelihood strategies. We will analyze the effects of agricultural practices on livelihood outcomes as well as on livelihood assets, such as their effects on natural capital (e.g. water quality). Ribot and Peluso's (2013) theory of access may expand this framework by highlighting differences in access to benefits within the community. An illustration of this framework is provided below:

Figure 1: Sustainable Livelihoods Framework (Carney et al 1999)



4.3 Quantitative Analytical Methods

By using both access theory and the SLF together we can isolate and examine key aspects of our research variables to improve learning. To verify that this is done correctly in the Lumpang Kanggir context additional statistical and geographical analytical methods will also be used:

Frequency Table Distribution: Used to analyze frequencies of occurrences with one defined variable to determine its importance

Chi-square Test (Parson's chi-squared): A statistical test based upon a contingency table distribution of two variables. This is done to identify significant correlations between the two variables.

Geographical Information System (GIS): joint analysis of collected GPS waypoints and spatial area images to create an overall outline of how main physical and natural resources are distributed around the longhouse area.

For utilizing the analytical methods above, Rstudio or similar software (Excel) will be used to perform statistical analysis of quantitative data.

5. Research Outputs and Variables of Investigation

The research plan will prioritize four key research outputs to ensure that the overall objective of the research is completed:

5.1 Agriculture Activities

This output will examine different agricultural activities in KL. This is critical to our understanding of the research question since we must understand the variety and nature of important agricultural activities prior to determining their effect on livelihoods. Understanding this output would require capturing information from certain variables that are critical to this output including (i) widely produced cultivars, and cultivars particularly important to inhabitants in KL in terms of livelihood contribution; (ii) How

do comparable agricultural activities differ[2]; (iii) finally, what specific assets factor into the adoption of agricultural activities within KL.

5.2 Livelihood Effects

This output will examine the largest perceived livelihood changes the local community of KL experienced and how are they related to agricultural practices? Many factors might influence common and individual experiences. Nevertheless, subjective and intersubjectively shared narratives of experienced livelihood changes will help us to understand what meaning individuals, groups, or the whole community assigns to agricultural practices in regards to their livelihoods. Operationally, investigating this output will be derived from information regarding (i) common trends between agricultural practices and household livelihoods, in particular incomes; (ii) widely perceived community livelihood and socio-economic changes in the past; (iii) understanding any changes in Iban communal values that may have shifted over time. The concept of 'value' is defined openly on purpose to allow an open exploratory investigation into communal and identity values linked to agriculture. They might include informal rules regarding shared labor, social functions of harvest beyond profit and income, ritual and spiritual functions of agricultural practices and crops, but also indirect links, such as changing social structures due income inequality as a result of a changing rural economy.

5.3 Agro-Ecological Assessment

As discussed above, agricultural practices might have different effects, varying in degree or quality of effect, on the local ecology which sustains Iban livelihoods. An agro-ecological assessment will determine whether and how different agricultural practices have different ecological effects. We will analyze biotic and abiotic differences of natural livelihood assets, such as fertile soils or water, as a consequence of differing land-uses. In contrast to the output above, this output assesses objective natural world facts independent of human experience. These two contrasting epistemological approaches will hopefully nourish each other and provide a deep contextualized understanding.

5.4 Interaction with External Institutions

Within the SLF the institutional structure mediates livelihood assets into strategies. By understanding how the local community in KL navigates within their surrounding institutional structure and interacts with public and private institutions, we will deepen our understanding how the community or individuals make use of or avoid agricultural practices promoted by outsiders and their development agendas. We would like to investigate patterns in attitude towards external policy and initiatives, access to services, such as extension services, and the form of communication or form of negotiation between external institutions and the community.

[2] Agricultural activities refer cumulatively to land use practices associated with (i) pre-planting, (ii) growth, and (iii) post-production of vegetative products

6. References

- TR Along Kang. Translated interview with headman Along Kang.
- TR Bandi Layeh. Translated interview with headman Bandi Layeh.
- TR Baying Kasam. Translated interview with headman Baying Kasam.
- TR Mengga Atak. Translated interview with headman Mengga Atak.
- Alvarez, S., Paas, W., Descheemaeker, K., Tittonell, P., Groot, J.C.J., 2014. Constructing typologies, a way to deal with farm diversity: general guidelines for the Humidtropics. Report for the CGIAR Research Program on Integrated Systems for the Humid Tropics. Plant Sciences Group, Wageningen University, the Netherlands.
- Bernard, H. Russell. 2011. "Research Methods in Anthropology, Qualitative and Quantitative Approaches". AltaMira Press. United Kingdom.
- Birdsall, N.M.; Campos, J. E. L.; Kim, C.; Corden, W. M.; MacDonald, L. [editor]; Pack, H.; Page, J.; Sabor, R.; Stiglitz, J. E. 1993. *The East Asian miracle : economic growth and public policy : Main report (English)*. A World Bank policy research report. New York, New York: Oxford University Press.
- Britha Mikkelsen.2005. Methods for Development Work and Research: a New Guide for Practitioners. Sage,
- Carney, D., Drinkwater, M., Rusinow, T., Neefjes, K., Wanmali, S. and Singh, N., 1999. Livelihoods Approaches Compared — a brief comparison of the livelihoods approaches of the UK Department for International Development (DFID), CARE, Oxfam and the United Nations Development Programme (UNDP) Department for International Development.
- Cramb, R. A. 2007. Land and Longhouse - Agrarian Transformation in the uplands of Sarawak. Copenhagen: NIAS Press.
- Graeber, D. 2001. Toward an Anthropological Theory of Value. Palgrave. ISBN 0-312-24044-9.pp.1-23
- Heil, K., & Schmidhalter, U. (2017). The application of EM38: determination of soil parameters, selection of soil sampling points and use in agriculture and archaeology. Sensors, 17(11), 2540.
- Lund. 2014. Of What is This a Case?: Analytical Movements in Qualitative Social Science Research. Human Organization: Fall 2014, Vol. 73, No. 3, pp. 224-234. https://doi.org/10.17730/humo.73.3.e35q482014x033l4
- Mertz, Reenberg, Bruun & Birch-Thomsen. (2012). Land Use Decisions in Smallholder Rural

Communities in Developing Countries.CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources (43)3. pp.8

- Preston D.; Ngha I. 2012. Interpreting rural change in Malaysia. Singapore Journal of Tropical Geography 33: 351–364.

- Ribot & Peluso. 2003. A Theory of Access. Rural Sociology. 68 (2). pp.153-181

- Robert Chambers. The origins and practice of participatory rural appraisal. World Development, 22(7):953{969, 1994.

- Sayer J.; Ghazoul J.; Nelson P.; Boedhihartono A. K. 2012. Oil palm expansion transforms tropical landscapes and livelihoods. Global Food Security 1: 114-119.

- World Bank 2019. World Development Indicators. [Data file]. Retrieved from: https://databank.worldbank.org/reports.aspx?source=2&series=NY.GDP.PCAP.CD&country=

- Scoones I. 1998. Sustainable Rural Livelihoods: A Framework for Analysis. Institute of Development Studies Working Paper 72.

10,847 Words

7. Appendices

Appendix A - Data Matrix

Overall objective: *How do different agricultural activities affect Iban livelihoods in KL?*			
Research Question	**Sub-Question**	**Data Output**	**Methods**
Agriculture Activities What are different agricultural activities among inhabitants in KL?	**What are the most important types of cultivars within the local production system?**	Quantitative & Qualitative descriptive data: - key cultivars that are important for livelihoods	*Semi-structured interviews * Questionnaire
	Are there more recent trends in agricultural activities that are different from previous activities?	Comparative data: - common land and production management techniques	*Soil sampling *NPK content *Semi-structured interviews *FRA *PRA
	What resource/asset factors determine the adoption of agricultural activities in the community?	Qualitative & quantitative interpretative data: - Common influences when making agricultural decisions	*Participant observation *Questionnaire *FGD
Livelihood Effects What are the largest perceived changes the local community of KL experienced?	**What contribution do the four main crops have on local incomes?**	Quantitative & Qualitative descriptive data: - Trends between agricultural livelihoods strategies and income	*Questionnaire *FGD
	When did these changes occur and over what period of time?	Descriptive Temporal Data: "When" key community changes occurred	*Semi-structured Interviews * Transect walk/Most significant change MSC *FGD
	How have local values been affected by different agricultural practices and livelihood strategies?	Qualitative comparative data: - communal values - community culture	*Participant observation *Transect walk/Most significant change MSC
Agroecological Assessment How do different agricultural practices in KL affect the local ecology?	**How are agro ecological outcomes different between agricultural livelihood strategies?**	Quantitative & Qualitative comparative data: - Biotic outcomes - Abiotic outcomes	*soil sampling: - NPK,PH, texture profile. *Water sampling: TDS,COD,BOD, PH, TSS, miniSASS *FRA *PRA, *Direct Observation,
Cohesion with outside institutions How does the local community of KL interact with agricultural private and public institutions and with what outcomes?	**What are relevant agroecological extension services/resources that are available in the area?**	Descriptive Qualitative data - Agroecological extension services - Connection with government extension services/government agricultural programs	*Participant observation *Transect walk/Most significant change MSC *Semi-structured Focus group

10,847 Words

Appendix B - Interview Guide for Farmer

Interview Guidelines with Uphill Rice Farmers*

1. Region: Sarawak
2. Name of the village: Kumpan Langgir
3. Longhouse no.:
4. Number of participants:
5. Gender of participants:
6. Ages of participants: above 18 years old

<Start recording after ensuring the recording device is in a good location>

Hello, my name is _____, I am conducting a semi-structured interview for a field research for Copenhagen University in collaboration with UNIMAS. We have been asked to find information about livelihood choices and agricultural practices, specifically in the village of KL. We particularly want to hear the perspective of uphill rice producers.

Your participation in this discussion is completely voluntary. At any point in the discussion you may choose to end the session or not discuss any details that make you feel comfortable. Any information you provide will be anonymous, and your identities will not be shared. In order to facilitate the discussion, I will be taking notes and an audio recording. The total time of the discussion should not last longer than 45 minutes.

Do you all understand and consent to participate in this discussion?

<WAIT FOR ALL PARTICIPANTS TO VERBALLY CONSENT BEFORE CONTINUING>

Do you have any questions before we begin?

Can you introduce yourself to the group by saying your name , age and number of your bilek?

Interview Questions/Topics	**Clarifying Questions /Statements**	**Probing Questions / Statements**	**NB: Look for comments about …**
Q1. Livelihood Strategies Choices **Can we begin the discussion by your description of main ways people to earn a living in KL?**	1.1What influence you to be a farmer? 1.2 Do you have any other jobs besides being a farmer?	1.2.i - What other jobs do you have besides being a farmer? 1.2.ii - Why do you have these jobs? 1.2.iii – How frequent do you practice these jobs?	*Number of jobs *Type of jobs

10,847 Words

Q2. Crop Production **Now can you describe essential crops productions in your community**	2.1 What crops do you grow? 2.2 How long have you been growing these crops? 2.3 Why have you chosen to work with these crops? 2.4 Where do you grow your crops? 2.5 How large is the area where you cultivate these crops/trees? 2.6 Which of these crops are most valuable to you?	2.1.i – Which of these crops are for selling? 2.1.ii – Which of these crops are to sustain your household? 2.5.i – What is your is your largest crop field?	*Different crops grown *Crops importance *Utility of crop *Land use for crops
Q3. Changes in Crop Production Systems **Describe the most significant changes (you have felt) experienced in your community in relation with crops.**	3.1 What changes have you experienced on your life as farmer? 3.2 Could you recall when the changes occurred? 3.3 What impact did the changes have for you? 3.4 Do you see yourself working as a farmer in the future?	3.3.i - Did you found your income increased after the changes? 3.4.i -Do you think your children would work as farmers too?	* Relevant changes in crops *Sequence of changes *Expectations of crops production.

The respondents for their time and photograph any relevant issues considered necessary.

Record notes and any valid comments in the site visit report (body language, side discussions that may not be heard in the audio recording, etc.)

****Make sure that any requested documents were recorded.****Leave your contact number should participants have any additional information they wish to share.*

10,847 Words

Appendix C - Time Schedule

25/2: Tuesday	26/2: Wednesday	27/2: Thursday	28/2: Friday	29/2: Saturday
*common proposal with counterparts *buy supplies	Arrival at KL (5h journey) * synchronize with translator * localize and test questionnaire *test GPS	* Talk with headman/make a contact list * Semi-structured interviews * Local mapping of community * Questionnaire finalization	* Questionnaire collection * PRA of Longhouses, households, * Semi-structured interviews	* Semi-structured interviews * Observational monitoring and participant observation * Questionnaire collection

1/3: Sunday	**2/3: Monday**	**3/3: Tuesday**	**4/3: Wednesday**	**5/3: Thursday**
*** Questionnaire** *** Semi-structured interviews** *** Relaxed time with locals, doing participant observation and unstructured interviews**	***Questionnaire analysis** *** Going to the fields with locals and help with daily activities** *** Free Pile Sorts**	***Soil and water sampling** ***Empirical observation of agricultural activities (transect walks)**	***Soil and water sampling** ***Empirical observation of agricultural activities (transect walks)**	*** Focus Groups** *** Free Pile Sorts**

6/3: Friday	**7/3: Saturday**	**8/3: Sunday**	**9/3: Monday**	**10/3: Tuesday**
	*** Semi-structured interviews** *** Observational monitoring and participant observation**	*** Focus Group**	**Goodbye to Longhouse**	**Goodbye**

Daily:

*Morning meeting after breakfast (around 1 hour).

**evening meeting to discuss the information collected.

10,847 Words

Appendix 3: Nutrition and Pest and Disease Inputs Table

Crop	Nutrient Dose Requirement (N:P:K - Kg/Ha)	Government Subsidized Fertilizer Composition (Providor/ Composition ratio)	Common Pests/Diseases/Fungi	Targets of provided agricultural inputs (Pesticide/Fungicide/Herbicides)
Hill Rice *Oryza sativa* *(IRRI:2020 ; FAO,2006)*	25-11-30-3Mg	PELADANG: 25-0-0 (Urea) 17-3-25-2 MgO2 BAJA SEBATIAN: 17.5-15.5-10	**Fungi/Diseases**: - Root Knot *Mycosphaerella graminicola* - Sheath Rot *Sarocladium oryzae* - False smut *Villosiclava virens* - Bacterial Blight *Xanthomonas oryzae* - Leaf blast *Magnaporthe oryzae* **Pests:** - rats *rattus* - Black bug *Scotinophara coarctata* - *Armyworm* *Spodoptera frugiperda* - Zigzag Leafhopper *Recilia dorsalis* - Rice skipper *Pelopidas mathias Fabricius*	**Disease/Fungi:** -Rice Leaf Rust *cercospora oryzae* - Rice stem rot *Sclerotium oryzae* - Rice Sheath Blight *Rhizoctonia solani Pests* - Brown Planthopper *Nilaparvata lugens* - White-backed Planthopper *Sogatella furcifera*

			- Mealy Bug *Brevennia rehi*	
Pepper *Piper nigrum* (Kueh: 1990)	NPK-Mg+T.E: (12-12-17-2)-T.E	MPB: 15-5-14-2 (MgO) JAMBATAN: 12-12-17-2-8S-TE	**<u>Fungi/Diseases:</u>** - Black rot *Colletotrichum gloeosporioides* - Root Rot *Phytophthora spp.* - Root-Knot *Meloidogyne incognita* - Wrinkled Leaf Disease *Glomerella cingulata*	**<u>Fungi/Disease:</u>** -Black stem rot *Colletotrichum gloeosporioides*

Oil palm *Elaeis guineensis* (Limsrivilai et al:1980) (Orwa et al:2009)	NPK-MgO-B2O3 (Kg/palm yr): 0.8/1-0.75-1/1.8/2.2-0.15/0.2-0.05/0.07	MPB (Baja Sawit): 10-5.4-16.2-0.27 (MgO) - 0.5 (B2O3)	**<u>Pests</u>**: - rats *rattus* - wild pigs *Sus scrofa* - Nematode *Rhadinaphelenchus cocophilus* **<u>Disease/Fungi:</u>** - Dry basal rot *Fusarium oxysporum* - Crown disease *Ceratocystis paradoxa* - Anoderma trunk rot *Ganoderma lucidum*	
Eggplant *Solanum melongena* *(Idio & Adinya, 2017)* *(CABI crop compendium:2010)* *(Hughes & Salathé:2010)*	NPK: 15-15-15	*	**<u>Fungi/Diseases:</u>** - Cercospora Leaf Spot *Cercospora melongenae* - Colletotrichum fruit rot *colletotrichum melongenae* - Damping-off *Fusarium* *Pythium spp.* *Rhizoctonia spp.* - Early blight *Alternaria tomatophilia*	

			<u>Pests</u>: -Cutworms *Agrotis spp.* *Peridroma saucia* *Nephelodes minians* - Flea beetles *Epitrix fuscula* *Epitrix hirtipennis* - Aphids *Myzus persicae* *Macrosiphon euphorbiae*	
Ginger *Zingiber officinale* *(Ravindran & BABU, 2004)*		*	**<u>Fungi/Diseases:</u>** - Phyllosticta Leaf Spot *Pellicularia filamentosa* - Wet Rot *Pellicularia pleroticum* - Mosaic Disease of Ginger *Potyviridae* - Nemotode Diseases *Meloidogyne spp., Radopholus similis Pratylenchus spp*	

Banana *Musa spp* *(Nagaraja et. al 2019)* *(CABI crop compendium:2019)*	NPK: 3-1-4	*	**<u>Pests</u>**: - Oriental Fruit Fly *Bactrocera dorsalis* - Banana fruit fly *Bactrocera musae* - Red Palm mite *Raoiella indica* - Grey pineapple mealybug *Dysmicoccus neobrevipes* - Common Spiral Nematode *Helicotylenchus dihystera* **<u>Fungi/Disease:</u>** - Banana bract mosaic virus *Potyviridae* - Blood disease bacterium *Ralstonia syzygii* - Tropical race 4 *Fusarium oxysporum f.sp. cubense* - Malayan leaf spot *Haplobasidion musae* - Sigatoka disease of banana *Mycosphaerella musicola* - Leaf stripes *Xanthomonas arboricola pv. celebensis*	

*Assumption of received fertilizer owing to intercropping of these crops with rice (transect walk 1, questionnaire, crop calendar).

10,847 Words

**Nutrient doses requirement might vary considerably depending on the soil fertility, climate conditions, cultivar characteristics, and yields (*FAO,2006*)

Appendix 4: Questionnaire Draft & Online Dataset

Dataset URL: https://drive.google.com/open?id=1KQafWn4REXOI2Rhz_xqucvXwYu_0v_fV

BEFORE SURVEY READ THE FOLLOWING MESSAGE: Hello, my name is <insert name>. We are university researchers who are trying to learn about the conditions in which families here in Kumpang Langgir live and how they use the surrounding Land. Your perspective is very important to this. We would like to have your permission for a short survey. The survey should take XXX minutes of your time. All information is anonymous and confidential – your identity and your answers will not be shared with anyone. If you feel uncomfortable with any of the questions you can stop the survey at any time. If you do not want to answer any questions they can be skipped. If the questions are not understandable, please let me know. Do you understand?

Do I have your consent to ask the questions that I have prepared?

YES	CONTINUE WITH THE REST OF THE SURVEY
NO	DO NOT ASK ANY QUESTIONS AND THANK THE PARTICIPANT FOR THEIR TIME

Interviewer :	**ED #**
Date :	**Building Unit#:**
Respondent's Name:	

A: DEMOGRAPHIC

A1. What is the respondent's gender? **(Select one)**

Male	1
Female	2

A2. What is your age? **(Select one)**

18 Years Old or Younger	1
19-29 Years Old	2
30-39 Years Old	3
40-49 Years Old	4
50-59 Years Old	5
60-69 Years Old	6
70 Years Old or Older	7

A3. What is your marital status? **(Select one)**

Married	1
Divorced	2
Widower/widow	3
Never married	4

A4. What is the respondent's relationship with the main decision-maker within your hilek (i.e household head)? **(Select one)**

I am the main decisionmaker/ household head	1	**GO TO A5**
Spouse	2	
Son	3	
Father/Mother	4	
Brother/Sister	5	
Uncle	6	
Cousin	7	
Nephew	8	
Niece	9	
Occasional Worker	10	
Unrelated person or friend	11	

Other	99	**Continue**

A4.1. If "Other", please specify **(Text)**

A5. Including you, how many people are currently living in this bilek in total? **(Number)**

A6. Including you (if male), how many males are currently living in the bilek? **(Number)**

A7. Including you (if female), how many females are currently living in the bilek? **(Number)**

A8. Are there any children or infants under the age of 6 are currently living in your bilek? **(Number)**

A9. How many children are currently living in this bilek who are 7-17 years old? **(Number)**

	IF ZERO: GO TO QUESTION A10

A9.1. Of these children, how many attend which type of schooling? **(Number)**

Primary Education	
Secondary Education	

A10. What is the highest level of education which has been completed by **ANY member** of your bilek? **(Select One)**

No Formal Education	1
Primary Education	2
Secondary Education	3
Tertiary Education	4
Prefer Not to Answer	97

HOUSEHOLD INCOME

B1. I would like to ask you about the **main job** that the household head/bilek held **during the last month** (or that you should have worked). What is the category of this job which you held. **(Select one)**

Government (i.e. Police, Fire department, School, Clinic): Salaried/Paid Employee	1	**CONTINUE**
Private Company/business: Salaried/Paid Employee	2	
Work for someone else: Non-Salaried/Non-Paid Employee (includes selling crops)	3	
Work Independently: Non-salaried (includes selling crops)	4	
Unpaid/Not working (includes caring for family members)	5	**GO TO B3**

B2. I would like to ask you about any secondary job the household head/bilek held **during the last month**. What is the category of this job **(Select one)**

Government (i.e. Police, Fire department, School, Clinic): Salaried/Paid Employee	1
Private Company/business: Salaried/Paid Employee	2
Work for someone else: Non-Salaried/Non-Paid Employee (includes selling crops)	3
Work Independently: Non-salaried (includes selling crops)	4

B3. In the past 12 months, did any member of your bilek own, or work in business (i.e. - shop, sale of building materials, computer equipment, phone cards, consumable household products, food, cigarettes)? **(Select one)**

Yes	1	**CONTINUE**
No	2	**GO TO 4**

B3.1 If yes, please explain what type of business **(Text)**

B4. **In the past 12 months**, did you receive any **significant cash or goods** from either a relative or acquaintance from outside of the Kumpang Langgir? **(Yes/No)**

Yes	1	**CONTINUE**
No	2	**GO TO B5**

B4.1 On a scale of 1-4: How important was **this money** that your household received in allowing your household to meet it's living needs (higher numbers indicate more significant)? **(Select one)**

These money/goods was not important at all to ensure my household/bilek had adequate supplies (food/clothing/shelter/etc)	1
These money/goods was slightly important to ensure my household/bilek had adequate supplies (food/clothing/shelter/etc)	2
These money/goods were important to ensure my household/bilek had adequate supplies (food/clothing/shelter/etc)	3
Without these money/goods my household/bilek would not be able to have adequate supplies to function (food/clothing/shelter/etc)	4

B5. Generally how would you describe the conditions (stored rice amount, condition of roof/walls, items) inside of your bilek compared to other bileks in Kumpang Langgir? **(Select one)**

My bilek is much worse condition than others inside the Kumpang Langgir	1
My bilek is slightly worse than others than others inside the Kumpang Langgir	2
My bilek is slightly better than others than others inside the Kumpang Langgir	3
My bilek is in a much better condition than others inside the Kumpang Langgir	4
Prefer not to answer	97

B6. What is the formalized arrangement you have with the land that you manage? (**Multiple Selection**)

Formal owner with title or deed of ownership	1	**GO TO B8**
Formal owner without title or deed of ownership	2	
Co-owner with formal title or deed	3	
Co-owner without title or deed	4	
Provided land in exchange for goods/services/payment	5	
Land was passed down through my family (generational)	6	
Other	98	**CONTINUE**

B6.1. If "Other", please specify (**Text**)

B7. Select any of the following items that **are functioning** and that **at least one member** inside your bilek has access to? **(Multiple Select)**

Electric or gas cooking stove	1
Television	2
Wheel barrel	3
Mobile telephone	4
Radio	5
Interior Home Furnishing (table/chair)	6
Bed or mattress	7
Fan	8
Electric generator	9
Smart phone (internet capability)	10

B7.2. **CONTINUED:** Select any of the following items that are functioning and that at least one member inside your bilek has access to? **(Select All that apply)**

Motorcycle/Scooter	1
Small car **[river boat acceptable]**	2
4x4 transportation (hilux)	3
Refrigerator	4
NJOI/ASTRO connection (Satellite Television)	5
Chainsaw	6
Mechanical Harvester (padi machine)	7
Washing Machine	8
Gun(s)	9
Sound System	10

B8. In the past year, did anyone in your bilek work outside of the Kumpang Langgir for more than 1 month during the year? **(Select one)**

Yes	1	**CONTINUE**
No	2	**GO TO B9.1**

B8.1 If so, what is this person(s) profession? **(Text)**

B9. Please select the activities that people in your bilek **(Select multiple)**

Agriculture		**CONTINUE**
Fishing		
Hunting		
Foraging (Picking plants, medicine, herbs, etc.)		
Livestock/includes fish farm (both for meat or animal products)		

B9.1 Of the activities you selected please rank them in order of how much time is spent:
1- most time; 5 least time (Ranked List)

Agriculture		**GO TO B10**
Fishing		**CONTINUE**
Hunting		
Foraging (Picking plants, medicine, herbs, etc.)		
Livestock/includes fish farm (both for meat or animal products)		

B9.2. Please explain what **specific types** and examples of all the selected the household member participates in (example: Pig - livestock, chickens - livestock, Fish - Empurau; forage - rattan) **(Text)**

B10. Does anyone in your bilek work **in creating handicrafts or textiles** (baskets, artwork, clothing, etc) **(Yes/No)**

Yes	1	**CONTINUE**
No	2	**GO TO B13**

B10.1. Please explain what specific types **handicrafts or textiles** (baskets, artwork, clothing, etc) **(Text)**

B11. Please select all the types of crops which any member of your household cultivates (prepares the land, ensures adequate growth, and harvests) **(SELECT ALL & TEXT) – IF AGRICULTURE NOT SELECETED IN B9.1 GO TO B11**

10,847 Words

CROP TYPE	CROP NAME	DO YOU CULTIVATE THIS CROP?	HOW MANY YEARS	Fertilizer Use LAST YEAR	Pesticide Use LAST YEAR	Herbicide LAST YEAR
Cash Crop	Getah - Rubber					
Cash Crop	Sawit - Oil Palm					
Cash Crop	Lada - Pepper					
Cash Crop	Nipah - Sugar Palm					
Cereal/Energy Crop	Jagong, Lingkau - Maize					
Cereal/Energy Crop	Padi - Rice (describe Hill/Swamp + smell) ( )					
Energy Crop	Pantu - Sago Palm					
Energy Crop	Tebu - Sugarcane					
Fruit	Sikup - Mangosteen					
Fruit	Pisang - Banana					
Fruit	Durian - Durian					
Fruit	Uah cristal - Crystal Fruit					
Fruit	Longan - soapberry					
Fruit	Rambai - Rambi					
Fruit	Nanas - Pineapple					
Fruit	Lansat - Langsat					
Fruit/Legume	Petai - Bitter bean					
Legume	Retak kayu - Pigeon Pea					
Legume	Retak - Longbean					
Root/Tuber	Bukau - Taro					
Root/Tuber	Ubi tiang - Purple Yam					
Root/Tuber	Ubi randau - Sweet potato					
Root/Tuber	Ubi kayu - Cassava					
Root/Tuber	Lia - Ginger					
Spices	Cabi - Chillie pepper					
Vegetable	Kucai - Chives					
Vegetable	Kundor, janggat - Wax gourd					
Vegetable	Ensabi - Mustard greens					
Vegetable	Rampu entimum - Cucumber					
Vegetable	Labu - Bottle gourd					
Vegetable	Kecula, empusut - Loofah (bitter)					
Vegetable	Terong kangan, bulu - Dayak brinjal					
Vegetables	Entekai - Pumpkin					

Vegetables	**Retak lender - Okra**					
Vegetables	**Peria - Bitter gourd**					

B11. Did anyone in your bilek receive either free or subsidized **fertilizer** in the previous 12 months? **(Yes/No)**

Yes	1	**CONTINUE**
No	2	**GO TO B12**

B11.1 If yes, from whom? **(Select multiple)**

MPOB	1	**GO TO B12**
SALCRA	2	
RISDA	3	
Department of Agriculture/PERLADANG	4	
Malaysian Pepper Board (MPB)	5	
Friends/Family	6	
Other	7	**CONTINUE**

B11.2 If Other, please explain **(Text)**

B12. Did anyone in your bilek receive either free or subsidized **pesticide** in the previous 12 months? **(Yes/No)**

Yes	1	**CONTINUE**
No	2	**GO TO B13**

B12.1 If yes, from whom? **(Select multiple)**

MPOB	1	**GO TO B12**
SALCRA	2	
RISDA	3	
PERLADANG	4	
Malaysian Pepper Board (MPB)	5	
Friends/Family	6	
Other	7	**CONTINUE**

B12.2 If Other, please explain **(Text)**

B13 Did anyone in your bilek receive either free or subsidized **herbicide** in the previous 12 months? **(Yes/No)**

Yes	1	**CONTINUE**
No	2	**GO TO B14**

B13.1 If yes, from whom? **(Select multiple)**

MPOB	1	**GO TO B12**
SALCRA	2	
RISDA	3	
PERLADANG	4	
Malaysian Pepper Board (MPB)	5	
Friends/Family	6	
Other	7	**CONTINUE**

B13.2 If Other, please explain **(Text)**

B14. What is the main destination for the products your bilek produces (food, fiber, feed, fuel,etc)? **(Select multiple)**

Consumption within bilek	1
Sale for money	2
Trade goods for other product(s)/service(s)	3

END OF SURVEY – THANK YOU SO MUCH FOR YOUR TIME; DO YOU HAVE ANY QUESTIONS?

Appendix 5: Crop Scoring Matrix Results

	Rice	Oil Palm	Rubber	Pepper	Vege-tables
Physical Effort	3	5	2	4	1
Knowledge Required	4	3	2	5	1
Fertilizer	3	5	1	4	2
Pest- & Herbicide	3	2	1	5	4
Start up Cost	3	5	1	4	2
Continued Cost	3	5	1	4	2
Income	3	5	2	4	1
Predictable	5	4	2	3	1
Enjoyment	5	3	1	4	2
Tradition	5	1	3	4	2
Priority	5	2	1	4	3

10,847 Words

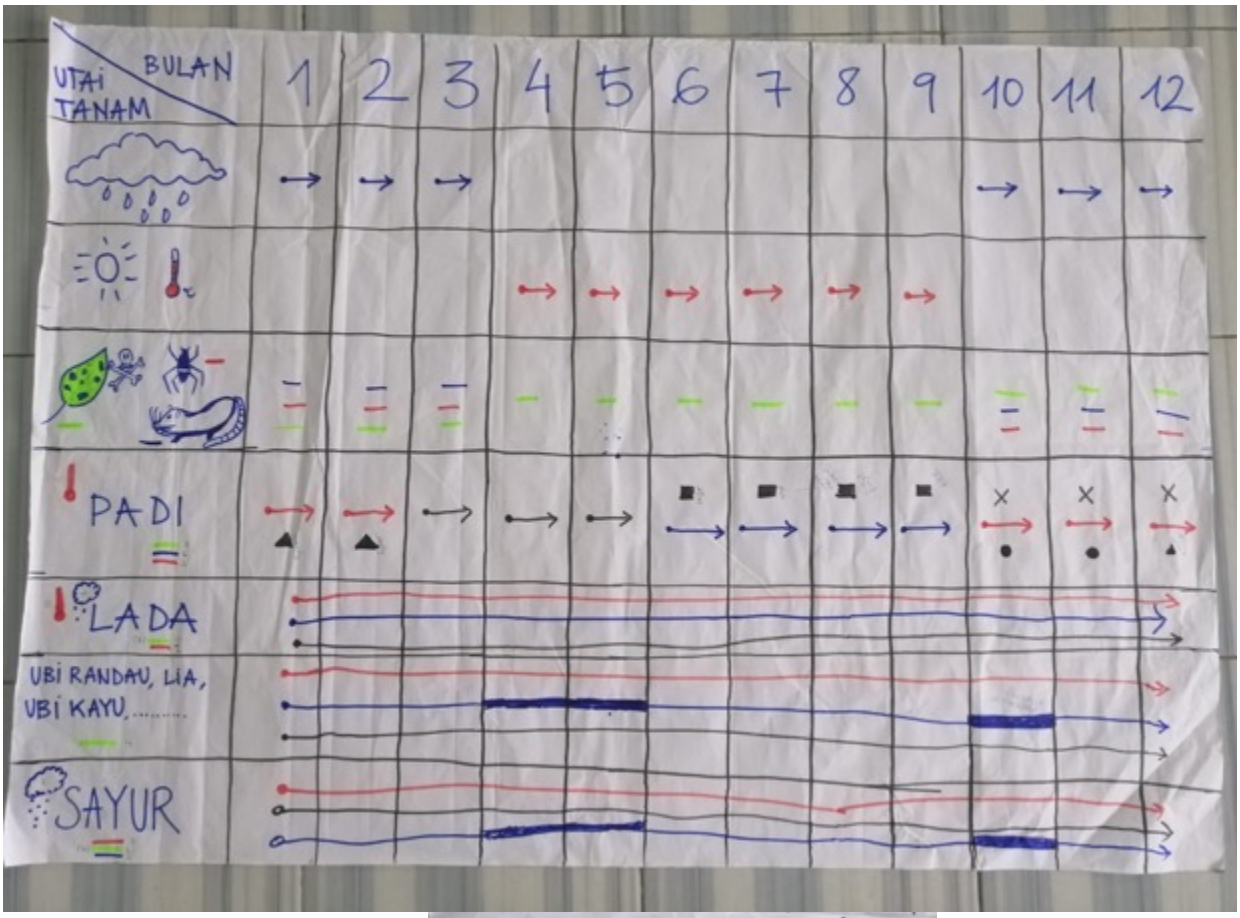
Appendix 6: Seasonal Calendar

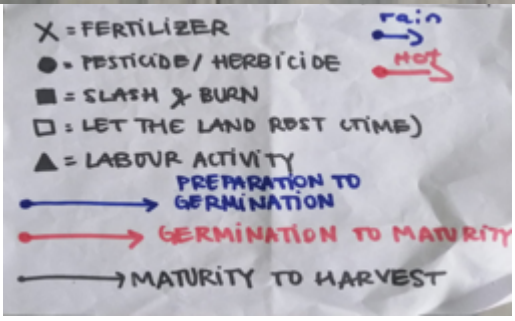
Adaptation and original version of the KL seasonal calendar.

Seasonal Calendar for Kumpang Langgir

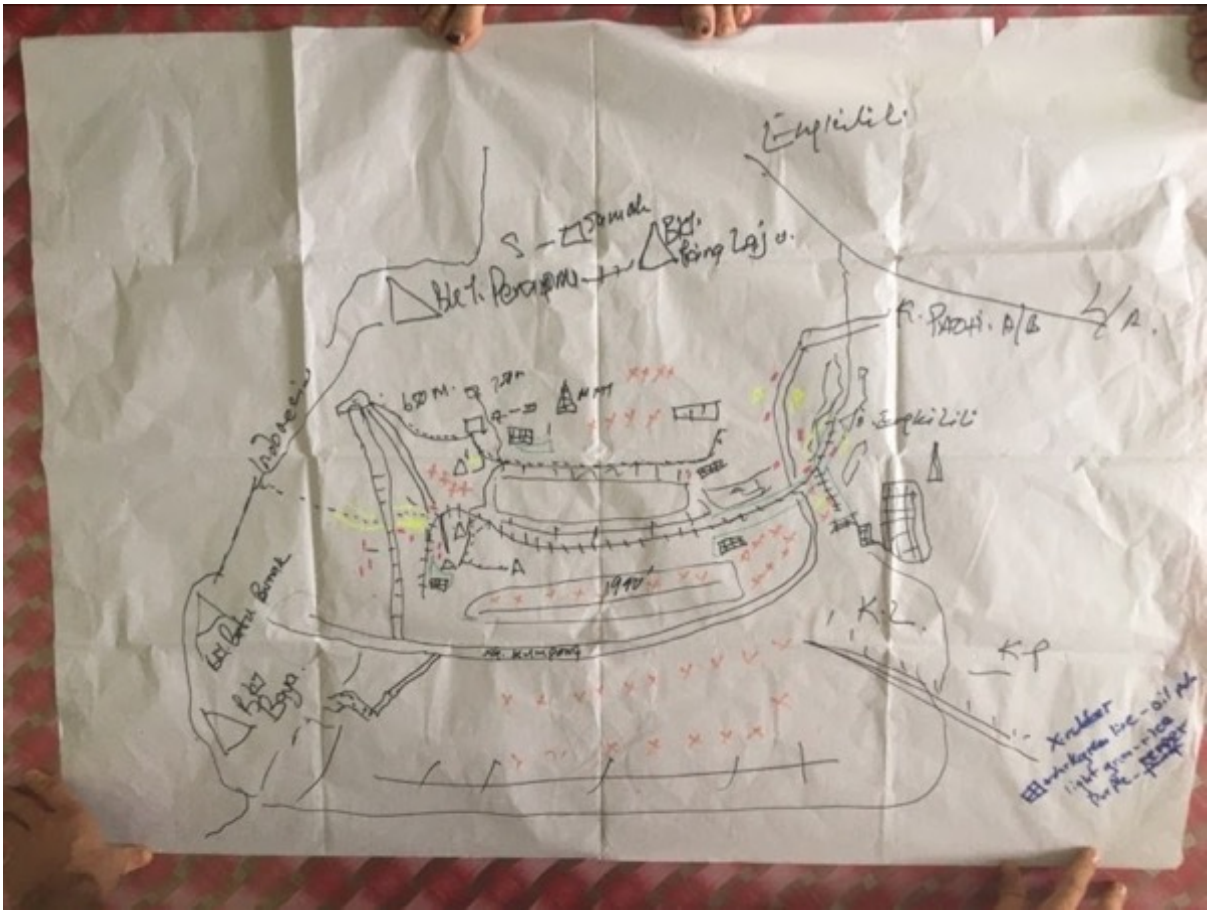
Seasons/Months:	Northeast Monsoon		1st Intermonsoonal Period			Southwest Monsoon				2nd Intermonsoonal Period		
	January	Feburary	March	April	May	June	July	August	September	October	November	December
	Rainy Season			Dry Season						Rainy Season		
Diseases												
Plagues												
Rats												
Black Pepper (*Piper nigrum*)												
Rice (Oryza sativa)												
Vegetables												

Sowing Period	
Growing Period	
Harvesting Period	
Planting at any time	

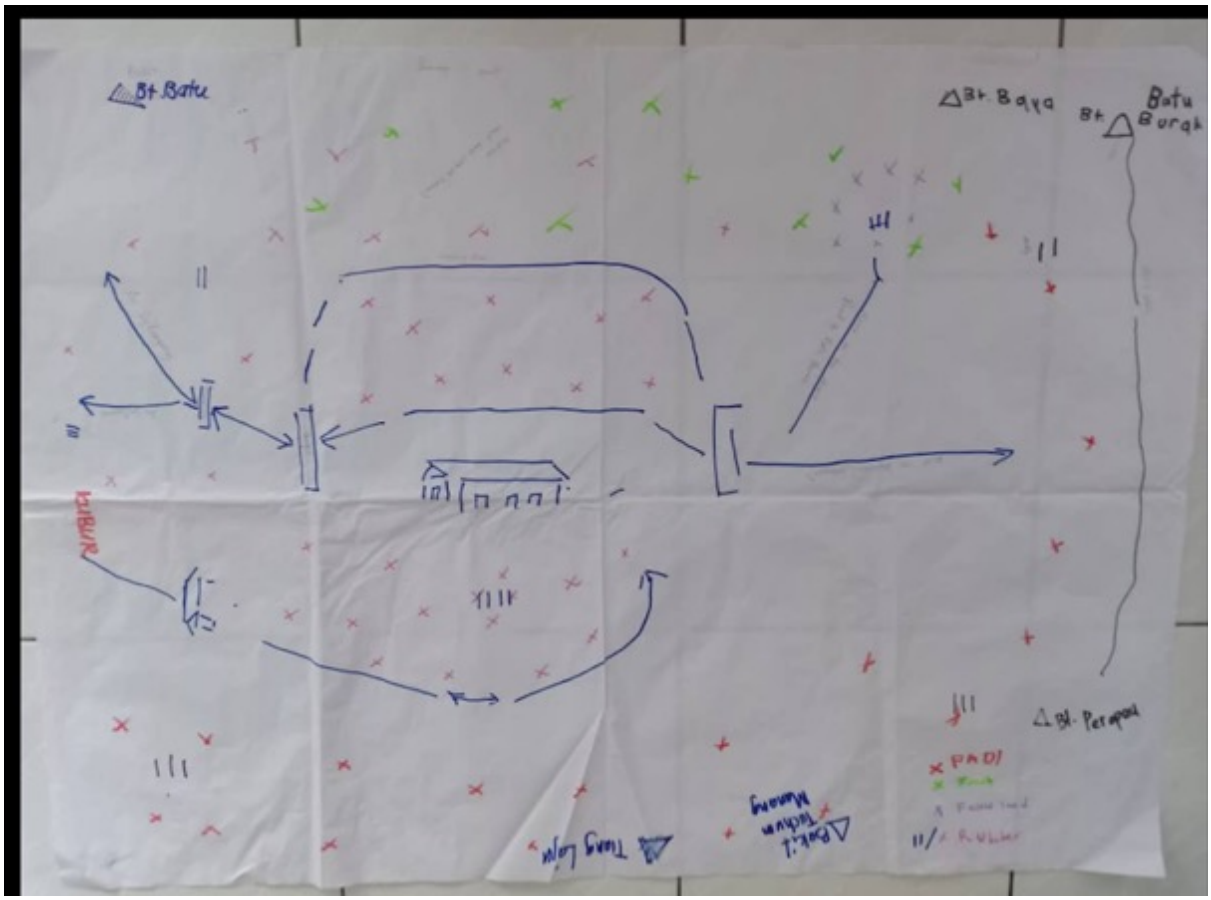




Appendix 7: Picture of Map-1



Appendix 8: Picture of Map -2



Appendix 9: Written interview for MPOB

Dear Haslina,

Thank you very much for your effort to help us out. You and others may forward this email to whoever you feel could be of help. We would like to improve our knowledge on the way the MPOB supports small holders.

In the community we visited, four individuals received support from the MPOB for their small-scale cultivation of oil palm (about 300 trees each). This support started around 2012 and included seedlings, training, and the provision of fertilizer, among other things. All of these farmers were very happy about this support.

What has sparked our interest is that nobody from that community has received any support from the MPOB after those four individuals were supported, although many of the other households applied for support. Nobody knew why MPOB support for that community had stopped. Accordingly, these are our questions:

1. Does the MPOB have certain requirements and factors by which they decide which smallholder gets support and who does not?

2. If yes, what are these requirements and have they changed in since 2009?

3. What could be the reasons why most people in that community have not received MPOB support?

And more generally:

4. How are smallholders supported precisely? It would be great to have a chronological overview over the different steps the MPOB takes to support smallholders set up an oil palm cultivation (e.g. providing seedlings, fertilizer, training, etc.). At what point do they receive how much input and support? What kind of fertilizer, pesticide, and herbicides are given out?

5. How could we track the fluctuation of prices for which smallholders sell their fresh fruit bundles to processing factories (are they published anywhere)? What are the different price levels for different qualities? How and when are farmers paid when they deliver fresh fruit bundles to a processing factory?

The first three questions are most important to us. Any additional information on the topic of MPOB smallholder support or MPOB publications on this topic are very much appreciated. We hope we managed to formulate our questions clearly, if there are any unclarities please do not hesitate to reach out. Thank you very much for your time and take care.

Regards,

Levin

Appendix 10: SSI guide

What intervention is Kumpang Langgir exposed to?		
1. What crops do you grow?		Specific interventions happening in Kumpang Langgir
2. Have you received any help from an organization for these crops?	IF YES? 2.1 What kind of help? 2.2 By whom? 2.3 When did it start? 2.4 Are you still receiving? 2.4.1 If no, when did it stop? 2.4.2 If no, why did it stop? **IF NO:** 2.5 Why not	Organizations / Actors targeting Kumpang Langgir Specific services (e.g. training) or inputs (e.g. subsidies, fertilizer, etc.)
3. Can you tell me about any other programs / Organizations?	**IF YES** 3.1 What do you know about these programs / organizations? 3.2 Did you consider apply for any of these? 3.3 Why or why not? (e.g. practical reasons such as family size, missing knowledge, land, age, etc.)	Reasons to refuse programs Practical conditions which prohibit participation
1. Are there any requirements needed to apply for these programs?	**IF YES** 1.1 What kind of requirements? (e.g. land titles, specific land properties, documents, age, permission (e.g. by the headman)	Formal conditions to participate in programs
2. Once you receive the help, are there any follow up audits?	**IF YES** What kind of requirements, rules, controls	
1. Some people apply for programmes but they use the names of other family members. Why would they do that?		The strategies people employ to increase benefits from the interventions
2. How do people use excess fertilizer/pest.?	**IF YES** 2.1. In what way? 2.2 Does that involve any risks for them?	