

Analyzing Drivers of Land Use

A study of how migration affects land use in Tepoi, Sarawak



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Abstract

The relationship between migration and land use in Sarawak Malaysia is a subject that has received much attention over the last decade (Windle 2002, Cheng Sim 2001). Expanding infrastructure and access to education for rural communities, combined with the allure of modern world commodities and big city life, has fuelled urbanization. This has reduced the traditional importance of agriculture, and the inherent knowledge of land use among the young generations is receding (Windle 2002). It stands to reason, that this migration from rural communities to urban centres, affects land use. The aim of this study is therefore, to investigate this effect in a single village in rural Sarawak.

The elected research site is Kampung Tepoi, a village of 87 households in south-west Sarawak, practicing a mix of subsistence and cash crop agriculture. Through a combination of social- and natural science methods, the drivers of land use choices, and specifically the dynamics between migration and land use is investigated.

Collected data shows that 37% of the population in Tepoi are non-residents, but the cultivated area does not seem to be decreasing despite reduced labor availability. Data indicates that government subsidies of pesticides and fertilizers are allowing villagers to intensify agriculture, and the introduction of new cash crops e.g. rubber and oil palm is changing the traditional agricultural practises of the village.

As such, it seems the direct effects of migration are being masked by complex interaction between numerous factors influencing land use choices and the drivers affecting them.

Key words:

Land use, underlying and proximate drivers, migration, cash cropping and Sarawak.

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List of Abbreviations

COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
FCC	Faecal Coliform Count
GPS	Global Positioning System
MCB	Malaysian Cocoa Board
MPB	Malaysian Pepper Board
NCR	Native Customary Rights
NH ₃ N	Ammoniacal Nitrogen
NTFP	Non Timber Forest Product
PRA	Participatory Rural Appraisal
RM	Malaysian Ringgit
RRIM	Rubber Research Institute of Malaysia
SALCRA	Sarawak Land Consolidation and Rehabilitation Authority
SAO	Sarawak Administrative Officer
TCC	Total Coliform Count

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4. Conclusion	All	
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1. Introduction

Kampung Tepoi is a small Bidayuh village close to the Indonesian border in the southwestern Serian division of Sarawak, Malaysian Borneo. The population of this remote village is feeling the effects of an increasingly globalized world not only due to their increasing connection to the outside world through expanding infrastructure but also due to the growing numbers of villagers who move away to urban centers. Globalization has connected populations and places and people to such an extent that drivers of change expressed in a far removed locations can have a direct influence on realities in small rural villages like Tepoi (Lambin & Geist 2009).

Malaysia is a country particularly proactive about responding to these influences in an effort move forward in the world economy. In order to do this, the government of this resource-rich nation has outlined clear and direct initiatives which have had a great impact on both its rural and urban populations. The most pronounced of these policies is 'Wawasan 2020' or 'Vision 2020', instituted by the former prime minister in 1991. This program "declared that it was the objective of the nation to become a developed nation in its own mould by 2020" (epu.gov.my). Among the outcomes of Wawasan 2020 are development projects created to strengthen urban centers and build roads to better establish in rural-urban interactions and trade (Windle 2002). Wawasan 2020, as well as the general rapid modernization of Malaysia, has also had the effect of making traditional practices or views seen as backwards and, predictably, this is most pronounced in the younger populations (Windle 2002).

This has contributed to the greatest rate of migration to urban centers Sarawak has ever experienced due to the rapid urbanization of cities like Kuching and the associated expansion of employment opportunities (Sim 2001). Along with the improvement and access to education associated with Malaysia's push to become a more developed country, young people increasingly seek opportunities unavailable in rural areas.

Realities such as the drainage of the labor force from villages, as well as policies set by the government promoting cash cropping are significant. The Malaysian government's policies reflect their agenda to discourage traditional farming practices like swidden agriculture in favor of cash cropping, and their support for plantation crops like pepper, oil palm and rubber (Windle&Cramb 1997). This is done by providing subsidized chemical



Figure 1. Map of south-west Sarawak, with locations of Tepoi, Tebedu and Kuching.

inputs like fertilizers, extension services and broad institutional support from the agricultural agencies like the Rubber Research Institute of Malaysia (RRIM) (Hansen&Mertz 2005, Wadley&Mertz2005).

As these drastic developments are relatively new, little is known about what consequences and adaptations farmers in villages like Tepoi are undergoing during this period of transition. Previous research done in this area has shown that remittances have a considerable effect on land use in relation to the adoption of cash cropping schemes (Best 1988), indicating that there can be a connection between demographic changes in village life in Sarawak and land use patterns in rural areas. This is particularly relevant in light of the fact that these changes in infrastructure, policy, and demographics in rural areas are likely to maintain at a high intensity in the coming years.

1.1 Objective and Research Questions

Therefore, this project endeavors to **identify and analyze the impact migration patterns have on land use in Tepoi**. In order to do so, an attempt will be made to answer the following questions:

What is the land use in Tepoi?

What are the drivers of land use in Tepoi?

What are the interrelations between the drivers of land use in Tepoi?

What are the direct and indirect effects of these drivers on land use in Tepoi?

With this information, it is possible to map the individual drivers, their effects on each other, and their direct and indirect effects on land use.

2. Methodology

2.1 Framework: Drivers of Land Use

The influences of land use choices are many and complex. This report uses an adaptation of the proximate (direct) and underlying (indirect) drivers described by Geist and Lambin (2002), Lambin et al. (2003), Ramankutty et al. (2006) and Steffen et al. (2004) as a tool to untangle this complexity. Although this conceptual framework explains the drivers behind tropical deforestation, it can be applied to explain drivers of land use choices. Factors in this approach are categorized depending on whether the impact is direct or indirect. The conceptual model (Figure 2) is subsequently used to describe the proximate and underlying drivers behind land use choices in Tepoi.

The proximate drivers are generated by human activities that have a direct impact on land use and generally operate at a local level. The underlying drivers are fundamental factors which underpin the proximate drivers. Unlike the proximate drives, these factors may originate from a regional, national or global level, and have a complex interaction between different organizational levels (Lambin et al. 2003; Geist et al. 2006).

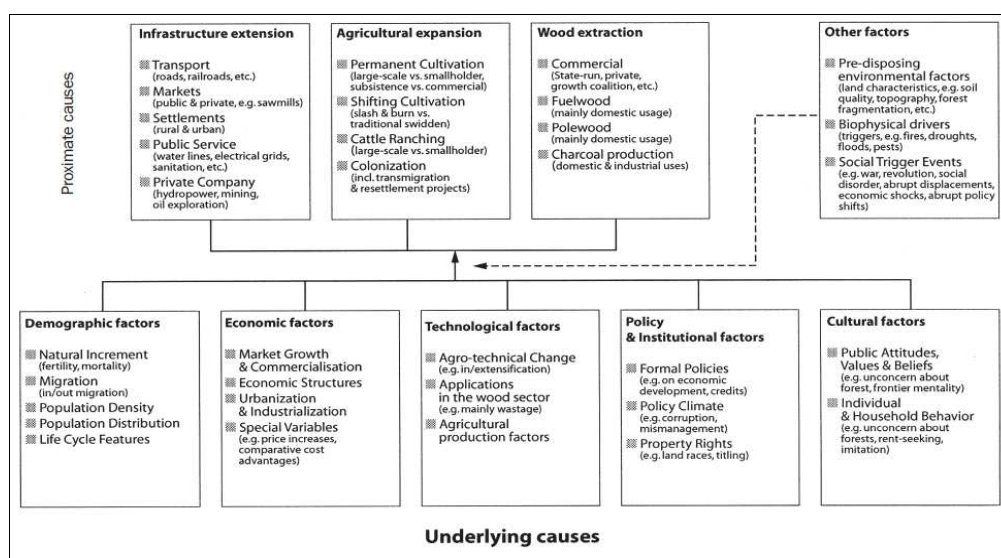


Figure 2. Conceptual framework explaining the causes of forest decline (Geist & Lambin 2002).

The model should not be construed as a general, static framework, but more like an adjustable tool used to create an overview and assess the driving forces within a given context. Although drivers are divided into proximate and underlying, it is important to understand that while some driving forces may be more dominant than others (Geist et al., 2006), no driving force alone influences choices. There are positive and negative

feedback mechanisms interacting between the forces, and thus the focus should be to understand these interactions.

The framework was further adapted to the research questions of this study, and used to guide the Results and Discussion (Section 3) to better illustrate the interactions between the drivers of migration and land use.

2.2 Methods

Different qualitative and quantitative methods were carried out during the research in Tepoi. These include the following:

Social science methods	Natural science methods
Questionnaires	Forest walk
Semi-structured interviews (SSI)	Farm walk
Participatory Rural Appraisal (PRA):	Soil sampling
Community map, seasonal calendar, timeline and focus group discussions	Water sampling
	GPS

For specific information on key informants, PRA sessions, farm and forest walks, see appendix 1.

2.2.1 Interpreters

When conducting fieldwork in a foreign location, communication with the local population has a crucial influence on the results, particularly when the researchers do not speak the local language. Thus interpreters play a key role in the dynamics and interactions with the local population. It is crucial to explain the aim of the methods and objectives so they understand the purpose and manner in which information should be obtained. As they are more familiar with the intricacies of local dynamics and customs, the opinions and observations of the interpreters are important. They may notice things that are not visible for the visiting researcher and can add important aspects to the research (Kerani). Thus, the translators were continuously involved with both the planning of data collection in Tepoi and discussion of results.

In spite of these considerations, because much of the data collection was reliant on inputs from the interpreters, it is expected that some of the research was influenced by their understanding and opinions. Some important data may have evaporated or changed during the many interactions between the three parties: the researcher, interpreter and informant.



Figure 3. Map representing paths in Tepoi and locations of questionnaire administration.

2.2.2 Questionnaire

A questionnaire was administered to 30 households in Tepoi. The aim was to obtain quantifiable data reflecting village demographics, crop production, forest use, and migration patterns. Respondents were selected randomly and asked to convey information representing the entire household. The distribution of administered questionnaires is represented in Figure 3. One pilot survey was administered and the questionnaire was subsequently adjusted to correct problems and expand on relevant data (Appendix 2).



Questionnaire Session (Photo: Lara Murray, March 2011)

Questionnaires are useful in gathering a large amount of objective information in a relatively short amount of time. For a study conducted by multiple researchers, it is a way to limit individual biases. By asking for responses representing the entire household, it is possible to gather data representing a large proportion of the population without having to survey the same number of individuals. The disadvantage is that the information received is second-hand and not always as reliable. While more pilot surveys would have been constructive, the small timeframe for the fieldwork restricted this. Little was known about how respondents would interpret questions, how capable they would be at responding, and their typical units of measurement. Therefore, obtaining complete and consistent answers presented

a large difficulty. A longer adjustment period to allow for better understanding of the village would have made it possible to adapt to how questions would be interpreted and answered. Some minor assumptions were made to correct inconsistency in units based on understandings gained from the 13 days of field observation. Open-ended questions should have been avoided as they are difficult to analyze. The ranking exercise should have been constructed to account for the fact that some of the options did not pertain to all respondents. Rankings are also extremely different to analyze; for the purposes of this study, a scale to rate relative importance should have been used. Before administering the questionnaire, it would have been useful to first construct the template for data entry to ensure that all essential data can be quantified coherently and can be entered in a format that is possible to analyze -- particularly for correlations.

2.2.3 Semi-structured Interviews

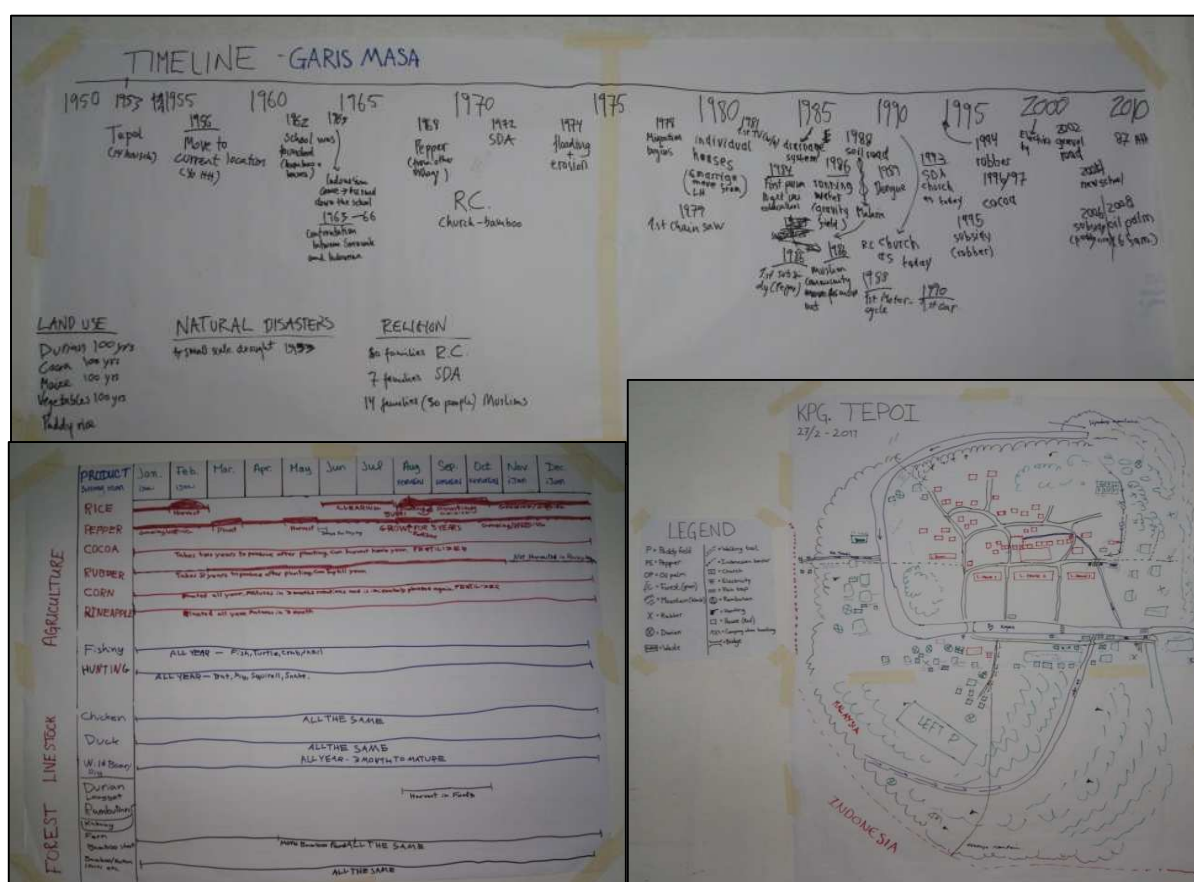
Nine SSIs were conducted with key informants (Appendix 3). The aim of this exercise was to generate more detailed knowledge from individuals who were identified as key informants because of their background, profession or position in the village society. The interviews were also conducted to gain insight on the differentiation within household types and generations. This type of interview gives a good introduction and insight into peoples' lives when time is limited. Compared to more basic information obtained from the questionnaires, interviews allow for more specific and in-depth knowledge of people, their livelihood strategies, and reflections. Open-ended questions allow the interviewees to express themselves on the subjects and issues they find important. SSIs also allow interviewees to introduce information not anticipated or known by the researchers (Mikkelsen 2005). However, the answers must still be seen in the light of questions asked; it is still the interviewer who leads the conversation when conducting SSIs.

The setting of the interview should allow the interviewee to feel free to answer questions without distractions or influences from other individuals or surroundings. In addition to setting, internal village power structures may influence some of the answers. For instance, responses from individuals closely related to the headman may have been skewed to present him in a positive light. The researchers' relationship with the interviewee also has an influence on the answers given. Some answers may have been constructed in a way to satisfy the perceived expectations of the researcher. In Tepoi, individuals who had developed friendly relationships with the researchers tended to provide more detailed answers.

2.2.4 Participatory Rural Appraisal

PRA methods are a broad term for methods that involve the local community in discussions about different aspects of their livelihoods and land use. It is a way of exploring complex aspects of village life, but must be managed carefully to eliminate as much bias as possible from people's internal relationships, cultural influences and demographic variations (Mikkelsen 2005). PRA methods conducted consist of focus group meetings which involved the creation of a community map, a seasonal activity calendar and a historical timeline of the village. Furthermore, three focus group discussions were conducted towards the end of the research period: one with general questions (FGD1), one with farmers (FGD2) and one with some younger members of the community (FGD3) (Appendix 1, 4 & 5).

The community map, seasonal calendar and timeline were carried out on the second evening of the data collection, serving as a good introduction to the village. The objective of the community map exercise (PRA1) was to get a view of Tepoi, land use patterns and boundaries from the villagers' perspective. In order to identify annual activities relating to agriculture, forestry and livestock a seasonal calendar (PRA2) was made. Finally, to get an overview of the history of Tepoi, a chronological map (PRA3) of major events was made (see photo below).



Visuals created during the PRA exercises: a timeline, a seasonal calendar and a community map.

PRA is a good method to collect a lot of data/information within a limited timeframe, however data collected can be superficial because of time limitations. Information gathered should be restricted to what is necessary. It is a bottom-up approach involving a high level of participation from the subjects. It can provide visual tools but results may be skewed depending on how questions are asked. As the activities took place in a public forum, the answers may have been influenced by power structures within the village. The three focus group discussions were conducted during the last days of the research period to triangulate data previously collected. The participants for the focus group discussions were chosen based on how outspoken they had been in previous interactions. There may have been power structures influencing their interactions and answers during

the discussions so it can be assumed that this approach may not have been the most unbiased approach to selecting participants.

2.3 Natural Science Methods

Natural science methods are employed to provide supplementary data to the land-use decision analysis as it provides quantifiable data to support statements, as well as qualitative data.

2.3.1 Farm walk & Forest Walk

Systematic observations of land areas under different systems of management were conducted during forest and farm walks (Appendix 6 & 7). The aim was to collect first-hand information about physical characteristics and management of agricultural land and natural resources. This data was combined and triangulated with interviews with the owners or users of the sites.

The farm and forest walks are loosely systematized methods of observation, and thus are useful in collecting data on general practices and outlooks, but do not necessarily produce quantifiable or measurable data. For this reason the data collected during the forest and farm walks is used for purely descriptive purposes.



River crossing during low-land forest walk
(Photo: Chloe Stemler, March 2011).

The loose format of the forest and farm walks lends itself well to improvisation both in terms of which questions are asked and in terms of impromptu forest or farm walks. This flexibility makes it possible to seize unexpected opportunities and carry out data collection with a minimum of inconvenience to the villagers. A drawback of the method is the difficulty in explaining to informants the intention of the forest or farm walk. As it might take up a considerable amount of the informants' time, it is important that he/she understands the motives of the endeavor and that he/she feels involved in the research.

2.3.2 Soil sampling

Soil sampling was conducted to classify and identify the origin and quality of the soils in Tepoi (Appendix 8). The selected plot is a fallow hill rice field reportedly left undisturbed for seven years with dense understory growth including fruit trees, shrubs, and ferns. The slope is 22° and a slight indication of terracing was observed. The excavated profile (presented in section 3.1.2) is 90 cm and 9 replicates of soil were collected at 10 cm supplemented by six pseudo replicates in the upper 30 cm of the profile. Soil quality is assessed in terms of fertility based on pH and content of nitrogen (N) and organic carbon (C). The replicates were sampled with sampling rings (volume of 100 cm³) and brought back to the laboratory where chemical analysis was carried out.

Doing analysis on one sample does not provide a truly representative assessment of the soils around Tepoi. However, the location was chosen because of characteristics including slope and historical use, which aim

to best represent most soils in the area. As the soil sampling is foremost approached to estimate intrinsic qualities and general fertility of soils in Tepoi, there are inherent limitations as the soil was previously cultivated.

2.3.3 Water sampling

Water sampling was conducted to evaluate the quality of water in the Kayan river. Pollution from nearby dump sites was voiced as a concern in villager reports.

The results are compared to the National Water Quality Standards for Malaysia (sabah.gov.my). They are based on the following parameters:

- Dissolved Oxygen (DO)
- pH
- Chemical Oxygen Demand (COD)
- Total Coliform Count (TCC)
- Faecal Coliform Count (FCC)
- Phosphorus
- Ammoniacal Nitrogen (NH₃N)

Pollution levels were assessed by measuring contents of bacteria, organic matter, suspended solids, and organic nutrients (phosphorus and ammonium nitrogen). These give indications of contamination resulting from human waste, and fertilizers which may run-off into the river.

Five samples were taken from various sites, some coming from points in the river with suspected contamination (Table 1). The tap water was also sampled to compare each of the various water sources in the village. Water sampling results were also compared with villagers' perception of the water quality at the different locations.

Sample no	Location	Rationale for sampling
1	One hour upstream from village	Villagers perceive the water is clean and safe to drink
2	Upstream from village, downstream from fields sprayed with pesticides	Potential pesticide contamination
3	In the village immediately after one of the dump sites	Potential human waste contamination
4	Downstream from village, after where the sewage water runs into the river	Assumingly this location enables detection of any contamination present. Also the water is claimed by villagers to be polluted and toxic at this location
5	Tap water	Gravity fed water in relation to the river water

Table 1. Overview of sampling strategy in the Kayan River in Kampung Tepoi, Sarawak, Malaysia.

3. Results and Discussion

The following section presents the findings of the 13-day study in Tepoi, beginning with the adaptation of Geist and Lambin's (2003) theoretical framework (Figure 2) for land use. The framework has been restructured to represent the drivers of land use in Tepoi and their relationship to migration (Figure 4). Direct and indirect effects on land use and migration are highlighted when appropriate throughout the discussion.

The drivers will be unfolded and discussed to describe the two main elements of the research objective: land use and migration. These elements are described separately yet interact as part of one system and are both affected by cross-cutting factors such as government policy, quality of life and accessibility.

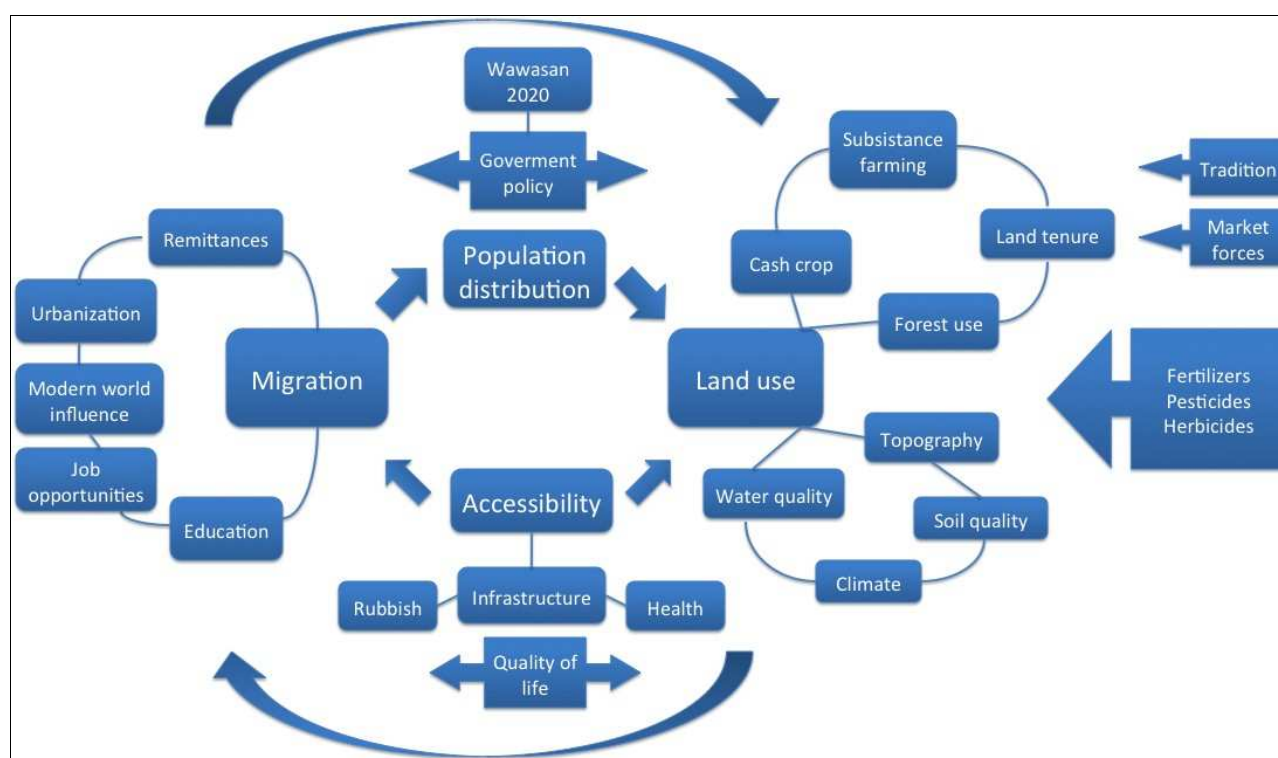


Figure 4. Illustration of the different factors affecting land use in Tepoi and their dynamics in feedback mechanisms.

3.1 Land Use

3.1.1 Physical Characteristics

The following describes the physical characteristics of land use by Tepoi's residents. Although these are placed in a separate discussion from the agricultural practices, interactions between the two discussions are identified.

Tepoi's terrain consists of steep slopes of cultivated or fallow plots and some secondary forest. The cultivated areas are susceptible to erosion, as the slopes are very steep; some were recorded to be over 45 degrees. A few farmers have a small degree of terracing on their plots and others integrate plants suitable for household use such as pineapple or tapioca into crops to minimize erosion. Villagers mention that erosion has caused some land to be unsuitable for cultivation, and they reserve more suitable land mainly for pepper. This is an instance of a proximate driver asserting a direct effect on land use.

The forest area can be subdivided into two distinct forest types: low-land forest and mountain forest. The low-land forest area consists mostly of fallow cropland with some areas left intact as they are important fruit tree and bamboo locations. The purpose of this land is primarily to increase soil fertility and to provide NTFPs like food and household materials (Ngidang 2005). For list of observed NTFP species see appendix 9.



Low-land forest: Many open areas under current or recent cultivation with rivers and streams and a large number of bamboo and pioneer species (Photo: Søren Brofeldt, March 2011).

The overall forest density in the mountain forest area consists of older and larger trees compared to the low-land area, although fewer older trees are left near the bottom of the slope. The villagers use the forest as its primary source of timber for construction and fuelwood so there is evidence of recent logging activity, thus classifying the area as secondary forest. Apart from logging, forest uses include hunting and collection of NTFPs. Data from SSIs indicates that villagers believe the forest is well-maintained because of the communal respect for its important forest resources.



Mountain Forest: Typical mountain forest outlook with many large trees, multi-story undergrowth, and complete crown coverage (Photo: Søren Brofeldt, March 2011).

The climate in Tepoi is characterized by a wet season occurring from November until February and a dry season from March until October. According to the World Meteorological Organization (WMO), the annual rainfall for Kuching, Sarawak is approximately 4000 mm/yr, and temperatures are consistent year-round hovering between 23 and 32 degrees Celsius. Villagers claim that weather patterns and seasons are changing and becoming increasingly unpredictable due to climate change. While most cropping activities are conducted year round, some are affected by seasonality such as rubber tapping which is impeded during the wet season and rice planting which is done at the end of the dry season. In addition, fruit such as durian, rambutan, langsat, and kabang are more abundant during the dry season.



Heavy rainfall in Tepoi (Photo: Søren Brofeldt, March 2011).

3.1.2 Soil quality

The soil in Tepoi is red and brown-reddish (figure 5) and is identified as an Ultisol which is the most common classification of soils in Sarawak (Hamdan 2008). The physiochemical characteristics are presented in table 2 and show a slight increase in pH with increasing depth with an average pH being 4.5. This acidity could be due to the high amount of aboveground biomass and subsequent biological activity producing CO₂ and carbonic acid. The clay content demonstrates a similar pattern showing an enrichment of clay in the lower part of B1 horizon. The quality of soil organic matter (C/N) is 13.4 with decreasing values with increasing depth and signifies a rather high amount of organic carbon. Apart from the high C content all results seem reliable and coincide with findings by Hamdan et al. (2008) and Tanaka et al. (2009) on Sarawak soil characteristics.

Although there are signs of human activity taking place over many generations, the soil sampled can be considered representative of soils from around Tepoi. This is because despite its historical use, the selected plot was left fallow for seven years reportedly without chemical inputs and it is located on a slope representative of Tepoi's topography. Signs of use include charcoal observed at 10 and 30 cm depth indicating several rotations of cultivation. This observation is supported by the fact that the owner of the field practices shifting cultivation. These factors imply that the present condition and characteristics of the soil are mostly affected by natural processes (foremost weathering) rather than artificial application of nutrients, validating this field as representative of the intrinsic characteristics of soils in Tepoi.



Figure 5. Soil profile (90 cm) under a seven-year fallow hill paddy in Tepoi, Sarawak, Malaysia.

Horizon	Sampling depth (cm)	Clay content	pH	% N	% C	C/N
A (0-6 cm)	5	10-27 (silt loam)	4,4	0,30	3,84	12,98
A/B* (6-30 cm)	15	10-27 (silt loam)	4,4	0,19	2,55	13,14
	25	10-27 (silt loam)	4,5	0,15	2,00	13,57
	35	8-27 (loam)	4,5	0,10	1,46	14,60
B1 (30-70 cm)	45	10-27 (silt loam)	4,6	0,08	1,03	12,92
	55	25-40 (clay loam)	4,3	0,07	0,87	12,31
	65	25-40 (clay loam)	4,6	0,07	0,95	13,85
	75	10-25 (sandy loam)	4,7	0,07	0,82	12,53
B2 (70-90 cm)	85	< 10 (sandy loam)	4,8	0,07	0,98	14,65
Average			4,5	0,2	2,1	13,4

Table 2. Physicochemical soil characteristics. Data conducted from profile completed in Tepoi Sarawak.

Results demonstrating soil acidity due to strongly weathered soil and hence low fertility are supported by Hamdan et al.'s (2008) statements regarding soils in western Sarawak. The soil is not ideal for rice and pepper and only marginally suitable for growing tapioca. Hamdan et al. (2008) also states that the soil is only moderately suitable for rubber and oil palm cultivation, therefore to optimize and sustain a production of rice, pepper and rubber, fertilizers must be applied. This is strongly supported by the observations and interviews with farmers conducted in Tepoi.

When discussing soil quality, villagers based their perceptions not strictly on inherent soil quality, but also factored in steepness of slope, accessibility, effect of fertilizer, and susceptibility to pests and weeds. Therefore, it was difficult to obtain a consistent interpretation of soil quality. During a farm walk with a key informant (KI1), the farmer asserted that a certain plot was valued higher than others, not because of intrinsic soil quality, but because of the close proximity to her home. Another key informant (KI6) reported there are noticeable changes in the soil quality even over very short distances influencing the location of crops. Some soil can be more sandy or contain more rocks, and is therefore reserved for rubber cultivation which can tolerate these conditions. Preferred soil is more moist and better for growing pepper or oil palm. Therefore, although in some situations soil characteristics constitute a proximate driver of land use, other drivers including access to fertilizers and plot locations often take precedence.

3.2 Agriculture

The following section describes the agricultural practices in Tepoi and associated drivers. Forest use is also addressed as links between forest use and agricultural practices were observed.

Cash cropping is the predominant source of income in Tepoi, and is practiced extensively (questionnaire data indicated that 93% of households grow pepper for sale). A common permanent cultivation system in the village is as follows: crop rotation begins with hill rice cultivation and is followed by pepper. When the pepper is within 2-3 years of the end of its productivity, rubber is introduced, maximizing the productive potential of the plot. Rubber may be intercropped with vegetables, pineapple or hill rice, both for consumption purposes, or to prevent soil erosion. Evidently, villagers still practice subsistence farming in addition to cash cropping; in fact, it is the most important activity for villagers in Tepoi, as presented in the questionnaire results. Cultivation of hill rice for household consumption is conducted by rotating the area under cultivation, and allowing for a fallow period before replanting hill rice at the same location.



Intercropping rubber trees and pepper vines. Photo Christoffer Nejrup March 2011)

3.2.1 Land Tenure

Like most of the land in Sarawak, Tepoi is located on Native Customary Rights (NCR) land. This system, integrated with indigenous 'adat' or customary rights laws, is one in which ancestral land is inherited. The NCR system provides limited security over land claims as the government recognizes the legitimacy of NCR land through the 1958 Sarawak Land Code. This states that citizens have the right to claim land if they can prove their own or ancestral occupation of the land prior to January 1, 1958 (in addition to several other qualifiers including government land permits and native court records). Nevertheless, because no formal titles are granted, and because the conditions for claiming land are often difficult to meet, land claims can be challenged, ultimately undermining tenure security for most people owning NCR land. It is often a concern for NCR land owners that they will lose their land if it is not under cultivation (Ngidang 2005).

In Tepoi, this potential insecurity was not explicitly expressed by the villagers, but there seemed to be respect for individual property. This was exemplified by the PRA1 which demonstrated a communal understanding of land ownership. When questioned about the possibility of having their land usurped, both the village headman and KI2 were both convinced that it was not possible in any way. Furthermore, a substantial amount of land cultivated by people in Tepoi is under permanent cultivation like rubber plantations which require large amounts of initial investment and time to become profitable (rubber takes 6-8 years to mature).

Such an investment would be less desirable if the owners of the land felt that their tenure could be challenged (Schlager & Ostrom 1992).

However, permanent cultivation may also be a way to secure land tenure born out of the fear that fallow land can be repossessed by the government. Furthermore, a potential link between tenure insecurity and land rental in Tepoi can be made. Through questionnaires, the prices and frequency of renting land was illustrated, indicating that it is both common and cheap to do: 11 out of the 30 households rent land, and the average price of renting one hectare of land annually is 87 RM. The fact that it is relatively unprofitable rent land indicates that there is value in having the land cultivated. This might be related to fears of landowners that land can be taken away if it is not under cultivation. Thus, it is difficult to determine whether or not people in Tepoi's decisions to practice permanent cultivation and rent their land result from feeling secure or insecure about their land tenure. Therefore it can be considered an indirect driver of land use in Tepoi.

3.2.2 Government Policy and Subsidies

One underlying driver which greatly affects farmers' decisions to carry out cash cropping in Tepoi is the availability of government subsidies for herbicides, pesticides and fertilizers. An interview with Mr. Atai, an officer from Department of Agriculture for the Sub-district of Tebedu, it was revealed that these subsidies began in the 1980's under the governments' New Economic Policies (NEP). Mr. Atai explained that subsidies for most crops have switched from the responsibility of the Department of Agriculture to government boards for specific crops (Malaysian Cocoa Board in the 1990s, The Rubber Rehabilitation Institute of Malaysia, The Malaysian Palm Oil Board, and The Malaysian Pepper Board in 2007). Fertilizer, herbicide and pesticide subsidies for subsistence rice still come from the Department of Agriculture (Atai 2011).

The first time chemical farming inputs were available to buy in Tepoi was in the late 1970's and the first government subsidies for farming inputs came in the early 1980's (FGD2 & PRA3). 24 out of the 30 households who were given questionnaires in this study receive institutional support in the form of subsidized farming inputs. Although there seem to be some discrepancies in the data indicating that this may not always be the case, the FGD2 revealed that in Tepoi, if a farmer who owns land fills out the application form for subsidies correctly, the headman unconditionally approves the application. The farmers reported that the decision on who actually receives the subsidies depends on the department of agriculture/cocoa/rubber/ oil palm boards. However, it seemed that this system was

Subsidies

Subsidies are defined as government-provided fertilizers, pesticides, and herbicides. If a farmer is awarded subsidies, they are provided free of charge, but the villagers of Tepoi must pay a transportation fee in order to bring them to Tepoi. KI6 provides this service as he owns a truck.

Alternatives to Government Aid

For the most part, subsidies are easily obtainable for all Tepoi residents. There are some exceptions, however, like KI1 who claimed that she has applied for these subsidies for years, but has never received any, and does not know why. Her husband started working in Kuching in 1984 because it was more lucrative than farming in Tepoi. Thus, she receives between 200-300 RM/month from her husband and uses a portion of the money to purchase fertilizers, pesticides, and herbicides. In this household, remittances serve as a substitute for government aid. This demonstrates how remittances may become increasingly important if the availability of government subsidies for farming inputs decreases.

affected by the internal politics of the village and it was difficult to find conclusive data about how villagers gain access to government subsidies.

Mr. Atai also reported a trend over the past few years that fewer subsidies are being allocated by the government. In 2010, there were fewer subsidies available than ever before; he estimated that less than 40% of applicants received subsidies for fruit and vegetables. Mr. Atai hypothesized that because the government is promoting and focusing on bigger plantation crops such as rubber and oil palm it has diverted funds towards these crops. The implications of Mr. Atai's statements are underlined by the projection of the Minister of Infrastructure for Sarawak, who during an address which the researchers of this report attended, stated that subsidies may come to a halt altogether around the finish line of Wawasan 2020. The Minister, Mr. Jawong, explained this projection by the fact that the government will not likely be able to financially support this extensive aid for agricultural inputs. The statements from this minister should be interpreted with some discretion as his motives and policies are not clear. This strong statement about the end of such an important government institution is nevertheless an interesting consideration for the future of Sarawak's farmers.

The Malaysian government has been strongly encouraging more intensive cash crop farming for decades, thus attempting to discourage traditional swidden agriculture which they have painted as both an environmentally and economically degrading practice (Best 1988). In particular, as mentioned by Mr. Atai, there has been a push towards large-scale oil palm and rubber plantations, and the government has provided training, assistance and subsidies to do this.

Most farmers in Tepoi rely on subsidized inputs for all of their crops and their decisions on what to plant are directly affected by the government's agricultural agencies. The Malaysian Pepper Board (MPB), the Malaysian Cocoa Board (MCB), the Rubber Research Institute of Malaysia (RRIM) visited Tepoi over the past decade to provide information and training. Moreover, so far, the government has been quite generous about providing farming inputs intensifying this dependence. For example, the annual subsidy allocation records in Tebedu reported that in 2009, all 69 Tepoi households whose applications were received in the Tebedu Agricultural office were allocated subsidies for 1ha of upland rice and all 24 households who applied received subsidies for 0.5ha of lowland rice.

An Alternate Scenario

Subsidies may allow for the continuation of certain cash cropping endeavors where they would not be employed otherwise. One study conducted by Wadley and Mertz (2005) compares two villages' relationship with pepper farming with respect to the availability of government subsidies. Both study sites are located close to the border 26 km apart but one village in Malaysia and the other in Indonesia. Both villages cultivate pepper but with different intensity and frequency due to the availability of subsidies. The Indonesian village cultivated pepper on a more periodical basis due to global market fluctuations while the Malaysian village maintained their pepper more permanently, and like Tepoi, cultivates hill rice as a risk management strategy.

3.2.3 Subsistence Cultivation

While nearly all villagers engage in cash cropping, (e.g 93% of the villagers interviewed are growing pepper destined for market sale), few, if any, can envisage ever ceasing to cultivate rice. Thus rice cultivation is not being replaced by government-supported cash cropping initiatives, although the system of cultivation is changing. One factor encouraging the continuation of rice cultivation includes the intensification of agriculture through use of fertilizers. As a result, fallow periods are shorter and demand for land area is reduced, as was mentioned by various farmers (FGD2). Villagers agree that the length of the fallow period has decreased (from around 7-8 years down to 4 years) due to application of fertilizer. In addition, there may be a trend in cultivating rice fields closer to the village and leaving shorter fallow periods as a result of lower labor availability. This has also been previously observed in other parts of Sarawak (Hansen and Mertz 2006).

In addition to fertilizer availability, another influence of continued subsistence rice cultivation is the desire to maintain food security and tradition. In some situations, subsistence rice cultivation is even favored over cash cropping. This is usually in situations where remittances from migration can provide the bulk of the household income, although this is not common in Tepoi. This situation has been observed in similar villages located in Sarawak in previous decades by Best (1988). The cases he explored demonstrate that some farmers prefer to engage in activities that provide food and a more secure source of income (subsistence rice cultivation and remittances), rather than activities that provide income susceptible to variations in market prices (cash cropping). Fluctuations in global market prices can be huge; one Tepoi farmer purported that in 2002 alone, the price received in Tepoi for white pepper dropped from 28RM/kg to 2RM/kg. While this farmer's claim might have been exaggerated, the global price of white pepper in 2001 is known to have fallen by one third from 1999 (Malaysian Pepper Board 2009). Such drastic short term fluctuations demonstrate how unreliable income generated from cash cropping can be. However, cash cropping remains widespread among Tepoi farmers.

Swidden Rice Cultivation

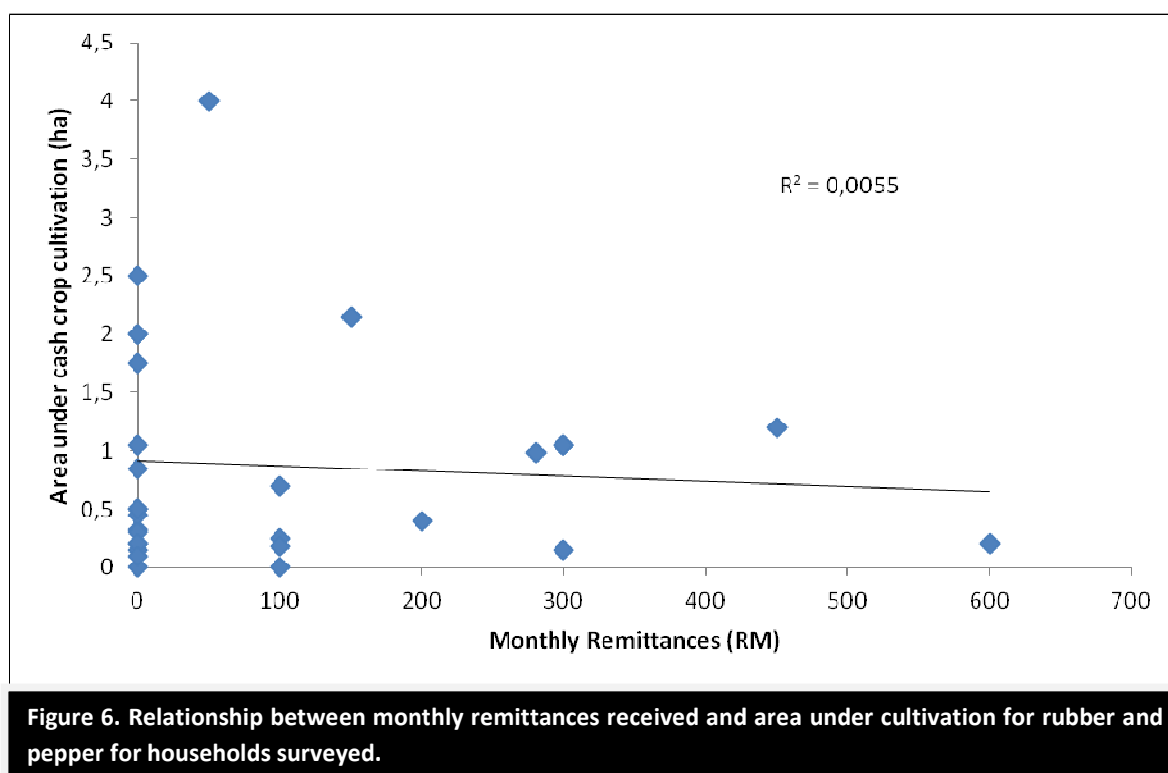
Multiple terms have been applied to describe rice cultivation in Southeast Asia: slash and burn, shifting cultivation, forest fallow, and swidden cultivation. The term "swidden" is used in this study as it is most representative of the cultivation system practiced in Tepoi. It has been best described by Cramb (1993) as:

"household clearing of a field of 1-3 ha using bush-knife, axe and fire, utilizing the field for one season to plant hill rice and intercrops...and allowing the field to revert to secondary forest for a fallow period of 5-15 years before reutilizing it for cropping".

It is appropriate for systems where previously uncultivated land is not being cleared every year and where farmers live in permanent settlements, such as in Tepoi. With the continued application of fertilizers, the term "swidden" may even cease to apply because fallow periods are becoming shorter, and eventually rice may be grown in nearly permanent plots.

The main difference between the villages presented in Best's (1988) study and Tepoi, is availability of subsidies. Much of the risk associated with financial investment in cash cropping is relieved through access to government subsidies. Hence inflow of remittances in Tepoi may not result in the same patterns observed in Best's study. An attempt was made to correlate relative importance of cash cropping vs. remittances under the hypothesis that a higher importance of remittances would decrease the importance of cash cropping (Best 1988).

However, because no consistent data was gathered on household income and the proportion this income that is constituted by cash cropping, an attempt was made to correlate area devoted to cash cropping, and remittances. No correlation was found, suggesting remittances do not influence relative importance of cash cropping (Figure 6). Of course this is overly simplistic as it does not take into account the impacts of factors like subsidies, size of household land owned, physical infrastructure, and alternate household responsibilities that affect the area under cash crop cultivation. It is left to be seen whether increasing the inflow of remittances (see section 3.4.3) (which may result from continued high rates of migration out of Tepoi) could begin to replace cash cropping. In an alternate scenario, remittances could be a proximate driver of cash cropping, especially in the event that subsidies cease within the next decade, as projected by the Minister of Infrastructure for Sarawak. For the moment, it appears to be diversifying household income and subsistence activities, which will be discussed in Section 3.4.3.



3.2.4 Forest use

Availability of forest resources was discussed with many villagers throughout the research. Although no conclusive data about this could be attained, one trend is that an increasing number of villagers are growing vegetables and rattan on their land, as observed on farm walks (FW1 & FW3) and indicated in FGD 2. Several villagers mentioned that areas close to the Indonesian border (2-3 hours away) have larger numbers of important NTFPs (Appendix 9), therefore some families choose to make this journey. Alternatively, many people choose to purchase these goods from Indonesian traders who come to Tepoi at regular intervals; however it was unclear whether labor availability or quantity of the NTFPs was the dominant driver for this. The ambiguity about NTFP availability might be explained by a changing dependence of forest products. As such, villagers who either grow

or purchase products previously collected, may not be aware of where to find them, and so will report a decline, even if this is not actually the case.

Questionnaire data revealed that fuelwood has been replaced in some households by gas as it lasts longer. KI2 mentioned that a family of 3-4 can make 2 canister of gas last for around 3 months, as opposed to families dependent on fuel wood who must collect it daily. Therefore, the potential depletion of forest products, combined with decreasing labor availability may lead to a greater dependence on purchased inputs which may become more available with improved infrastructure. This suggests that infrastructure and labor availability could be underlying drivers of the potential decreasing use of forest land.

3.3 Quality of Life

Quality of life is identified as a main connecting factor between land use and migration. Decisions made relating to land use have major impacts on health, how people perceive their surroundings and affect their level of life satisfaction. Influences on quality of life observed and studied include water quality, waste management, health and accessibility to infrastructure which could empower people to effect change.

3.3.1 Water quality

SSI, questionnaire and focus group discussion data all indicate that villagers are concerned with the quality of the water in the Kayan River (questionnaire data indicate that 2/3 of households asked do not consider the water drinkable). The water upstream is considered by many as safe to drink. However, pollution attributed to rubbish sites and sewage drainage near the river and logging activities conducted upstream in the past is thought to contaminate this resource. Tepoi's main drinking water supply (available to all villagers) is a gravity-fed system from sources in the surrounding mountains, and most agree that it provides clean water (although they generally boil it before use). To investigate claims about water quality/contamination, testing and analysis of the Kayan River water at sites close to Tepoi were conducted (see Table 3).

The following page shows the levels found in the five samples taken in the Kayan River.

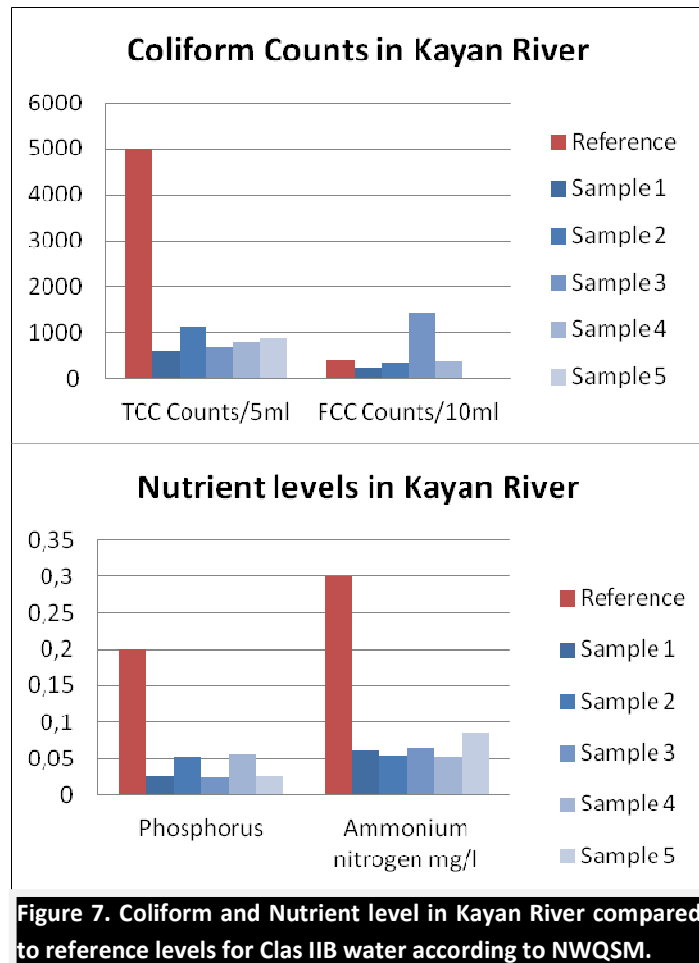
Results:							
Sample ID	DO mg/l	pH	COD mg/l	Coliform (Counts/ml)		Phosphorus	Ammonium nitrogen mg/l
				TCC	FCC		
NWQSM Class IIB, lowest class still considered drinkable ¹	5-7 mg/l	6-9	25 mg/l	5000 counts/ 100ml	400 counts/ 100ml	0,2	0,3 mg/l
Sample 1	9.97	6.36	0.00	580	240	0.0261	0.061
Sample 2	8.84	6.69	0.01	1120	350	0.0522	0.055
Sample 3	8.23	6.79	0.03	660	1440	0.0228	0.065
Sample 4	8.51	6.91	0.00	780	360	0.0554	0.052
Sample 5	9.05	6.63	0.00	900/10ml	9/100ml	0.0261	0.085
Comments:							
DO	The Dissolved Oxygen is the amount of gaseous oxygen (O2) dissolved in an aqueous solution, and a relatively high count is a necessity for good aquatic life (Water Quality for Ecosystems and Human Health. 2nd edition. UNEP, ERCE, UNESCO. 2008). The levels found in the Kayan River indicate good conditions for aquatic life.						
pH	A pH range of 6.0 to 9.0 appears to provide protection for freshwater fish and bottom dwelling invertebrates (Water Quality for Ecosystems and Human Health. 2nd edition. UNEP, ERCE, UNESCO. 2008). The levels found in the Kayan River indicate good conditions for aquatic life.						
COD	Chemical oxygen demand is a measure of the amount of organic compounds in the water. Too much organic material in the water can lead to a decrease in aquatic life. The levels found in the Kayan River indicate good conditions for aquatic life.						
Coliform (FCC)	Indicates the amount of fecal matter in the water. Even very low amount greatly increase the health risks connected with drinking the water. The levels found near the village indicate that the water is unsuitable for drinking (Wilkes University 1999).						
Phosphorous/A mmonium nitrogen	The relatively high level of phosphorus in the samples near the Coco plantations and the village, compared to the other samples, indicate that the use of fertilizer is having an effect on the water quality of the river. The levels are however low enough, that the fluctuations might be within the margin of error of the sampling methods. Based on these result no clear conclusion can be made regarding levels of nutrients in the river.						
Table 3. Results from water sampling in the Kayan River, and comments on the effects on water quality.							

¹ **Class IIB definition (sabah.gov.my):** “Represents water bodies of good quality... no body contact activity is allowed in this water for prevention of probable human pathogens... The determination of Class IIB standard is based on criteria for recreational use and protection of sensitive aquatic species.”

The results show no strong contamination from garbage dumping in the Kayan River. They do, however, indicate that the water is measurably (but not significantly) contaminated with sewage from the village, and it is much less clean than the water from the gravity-fed system. Fecal coliform contamination in sample 4 near the village dump and sewage drainage site (see figure 7), indicate that these might have some impact on water quality.

The analysis also indicates that the use of fertilizer might have an effect on water quality in the river (See figure 7). However, further testing over a longer period of time, allowing for the consideration of different weather conditions and cycles of the application of fertilizer, is necessary for this to be conclusive.

If the presence of nutrients from fertilizers reach levels which can cause problems for aquatic life or livestock, e.g. ammonia pollution (Wilkes University 1999), fish populations may be affected, thus diminishing an important food source. Regardless of the low pollution levels that were measured, perceptions of the Kayan River's water quality has an effect on life in Tepoi.



3.3.2 Rubbish

FGD 1 and questionnaire data, revealed that the rubbish management in Tepoi is perceived as a problem. Amounts reportedly increased and there is pronounced concern about the aesthetic, environmental and health problems associated with mismanagement of waste. There are four dump sites in Tepoi, all near streams running into the river (but indiscriminate dumping was observed). Several villagers claim that the dump sites' capacity has been reached and that it has had consequences on the river's water quality. The village has applied for government help, but was denied due to the poor condition of the road leading to Tepoi, hindering garbage truck access. Thus, the improvement of infrastructure via the new road to Tebedu could bring solutions to this problem.



**One of four dumpsite locations in Tepoi
(Photo Søren Brofeldt, March 2011).**

3.3.3 Health

There is no clinic or medical professional in Tepoi which was a noted grievance of several villagers during questionnaire data collection. Although a medical team visits the village on occasion, villagers note that they often do not bring enough medication. To receive medical attention, villagers can go to a clinic in Tebedu, but the closest hospital is in Serian -- roughly a two-hour drive from Tepoi. The medical team that visited Tepoi during the researchers' stay claimed the village is located in a malaria 'red zone', putting residents at a higher risk of contracting the illness. Through questionnaires, data was collected about incidents of dengue and malaria. Although the incidents of the disease were not high (only 3 dengue cases among the 30 households were reported during the lifetime of the respondents), access to medical treatment and fear of malaria is a concern for many living in Tepoi.

These quality of life factors involving the interplay between health, natural aesthetics, and access to improving these determinants of quality of life affect villagers' decisions to stay in Tepoi. For example, a young KI3, expressed concern about the rubbish management in Tepoi and mentioned that it affects the way she views Tepoi and her future in it. Thus, these aforementioned factors are indirect drivers in the decision-making process to relocate.

3.4 Population and Movement Patterns

The following section goes into depth about migration and the context in which these movement patterns are to be understood. There are several reasons for why people leave Tepoi and to understand the impact migration has on land use it is necessary to clarify these factors and their interrelations. In including divergent perspectives, a more detailed understanding of the relation between migration and land use is gained. Education, job opportunities, movement patterns and villagers' attitudes, values and beliefs are all important to include in trying to understand in which context migration is to be seen and will be discussed in the following section.

3.4.1 Demographics

To investigate factors influencing land use in Tepoi, it is relevant to analyze demographic features of the village. Thirty questionnaires representing 189 persons, provided information regarding age and household migration. They show a trend that significant parts of certain age groups, namely ages 21-40, are leaving the village (Figure 8). The majority of people living in Tepoi are thus children and youngsters under the age of 20 and adults 41 years and up. Many 11-20 year olds are leaving the village to attend secondary school in Tebedu (see section 3.4.2). The work force between 21-40 years is largely absent, which can be explained by several factors illustrated in the following discussion. In total, 75 of the 189 persons included in the questionnaire survey are not living in Tepoi permanently.

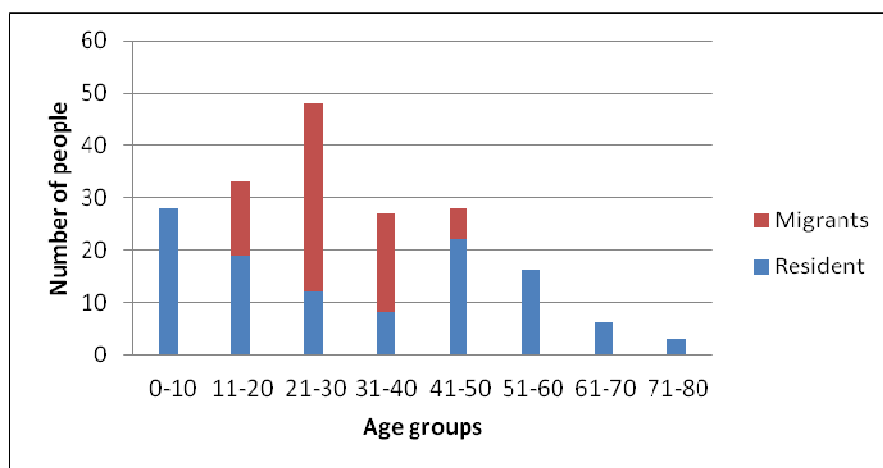


Figure 8. Age distribution of Tepoi representing both the permanent residents and migrants from Tepoi.

Clarification on migration

In this report the term movement patterns is used as a way to describe the population of Tepoi that does not permanently reside in the village. Migration is a more specific term referring to adults who have moved to urban centers to work yet are still considered members of the households and return periodically. For example, the students going to secondary school in Tebedu are not considered part of the migrant population as they have stronger ties to Tepoi and are the dependents of households there. However both migrants and students have an effect on labor availability in Tepoi and thus are often treated equally in this paper in relation to the affect their absence has.

3.4.2 Education and Infrastructure

The Malaysian educational system is composed of pre-school (ages 4-6), primary school (ages 6-12), and secondary school (ages 12-18). Primary school is compulsory by law and is free for all Malaysians (Ministry of Education 2011). After primary school students have the option to attend secondary school, but this requires more household funds as the schools are often in urban areas and therefore transportation and boarding costs are involved. FGD1 demonstrated that there was a general understanding that parents recognize that sending their children to school is as an option of getting them away from the more traditional livelihoods such as farming. This is expressed by KI7 as *“It is actually good to see our young generation to move on and continue to increase their standard of life. Many young teenagers (...) have high education and they should get a better job and salary”*. This statement was made by a father of four children who have all obtained a high education and are now working and living in urban centres. This general positive attitude towards education as a way of improving life is a theme seen through government policy (Wawasan 2020), the views of the villagers and head man. Even KI4 who does not have any migrated family members, expressed similar support for education. Generally, educational improvement was seen as a source of pride in the village. Many families display pictures of their graduating children posted in prominent places in the house.

Throughout Sarawak, primary schools can often be found in small villages such as Tepoi, whereas secondary schools are located in larger towns. The infrastructure in Sarawak is often poor, so children only return home periodically (Sim 2000). The questionnaires also suggest that students attending secondary school do not return home on a daily basis. Thus, accessibility to education is improved through physical infrastructure making infrastructure an underlying driver of migration. This statement is supported by conversations had with KI 1, KI 4, and KI 7, who agree that better access to schools through proximity and roads further encourages

The New Road

Tepoi is located at the end of a road which is the only paved way in and out of Tepoi. Paved in 2002, this road allows people to travel to Tebedu in 30-40 min by car. A new road is currently being constructed which will still connect Tepoi with the main road (leading to Serian and Tebedu) but will also new access to. Furthermore, the parking lot in Tepoi is currently being reconstructed to accommodate the increasing amount of cars returning on the weekends – a sign of Tepoi’s growing migrant population. Based on information given by the village headman, half of the 87 households have a motorbike and 20 households have their own car. The villagers who do not have their own means of transportation can get rides for 3-4 RM one-way to Tebedu.

Right: Construction of new road going from Tebedu Junction to Tepoi. (Photos Sofie Hjelm, March 2011).



young people to continue their education after primary school, making them proximate drivers of migration. The new road set to be completed in 2015 may improve this access and shorten travel time.

Alternative income sources in Tepoi

One of the only exceptions from farming as the primary income source in Tepoi is the family of a local schoolteacher from the primary school. Being the only teacher actually living in the village, his primary source of income is teaching. His wife and daughter also run a small shop which contributes to the household income. His income is further supported by a rice husking machine that he purchased and charges villagers a small fee for the service.

Right: Shop in Tepoi (Photo: Sofie Hjelm, March 2011)



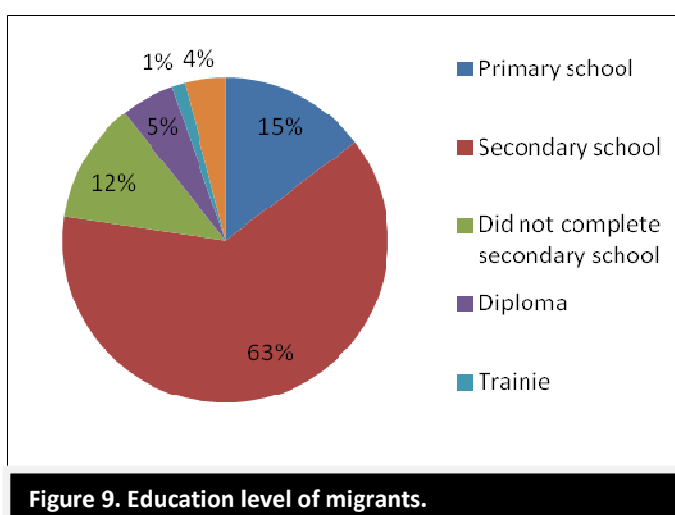
The impact of accessibility through physical infrastructure is already seen with the existing road. KI 7 is able to operate a shop in Tepoi because the road facilitates access to the urban centers where products to sell in his store can be purchased. It should be taken into account KI 7 has the resources to own a car making this possible. This informant's access to the road and his car strongly influence his ability to practice supplementary income-generating activities. In light of this, it is likely that the new road may have a profound effect on people's livelihood strategies in Tepoi.

Access to physical infrastructure promotes more movement (Windle 2002), which also can be observed in Tepoi. With only few exceptions, there is a lack of income sources in Tepoi besides farming. Therefore, to supplement their income, many villagers seek job opportunities outside the village. This results in a large number of people working and living elsewhere (Fig. 8).

Looking at the movement patterns of the 75 people living outside Tepoi (see section 3.4.3) there seems to be a correlation showing that migrants have higher education levels: 63 % of the migrants have completed secondary school (Figure 9).

Furthermore, Figure 10 (page 34) shows that for the majority of occupations held by migrants from Tepoi, no higher educational level is required. There is a discrepancy between educational level among migrants and their occupation. This tendency is also emphasized by a similar study on the relationship between education and migration from Sarawak done by Sim (2000).

Thus, secondary education does not seem to guarantee a job necessitating such an educational level. However, it does seem to affect



and enable the decision to relocate. Therefore, it is worth investigating other factors which influence this relocation and will be illustrated in the following discussion.

From interviews with young key informants (KI 3 and KI 8) as well as the FGD3, the lives and perspectives of the young people from Tepoi were explored. There is a general consensus among these youth to distance themselves from the farming lifestyle of their parents. This is demonstrated by their limited knowledge of farming practices as they spend more time at school than on the field. This phenomenon is also observed by Windle (2000).

Young people express pride in their heritage and have strong ties to Tepoi, yet at the same time, acknowledge that in order to achieve their desired lifestyle they must leave. Statements such as *“I would like to experience the world outside Tepoi”* (FGD3), *“I would like to have internet access for fun and job searching”* (KI 8) and *“I do not know where to work after school but definitely not as a farmer (KI 3)”* emphasize how the young generations in Tepoi have a different view about the surrounding world and desires than older generations in the village.

Despite their strong ties to home, there is a tendency for the youth to leave Tepoi. With limited resources and options in the village, young people's desire to leave is not surprising as they are influenced by their education, the inputs from the media and interaction with relatives in urban centers. Coupled with the encouragement from their parents to further their education and move to urban centers for a better job, these reflections are understandable. From interaction with the young villagers we learned that they are in general minded on what is going on in the world that surrounds them.

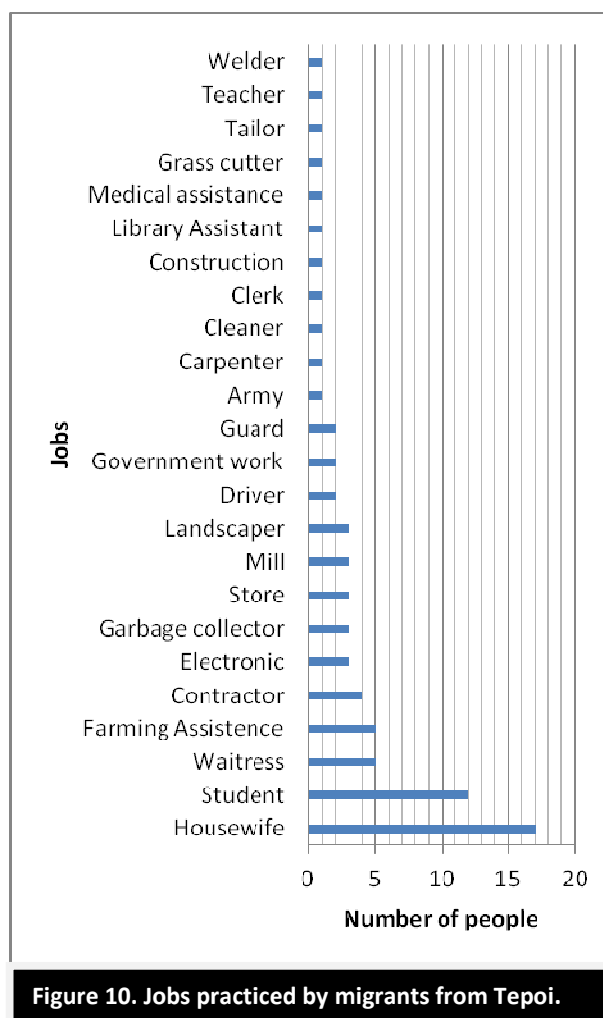


Figure 10. Jobs practiced by migrants from Tepoi.

3.4.3 Job Opportunities and Remittances

The modern world influence and increased job opportunities encourage movement to cities. In Sarawak 48 % live in urban areas (Sim 2000) and Kuching, Miri, Bintulu and Sibu are the most common cities of relocation. The questionnaire data from Tepoi shows a similar pattern (Figure 11).

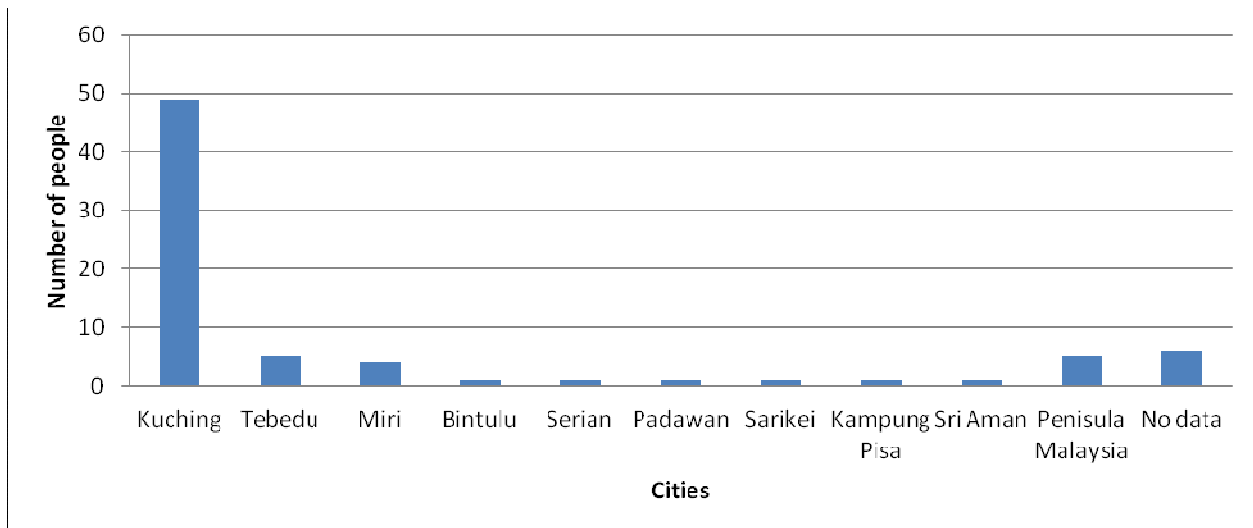
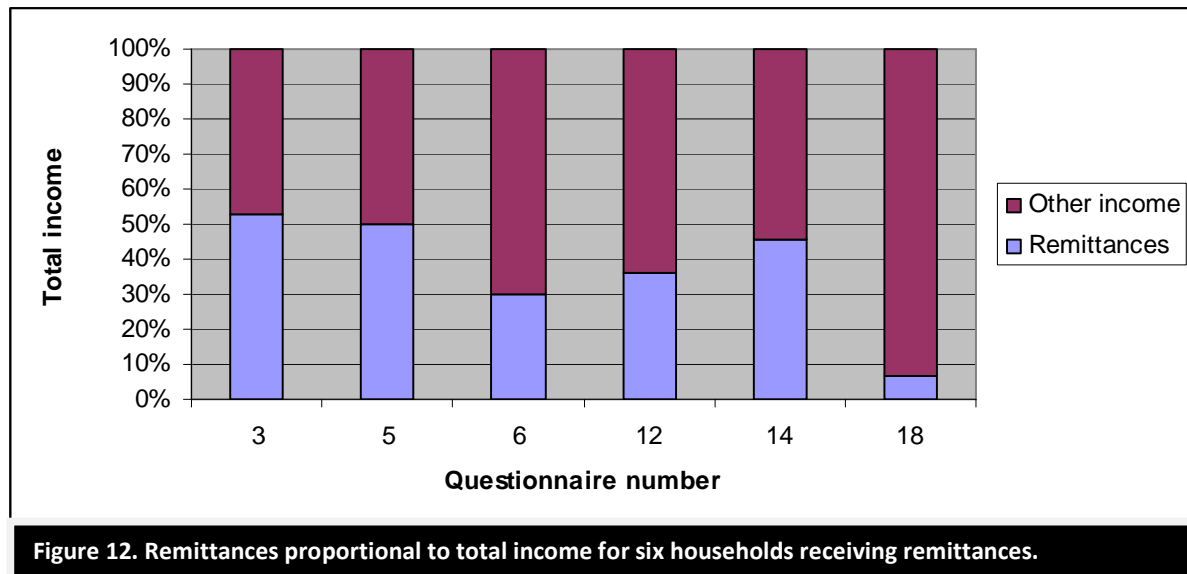


Figure 11. Cities migrants from Tepoi have relocated to.

According to the questionnaires, 65 % of the migrants from Tepoi live and/or have a job in Kuching, for the most part in the service sector. The growth rate of urban centers in Sarawak has accelerated within the last 10 years. In 1991 approximately 22 % Sarawak's population lived in urban areas, which had increased to 48 % in 2000 (Sim 2000). This rapid urbanization has been influenced by government policies such as Wawasan 2020. In Tepoi the influence and introduction of modern world lifestyle was observed in several houses visited. Commodities such as flat screen TV's and stereos are not uncommon, and posters of western soccer teams decorate the walls of many households visited. This may serve not only as a status symbol, but also may influence other villagers to desire the same commodities and ties to the modern world.

Access to physical infrastructure enables movement and greater influence from population centers. Remittances sent or brought back to the household are also facilitated by infrastructure. According to Windle (2002) good infrastructure can increase the amount of remittances as good roads make it easier for migrants to bring back money (Windle 2002).

In Tepoi 13 of the households (43%) covered in the questionnaire survey receive remittances ranging from 50 to 600 RM per month. In comparing data from the questionnaires and records given by the village headman on issues regarding remittances and monthly income, six out of the 13 households can be identified. It shows that remittances constitute between 10% and 50 % of monthly income available, and hence a significant proportion for these households (Figure 12).



KI 1 (questionnaire 14) receives remittances accounting for 45 % of monthly income. This enables the household to buy different goods (food, fertilizers and pesticides) and save up money to build a second floor on the house in Tepoi.

Remittances can also be important for people not receiving governmental subsidies as they can ease the purchase of agricultural inputs. In investigating the remittances' effect on crop choices, there is a slight tendency to grow several different crops supplemented by various livestock. Based on the questionnaire survey the 13 households receiving remittances, on average, engage in 6.4 different cropping/livestock activities, whereas households not receiving remittances engage in 4.6 (Appendix 10). This indicates that remittances affect land use choices, by facilitating diversified crop and livestock selection, as a strategy to counter poor yields or unexpected negative events. Nonetheless, there are households which do not fit this trend, as they do not receive remittances yet still have high diversification in their agricultural practises; these include questionnaires 9, 13, 15, 20, 21, 30 and 31 (Appendix 10). Questionnaire no. 30 is especially remarkable, as he has nine different agricultural practices. This is possible due to his possession of a large area of land, his access to infrastructure and the fact that he engages in other income-generating activities. Therefore the remittances' influence on land use cannot be simplified and ought to be interpreted in a broader context of dynamic interrelations.

The Entrepreneur

Although remittances do not represent a substantial portion of income in many Tepoi households, it can drastically affect the flexibility of some villagers and fund new farming ventures independently of the availability of subsidies and government agricultural assistance. One key informant who works in Kuching during the week as a landscaper saved up 1000 RM of his wages so that he and his wife could purchase oil palm seeds which they grew and planted on two hectares of their land (roughly 450 trees). Due to the fact that he is often gone during the week, this farmer and his wife regularly hire outside labor to help apply pesticides etc. The planting and maintenance of the oil palm was independently prompted and funded, and this farmer asserts that he receives no subsidies or assistance from the government for the oil palm. This farmer did mention, however, that he may apply for them at another point, but stated that he did not care to wait for government assistance in order to make land use decisions.



Right: The entrepreneur with one of his oil palms (Photo: Lara Murray, 2011)

The increasing movement out of Tepoi affects the labor availability as seen in figure 8 where the absence of the younger segment of the workforce (21-40 years) is clear. Data from SSI, questionnaires and observations support this indication that not many people in the households are working in the fields. It is therefore common for households to hire or exchange labor during peak seasons. This is both due to communal solidarity and the fact that much of the population left in Tepoi are aging and thus less capable of intensive labor. Remittances can help mitigate decreasing labor availability as it supports the purchase of labor, fertilizers and pesticides, and can minimize the necessity of cash cropping, as Best (1988) posits.

Education, urbanization and modern world influences are underlying drivers impacting decision-making and future perspectives for people in Tepoi. As the young generations express little interest and knowledge of farming, it is clear that they are interested in alternative livelihoods. This has led to the present migration flow towards urban centers which both affects labor availability and economic factors through remittances. The movement of a large portion of younger people in Tepoi drains social capital and knowledge in Tepoi, posing challenges for the village and for land use, as also discussed by Hansen & Mertz (2005). These changes have been mitigated partly through alternative income sources for the remaining farmers in Tepoi in the form of remittances. These remittances bring in a more complex but flexible system facilitating new farming strategies which attempt to secure livelihoods through crop diversification. However, remittances and wage labor should not necessarily be seen as replacing farming in Tepoi. The money brought in only allows for more flexible farming practices as diversified crop systems are facilitated.

4. Conclusion

The objective of this study is to identify and analyze the impact migration has on land use in Tepoi. Drivers for land use interact to create a multifaceted system of direct and indirect effects on land use. Through adapting Geist and Lambin's (2002) framework, understanding how the present land use relates to migration is possible as it helps identify important interacting drivers that influence land use decisions. Thus, the interrelationships of this complex system are illuminated.

The agricultural practices in Tepoi consist of both subsistence farming and cash cropping. Rice cultivation for household consumption is practiced by the majority of the households and is seen as a valued tradition. However, the patterns and choices revolving around cash cropping are less predictable as there are large differentiations between the households and their choices of crops and livestock. What can be said is that the villagers recognize the instability that cash cropping can bring, and thus practice subsistence farming as well to promote security.

Migration influences land use on a continuum between limitation and creation of opportunities for the villagers. In one way, migration limits aspects of village life and exploitation of land. For instance, this is expressed when the decrease in labor availability caused by the rural-to-urban migration flow limits potential within a household to expand economic activities. It can be asserted that the resulting limitations are somewhat mitigated by government subsidies of pesticides and fertilizers which enable the agricultural intensification that maintains the land use at a constant. On the other hand, migration also creates possibilities in Tepoi bringing in economic flexibility which opens up possibilities for multiple land use strategies. Supplementary cash income from remittances makes households less vulnerable to unforeseen events or sudden global market fluctuations associated with cash cropping. Therefore, although the observed patterns of migration in Tepoi do have a relationship with land use, it is not appropriate to portray it as a proximate driver.

Migration is likely to maintain as it continues to be fueled by increasing education levels within the village, urban job opportunities, government policies, and a general desire in the community to attain modern world commodities. Furthermore, aspects influencing quality of life in Tepoi affect people's decisions to relocate. These factors include water quality, rubbish, health, and the desire for modern commodities. Thus access to a higher standard of living through infrastructure extension may play a key role in the future of Tepoi's population.

5. Reflections

This report is a result of collaboration between numerous academic disciplines and therefore diverse approaches to conducting academic research. The complex nature of the topic chosen and the variety of methods applied has made for a remarkable learning experience for all involved. It became evident that allowing for room and time to understand the perspectives of the different researchers provided the most fruitful dialogue.

Although both social and natural science methods were employed, the fact that land use was the main focus of the study lent itself best to social science methods. This has left the results and subsequent conclusions, subject to the inherent weaknesses of using second hand information to describe a factual situation. Natural science methods and direct observations were applied where possible to triangulate claims by villagers, but a large part the project is based on interactions with the villagers of Tepoi.

An effort has been made to interpret data in the context it has been collected, but the time frame of the study and experience level of the research team did not allow complete understanding of the factors influencing data collected. In spite of these factors, the researchers can assert that the results have value because the research process involved constant reflection and attempts to triangulate information.

One important lesson learned was discretion and focus when collecting data, especially in such a limited timeframe. Mastering the process of data collection is about reaching a balance between what is necessary to understand and what is interesting but not crucial information. This is what makes the planning process so crucial for conducting constructive field work. Data collection is a reflective process where it is necessary to process internalize information as it is being collected.

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Appendix 1: Reference codes for methods

Reference code	Subject	Description	Influences (Biases)
PRA 1	PRA (Community Map)	Participatory exercise involving 15 people representing a broad cross-section of villagers, communally creating a village map.	Public setting (outspokenness) Power structures Knowledge Translation
PRA 2	PRA (Seasonal Calendar)	Participatory exercise involving 13 people representing a broad cross-section of villagers, communally creating a seasonal calendar.	Public setting (outspokenness) Power structures Knowledge Translation
PRA 3	PRA (Time Line)	Participatory exercise involving 15 people representing a broad cross-section of villagers, communally creating a historic time line.	Public setting (outspokenness) Power structures Knowledge Translation
FAW 1a	Farm Walk 1a (hill paddy & rubber)	Direct field observations combined with interview of land owner. Few participants all part of research team or known by the informant.	Pride (in own achievement) Knowledge Translation
FAW 1b	Farm Walk 1b (pepper)	Direct field observations combined with interview of land owner. Few participants all part of research team or known by the informant.	Pride (in own achievement) Knowledge Translation
FAW 2	Farm Walk 2 (oil palm)	Direct field observations combined with interview of land owner. Few participants all part of research team or known by the informant.	Pride (in own achievement) Knowledge Translation
FAW 3	Farm Walk 3 (oil palm, rub., peb., h paddy)	Direct field observations combined with interview of land owner. Few participants all part of research team or known by the informant.	Pride (in own achievement) Knowledge Translation
FAW 4	Farm walk 4 (Hill paddy harvesting)	Direct field observations of farm work combined with interview of land owner. Few participants all part of research team or known by the informant.	Pride (in own achievement) Knowledge Translation
FAW 5	Farm walk 5 (collecting NTFP)	Direct field observations of farm work combined with interview of land owner. Few participants all part of research team or known by the informant. Ad hoc planning.	Pride (in own achievement) Knowledge Translation
FOW 1	Forest walk 1 (Trail to Indonesia)	Direct field observations of forest area combined with interview with forest user. Many participants all part of research team or known by the informant. Accompanied by vegetation expert.	Pride (in own achievement) Knowledge Translation
FOW 2	Forest Walk 2 (Hunting)	Direct field observations of forest area combined with interview with forest user. few participants all part of research team. Set up as hunting trip.	Pride (in own achievement) Translation Loose format
KI 1	Key informant 1	Relatively wealthy villager, related to village headman. Farmer with large influx of remittances from husband.	Relationship to headman Translation

KI 2	Key informant 2	School teacher among the wealthiest in the village. Diversified livelihood, with farming, shop keeping, rice milling and salaries. Good English skills. Outspoken.	Pride (feeling superior) High social status Knowledge
KI 3	Key informant 3	18 y.o. Granddaughter of older villager, currently studying.	Shy Knowledge Translation
KI 4	Key informant 4	Villagers living with his young son. Farmer and deputy headman. Decent English skills.	Relationship to headman Knowledge Translation
KI 5	Key informant 5	Off-farm worker and farmer with subsistence and cash crops including oil palm. Entrepreneurial. Small household with many resources. Decent English skills. Outspoken.	Modesty Knowledge Translation
KI 6	Key informant 6	Well off villager living on outskirts of village land. Large areas under cultivation with many cashcrops. Entrepreneurial. Middleman for cash crops and other commodities. Outspoken.	Pride Relation to other villagers Translation
KI 7	Key Informant 7	Well-off villager heavily involved with village politics. A member of several JKKK boards and was reluctant to introduce himself and express his views.	Pride Reservation in communicating with researchers
KI 8	Key Informant 8	22 y.o. Did not complete secondary school, currently farms in Tepoi	
FGD 1	Focus Group Discussion 1 (General)	Participatory exercise with 5 villagers specifically invited to discuss topics relating to village life in general.	Public setting (outspokenness) Power structures Knowledge Translation
FGD 2	Focus Group Discussion 2 (Farmers)	Participatory exercise with 5 farmers specifically invited to discuss topics relating to agricultural activities.	Public setting (outspokenness) Power structures Knowledge Translation
FGD 3	Focus Group Discussion 3 (Young)	Participatory exercise with 5 young villagers specifically invited to discuss topics relating to village life for young people.	Public setting (outspokenness) Power structures Knowledge Translation

Appendix 2: Questionnaire

Introduction

Introduce yourself (name, nationality)

Purpose: I am part of a small team from the University of Copenhagen and University Malaysia Sarawak doing research on the migration to the cities that is happening in Tepoi.

We want to understand if and how this migration is affecting the way you do agriculture and use the forest.

I have seventeen questions to ask you.

If there are any questions that you do not feel comfortable answering, please do not feel pressure to.

Date:

Interviewer:

Index no:

Independent variables

Getting to know you and your family.

1) House/GPS key point:

2) Gender:

3) Age:

4) Ethnic group:

5) How many people live in this house?

What are their ages?

What do they spend most of their time doing/what is their main responsibility in the household?

Gender:	Age:	Primary occupation:

Land use

Getting to know about your farm, and how you use your land.

6) How would you rank these five activities in terms of importance for your family?

Ranking: (5 is most important, 1 is least important)

System:	Rank:	Notes:
Selling crops		

Growing your own food		
Money from family members living elsewhere		
Collecting Forest Product		
Working away from your farm		

7) What crops do you grow in your fields?

Crop:	Area:	Livestock:	Number:

8) Do you sell any of the crops you grow?

If yes:

What crop:	To whom:	(where):	How often:

9) Do you get any fertilizers from the government? Y/N

If yes:

What:	For what crops:	How much:	Notes:

10) Do you get any other government help?

If yes, please specify (what, for what, how much):

11) Do you collect any products from the forest?

If yes:

What:	For what:	How often:	How much:

E.g: NTFPs (medicinal plants/herbs, mushrooms, fruit, rattan, ferns, animals/meat) etc.

12) Do you spend a lot of time on something we haven't mentioned?

If yes, please specify:

Land tenure

Understanding the official ownership of your land.

13) Is your land Native Customary Rights land?

14) Do you rent the land from someone?

If yes, please specify:

Migration Patterns in Tepoi

Getting to know your family members away from this farm.

15) Is there anyone from your family working and/or living outside your farm?

If yes:

Relation	Age	Occupation	Education	How often are they home:			Where:	How money is sent home:	Available for work when home:
				Weekly:	1/month:	Less:			

16) Have there been any health problems in your household?

17) What do you think of the river's water quality?

Interviewers' thoughts

Thoughts about the setting:

Who was present while interviewing?

Things that could have had an influence on the interview/the answers?

Thoughts about the informant:

Further questions:

Appendix 3: Semi-structured interview guide for villagers

Date: / - 2011

Interviewer:

Introduction

Introduce yourself (name, nationality)

Purpose: I am part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I have about 30 questions to ask you.

I would like to hear about you and how you live your life.

If there are any questions that you do not feel comfortable answering, please do not feel pressure to.

This is an anonymous interview, so we will not be using your name in our report or give the information we get from you to anybody else.

Independent variables

Questionnaire no.:

1) House/GPS key point:

2) Gender: Male Female

3) Name:

4) Age:

Land use

Agricultural practices and use of forest

5) For how long have you lived in Tepoi? (Lifetime, on-off)

If on-off: Why did you live there?

6) Have you always grown what you grow now or did you grow anything else in the past? (change in agricultural practices)

Land tenure

7) How do you know which land belongs to whom?

8) How do you choose the locations that you cultivate?

Do you know the size of the land that you own? How big is it?

Do you know the size of the land you are currently growing crops on? How big is it?

9) Are you allowed to use the land the way you want to or are there some restrictions? (Government/village policies regarding land use)

If restrictions, who makes these?

How do you perceive these restrictions?

Land use

10) Do you have good soil on your fields?

11) In the questionnaire you told us that you collected these products in the forest. Do you use more or less forest products now than before?

12) Do you do other activities in the forest? (Production, religion, traditions, etc)

13) May everyone use the forest? (Land tenure, hierarchy, forest management)

14) If someone does something they should not do what do you then do? (Power structures, customary law)

Migration and off-farm work patterns in Tepoi

Past, present and future patterns

So I can see from the questionnaire that X lives outside Tepoi. (Based on one person from the scheme).

15) At what age did X leave?

16) For how long has X been away now?

17) Was it X's own decision to leave?

18) Does X help you with anything here in Tepoi?

You said that X send back money:

19) What do you use the money you get from X for? (Food, seeds, fertilizers, conveniences, etc

The relationship between infrastructure and migration/off-farm work

20) How do you get around in and outside the village? (By car, the river, bus, etc)

21) Who owns the "transportation option"?

22) How did you get around before the road was built in 1991?

23) Was Tepoi the same size when you were a child? (Purposely very open ended question, hopefully opens up on narratives on changes)

24) Do you see migration out of Tepoi continuing in the future? How?

- 25) Do you foresee the new secondary school in Tebedu affecting the future migration of people out of Tepoi?
- 26) Has labor division in households changed in Tepoi during your lifetime? For example, are older people doing the jobs that younger people used to be responsible for?
- 27) How hard is it to find labor in Tepoi?
- What is the demographic of people hired to help in fields?
- 28) What is the role of the JKKK (community association)
- 29) What is the role of the farmer's association?
- 30) How do people apply for farming subsidies?
- Do they normally receive the subsidies they apply for?

Interviewers' thoughts

Thoughts about the setting

Who was present while interviewing?

Things that could have had an influence on the interview/the answers?

Thoughts about the informant:

Appendix 3.1: Semi-Structured Interview Youth

Date: / - 2011

Interviewer:

Introduction

Introduce yourself (name, nationality)

Purpose: I am part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I have about 30 questions to ask you.

I would like to hear about you and how you live your life.

If there are any questions that you do not feel comfortable answering, please do not feel pressure to.

This is an anonymous interview, so we will not be using your name in our report or give the information we get from you to anybody else.

Independent variables

Gender:

Name:

Age:

Family status:

Family/household name:

Questionnaire Number:

Education

What level of education do you have:

Years:

School level:

Where have you gone to school:

If relevant – Have you lived outside of Tepoi to go to school:

Where:

For how long:

Do you have any future schooling planned:

What:

Where:

For how long:

Who pays you school fees:

How much is it:

Can you get any government support:

Living in Tepoi

How long do you go to school each week?

What do you do when you are not in school:

(Help your parents, job, sports etc?)

How much time do you spent on this:

Is there anything you would like to be able to do in Tepoi, that you cannot do now:

(Internet, Sports facilities, etc.?)

Have you lived outside of Tepoi:

Have you been outside of Sarawak:

Future prospects

What do you want to work with after school:

What has influenced this decision (why):

Do you plan to work outside of Tepoi after you finish school:

Why:

If relevant: Do you plan to return to Tepoi some day:

When:

Why:

Job opportunities

Do you think it will be easy to get a job when you have finished school:

How do you plan to get a job:

How far away would you be willing to go to find work:

Would you be willing to go to peninsular Malaysia:

Thoughts about livelihoods

If you had live as a farmer in Tepoi, would you know how to grow crops:

Where did you get this knowledge:

What is more popular for young people in Tepoi, staying and farming, or going away to find work:

Why is that:

Have you thought about when you want to get married:

(before you finish your education, job etc.)

What is the general opinion in Tepoi:

Do you have any other things that we should talk about, that we have not talked about yet:

Appendix 3.2: Semi-structured interview questions for village headman

Introduction

Official welcoming/presentation

Date:

Interviewer:

House/GPS Keypoint:

Name:

Age:

Land use in Tepoi

- 1) What are the main crops grown in Tepoi?
- 2) What type of cultivation practices are used (shifting, use of inputs, fallow, improved fallow, plantation etc.)
- 3) Do the families grow most of the food they eat or what do they buy?
- 4) Do you export anything from Tepoi?
- 5) What things do you import to Tepoi?
- 6) What are the main economic activities in Tepoi?
- 7) What land rights do the villagers have on the local area for agricultural production?
- 8) How far from the village do community members use land?
- 9) Are community members satisfied with the rights they have over the land in the local area?
- 10) Are there any external projects taking place (government, NGO, etc)? Please describe what the projects are and how they are being implemented.

Forest use in Tepoi

- 11) What rights do the villagers have on the use of the local forest?
- 12) What is harvested from the forest?
- 13) Has the local forest area changed in your lifetime?
- 14) Has the health/condition of the forest changed in your lifetime?
- 15) Has availability of forest resources changed in your lifetime?

Policy Issues

- 16) What federal or regional policies on land use are affecting the community?
- 17) Does the community have influence over the policies which affect their land use?
- 18) What is your role in this?

Social Issues

- 19) Have there been changes in demographics (age, gender, etc) in the community in your lifetime?
- 19B) Do you think this have affected the way the villagers use the land/how they farm?
- 20) Are children required to go to school?
- 21) Does the youth in the community wish to seek higher education outside of the community?
- 22) Do you have a village council?

Migration Patterns

- 23) Are more people leaving Tepoi or moving in to Tepoi?
- 24) What people are moving into Tepoi?

- 25) What people are moving out of Tepoi?
 - 26) Where do most community members go?
 - 27) Why do people leave Tepoi?
 - 28) Why do people move in to Tepoi?
 - 29) Do people migrate as groups or individually?
 - 30) Are there annual changes in migration?
 - 31) How often do those who migrate return to visit?
 - 32) How often do those who migrate return permanently?
 - 33) How many members of the village own a vehicle or other transportation forms?
 - 34) What are these used for?
 - 35) Who makes the decisions regarding road building to the community?
 - 36) Does the village have influence in these decisions?
 - 37) Who funds the construction?
 - 38) Do you think migration will play a larger role in Tepoi's economy in the future?
 - 39) Do you think migration is positive for the development in Tepoi?
- If this will affect the future land use?

Interviewers' thoughts

Thoughts about the setting:

Who was present while interviewing?

Things that could have had an influence on the interview/the answers

Thoughts about the informant:

Appendix 3.3: Semi-structured interview guide for Mr. Joseph

Date:

Interviewer:

Introduction

Introduce yourself (name, nationality)

Purpose: I am part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I have about 30 questions to ask you.

I would like to hear about you and how you live your life.

If there are any questions that you do not feel comfortable answering, please do not feel pressure to.

This is an anonymous interview, so we will not be using your name in our report or give the information we get from you to anybody else.

Independent variables

Questionnaire no.:

1) House/GPS key point:

2) Gender:

3) Name:

4) Age:

Land use

Agricultural practices and use of forest

5) For how long have you lived in Tepoi? (Lifetime, on-off)

6) Have you always grown what you grow now or did you grow anything else in the past? (change in agricultural practices)

Land tenure

7) How do you know which land belongs to whom?

8) How do you choose the locations that you cultivate?

Do you know the size of the land you cultivate? How big is it?

-Size of the land he owns:

Size he cultivates:

-Who decides where you have your fields?

9) Are you allowed to use the land the way you want to or are there some restrictions? (Government/village policies regarding land use)

If restrictions, who makes these?

How do you perceive these restrictions?

Land use

10) Do you have good soil on your fields?

11) In the questionnaire you told us that you collected these products in the forest. Do you use more or less forest products now than before?

12) Do you do other activities in the forest? (Production, religion, traditions, etc) No

13) May everyone use the forest? (Land tenure, hierarchy, forest management) Yes

14) If someone does something they should not do what do you then do? (Power structures, customary law)

Migration and off-farm work patterns in Tepoi

Past, present and future patterns

He doesn't have any family members migrating.

The relationship between infrastructure and migration/off-farm work

20) How do you get around in and outside the village? (By car, the river, bus, etc)

21) Who owns the "transportation option"?

22) How did you get around before the road was built in 1991?

23) Was Tepoi the same size when you were a child? (Purposely very open ended question, hopefully opens up on narratives on changes)

24) Do you see migration out of Tepoi continuing in the future? How?

25) Do you foresee the new secondary school in Tebedu affecting the future migration of people out of Tepoi?

26) Has labor division in households changed in Tepoi during your lifetime? For example, are older people doing the jobs that younger people used to be responsible for?

27) How hard is it to find labor in Tepoi?

-What is the demographic of people hired to help in fields?

28) What is the role of the JKKK (community association)?

29) What is the role of the farmer's association?

30) How do people apply for farming subsidies?

-Do they normally receive the subsidies they apply for?

Interviewers' thoughts

Thoughts about the setting:

Who was present while interviewing?

Things that could have had an influence on the interview/the answers?

Thoughts about the informant:

Appendix 3.4: Semi-structured interview guide for Ms. Ming

Date: / - 2011

Interviewer:

Introduction

Introduce yourself (name, nationality)

Purpose: I am part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I have about 30 questions to ask you.

I would like to hear about you and how you live your life.

If there are any questions that you do not feel comfortable answering, please do not feel pressure to.

This is an anonymous interview, so we will not be using your name in our report or give the information we get from you to anybody else.

Independent variables

Questionnaire no.:

1) House/GPS key point:

2) Gender:

3) Name:

4) Age:

Forest use

5) As we have seen, you collect products from the forest and wild vegetables. Do you do this more or less than you did 10 yrs ago? 20 yrs ago?

6) Do you think this is the same for other people in Tepoi?

7) Is it harder to find than before?

8) Do you have to go farther to find them?

If so, what do you do about the increasing scarcity?

Land use

9) How long is the normal fallow period for paddy?

10) Has this amount of time changed in your lifetime? Why?

11) Has the amount of land that you grow paddy on changed in your lifetime?

12) Have you noticed any patterns of change in the size of paddy fields in the village in your lifetime? If so, why?

Is this because paddy takes a lot of time?

13) Do cash crops (pepper, rubber, etc.) require more or less work than paddy?

14) Do people need to hire more labor to help in the fields than before? Why?

If so, how do people deal with the need to hire labor?

16) Who is usually hired to help in the fields (men, women, age...)

17) Do you plant paddy according to how much you need, or how much help you have available to work? Explain.

18) Do you ever have a problem where you don't have enough help to plant the paddy that you need? If so, what do you do? Do you hire help? Do you plant a smaller area? Do you plant something else?

Migration and off-farm work patterns in Tepoi

Past, present and future patterns

19) How many family members do you have in Tepoi?

20) How many have left to work in the city?

21) Do you think the number of people leaving Tepoi will increase in the future? Why?

22) Do you foresee the new secondary school in Tebedu affecting the future migration of people out of Tepoi?

23) Has labor division in households changed in Tepoi during your lifetime? For example, are older people doing the jobs that younger people used to be responsible for?

24) What is the role of the JKKK (community association)

25) What is the role of the farmer's association?

26) How do people apply for farming subsidies?

-Do they normally receive the subsidies they apply for?

Interviewers' thoughts

Thoughts about the setting:

Who was present while interviewing?

Things that could have had an influence on the interview/the answers?

Thoughts about the informant:

Appendix 3.5: Semi-structured interview guide for Schoolteacher

Date: - 2011

Interviewer:

Introduction

Introduce yourself (name, nationality)

Purpose: I am part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I have about 30 questions to ask you.

I would like to hear about you and how you live your life.

If there are any questions that you do not feel comfortable answering, please do not feel pressure to.

This is an anonymous interview, so we will not be using your name in our report or give the information we get from you to anybody else.

Independent variables

Questionnaire no.:

1) House/GPS key point:

2) Gender:

3) Name:

4) Age:

Land use

Agricultural practices and use of forest

5) For how long have you lived in Tepoi? (Lifetime, on-off)

If on-off: Why did you live there?

How do people in Tepoi learn about farming?

6) Have people in Tepoi always grown what they grow now or did they grow anything else? (change in agricultural practices)

Land tenure

7) How do people know which land belongs to whom?

8) How do people in Tepoi choose the locations that are cultivated?

Do you know the size of the land you cultivate?

Who decides where you have your fields?

Can you lose your rights to cultivate this land?

9) Are they allowed to use the land the way they want to or are there some restrictions? (Government/village policies regarding land use)

If restrictions, who makes these?

How do you perceive these restrictions?

Land use

10) Do you have good soil on your fields?

11) In the questionnaire you told us that you collected these products in the forest. Do people in Tepoi use more or less forest products now than before?

11) Do people do other activities in the forest? (Production, religion, traditions, etc)

12) May everyone use the forest? (Land tenure, hierarchy, forest management)

13) If someone does something they should not do what do you then do? (Power structures, customary law)

Migration and off-farm work patterns in Tepoi

Past, present and future patterns

The relationship between infrastructure and migration/off-farm work

19) How do you get around in and outside the village? (By car, the river, bus, etc)

20) Who owns the “transportation option”?

21) How did you get around before the road was built in 1991?

22) Was Tepoi the same size when you were a child? (Purposely very open ended question, hopefully opens up on narratives on changes)

23) Do you see migration out of Tepoi continuing in the future? How?

24) Do you foresee the new secondary school in Tebedu affecting the future migration of people out of Tepoi?

Interviewers' thoughts

Thoughts about the setting:

Who was present while interviewing?

Things that could have had an influence on the interview/the answers?

Thoughts about the informant:

Appendix 4: PRA Community map, Seasonal Calendar and Historic Timeline of Tepoi

The Community Map

To provide a good starting point, one fixed landmark was drawn first (the rivers) and afterwards the participants were asked to draw other important landmarks, their household and fields including the different kinds of crops or livestock. The process of the community map made it possible to gain further information about the participant's opinions on the land use choices and activities in Tepoi.

The session started out with 10 participants but during the meeting several others joined. The group were represented by both men and women. The following subjects were asked to be drawn on the map: the rivers, the roads, the residential area, the mountains, the bridge, the garbage dump sites, the church, the school and the Indonesia border. This was followed by a discussion of their land use.

The Seasonal Calendar

The activity was organized by preparing a large graphic displaying different land use sectors (agriculture, livestock, forest) and the activity related to these sectors throughout one year. Participants were asked to list important products followed by the labor required for production throughout the year. This would enable to explain if there is any relation between cropping cycles and migration patterns. There were 12 participants 9 female and 3 male between the ages of about 30-70.

The Historic Timeline

In order to get the discussion going some prepared questions were asked which was considered 'need to know'. These were divided into three different categorized which included:

Roads School Running water Sanitation drainage Electricity Longhouse/individual houses (house construction/architecture)	Oil palm Durian Paddy Maize Cocoa Pepper Rubber Subsidies	Disease outbreak Religion (R.C, SDA and Muslim) Migration Natural disasters
---	--	--

At the end the participants were asked if they could think of any important event that had not been drawn on the map and several suggestions followed. Approximately 30 people were present during the exercise but only 10 active men and 3 active women.

Appendix 5: Focus Group Discussion General Village Topics

Informants:

Topics: Labor demographics and changes

Education's relation with migration

Water quality

Garbage sites/disposal

Medical Access

Labor demographics and changes

Who usually work in the fields/which age groups? And who migrates

Are you concerned with the young people leaving Tepoi or would you rather have them to stay?

Do you see a pattern between those who goes to the city and their educational level?

Water quality

What do you think of the water quality in the river?

Has the quality change during the last 20 years?

Dry vs. rainy season

What do you think of the quality of the water from the gravity feed?

Has the aquatic life changed during the last 20 years?

Garbage sites/disposal

How many dumpsites are there in Tepoi and do the villagers use them?

Do you think there is a connection between the quality of the river and the dumpsites?

What should be done to improve the garbage situation?

Medical Access

How often do the health team comes to Tepoi and do the villagers use it?

Thoughts about meeting:

Appendix 5.1: Focus Group Farmer Meeting**Topics:** _____

Change in amount of land cultivated (abandoned paddy field)

Labor availability

Subsidy applications

NTFP availability

Extension Services/Improved farming techniques

Future of agriculture in the area

Cultivated Area: _____

Has the area around Tepoi that is used for cultivation changed in your lifetime?

What is the general teaching about how long to leave a field before planting new crops?

Has the length of the fallow period used before planting crops changed in your lifetime? Why?

Has the distance that people in Tepoi cultivate crops on changed in your lifetime? How? Why?

Has the availability of fertilizer and pesticide subsidies had an influence on how much land is cultivated? Has it had an influence on the location of plots cultivated?

Labor availability: _____

Do fertilizer and pesticide subsidies change the amount of labor required for farming activities?

Have changes in the availability of labor had an impact on where, how or how much land is cultivated?

We noticed that many of the young people in Tepoi are choosing to migrate to cities. Is this your impression as well? What are farmer's strategies for continuing their farming activities despite the high rate of out migration?

Is there a change in the age or gender of those working in the fields? Is this related to migration?

Subsidies: _____

We have learned that farmer subsidy applications are filled by the farmer, then the application is given to the Farmer's Association and submitted to the headman. He makes the selection of applicants and submits the applications to the Tebedu Department of Agriculture, which then goes to Serian. The fertilizers are distributed to Tebedu Office of Agriculture, then brought to Tepoi. Villagers must pay for the transportation of the fertilizers from Tebedu to Tepoi. Is this correct?

Where along this process does the main part of the decision about who receives fertilizers take place?

Is the availability of subsidies influencing the crops you choose to grow? How? Why? E.g. Are there crops which you would not grow if you could not receive subsidies for them? Why?

How do you apply for subsidies for your cocoa fields?

How do you apply for subsidies for your pepper fields?

How do you apply for subsidies for your paddy fields?

NTFP availability

Has the amount of products (bamboo, rattan, wild vegetables, etc.) which you do not grow but use often, changed? How? Why?

Do you do anything differently because of this change?

Do you cultivate more of these forest products because of this change?

Development of Agriculture

Has the way you farm improved from the way previous generations used to farm? Are you getting higher yields? Is the labor less intensive?

What has been the main reason for any change/improvement?

Please give examples of how the farmer's association, the JKKK or the Department of Agriculture help in your farming decisions and yields?

Looking to the future

Do you think people in Tepoi will ever stop growing paddy?

-If so, what will they do instead?

Do you think the current problems you experience with the increasing difficulty to find rattan and bamboo will get worse in the future?

Do you think that there is a way to get young people interested in farming again?

Appendix 5.2: Focus group discussion young people

Date: / - 2011

Interviewer:

Introduction

Introduce yourself (name, nationality)

Purpose: I am part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I have about 30 questions to ask you.

I would like to hear about you and how you live your life.

If there are any questions that you do not feel comfortable answering, please do not feel pressure to.

This is an anonymous interview, so we will not be using your name in our report or give the information we get from you to anybody else.

Participants: Name, age, gender, education, occupation.

Living in Tepoi

Are you happy about living in Tepoi?

Would you rather move to somewhere else?

What do you spend time on in Tepoi?

Future plans

Are you happy about the education opportunities in this area?

Happy with the new high school opportunities in Tebedu and the extension of Tepoi primary school. Before they only had classrooms for three grades so they would share E.g. one year first grade and then it would take three years till the next first grade would begin. Now room for all steps.

If you could choose yourself what do you dream of doing in your life? (hint to us, DON'T ASK: survival, easy living, material needs, etc.)

Interviewer thoughts on dreams:

Life world (how do they perceive their life)

Do you think about leaving Sarawak some day?

For what purpose:

Parents' opinion:

Can you imagine yourself growing old in Tepoi?

Do you enjoy helping your family in the fields?

Life opportunities

Do you know how to manage a paddy field, pepper field, rubber field, etc.?

Do your parents encourage you to leave Tepoi?

Experiment 1: Imagine that you are the JKKK in this kampung and should take care of problems around here.

Case: The bridge from the parking lot to the actual village is broken. What would you do?

Interviewers thoughts:

How much do your parents opinions mean to your choices?

When is it normal to marry in Tepoi?

What do you think about that?

When do you want to marry?

Etc....

Overall thoughts (interviewer):

Appendix 6: Farm Walk – General Notes.

Introduce yourself (name, nationality)

Purpose: I am/ We are part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I/we would like to ask you draw a map of where is your farm/house and fields in relation to the village and thereafter go for a walk to your fields and learn about your agricultural practices.

General questions:

Optional: Questionnaire/SSI id. No:

1) Gender: Male/Female

2) Name:

3) Age:

4) Ethnic group:

5) No. of people in household:

(no. of people crops must support)

6) No of people from the family working on family fields:

7) No of people hired to work on fields:

(How many, how often)

8) Ages of hired help (generally):

9) How many fields does the household have in total:

Id. no	Crop	Size	Distance from household	Ownership
--------	------	------	-------------------------	-----------

1				
2				
3				
4				
5				
6				
7				
8				

Farm walk – Field notes.

Field no: Location (GPS point no.): GPS coordinates:

Data topic	Interviewee response	Observation
Distance from house to field		
Size of field: Slope: Orientation:		
Crops (primary) (species, amount, age)		
Crops (secondary) (species, amount, age)		
Farming system (shifting, fallow, mixed, consistency of use)		
Farming methods (soil preparation, water management, labor requirements)		
Optional: Equipment/livestock used		
Fertilizers applied/stored (Amount, type, intervals, signs of singing)		
Pest/Weed problems (types, extent of problem, solutions)		
Time allocated to primary crop		
Time allocated to secondary crop		
Yield primary crop		
Yield secondary crop		
Purpose of crop (cash crop, subsistence etc.)		
Opinion of field (good field, bad field etc.)		
History of the field: (previous crops, reasons for change)		

Information on other fields:	
------------------------------	--

Appendix 7: Sketch for forest walk

Introduce yourself (name, nationality)

Purpose: I am/ We are part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I/we would kindly ask you to introduce me/us to the forest and the importance of the different products it provides and teach us the present forestry practices.

Observation/aspect to ask about

People present:

Time:

Location:

Elevation:

Distance to forest	
Dominant forest outlook (tree species, density, infrastructure)	
Important plant species for villagers	
Purpose of important species	
Forest type/health	
Management/labour requirements	
Historic forest use	
Cultural use	
Wildlife	

Appendix 8: Soil sampling

Date:

GPS coordinates:

Description of site:

Slope:

Description of Profile:

Horizon (cm)	Distinctness	Topography	Colour	Clay content	Notes

Scheme for chemical analysis

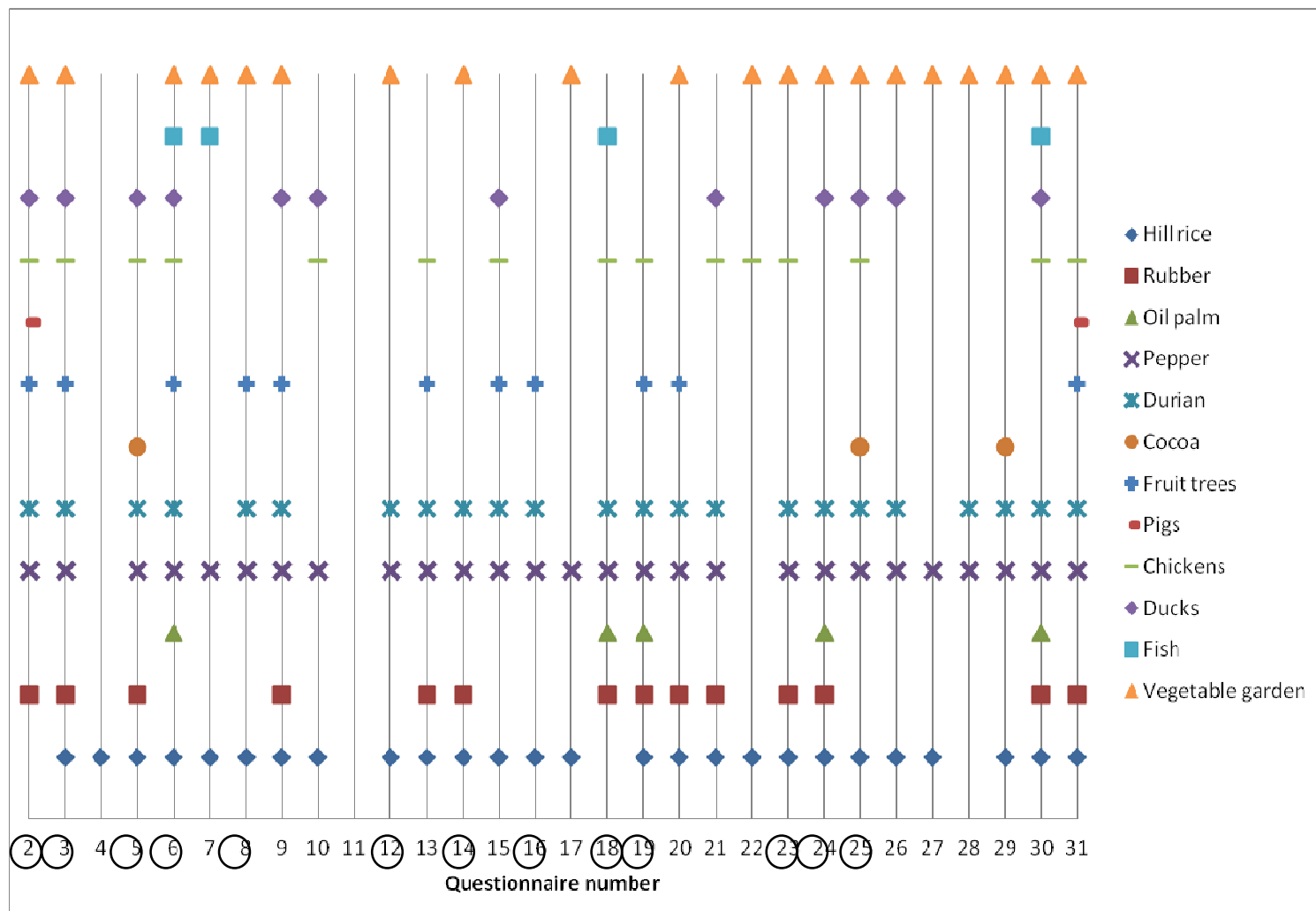
Horizon	Sampling depth (cm)	Clay content	pH	% N	% C	C/N

Other notes

Appendix 9: Plant species

No.	Local Name	Species	Family	Purpose
1	Riang	Bigonia		Medical – stomach ache
2	Ramayong			Fruit that can be eaten
3	Ara/Nuri (Bidayuh)	Ficus		Fruit that can be eaten
4	Lembak/Rambang (Bidayuh)	Cuculingo		For making pua kumbu (blanket)
5	Kelindang	Blechnim		For small cuts
6	Tekalung/Bayuh (Bidayuh)	Artocarpus	Elasticcus	Bark is for making mat/bucket
7	Paku/ Dengut (Bidayuh)	Nephrolepes	Biserata	Fern that can be eaten
8	Tepus/ Tipuk (Bidayuh)	Plagiostachys		Stem that can be eaten
9	Piper/ Ba'it (Bidayuh)			Medical- stomach ache especially for children
10	Gemuh Ki'uh (Bidayuh)	Staculia		Pepper poles
11	Kap trees	Seraka		Construction - home
12	Palm tree	Arenga	Palmae	Eating shoots
13	Tampoi	Baccaurea		Fruit that can be eaten
14	Langgir	Xanthoptyllun	Amonum	For shampoo

Appendix 10: Crop and livestock choice in Tepoi



Representation of various crop and livestock activities practiced by households in Tepoi. Questionnaire numbers marked with a circle receive remittances from migrating family members.

Land Use Patterns

Assessing the influence of migration patterns on land use choices in Tepoi, Sarawak, Malaysian Borneo



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1. Introduction

In recent decades, economic development in the state of Sarawak, Malaysia has taken place in the form of large scale conversion of land for timber or plantation crops (Abdullah & Hezri 2008). Rural areas often bear a large portion of the environmental cost and experience significant societal change, yet receive little of the economic benefits (Drummond & Taylor 1997). This study seeks to evaluate land use in the village of Tepoi, located around 65 km from Kuching in southwestern Sarawak. It represents an area vulnerable to land conversion and change induced by nation and state-wide development aims, as well as urbanization and modernization. Tepoi is a Bidayuh village close to the Indonesian border consisting of 86 households with 533 inhabitants. The Bidayuh are an ethnic minority on the island constituting 8.4 percent of the population (Cheng Sim 2001). While many of the villagers still practice subsistence cultivation and cash cropping, a large source of income in the village comes from off-farm work and remittances from villagers who have migrated elsewhere². This high incidence of migration and reliance on outside labour demands may be associated with the villages' decent infrastructure as they have both a road and electricity. The gravel road built in 1991 grants the villagers good access to labour opportunities in urban centers and the electricity may fuel the market in the village for cash income in order to buy electrical appliances. A paved road is currently being built which may further intensify the dynamics revolving around this infrastructure in the village.

The literature on this area of Sarawak postulates that the area has poor, highly acidic and weathered soils, limiting farmers' choice of crop selection (Hamdan et al 2008). In order to mitigate these limitations, the government of Sarawak has reportedly been providing farmers with subsidized fertilizers to strengthen the farmers' flexibility and yields. Tepoi's cash crops include durian fruit, rubber, pepper and cocoa, and contrary to the literature about the generally poor tropical soils in the area, Tepoi reportedly boasts good soil quality in the land surrounding the village.

Subsistence farming is still practiced by many villagers as well and they still produce upland rice using shifting cultivation. Officially, the government of Sarawak has endeavoured to discourage shifting cultivation in favour of more intensive land use like oil palm plantations through multiple policies and endeavours. Among these are the establishment of Sarawak Land Consolidation and Rehabilitation Authority (SALCRA) which since the 1970's has aggressively worked to transform Native Customary Rights (NCR) land into oil palm or rubber plantations. Another policy that has worked against traditional slash and burn farming is the banning of the open burning of shifting cultivation fields. In much of Southeast Asia, people maintain this type of land use due to the cultural and religious importance of hill paddy cultivation, the desire to maintain a self-sufficient source of food, and the desire to continue to cultivate the land due to tenure insecurities (Cramb et al 2009). Moreover, it is likely that due to the flexibility in terms of time allocation that hill rice production involves, it is an attractive way to maintain insecure NCL tenure even if much of the labour force is away during some of the year due to migration (Hansen & Mertz 2006). Ultimately, the mixed-income strategy that some Tepoi households practice is a good way to secure livelihoods as it can

² Information and assumptions about Tepoi in this report are based on a preliminary introduction given by the course instructors who visited the village for a short period.

mitigate vulnerabilities associated with market fluctuations relating to cash crop production by allowing families to be self-sufficient in terms of rice and food production while providing a buffer through financial capital. The extra cash income from remittances and off-farm labour allows households to absorb shocks or opportunity costs associated with global market fluctuations. Furthermore, the highest rates of rural poverty in Sarawak are among Bidayuh paddy farmers, so this need to buffer household income may be more pronounced in Bidayuh communities who feel extra vulnerable (Cheng Sim 2001).

The high rate of migration seen in Tepoi is likely attributed to pull factors originating from policies set by the central government in Kuala Lumpur. The most striking of these is “Masyarakat 2020” which is a national goal of establishing Malaysia as a ‘developed’ or fully industrialized country by 2020. This has favoured initiatives to strengthen urban centers and build roads to better establish in rural-urban interactions and trade. This has led to the greatest rate of migration to urban centers Sarawak has ever experienced due to the rapid urbanization of cities like Kuching and the associated expansion of employment opportunities, particularly in the service sector (Cheng Sim 2001). Furthermore, this “Masyarakat 2020” policy as well as the general rapid modernization of Malaysia has also had the effect of making traditional practices or views seen as backwards and, predictably, this is most pronounced in the younger populations (Windle 2002).

Fluctuations in localized population densities and demographics spurred by migration activity affect labour availability and intensity of cropping. The effects however, depend on the nature of the migration. In-migration due to opening of new territory after recent road construction may lead to increased swidden activity from newcomers cultivating along the road. Alternatively, if the road was constructed to allow establishment of plantations, subsequent in-migration would likely be associated with land intensification and movement away from swidden agriculture (Cramb et al. 2009). Demographic changes induced by outmigration affect labour availability, especially crucial during planting and harvest times. It also limits capacity to clear the forest and results in tendency to farm in more recently cleared plots closer to the village (Cramb et al. 2009).

1.1 Objective

In light of both speculative and certain societal changes affecting the village of Tepoi, the immediate objective of this report is to identify and analyze the impact migration patterns have on land use in Tepoi. This will be approached through four research questions:

1. What is the land use in Tepoi?
2. What are the drivers of land use in Tepoi?
3. What migration is occurring in Tepoi?
4. What is the off-farm work undertaken in Tepoi?

2. Methodology

The report data matrix (appendix 1) presents the questions and data required to answer the research questions.

This objective is based on a series of assumptions, and will be subject to change and adjustment once the fieldwork starts. The main assumptions are:

- There is migration going on in the village, and it has an effect on land use.
- That remittances from migrating family members play a role in household economy.

Furthermore in order to diminish misunderstanding defining certain terms is crucial, hence:

- By *migration patterns* we include in and out-migration as well as off-farm work.
- An *in-migrant* is defined as one now living in Tepoi and leaving once a month or less; an *out-migrant* defined as one who has left Tepoi and visits Tepoi once a month or less.
- An *off-farm worker* is someone living in Tepoi (e.g. returning to Tepoi at least once a month) whose primary economic activity is conducted off the household cultivation area.
- Within household migration and off-farm work may show different effect on land use decisions due to labour capacity and income generation. Thus to make data comparable, a *household* is defined in terms of family members living together and/or economically contributing to activities both subsistence and/or income generating.

In order to better understand the factors that determine and influence land use in Tepoi, Eric F. Lambin, Helmut J. Geist, and Erika Lepers's framework for understanding land use/cover change will be used. In their article, 'Dynamics of Land-Use and Land-Cover Change in Tropical Regions' (2003), they create a framework for assessing change in land use and cover in the tropics. In a related article, 'Proximate Causes and Underlying Driving Forces of Tropical Deforestation' (2002), Eric F. Lambin, Helmut J. Geist's created a flowchart identifying proximate and underlying causes of land use/cover changes related to deforestation which we will adopt to describe and understand land use and drivers of land use in Tepoi. See appendix 2 for Lambin and Geist's (2002) flowchart which will be our theoretical framework.

3. Methods

The following methods will be carried out over a field work period from Feb. 26-Mar. 8 2011. The timeline including the order of activities, materials required, and participants is represented in appendix 3.

3.1 Questionnaire

Questionnaire surveys will be carried out to collect quantifiable qualitative data regarding land use in Tepoi. The questionnaires will be conducted in the form of structured interviews, to ensure complete

comprehension and response to all questions. The main drawback to the questionnaire form is its rigidity, therefore is only applied to specific topics regarding quantifiable data. The questionnaire is given in appendix 4. Some questions (e.g. question 7) may require revision following consultation with the village headman.

The quantitative requirements for a reasonable sample size, makes questionnaires a time consuming task. The intention is to do at least 30 questionnaires sampled systematically random hence based on a grid based over the community map in order to represent the entire village geographically.

3.2 Semi-structured interview (SSI)

The SSIs are in-depth conversations with the subjects allowing the informant to tell about his life in his own words. In this way unexpected, relevant issues can also be followed up with further questions giving the interviewer an insight into the life and issues relevant for the informant (Mikkelsen 2005). The main drawback is that it is time consuming, and needs careful structuring to ensure the data collected is set in the right context. Also we should be aware that in a SSI the interviewer is still the one posing the questions.

It is intended to do at least 5 SSI on a household level, thus representing all relevant activities carried out by that household, please see appendix 5. In the first days we hope to be introduced to villagers who can become key informants in our research. The questionnaires and PRA methods, e.g. community mapping and village walks, will be the basis for getting in contact with the locals participating in these interviews.

Furthermore an interview with the village headman is approached via more specific interview questions, see appendix 6. This is planned to be done one of the first days in the village. With this we hope to get an initial introduction to the village and the factors that play a role in this community.

3.3 Participatory Rural Appraisal (PRA)

PRA methods are a broad term for methods that involve the local community in discussions about different aspects of their livelihoods and land use. This is a thorough way of exploring complex relations of village life, but must be managed carefully to eliminate as much bias as possible from people's internal relationships, cultural influences and demographic variations (Mikkelsen 2005). The PRA methods we intend to use are focus group discussions by making a community map, a seasonal activity calendar and a timeline.

3.3.1 Community Map

The objective with the community map is to get a view of the village, the land use patterns and its boundaries, from the villagers' perspective. Afterwards, the community map can also be used in the process of selecting households for questionnaires and SSIs.

To provide a starting point to the exercise, one fixed landmark will be drawn first (e.g. the school). Afterwards, the participants will be asked to draw other important landmarks, their household and fields including the different kinds of crops or livestock. The process will enable us to gain further information

about the participant's opinions on the land use choices in Tepoi. If possible and appropriate, land tenure rights and issues will be discussed during the community mapping. For the community mapping key informants of both sexes will be selected.

3.3.2 Seasonal Calendar

The objective of the seasonal calendar is to identify the annual activities of agriculture, forestry and husbandry in Tepoi. This will be done by making cropping cycles and identify associated labor requirements, which enable us to explain if there is any relation between cropping cycles and migration patterns see appendix 7.

3.3.3 Timeline

The objective of the timeline is to make a chronological map of cause and effects of major events, which have had an impact on land use and migration patterns (appendix 8). For the seasonal calendar and timeline key informants will be selected to encourage a broad spectrum of occupations, education levels, ages and sexes.

3.4 Natural Science Methods (NSM)

NSM are methods that involve direct field observations and measurements of quantifiable data. The main documentation will be done by physical sampling, photography, and where possible GPS and GIS logging. Different walks will be approached to enable quantifying certain specific observations.

3.4.1 Village Walk

A village walk, done as an introductory exercise, will give an overview of the village and its lands. It will include a walk to an elevated lookout point will help identify important landmarks and landscape features.

3.4.2 Farm Walk

Through farm walks data on agricultural land use decisions and management will be obtained. Based on observations and informal interviews with the respective farmers it is intended to obtain data regarding choices of crops, purpose and labour requirements. Furthermore, data on measurable indicators as distance to and size of field and yields in respect to primary or secondary crops will support the analysis on whether decisions on agricultural activities are influenced by migration patterns in Tepoi (appendix 9). Due to little knowledge on geographical patterns of cultivated land in Tepoi the community map (see PRA section above) and interview with headman will help identify which farm walk could be interesting. It is intended to do farm walks on different farms characterized by different farming methods and economic wealth in order to enable correlation analysis. Once the farm walks have been chosen each of them will start with a farm sketch

session, where the farmer will be asked to map his lands in terms of location of farmhouse and village and the fields. This is to better understand the agricultural decisions on the particular farm and how and why these could be influenced by migration patterns.

3.4.3 Forest Walk

A forest walk with observations and an informal interview with a designated informant is planned in order to obtain data on the use and purpose of the forest. This data is collected to gain an understanding of the importance of the forest, whether in economic, cultural or subsistence terms. Measurable indicators such as distance to the forest, the amount of goods collected/produced and labour requirements will be used for identifying whether decisions on forest use and management are influenced by the migration patterns. For more detailed aspects to keep in mind while doing the forest walk, please see appendix 10. If several forests are used decision on which to investigate will be based on the community map (see PRA section above), interview with headmen and the key informant's perception on the one that is most representative regarding labour intensity requirements.

3.4.4 Soil Sampling

The soil quality will be measured in terms of pH and content of organic carbon, thus a fertility assessment is approached. The soil quality is included as an indicator to analyze soil quality's affect on crop decisions and management. This will further be related to the labour requirements that presumably are affected by the migration patterns which also affect the decisions on land use. The strategy for soil sampling will be random within identified plots of a certain land use. These plots will be chosen based on a soil map completed through PRA techniques. The samples will be taken with coring tools, as this method is relatively quick and fruitful when time is limited. The intention is to take soil samples representing differences according to land use and soil quality, the latter based on villager's perception. Three replicates for each sample will ensure diminished standard deviation. The pH will be measured in situ with Litmus paper yet also measured once laboratory facilities are available. The carbon content will likewise be estimated in the laboratory after weighing, heating and reweighing the soil. To view the scheme for soil sampling, please see appendix 11.

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Appendix 1: Data matrix

Research Questions	Operational Questions	Operational data required	Methods	Analytical Questions (how, what, why)
1.What is the land use in Tepoi	1.1What is the land tenure?	Predominant types of land tenure	Community map with tenure and land use.	
		Assosciated Security	Questionnaire/SSI	
		Land rights	SSI with chief	
		Villager's perception of the above	Farm/transect walks	
	1.2 What is the use of the forest?	Overall use and management of the forest	Community map with forest area.	
		Importance of forest (economic, cultural, subsistence etc.)	Questionnaire/SSI	
		Threats to forest	Forest/transect walks	
	1.3 What are the Agricultural Practices?	Crops grown (species, amount, uses, animals)	Seasonal activity calender	
		Cultivation systems used	Observations/transect walks	
		Tools and incentives	Village History Timeline	
		Skills, knowledge, extension services	Questionnaire/SSI	
		Labourer demographics		
		Farming history		
	1.4 What are the geobiophysical characteristics?	Soil type and quality	Soil samples	
		Soil and water management	Photographs.	
		Mapping and contours	GPS logging and GIS	
	1.5 What is the policy on land use?	Formal policies on land use in Sarawak	Field observations.	
		Villagers interpretation of government policy on land use	Literature Review	
			Questionnaire/SSI	

Research Questions	Operational Questions	Operational data required	Methods	Analytical Questions (how, what, why)
2. What are the drivers of land use in Tepoi (excluding migration)	2.1 What are the demographic factors?	Life cycle features	SSI with village chief	Has (any) changes in labour availability had an effect on land use?
		Population distribution/density	National census data	Has (any) changes in demographic distributions had an effect on land use?
	2.2 What are the economic factors?	Household reliance on remittances	SSI/Questionnaires with random households	Has (any) access to remittances been a driving factor in (any) Urbanization?
		Proportion of income consisting of remittances		Has (any) influx of cash from remittances lead to industrialization of land use?
	2.3 Is land tenure an issue?	How land tenure plays a role in land use choices of households	SSI/Questionnaire	Has (any) unclarity in land tenure, led to short/long term cropping systems being adopted?
	2.4 What are the issues regarding policy?	Systems of informal policies (corruption, mismanagement etc.) in effect in Tepoi's local land use management	Literature Review	Has formal policies had an effect on land use in Tepoi?
		Systems of informal policies (corruption, mismanagement etc.) in effect on a national of level land use planning	SSI with chief or NGOs	Does corruption negatively affect the land use choices of Tepoi households?
		Subsidies and their use	SSI with farmers and households	Does the availability of subsidies affect land use changes towards e.g. cash crops?
		Influence of subsidies on the land use choices		
	2.5 What are the Market Dynamics?	Crops are exported out of Tepoi, amounts, and destination	Questionnaire/SSI	Has (any) specific access to markets had an influence on land use choices?

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		Trends in these markets (expanding/shrinking)		
	2.6 What are the technological factors?	Intensification or extensification of land use?	SSI with farmers and households	Has farming technology changed since (any) migration and resulting remittances have occurred?
		Agricultural production technologies	Observation	
	2.7 What are the cultural factors?	Role of religion in land use decisions	SSI/Questionnaire	Has (any) influx of cash from e.g. remittances or cash crop successes moved Tepoi towards more individual or collective behaviour?
		Trends towards individual or collective behaviour	Focus group discussion	

Research Questions	Operational Questions	Operational data required	Methods	Analytical Questions (how, what, why)
3. What are the migration patterns in Tepoi	3.1What is the past, present and future migration?	Who migrates	Questionnaire/SSI	
		When migration happens	Seasonal calender	
		Reasons people migrate		
		How migration happens (Type of transportation available)		
		Where people migrate to		
		Migration strategies (community vs. Household)		
	3.2 The relationship between infrastructure and migration?	Existing infrastructure	Village History Timeline (including infrastructural changes and subsequent cause/effect factors) Questionnaire/SSI	
		Users of the different transportation corridors (road, river etc.)?		
		Vehicles used and owned		
		Uses of infrastructure		
		History of infrastructure		
	3.3 How does infrastructure affect decision making regarding migration?	Funding for infrastructure	SSI with the chief	
		Construction plans		

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Research Questions	Operational Questions	Operational data required	Methods	Analytical Questions (how, what, why)
4. What are the off-farm work patterns in Tepoi?	4.1 What is the past, present and future off-farm work?	Who does off-farm work	Questionnaire/SSI	Is distance to work place a factor when choosing a whether to do off-farm work or migrate?
		Reasons do people do off-farm work	Seasonal calendar (including crops, note associated labour requirements and their relation to migration patterns)	
		Where people do off-farm work		
	4.2 What is the relationship between infrastructure and off-farm work?	How many use the different transportation corridors for off-farm work (road, river etc.)	Questionnaire/SSI	

Appendix 2: Theoretical framework

Flowchart from Eric F. Lambin, Helmut J. Geist's article, 'Proximate Causes and Underlying Driving Forces of Tropical Deforestation'(2002), identifying proximate and underlying causes of land use/cover changes related to deforestation.

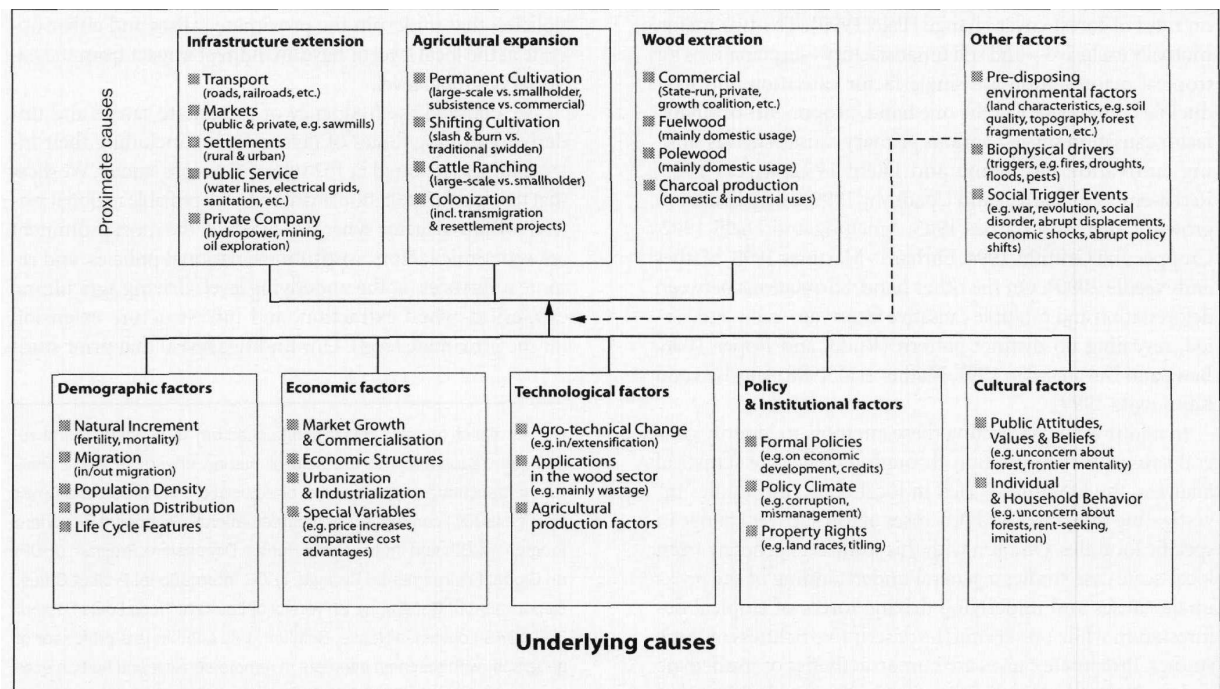


Figure 1. Causes of forest decline. Five broad clusters of underlying driving forces (or fundamental social processes) underpin the proximate causes of tropical deforestation, which are immediate human actions directly impacting forest cover.

Appendix 3: Timeline for fieldwork

Date	Activity	Villagers involved	Topics to Cover	Inputs	Students/professors	Interpreter
SAT	Intro to village			-camera		
Feb 26	-Meet with village headman	Village Headman	Ask about good times to meet with villagers for PRA	-notebook -gift for headman		
	Translate questionnaire					
SUN Feb 27	Find an elevated lookout point	Guide	-Observe/document land uses, land cover, landmarks, infrastructure	-notebook -GPS -camera		
	Village walk	Guide	Observe/document land uses, land cover, landmarks, infrastructure	-notebook -GPS -camera		
	-Interview village headman	Village Headman	-Interview questions -Questionnaire approval -Suggestions of good key informants (village elder, forest guide, cash cropper, subsistence farmer, ex-migrant) -Suggestions for when is a good time to hold PRA -Is there a list of village households? -Is there a village map?	-Interview questions -Notebook		
	Finalize questionnaire					
	Start presentation for Tebedu officials					
MON Feb 28	Questionnaires	3 households		-GPS -questionnaire forms -camera		
	Questionnaires	3 households		-GPS -questionnaire forms -camera		
	Community Map PRA	10 key informants	-settlement patterns -land units -land tenure -land use -soil fertility -forest area -roads/	-big roll of paper -tape -markers -camera -stickers for labelling houses? -list of households? -Tea/coffee/		

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			infrastructure -river -important landmarks	snacks		
	Finish presentation for Tebedu officials					
TUES Mar 1	Go to Tebedu for presentations					
WED Mar 2	Questionnaires	3 households		-GPS -questionnaire forms -camera		
	Farm walk	Farmer who answered a questionnaire		-Farm walk documentation guide -Camera -GPS		
	Semi-Structured Interview	Key informant (village elder, cash cropper, subsistence farmer, ex-migrant)		-SSI guide -GPS -camera		
	UNIMAS Soil Prof. present				UNIMAS Prof.	
	PRA: -Seasonal Calendar -Village History Timeline *UNIMAS Social Study Prof. present*	-10-15 key informants	-Seasonal Calendar: crops, labor input from migrants -Timeline: cause and effects of major events	-2 big rolls of paper -tape -markers -camera -Tea/coffee/ snacks		
THURS Mar 3	Questionnaires	3 households		-GPS -questionnaire forms -camera		
	UNIMAS Social Study Prof. present					
	Questionnaires	3 households		-GPS -questionnaire forms -camera		
	Semi-Structured Interview	Key informant (village elder, cash cropper, subsistence farmer, ex-migrant)		-SSI guide -GPS -camera		
	UNIMAS Social Study Prof. present					
	Farm walk	Farmer who answered a questionnaire		-Farm walk documentation guide -GPS -camera		
FRI Mar 4	Questionnaires	3 households		-GPS -questionnaire forms -camera		

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	Questionnaires *UNIMAS Social Study Prof. present*	3 households		-GPS -questionnaire forms -camera		
	Semi-Structured Interview	Key informant: villager knowledgeable about the forest		-SSI guide -GPS -camera		
	Soil Sampling	Farmer who answered a questionnaire/SSI		-camera -GPS -core sample device -3 buckets -spade -shovel -litmus paper -slope measuring device -vessel to contain sample -labels/marker -soil sample documentation sheet	Thilde	
	Forest Walk *UNIMAS Vegetation sampling Prof. present*	Villager knowledgeable about the forest		-Forest walk documentation guide -camera -GPS		
SAT Mar 5	Questionnaires	3 households		-GPS -questionnaire forms -camera		
	Questionnaires	3 households		-GPS -questionnaire forms -camera		
	Semi-Structured Interview *UNIMAS Social Study Prof. present*	Key informant (village elder, forest guide, cash cropper, subsistence farmer, ex-migrant)		-SSI guide -GPS -camera		
	Farm walk	Farmer who answered a questionnaire		-Farm walk documentation guide -GPS -camera		
	Soil Sampling	Guide and a farmer who answered a questionnaire/SSI		-camera -GPS -core sample device -3 buckets -spade -shovel -litmus paper -slope measuring device -vessel to contain sample	Thilde or a Malaysian professor	

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				-labels/marker -soil sample documentation sheet		
	Start presentation on findings to present					
SUN Mar 6	Questionnaires	3 households		-GPS -questionnaire forms -camera		
	Questionnaires	3 households		-GPS -questionnaire forms -camera		
	Semi-Structured Interview *UNIMAS Social Study Prof. present*	Key informant (village elder, forest guide, cash cropper, subsistence farmer, ex-migrant)		-SSI guide -GPS -camera		
	Final Focus Group discussion *UNIMAS Social Study Prof. present*	10-15 villagers		-big roll of paper -tape -markers -camera -Tea/coffee/ snacks		
	Finalize presentation on findings					
MON Mar 7	Research findings presentation in Tebidu					
TUES Mar 8	Farewell gathering with villagers					

Appendix 4: Questionnaire

Introduction

Introduce yourself (name, nationality)

Purpose: I am part of a small team from the University of Copenhagen and University Malaysia Sarawak doing research on the migration to the cities that is happening in Tepoi.

We want to understand if and how this migration is affecting the way you do agriculture and use the forest.

I have sixteen questions to ask you.

If there are any questions that you do not feel comfortable answering, please do not feel pressure to.

Date: / -2011

Interviewer:

Index no:

Independent variables

Getting to know you and your family.

1) House/GPS key point:

2) Gender: Male Female

3) Age:

4) Ethnic group:

5) How many people live in this house?

What are their ages?

What do they spend most of their time doing/what is their main responsibility in the household?

Gender:	Age:	Primary occupation:

Land use

Getting to know about your farm, and how you use your land.

6) How would you rank these five activities in terms of importance for your family?

Rank: 1 = least important → 5 = most important

System:	Rank:	Notes:
Selling crops		
Growing your own food		
Money from family members living elsewhere		
Collecting Forest Product		
Working away from your farm		

7) What crops do you grow in your fields?

Crop:	Area:	Livestock:	Number:
Rice		Cow	
Rubber		Goat	
Oil Palm		Pig	
Pepper		Chicken	
Vegetable garden		Duck	
Durian			

8) Do you sell any of the crops you grow? Y/N

If yes:

What crop:	To whom:	(where):	How often:

9) Do you get any fertilizers from the government? Y/N

If yes:

What:	For what crops:	How much:	Notes:

10) Do you get any other government help? Y/N

If yes, please specify (what, for what, how much):

11) Do you collect any products from the forest? Y/N

If yes:

What:	For what:	How often:	How much:
Fuelwood			
Fodder for animals			

E.g: NTFPs (medicinal plants/herbs, mushrooms, fruit, rattan, ferns, animals/meat) etc.

12) Do you spend a lot of time on something we haven't mentioned? Y/N

If yes, please specify:

Land tenure

Understanding the official ownership of your land.

13) Is your land Native Customary Rights land? Y/N

14) Do you rent the land from someone? Y/N

If yes, please specify:

Migration Patterns in Tepoi

Getting to know your family members away from this farm.

15) Do you own any means of transportation? Y/N

If yes:

What type:	How many:	What do you use it for:

16) Is there anyone from your family working and/or living outside your farm?

Y/N

If yes:

M/F	Age	Occupation	Education	How often are they home:			Where:	How money is sent home:	Available for work when home:
				Weekly:	1/month:	Less:			

Interviewers' thoughts

Thoughts about the setting:

Who was present while interviewing?

Things that could have had an influence on the interview/the answers?

Thoughts about the informant:

Appendix 5: Semi-structured interview guide for villagers

Date: / - 2011

Interviewer:

Introduction

Introduce yourself (name, nationality)

Purpose: I am part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I have about 30 questions to ask you.

I would like to hear about you and how you live your life.

If there are any questions that you do not feel comfortable answering, please do not feel pressure to.

This is an anonymous interview, so we will not be using your name in our report or give the information we get from you to anybody else.

Independent variables

Questionnaire no.:

1) House/GPS key point:

2) Gender: Male Female

3) Name:

4) Age:

Land use

Agricultural practices and use of forest

5) For how long have you lived in Tepoi? (Lifetime, on-off)

If on-off: Why did you live there?

6) Would you mind tell us again which crops you grow?

7) What do you use your crops for? (Economic value, food)

Is it easy to sell crops around here? (where and how)

8) Do you go to your fields every day? (Intensity, time consuming, etc)

Do you easily get to your fields and how? (Walk, transportation means)

9) Is anybody helping you on the fields?

What do they help you with?

10) How did you learn about farming? (Family tradition, education, etc)

11) What kind of food do you buy? (Subsistence vs. cash – any tendencies?)

If relevant: Why don't you grow this yourself? (Time, money, possibilities, labor)

12) Have you always grown what you grow now or did you grow anything else? (Change in agricultural practices)

Land tenure

13) How do you know which land belongs to whom?

14) How do you choose the locations that you cultivate?

Who decides where you have your fields?

Do you have any rights to the land you use? (In what way)

Can you lose your rights to cultivate this land?

15) Are you allowed to use the land the way you want to or are there some restrictions? (Government/village policies regarding land use)

If restrictions, who makes these?

Land use

16) Do you have good soil on your fields?

17) Forest products collected:

What:	For what:	How often:	How much:
Fuelwood			
Fodder for animals			

18) In the questionnaire you told us that you collected these products in the forest. Do you use more or less forest products now than before?

19) Do you do other activities in the forest? (Production, religion, traditions, etc)

20) Is it everyone who may use the forest? (Land tenure, hierarchy, forest management)

21) If someone does something they should not do what do you then do? (Power structures)

Migration and off-farm work patterns in Tepoi

Past, present and future patterns

22) Family working and/or living outside your Tepoi:

M/F	Age	Occupation	Education	How often do they come home:			Where:	Money sent home:	Working home for:
				Weekends:	1 a month:	Less:			

So I can see from the questionnaire that X lives outside Tepoi. (Based on one person from the scheme).

23) At what age did X leave?

24) For how long has X been away now?

25) Was it X's own decision to leave?

26) Does X help you with anything here in Tepoi?

You said that X send back money:

27) What do you use the money you get from X for? (Food, seeds, fertilizers, conveniences, etc)

The relationship between infrastructure and migration/off-farm work

28) How do you get around in and outside the village? (By car, the river, bus, etc)

29) Who owns the "transportation option"?

30) How did you get around before the road was built in 1991?

Has this changed the way you get around? (Is it different/faster from now?)

31) Was Tepoi the same size when you were a child? (Purposely very open ended question, hopefully opens up on narratives on changes)

Interviewers' thoughts

Thoughts about the setting:

Who was present while interviewing?

Things that could have had an influence on the interview/the answers?

Thoughts about the informant:

Appendix 6: Semi-structured interview questions for village headman

Introduction

Official welcoming/presentation

Date: / - 2011

Interviewer:

House/GPS Keypoint:

Name:

Age:

Land use in Tepoi

- 1) What are the main crops grown in Tepoi?

- 2) What type of cultivation practices are used (shifting, use of inputs, fallow, improved fallow, plantation etc.)
And what is dominant?

- 3) Do the families grow most of the food they eat or what do they buy?

- 4) Do you export anything from Tepoi?
- 5) What things do you import to Tepoi?

- 6) What are the main economic activities in Tepoi?

- 7) What land rights do the villagers have on the local area for agricultural production?
- 8) How far from the village do community members use land?

Also explain about community mapping. When and why and that we need local people for this exercise)

9) Are community members satisfied with the rights they have over the land in the local area?

10) Are there any external projects taking place (government, NGO, etc)? Please describe what the projects are and how they are being implemented.

Forest use in Tepoi

11) What rights do the villagers have on the use of the local forest?

12) What is harvested from the forest?

13) Has the local forest area changed in your lifetime?

14) Has the health/condition of the forest changed in your lifetime?

15) Has availability of forest resources changed in your lifetime?

Policy Issues

16) What federal or regional policies on land use are affecting the community?

17) Does the community have influence over the policies which affect their land use?

18) What is your role in this?

Social Issues

19) Have there been changes in demographics (age, gender, etc) in the community in your lifetime?

Do you think this have affected the way the villagers use the land/how they farm?

20) Are children required to go to school?

Until when?

Have there been recent changes in these requirements?

21) Does the youth in the community wish to seek higher education outside of the community?

22) Do you have a village council?

What kind of decisions do they take?

Who is represented in this council?

How do you get elected for this?

Is it popular to be in this council?

Migration Patterns

- 23) Are more people leaving Tepoi or moving in to Tepoi?
- 24) What people are moving into Tepoi?
- 25) What people are moving out of Tepoi?
- 26) Where do most community members go?
- 27) Why do people leave Tepoi?
- 28) Why do people move in to Tepoi?
- 29) Do people migrate as groups or individually?
- 30) Are there annual changes in migration?
- 31) How often do those who migrate return to visit?
- 32) How often do those who migrate return permanently?

- 33) How many members of the village own a vehicle or other transportation forms?
- 34) What are these used for?

- 35) Who makes the decisions regarding road building to the community?
- 36) Does the village have influence in these decisions?
- 37) Who funds the construction?

- 38) Do you think migration will play a larger role in Tepoi's economy in the future?
- 39) Do you think migration is positive for the development in Tepoi?

Interviewers' thoughts

Thoughts about the setting:

Who was present while interviewing?

Things that could have had an influence on the interview/the answers

Thoughts about the informant:

Appendix 7: Sketch of Seasonal Calendar

	Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Agriculture	Cacao												
	Palm Oil												
	Pepper												
	Rubber												
Livestock													
Forest	Durian												

Appendix 8: Sketch of timeline

		↓	19XX	↓	19XX	↓	2011
Environmental	Drivers of change	Drought					
		Erosion					
		Political					
		Transport/ Infrastructure					
		Technology and land improvements					
Natural resources - Management and change		Pest					
		Vegetation					
		Soil fertility					
		Crop change					
Cumulative change		Population (de jura/de facto)					
		Food preference					
		Land availability					
		Mobility					

Appendix 9: Sketch for farm walk

Introduce yourself (name, nationality)

Purpose: I am/ We are part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I/we would like to ask you draw a map of where is your farm/house and fields in relation to the village and thereafter go for a walk to your fields and learn about your agricultural practices.

Observation/aspect to ask about

Distance from village/house to field	
Size of field	
Crops (which are primary/secondary)	
Time allocated to each crop	
Yield	
Purpose of crop/Market relations	
Farming system (subsistence, cash, shifting, fallow, mixed)	
Farming methods (soil preparation, water management, labour requirements)	
Equipment/livestock used	
Fertilizers applied/stored	
Pest/Weed problems	

Appendix 10: Sketch for forest walk

Introduce yourself (name, nationality)

Purpose: I am/ We are part of a small team from a collaboration between the University Malaysia Sarawak and the University of Copenhagen doing a research on how people live in this area of Borneo.

I/we would kindly ask you to introduce me/us to the forest and the importance of the different products it provides and teach us the present forestry practices.

Observation/aspect to ask about

Distance to forest	
Dominant forest outlook (tree species, density, infrastructure)	
Important plant species for villagers	
Purpose of important species	
Important tree/shrub species for villagers	
Use of important tree/shrub species	
Forest type/health	

Management/labour requirements	
Historic forest use	
Cultural use	
Wildlife	

Appendix 11: Scheme for soil sampling

Date	
Name of sample Collectors	
Waypoint	
Coordinates	
Farmer's name/ field identifiers	
Profile numbers	A1, A2, A3
Slope	
Photo #	
Vegetation	
Land use history	
Soil observations/Color	
pH of soil	
Comments:	

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Date	
Name of sample Collectors	
Waypoint	
Coordinates	
Farmer's name/ field identifiers	
Profile numbers	B1, B2, B3
Slope	
Photo #	
Vegetation	
Land use history	
Soil observations/Color	
pH of soil	
Comments:	

Date	
Name of sample Collectors	
Waypoint	
Coordinates	
Farmer's name/ field identifiers	
Profile number	C1, C2, C3
Slope	
Photo #	
Vegetation	
Land use history	
Soil observations/Color	
pH of soil	
Comments:	

