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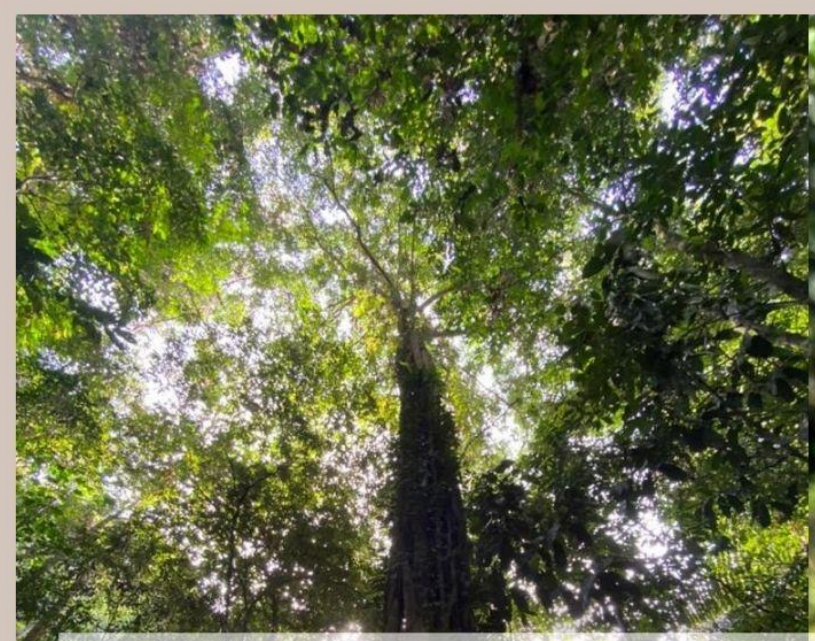
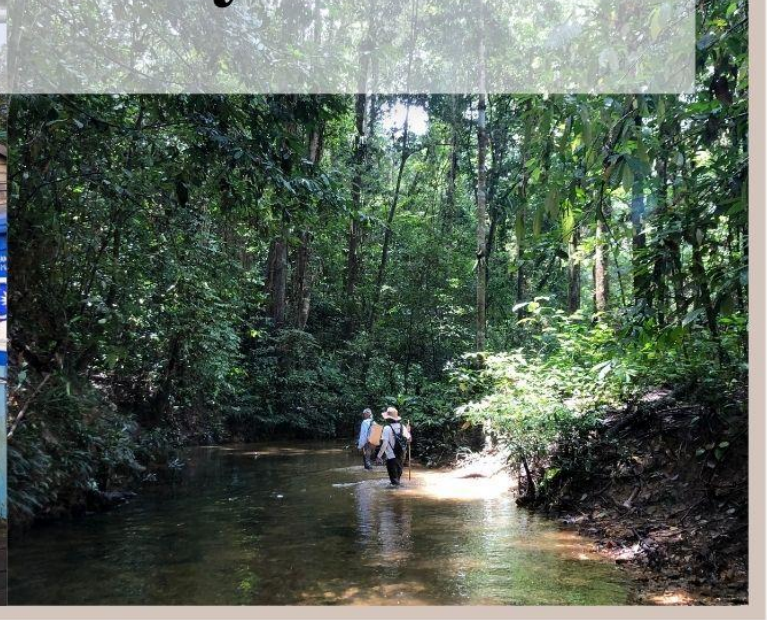



Exploring the role of Non-Timber Forest Products in Ulu Poi, Sarawak, Malaysia

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Abstract

Sarawak is known for its biodiverse rainforests; indigenous Dayak, including Iban, communities have historically lived within these forests and utilised the resources found in their surrounding environment to support their livelihoods. While the importance of natural resources for indigenous forest-dwelling communities has been increasingly acknowledged, limited studies have been carried out on the roles of non-timber forest products (NTFPs) in rural Iban livelihoods. In this light, this research adopts a mixed-methods approach to understand the contributions of forest products to the livelihoods of the Ulu Poi community, as well as the potential impacts of forest products collection on the environment. Among other livelihood outcomes, this study highlights how the domestication of NTFPs is as a livelihood strategy is ensuring food security and providing a safety net, reducing vulnerabilities to adversities and thereby increasing the community's resilience. The achievement of mentioned livelihood outcomes largely depends on the maintenance and transfer of traditional ecological knowledge (TEK); the latter is perpetuated as a communal resource individuals can draw upon and adapt. Finally, this study suggests that harvesting of NTFPs from forested areas is not negatively impacting biodiversity, due to domestication of wild plant species, a reduced number of collectors as a result of outmigration, and an ageing population.

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Acknowledgements

We would like to sincerely thank the Ulu Poi community, especially the headmen, for their warm welcoming and willingness to share their knowledge and insights during the group's fieldwork. Without their participation and help this research would not have been possible. Likewise, we would like to express our gratitude to our Malaysian counterparts: Iziani, E'zzah, Ah Na, Madeline, Francis, and Azmir, who helped us undertake this project. Also, the translations of the information provided by our informants would not have been possible without our interpreters: Restiza and the headman, who endeavoured to facilitate communication with the longhouse residents. Finally, we are also very thankful for the feedback and comments we received from our main supervisors, Dorette Sophie Müller-Stöver and Sinne Borby Ørtenblad, not to mention the invaluable collaborative help of all the other professors from the University of Copenhagen and the University of Malaysia Sarawak in bringing this project to life.

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Introduction

Sarawak is one of the two Malaysian states located on the island of Borneo and it is known for its extensive forest cover, accounting for around 62% of its land area (Koh et al., 2023). The forest is home to a vast array of plants and animals, including several endangered species; the forests in Sarawak provide many ecosystem services, amongst which are timber production, carbon sequestration, and biodiversity conservation. Importantly, the forests also provide numerous non-timber forest products (NTFPs)[1] that are vital to the livelihoods[2] of local communities; indeed, indigenous communities in Sarawak have always relied on natural resources found in their surrounding environment and their traditional ecological knowledge (TEK)[3] on the uses of these resources to sustain their livelihoods (Baumann, 2002).

The Iban people are one of the largest indigenous groups in Sarawak; they are traditionally known as expert warriors and farmers who are highly skilled in hunting, fishing, and gathering forest products. The Iban people have a unique cultural heritage and are known for their longhouses, traditional dances, music, and elaborate tattoos. Today, the Iban people are still residing in the rural areas of Sarawak, where they continue to practice their traditional ways of life, such as subsistence farming, fishing, and hunting; however, many Iban people have also migrated to urban areas, and adopted modern ways of living (Ryoji, 2001).

The Ulu Poi community is one of the many rural, Iban communities in Sarawak that rely on forest resources for their livelihoods. The community is located in the central region of Sarawak, along the river Poi within the Kanowit District of the Sibu Division. The Ulu Poi people are predominantly farmers and gatherers, relying on the forest for a variety of resources, including timber, firewood, edible plants, and wildlife. Despite the increasing

[1] "de Beer and McDermott (1996) define NTFPs as all biological materials other than commercial timber extracted from forests for human use', **including wood products**; this definition can be expanded to include the following characteristics: consumptive and non-consumptive uses; local use and benefit; all habitats; self-replicating wild species" (for a detailed discussion see Shackleton, 2015)

[2] "A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household" (Allison & Ellis, 2001, p. 379).

[3] TEK is hereby understood as a "cumulative body of knowledge, practices and representations that describes the relationships of living beings with one another and with their physical environment, which evolved by adaptive processes and has been handed down through generations by cultural transmission" (Berkes F et. al, 2000, pp.1251–1262)

acknowledgement of the importance of NTFPs in the livelihoods of indigenous peoples, there is still limited knowledge on the extent to which these products are utilised, how their role is changing over time due to external forces, the economic and social benefits they provide, and the challenges faced in accessing and utilising these resources.

This research seeks to partially address these gaps in knowledge by providing insights into the role of NTFPs in the livelihoods of the Ulu Poi people. Specifically, this paper seeks to address the following research question and sub-questions:

How do NTFPs contribute to the livelihoods of the Ulu Poi community in Sarawak, Malaysia?

1. *What are the main livelihood strategies the community is engaged in?*
2. *What are the main NTFPs the community relies on, where are they collected from, and who collects and uses which NTFPs?*
3. *What is the perceived relative contribution of NTFPs to income generation and food security?*
4. *How do recent demographic trends impact the use and transfer of traditional ecological knowledge (TEK) about NTFPs?*
5. *What is the impact of NTFPs collection on the environment?*

The paper will endeavour to address the above questions by, firstly, presenting what literature on the diverse contribution of NTFPs to the livelihoods of rural communities has found; the paper will subsequently address the methodological approach adopted during the fieldwork and explore how different methods have been applied and the limitations of these. The report will then, after a brief presentation of the study area, present the analysis of results, which will be followed by a discussion of the main themes emerging from the analysis and of how these themes relate to the broader academic discussion sketched out in the literature review. The paper will conclude with some reflections on the overall research experience, alongside some considerations on the factors that might have impacted the reliability of the findings.

Literature review

The relevance of Non-Timber Forest Products (NTFPs) in rural livelihoods in developing countries has become widely acknowledged within research and policy-making arenas over the last decades. "Scherr et al. (2004) estimate that 1.4–1.6 billion people worldwide make use of NTFPs to some degree, while 350 million people depend on NTFPs for their livelihoods either as a safety net or as supplementary income" (Sakai et al., 2016, p. 341). Despite the importance of NTFPs in the livelihoods of rural communities, government agencies in many countries place considerable restrictions on which NTFPs can be harvested and in which quantities. While these restrictive legislations might help protecting and conserving environmental resources, these policies might also have negative implications for the livelihoods of millions of rural and urban poor.

Indeed, there are various roles that NTFPs take on in the livelihoods of rural communities. Millions of the rural poor, as well as a considerable number of the urban underprivileged, use NTFPs daily to provide a portion or all their food, shelter, and medicine needs. This has been termed by Shackleton and Shackleton (2004) the *daily net*, which refers to subsistence uses or household provisioning. In providing food that might not have otherwise been available, NTFPs appear to play a crucial role in increasing households' *food security*[4], especially in increasing *dietary diversity*. Moreover, the free provision of food, energy, construction material, fibres, and medicines mean that "scarce cash resources can be saved or directed to goods and services not available via harvesting that poor households might otherwise struggle to acquire", as for instance agricultural inputs, school fees or books, and small assets (Shackleton et al., 2015).

Not all NTFPs harvested are used within the household: some are sold in raw form or after some value-added processing. Unfortunately, there are hardly any statistics illustrating the proportion of households engaged in NTFPs trade. Some researchers suggested that the number of people that do trade in NTFPs is steadily growing. Trade in NTFPs takes place at multiple scales, from inter-household trade to trade in local markets up to regional, national, and

[4] "Based on the 1996 World Food Summit, food security is defined when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (worldbank.org); the four main dimensions of food security are: physical availability of food, economic and physical access to food, food utilisation, and stability of the other three dimensions over time (ibid.).

international markets. The extent and nature of trade chains, and the benefits accruing along the chains, varies significantly between the different scales.

Another substantial contribution of NTFPs to local livelihoods is via *safety nets*, or self-insurance. This refers to using NTFPs as a coping mechanism during household stress or adversities. Indeed, even when the contribution of NTFPs to the overall household income is small, these products play a significant role in reducing risks and vulnerabilities of rural households. NTFPs might help to provide income and subsistence stability in the face of fluctuations in farm production or market conditions for agricultural products; NTFPs are, in fact, generally most extensively used to supplement household income during particular seasons of the year as to help, for instance, meet dietary shortfalls (Arnold & Pérez, 1998).

Alongside their role in food security, income generation, and safety net, NTFPs harvesting is said to be well embedded in the cultures of using communities. Indeed, some NTFPs species are often used for certain rituals or ceremonies or assume cultural relevance to forest dwelling communities through their daily usage, becoming thus integral components of local symbolism and folklore as well as of traditional ecological knowledge.

Finally, a dimension hardly considered in the NTFP literature is the role of NTFP species in providing supporting or regulating services to local livelihoods; some NTFP species provide habitat, food, and nesting sites to other important species. As research suggests, NTFP species constitute a considerable proportion of overall species richness and biomass. Hence, they play a crucial role in general community ecology and resilience. Their loss or mismanagement could undermine ecosystem functioning or resilience.

Patterns of use of NTFPs are likely to differ among groups or households and within households by factors such as gender and age. One relationship that has been widely observed is that where people have nearly unrestricted access to forests and forest products, reliance on NTFPs is significant for women and poorer groups within the community (Arnold & Pérez, 1998.). Nonetheless, there seems to be a paradoxical relationship between the gathering of NTFPs and incomes: whilst a study by Svarrer et al. (2005) found that development of modern infrastructure has increased access to wage-labour for rural communities and as incomes increase, the gathering of NTFPs decreases, another study by Sakai et al. (2016) found that gathering of NTFPs had a positive relationship with incomes.

Similarly, research exploring the impacts on the environment of NTFPs harvesting is yet to reach a unanimous understanding. Some studies have argued that the harvesting of NTFPs is a sustainable practice that does not negatively impact the environment, as their extraction is seen as less destructive than the logging of timber products. Nevertheless, some ecologists suggest that the collection of NTFPs has a more significant environmental impact than we might think, and that negative externalities happen over time. If uncontrolled, the harvesting of NTFPs can lead to the depletion of wild plants and animals in the forest. As Arnold and Pérez (1998) explain, "almost any form of resource harvest produces an impact on the structure and function of tropical plant populations" (p.19), but also on animal populations - playing a key role in the forest and the provision of ecological services.

The role of NTFPs in the livelihoods of households is also said to be changing due to a variety of factors and external forces, such as demographic changes, increasing access to purchased foods, improved supplies of food crops, or new opportunities to engage in more profitable income-generating activities, especially in urban settlements. Similarly, demographic changes within rural communities might be impacting NTFPs collection. In Sarawak in particular, one trend widely observed is the outmigration of younger generations from the longhouse and the ageing of forest-dwelling communities (Ryoji, 2001). A decline in forest food use can also reflect reduced traditional ecological knowledge (TEK), especially of species infrequently used, or result from changes in demand of these products (Arnold & Pérez, 1998.).

Methodology

The purpose of the following chapter is to provide an overview of the methodological approach to the fieldwork and to discuss the advantages and limitations of each method applied. Given the diversity of backgrounds within the research group and the interdisciplinary nature of the SLUSE course, a natural and social sciences mixed methods approach was chosen. Combining qualitative and quantitative data allows the research group to benefit from both the detailed, contextualised insights of qualitative data and the generalisable insights of quantitative data, enabling methodological triangulation. The latter can be said to contribute to a higher reliability of the findings (Mikkelsen, 2005). Moreover, mixed methods offer more flexibility in designing and carrying out the research, while allowing individual researchers to both contribute with their particular competences and experiment with methods beyond their field of expertise. The group implemented the following qualitative methods: participatory rural appraisal methods (resource mapping, transect walks, and ranking exercises), informal interviews, and focus group discussions. The choice of participatory methods is to be understood in terms of the group's desire to achieve a greater involvement of research participants, as to address the power imbalance between researchers and 'subject of research', and to allow participants themselves to establish what is of relevance to them, thereby co-producing rather than extracting knowledge. Quantitative methods such as survey, biodiversity assessment, and forest inventory were also applied. Research participants have been anonymised, hence their names are never disclosed in the report, as to ensure their privacy.

Participatory Rural Appraisal

Resource Mapping

Two resource mapping exercises were carried out with two groups, one of seven women and one of five men[5] from the first longhouse. The exercise aimed to identify which natural resources the community relies on as well as the locale of the resources. Through resources mapping, participants were encouraged to draw the elements of natural capital most important to them and explain why they pinpointed those particular resources. The exercise allowed for a broader understanding of the community's knowledge of their natural resources, as well as

[5] The research team decided to separate men and women in two groups to avoid potential gender power dynamics that could hinder meaningful participation.

an overview of the surrounding area. Nevertheless, the presence of the headman during the exercises and possible leading questions might have influenced participation and the results.

Transect Walks with GPS

A total of four guided transect walks were used to collect information on the community's land use management strategies and the distribution and availability of natural resources. During the transects, particular attention was paid to topics related to accessibility and drivers of change in livelihood strategies. To gain specific geographical data in relation to farm crops and forest products, global positioning system (GPS) waypoints and fieldnotes were systematically taken and later coded into categories. An open-ended approach, not focused on forest products only, allowed for a broader understanding of how individuals within the community relate to and utilise the surrounding environment. However, the specific interests of and activities conducted by the informants, alongside the involvement of a reduced and homogenous sample, might have impacted the generalisability of the findings.

Ranking Exercises

Two ranking exercises (assets ranking and resource ranking) were carried out with four groups: two of men and two of women[6]. The assets ranking sought to rank cash crops, livestock, forest products, and game meat in terms of perceived contribution to income, management, financial investments, harvest time, and overall importance based on the previous categories. The second exercise, the resource ranking, focused on forest products, categorised as food, craft materials, timber, medicinal and ornamental plants, as well as game meat; the groups ranked the products based on accessibility, reliability, value, and importance to livelihoods. While both ranking exercises proved very insightful, a greater involvement of participants in the very development of the exercises, specifically in the selection of the categories, could have resulted in a more accurate reflection of the participants' own perception of value.

[6] The separation of men and women during these exercise follows the same rational behind the separation of the two groups for the resource mapping.

Qualitative Methods

Focus Group Discussion

A focus group discussion, comprising nineteen participants from the third longhouse, was conducted to gain in-depth insights into the community's livelihood strategies and to better understand recent patterns of socio-economic, demographic, and environmental changes. Prompting questions revolved around four main themes: out-migration, maintenance of cultural practices, food-security, and access to infrastructure, framed in relation to forest products and natural resources. The focus group provided a nuanced understanding of the participants' perceptions and allowed for a dialogue between their different views on the topics. However, the implementation of a sampling strategy and the splitting of the nineteen participants into two smaller groups might have allowed for a greater contribution of individual participants and a more detailed elaboration of their views (Bryman, 2015).

Informal Interviews

Two informal interviews were conducted with two key informants, with the aim of sharing preliminary findings and receiving additional feedback. An essential part of the interview was the sharing of the experiences had throughout the fieldwork, as a means of rounding off the collaboration between key informants and the research group. With the additional goal of exploring emerging themes from the survey and participatory exercises, the group used photo elicitation to inspire a discussion on the interviewees' perception of current livelihood strategies, current trends of out-migration, maintenance of traditional ecological knowledge, and the factors regulating access to resources and income for the longhouse. While the interviewees provided relevant information, they represent only two voices within the community, and in leadership positions no less, and hence their views might not be representative of the community at large.

Quantitative Methods

Survey

A survey was administered to 44 respondents, selected through convenience sampling. All the respondents belong to the three longhouses of Ulu Poi. The survey was conducted to gather general pieces of information on the longhouse's demographics as well as more detailed

information on respondents' use of forest products; the latter was used as a starting point for the collection of more in-depth knowledge through interviews and focus group discussions. Of the 44 surveys, three were discarded as they were used to test and revise the survey; an additional three surveys were disregarded as answers were missing. Hence, a total of 38 surveys were used for this report. The questions in the survey were adjusted to address interpretation discrepancies. The limited number of respondents might have hindered the reliability of the statistical tests run on the dataset; similarly, the surveying of children, where the survey was intended for adults, meant that children's survey answers were at times not applicable, hence some of the statistical testing was carried out with fewer respondents.

Biodiversity Assessment

With the aim of exploring whether the current state of natural resources affects the community's ability to forage and whether human activity has an impact on the forest itself, a 20 x 20 metre plot was assessed at three distinct locations: a highly disturbed farm, a less disturbed secondary forest, and an undisturbed old-growth secondary forest. The selection of the assessment locations was based on areas highlighted by participants during the resource mapping exercises. The undisturbed, old-growth secondary forest served as a baseline for Gini-Simpson indexing. Nonetheless, knowledge of the forest plants and ecology of Sarawak might have enabled a more meaningful comparison and conclusions about the of biodiversity of the area.

Inventory

Preliminary findings revealed the depth of knowledge and understanding within the community of their environment and natural resources, particularly plants. In order to further explore the nuances of the community's ethnobotanical knowledge, an inventory of the plants mentioned and observed during the fieldwork activities and exercises was compiled. Inventoried plants are defined by: Iban vernacular name, common name, scientific name and family, level of domestication, and general use. While the inventory allows for ethnobotanical generalisations and comparisons, it does not consider factors such as seasonality, which might have influenced whether specific plants were mentioned or not.

Presentation of the Study Area

Ulu Poi is in the Kanowit district, which is under the administration of the Sibu Division, covering an area of 2,250 square kilometres. The district has a population of around 30,000 of which the majority are of Iban decent, followed by Chinese, Malay, and other ethnic groups. Kanowit district is administered by a District Officer who oversees development projects, community welfare, and public security matters. Located on the river Poi, Ulu Poi is approximately 35 kilometres from Kanowit and is only accessible by boat.

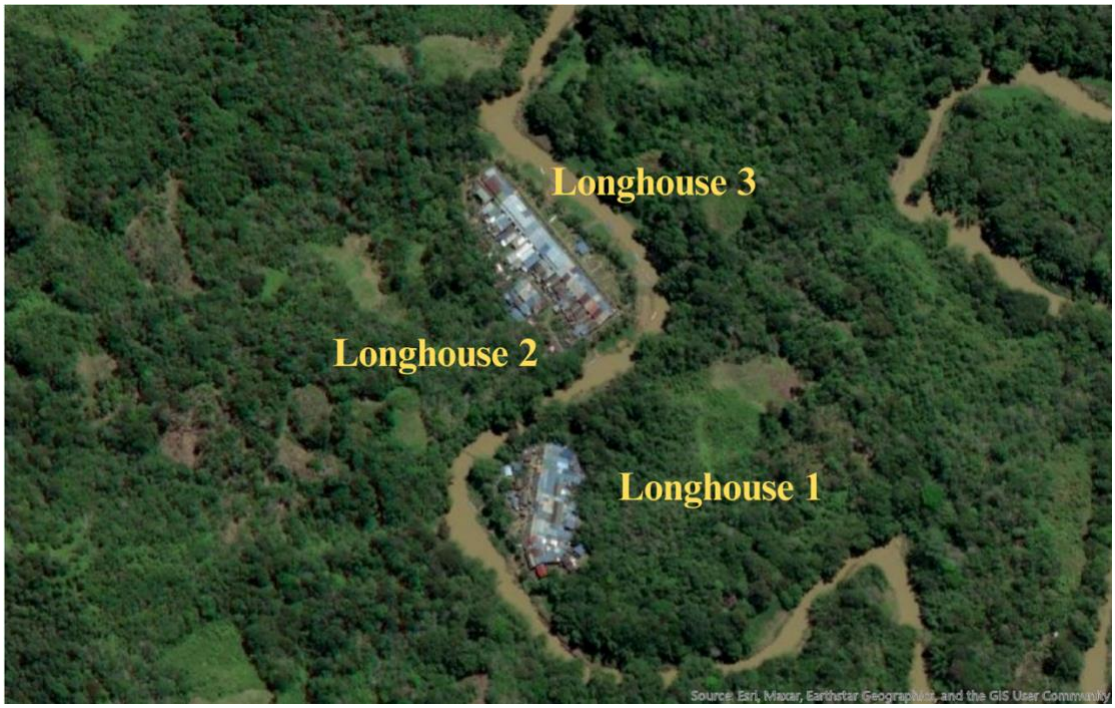


Figure 1: Map of the three longhouses of the Ulu Poi community.

The oldest longhouse of the Ulu Poi community was constructed in 1958. Just across the River Poi, and within walking distance from the first one, are the two others located (Figure 1), which were established as the first longhouse population increased and space for new construction around the longhouse became scarce. While there are now three separate longhouses, the residents continue to manage and utilise common land and identify as one Iban community. Of the survey respondents, 39% are women and 61% are men; 29% belong to Longhouse 1, 16% to Longhouse 2, and 55% to Longhouse 3. Most respondents (82%) are permanent residents of the longhouses, 5% are commuters (visiting the longhouses on a weekly basis), and 13% visit the longhouse occasionally (to attend *Gawai* or other festivities). Of the survey respondents, 91% from Longhouse 1, 86% from Longhouse 3, and 50% from Longhouse 2 are permanent

residents. However, as in the case of Longhouse 1, of the 200 people registered, only around 20 people currently live in the longhouse.

Most of those registered to the longhouses are now living in urban areas; the outmigration of younger generations is not a trend unique to Ulu Poi and can be understood in terms of at least three factors: a) the community is lacking basic infrastructure, such as road access, electricity, water, and a waste management system; b) young people lack education possibilities; c) and urban areas offer more profitable and stable income opportunities. The trend of outmigration is resulting in the ageing of the longhouse population: the average age of the three longhouses is 66, 37, and 50, respectively[7]. The exodus of the younger generation to urban areas is also resulting in a lack of labour force within the Ulu Poi community, as well as potentially affecting the transfer of TEK between generations.

Amongst survey respondents, 37% are illiterate, 42% attended up to primary school, 16% attended up to secondary school, and 5% have a higher secondary school diploma. More than half of the respondents do not receive any income, while 14% said they receive remittances, 12% are engaged in paid work, 6% receive pensions, and 4% receive welfare benefits. As we shall see in greater detail in the following chapter, the community's livelihood portfolio comprises two main activities: agriculture and NTFPs collection.

[7] Here, it is deemed relevant to point out that the average age for the longhouses 2 and 3 is significantly lowered by the presence of eight children/teens, aged eight-eighteen, most of whom are occasional residents of the longhouse. If one were to exclude the children, the average age for the two longhouses would be forty-nine and sixty-five respectively.

Results and Analysis

Subsistence Agriculture

There are community members who still remember the gradual change over time from shifting cultivation to stable, place-based agriculture. Resource mapping revealed the location of an extensive *bumai* (rice paddy) site, cultivated in the past and located at a great distance from Longhouse 1 (Image 1). The former *bumai* site is delineated by shallow tributaries, which served as boundary landmarks as well as a means for site selection during annual crop rotations in past shifting cultivation. The site was transitioned to rubber cultivation; subsequent decrease in profitability of rubber resulted in the gradual end of active rubber tapping, and the site has remained fallow for over a decade, being now considered *hutan tebal* (dense secondary forest). The dense secondary forest site is now managed as a communal, shared timber reserve; timber is primarily used for longhouse construction and repair. Only one farmer still cultivates rice paddy routinely for personal consumption.

Image 1: Resource mapping men group.

At comparatively close distance from the longhouses, a short trip by boat or by foot (Figure 2), rainfed farm plots are located primarily along the navigable *Sangai Poi* (River Poi). The majority of surveyed informants (71%) engage in varying intensities of diversified agriculture at individual farm sites. During transect walks, the farming community of Ulu Poi was observed employing an amalgamation of conventional[8] and traditional[9] agricultural practices. Farming survey respondents stated their utilisation of conventional cultivation methods including row-cropping as well as the use of inputs like fertilisers, herbicides, and pesticides to cultivate income-generating crops; the use of these inputs and practices were also observed at the farm sites. Farming respondents perceive one of the barriers to market entry to be high financial investment required by agriculture. To cope with this obstacle, farmers were observed integrating traditional agricultural practices including row-cropping of Iban traditional plants as well as NTFPs. While domestication of wild plants is not a novel practice, Ulu Poi farmers actively domesticate previously undomesticated (collected) NTFPs.

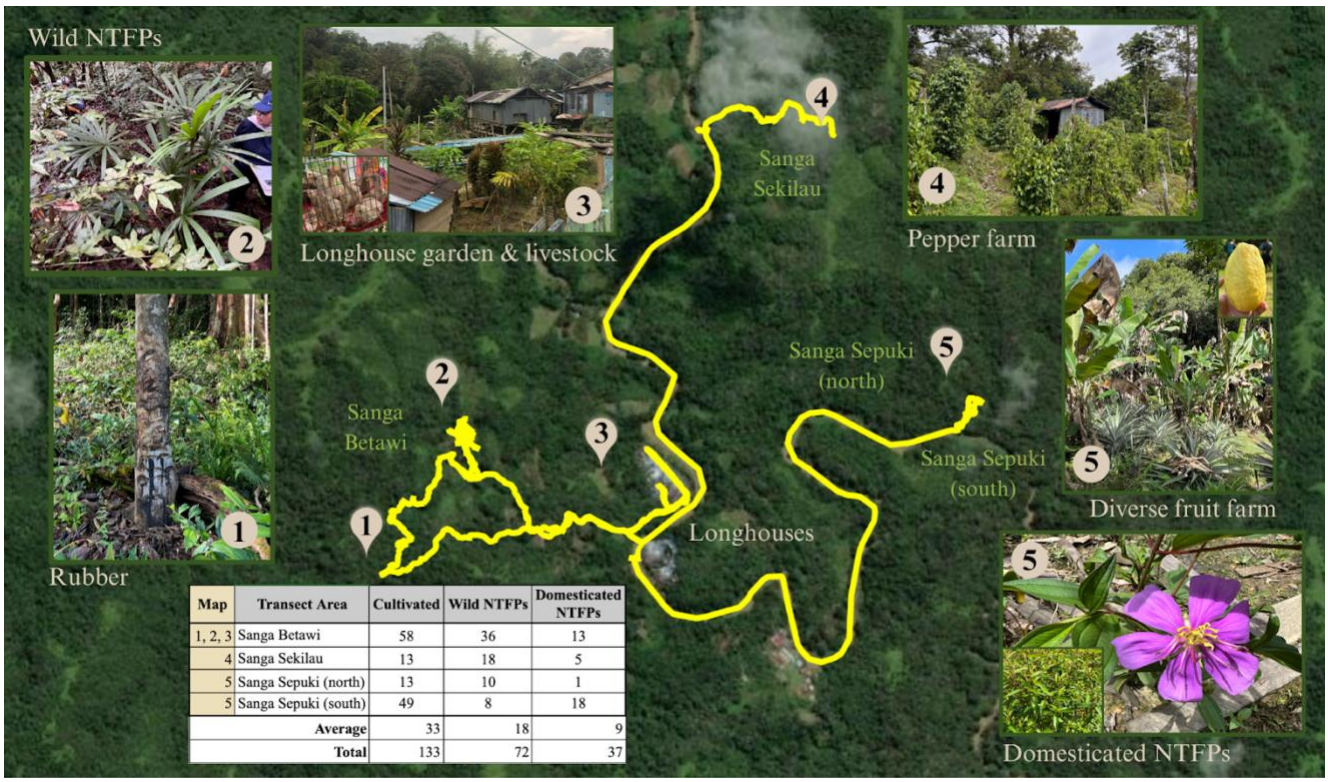
The plant inventory (Table 1) reveals a diverse overall crop portfolio comprising 101 distinct plant species (72 cultivated and 29 domesticated NTFPs species) being grown by farmers of Ulu Poi. During transect walks an average of 45 distinct species were observed being cultivated at the respective farms. Staple crops, or those eaten daily, were observed being cultivated to a small degree at the longhouses, with most production happening at the respective farm sites. Farming respondents and transect guides indicated that pepper, rubber, fruit, livestock, and mixed vegetables are what the community considers "cash crops" (Figure 2). Here, cash crops are defined as plants that are actively cultivated, with production at a sufficient level allowing for marketability beyond subsistence. Subsistence agriculture, cultivation for the sole purpose of consumption, is practised by 34% of farming respondents, while the remaining respondents, the majority, utilise produce for consumption as well as commodity assets through selling and/or trading. During asset ranking, women indicated that less effort is required to cultivate vegetable crops (Table 2). Women also felt vegetable crops contribute more to income, in comparison to forest products like timber and game meat; this is in direct opposition to the perception of men.

[8] "Conventional farming is generally defined as the cultivation of crops that yield consistent and marketable produce for the purpose of income-generation; also referred to as cash crops" (USDA, 2015)

[9] "Traditional agriculture is defined as an indigenous form of farming which includes a high level of ecological consideration through the use of local knowledge" (FAO, 2009).

Iban Vernacular Name	Common names	Scientific name	Family	Habit	Native, introduced	Cultivated, Wild, or Domisticated (NTFP)
sabai		*Eulaliopsis Binata*	Poaceae	grass	introduced	cultivated
ouchung		*Stachytarpheta cayennensis*	Verbenaceae	herb	introduced	cultivated
palak patang	butter tree	*Madhuca longifolia*	Sapotaceae	tree	introduced	cultivated
pinang	betel tree	*Areca catechu*	Aracaceae	palm	introduced	cultivated
getah	rubber	*Hevea brasiliensis*	Euphorbiaceae	tree	introduced	cultivated
limau susu	citron	*Citrus medica*	Rutaceae	tree	introduced	cultivated
marau	semambu, neem	*Azadirachta indica*	Meliaceae	tree	introduced	cultivated
tembakau	tobacco	*Nicotiana tabacum*	Solanaceae	herb	introduced	cultivated
cabik	red chili pepper	*Capsicum annuum*	Solanaceae	herb	introduced	cultivated
kuci	ladies finger	*Boesenbergia rotunda*	Zingiberaceae	herb	introduced	cultivated
lada	black pepper	*Piper nigrum*	Piperaceae	vine	introduced	cultivated
lia, halia	edible ginger	*Zingiber officinale*	Zingiberaceae	herb	introduced	cultivated
limau purut	kaffir lime	*Citrus hystrix*	Rutaceae	tree	introduced	cultivated
	ghost pepper	*Capsicum chinense*	Solanaceae	herb	introduced	cultivated
kunyit	turmeric	*Curcuma longa sp.*	Zingiberaceae	herb	introduced	cultivated
terung cina	eggplant	*Solanum melongena*	Solanaceae	herb	introduced	cultivated
cempedak, temedak	jackfruit, chempadak	*Artocarpus integer*	Moraceae	tree	native	cultivated
dabai	Sarawak olive	*Canarium odentophyllum*	Burseraceae	tree	native	cultivated
duku		*Lansium domesticum*	Meliaceae	tree	native	cultivated
durian	durian (common)	*Durio zibethinus*	Malvaceae	tree	native	cultivated
kepayang	pangi, football fruit	*Pangium edula*	Achariaceae	tree	native	cultivated
langsat	lanzones	*Lansium parasiticum*	Meliaceae	tree	native	cultivated
salam	mangosteen	*Garcinia mangostana*	Clusiaceae	tree	native	cultivated
nangka	jackfruit	*Artocarpus heterophyllus sp.*	Moraceae	tree	native	cultivated
petai	bitter bean	*Parkia speciosa*	Fabaceae	tree	native	cultivated
rambai		*Baccaurea motleyana*	Phyllanthaceae	tree	native	cultivated
rambutan	rambutan	*Nephelium lappaceum*	Sapindacea	tree	native	cultivated
rian isu, durian burung, buah isu	durian	*Durio oxleyanus*	Malvaceae	tree	e (IUCN: near threate	cultivated

Table 1: Overall plant inventory.



Map	Transect Area	Cultivated	Wild NTFPs	Domesticated NTFPs
1, 2, 3	Sanga Betawi	58	36	13
4	Sanga Sekilau	13	18	5
5	Sanga Sepuki (north)	13	10	1
5	Sanga Sepuki (south)	49	8	18
	Average	33	18	9
	Total	133	72	37

Figure 2: Mapped routes of Ulu Poi transect walks with table of plant types observed.

	Highest to Lowest		Easiest to Hardest		Highest to Lowest		Shortest to Longest		Most to Least	
	Price		Management		Cost		Harvest		Importance	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Vegetables	8	1	8	4	3	3	1	1	1	2
Pepper	5	2	6	2	1	1	3	4	3	5
Livestock	3	3	7	3	2	2	2	2	2	3
Rubber	6	4	4	1	5	5	4	3	4	1
Fruit Trees	7	5	5	5	4	4	5	5	5	4
Game Meat	2	6	3	8	8	7	6	6	6	8
Forest Prod	4	7	2	6	7	6	8	7	8	6
Timber	1	8	1	7	6	8	7	8	7	7

Table 2: Assets ranking exercise results with men and women from Longhouse 1.

Assets ranking revealed that both men and women agree that agricultural crops require high financial and time investments in comparison to the gathering of NTFPs (Table 2). Additionally, it was observed that factors like a recent influx in pest pressure – from monkeys, rodents, and birds – has negatively impacted and sometimes prevented crop production (Image 2); these same factors negatively impact collection of forest products to a lesser extent. Transect guides indicated that the crops particularly affected by pest pressure include rice, durian, and pineapple. With varying levels of success, farmers have employed several techniques to combat and repel pests, including traps, visual deterrents, and mechanical disturbance (Image 3) – ultimately choosing to forego cultivation of a particular crop if the return on time and financial investment becomes unsustainable.

Image 2: Pineapple eaten by farm pests.

Image 3: Undulate trap for pests on a farm

Collection of forest products

Alongside practicing agriculture, a vast majority of the respondents, 32 out of 38 survey respondents, stated that they collect NTFPs; moreover, amongst the few respondents who are not engaged in NTFPs collection, 80% affirmed that they used to forage in the past, with increasing age being the main reason for no longer harvesting. A total of 109 species were identified during transect walks, while additional 39 species were mentioned in the survey and at least nine different uses were described (Figure 3)[10]; 63% of the species listed in the survey are edible, and more than half of the multiple use plants have edibility as one of their main uses. Edible NTFPs were central during the resource ranking exercise for both men and women (Table 3): men in particular ranked food the highest in each respect. The women emphasised how "*the forest is a free market*", from which they can freely collect whenever there is need. While the community was observed largely relying on edible NTFPs, using them as a sort of food safety-net, residents did not openly ascribe high financial value to forest product during the assets ranking. As highlighted during the resource mapping exercise, the community also relies on the river, not only as a means of transportation but also as a source of fresh water and food; the river was the first element drawn by both men and women during the exercises. In

[10] A complete list can be found in Appendix 4.

addition, the community continues to rely on game meat but to a much lesser extent than in the past, due to at least two factors: the high price of hunting gear (10 bullets for 65 Malaysian Ringgit, according to the informants) and a significant decline in especially boar populations in recent years, due to what the community referred to as "*pig COVID*" (swine fever). Indeed, amongst the 53% of survey respondents who affirmed that they perceived a decline in availability of NTFPs, a majority mentioned boars and certain fish as the species no longer available. It is worth mentioning here that most of the respondents who mentioned hunting in the survey were male.

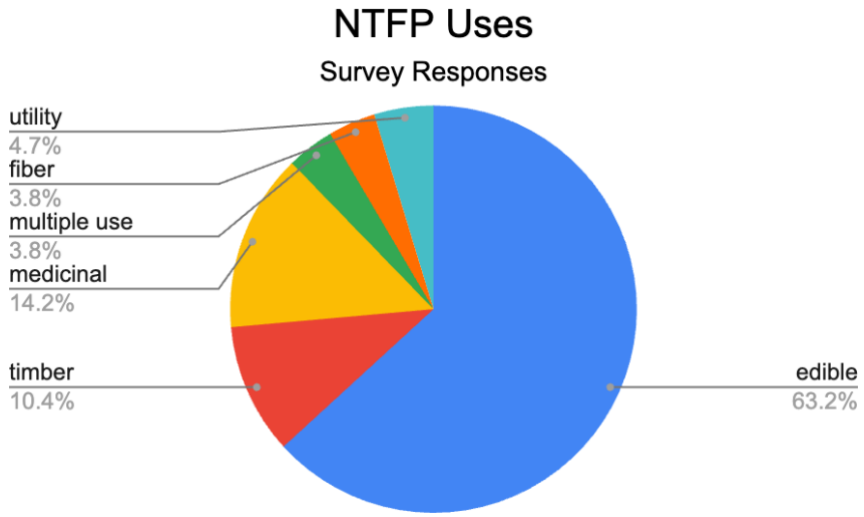


Figure 3: NTFP uses mentioned by the informants during the survey.

	Easiest to Hardest		Most to Least		Highest to Lowest		Most to Least		Highest to Lowest	
	Accessibility		Reliance		Value		Importance to Livelihood		Overall Knowledge	
Usage	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Craft	2	4	3	2	3	1	4	3	4	2
Food	1	3	1	3	1	2	1	1	1	1
Timber	3	1	2	1	4	3	3	2	3	3
Ornamental	4	5	4	4	5	4	5	4	5	4
Medicinal	5	2	5	5	2	5	2	5	2	5

Table 3: Resources ranking exercise results comparing men and women's perceptions from Longhouse 1.

Interestingly, however, there is no correlation between gender and NTFPs collection (p value= 0.61922), hence men and women are equally involved in the harvesting of forest products. Conversely, a correlation does appear to exist between gender and the collection of different kinds of NTFPs: women primarily collect firewood, timber, and medicinal plants whereas men collect mostly edibles and handicraft materials. This finding is reflected by the community's differing perceptions of ease of accessibility to forest products that emerged during the resource ranking exercise: women ranked firewood/timber easiest to access, followed by medicinal plants; men, conversely, ranked food first, followed by handicraft materials (Table 3). There appears to be no difference in uses of NTFPs based on gender (p value=0. 34984): men and women both consume, sell, exchange, and create handicrafts.

Likewise, there is no correlation between occupation and the collection of forest products (p value=0.16373) nor between income and NTFPs collection (p value=0.2990). Both respondents engaged in agriculture and those not, as well as respondents receiving an income and those not receiving any income harvest from the forest.

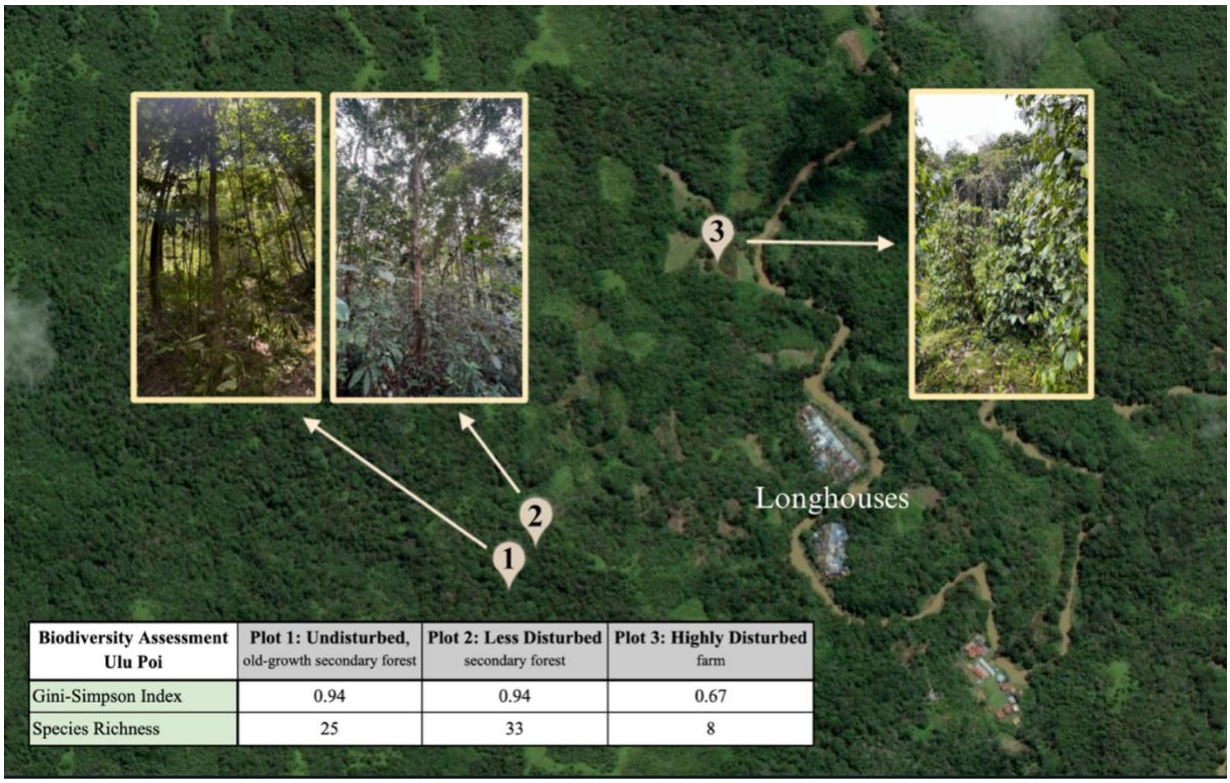
Interestingly, a positive correlation emerged between age and the collection of NTFPs (p value= 3.27E-15), highlighting that most individuals who collect are elderly. In addition, age influences the frequency of collection, with elders collecting more often than younger people (p value= 1,691E-15). A correlation also appeared between age and the collection of different products (p value= 1.256E-07) and the number of products collected (p value= 1,446E-15), with older people collecting a greater diversity of NTFPs. Finally, a correlation between age and distance from the longhouse to collection sites was also found (p value=9,520E-16): elderly individuals collect at a closer distance than younger individuals, shedding light on how mobility is a factor affecting the collection of forest products. During the administration of the survey and focus group discussion, several respondents mentioned health issues as one of the main factors impeding them to collect products from the forest.

Image 4: Example of steep topography of the land

In addition to reduced mobility, the observed *topography* of the land (Image 4) – characterised by uneven and steep forested terrain – and *distance* are compounding factors in reducing accessibility of natural resources. According to the women's resource ranking exercise, most NTFPs are easy to find but, as shifting cultivation and other land use changes "*pushed the deep forest away from the longhouse*", they would now need to travel further distances to collect products such as *upak lalis* (rattan) or *buruk* (Chinese fan palm). Women recalled how in the past they had to leave at 2 AM to collect rattan and how it would take six hours walking distance to harvest *belian* hardwood. Moreover, the assets ranking exercise revealed a shared perception of high financial and labour investments associated with the collection of forest products. During resource ranking, the women's group was very frank in their explanation that the effort required to collect and sell, including a two-hour journey by boat and car to the market in Kanowit, does not result in any profit. On the other hand, informants also reiterated how NTFPs are still valuable assets: especially in case of cash shortages, NTFPs can serve a role as safety-

net as they can always be sold, especially after some value-adding processing, to generate some quick income.

In light of reduced mobility, inaccessibility, and high financial and labour investments, the community rarely harvests from the "deep forest", but instead selectively replants and cultivates these products nearer to the longhouses and farm sites. And indeed, based on observations made during the transect walks, the locations of many of the identified NTFPs happen to be surrounding or within the longhouse gardens and farm plots. As emerging from the survey, 78% of the respondents who collect NTFPs also replant them; the main reason for replanting appears to be convenience (53%), with a smaller number of respondents (8%) alluding to preoccupation for the state of the environment as the reason for replanting. As already mentioned, 29 domesticated NTFPs species were observed during the transects.



Biodiversity Assessment Ulu Poi	Plot 1: Undisturbed, old-growth secondary forest	Plot 2: Less Disturbed secondary forest	Plot 3: Highly Disturbed farm
Gini-Simpson Index	0.94	0.94	0.67
Species Richness	25	33	8

Figure 4: Mapped biodiversity assessment plots with table of respective Gini-Simpson Indices and species richness.

The practice of domestication of NTFPs has likely reduced pressure on the secondary forests from which the community used to frequently collect. Indeed, the Gini-Simpson indexes calculated for two areas, a disturbed secondary forest and an old-growth secondary forest, show a high degree of biodiversity for both plots: the former having a score of 0.936, with a species

richness of 33, and the latter a score of 0.941, with a species richness of 25 (see Figure 4). The estimated high biodiversity of forested areas on which the Ulu Poi community relies is further supported by the presence of indicator species of forest health, such as the greater horseshoe bat (*Rhinolophus ferrumequinum)* and Hardwicke's woolly bat (*Kerivoula hardwickii)*, which were observed during a quick wildlife survey (Image 5). The reduced collection of NTFPs within these areas and the domestication of specific forest products, while seemingly beneficial for biodiversity, might be impacting traditional ecological knowledge and its transfer between generations.

Image 5: Forest health indicator species: the greater horseshoe bat (R. ferrumquinum) at left and Hardwicke's woolly bat (K. hardwickii) at right.

Transfer and use of traditional knowledge

Based on the collected data, age, experiences, interests, and time spent in the longhouse appear to influence the assimilation and active use of TEK. The latter does not appear to be equally distributed across individuals: for instance, differences in frequency of harvest and use might affect the level of knowledge an individual has about the natural resources available in the surrounding environment. During a transect walk, a key informant repeatedly doubted his own knowledge of forest products due to having lived away from Ulu Poi for a very long time; he stated he is not "*a forest-man*", as opposed to the second guide who never left the longhouse and displayed a greater ability to recognise plants and their uses. Similarly, one of the men involved in the ranking exercise mentioned being way more knowledgeable about timber rather than medicinal plants, due to his passion for building boats. Interestingly, however, as emerging

from survey data and transect walks, the community as a whole seems to continue to maintain knowledge of products they infrequently use, such as medicinal and ornamental plants.

Inter-community relationships and family ties appear to be the main means of knowledge transfer and maintenance. According to the survey, 73% of the respondents declared having acquired knowledge from family members; furthermore, most of the respondents confirmed sharing TEK both horizontally between peers (53%), and vertically from parents to children (66%). The maintenance of traditional ecological knowledge as a human asset is also relevant from a cultural perspective. During the women's resources ranking exercise, participants expressed a desire to teach the younger generations how to recognise and use forest plants in order to keep their identity and culture: "*for them not to forget where they come from*". This desire was also emphasised during informal interviews, when one of the respondents highlighted the importance of teaching peers how to make traditional Iban costumes and handicrafts (Image 6).

Image 6: An Ulu Poi elder making handicrafts for miring (a ritual offering ceremony).

Whilst traditional ecological knowledge appears to be maintained within the community, current trends of out-migration and the ageing of the longhouse population seem to be impacting how traditional knowledge is used. Women from both the resource ranking exercise and informal interviews expressed a desire to teach children and grandchildren, but since they do not permanently live in the longhouse, distance prevents the women from sharing their

knowledge on a daily basis. Similarly, the group expressed a fear that, as the younger generations live most of the time in urban areas, they might not put their knowledge to practice and might hence lose it.

Importantly, it emerges from this study that ecological knowledge is undergoing an adaptation process. Relevant changes include, for example, the increasing role of digital media in knowledge sharing, the use of plastic instead of organic fibres to make handicrafts (Image 7), and the reproduction of traditional Iban motifs on printed textiles instead of hand-woven handicrafts. Still, it appears that certain products and associated traditional practices cannot be changed, especially when they are used to fulfil specific cultural roles. For example, during sacred festivities such as *miring*, residents go to great lengths to collect specific species of plants that allow them to conduct the ceremony as prescribed by traditions. Similarly, some handicrafts such as *pua kumbu* (Image 8) requires acquisition of specific skills through apprenticeship with an expert weaver.

Image 7: Handicraft called capan is made from plastic as well as from traditional fibre material.

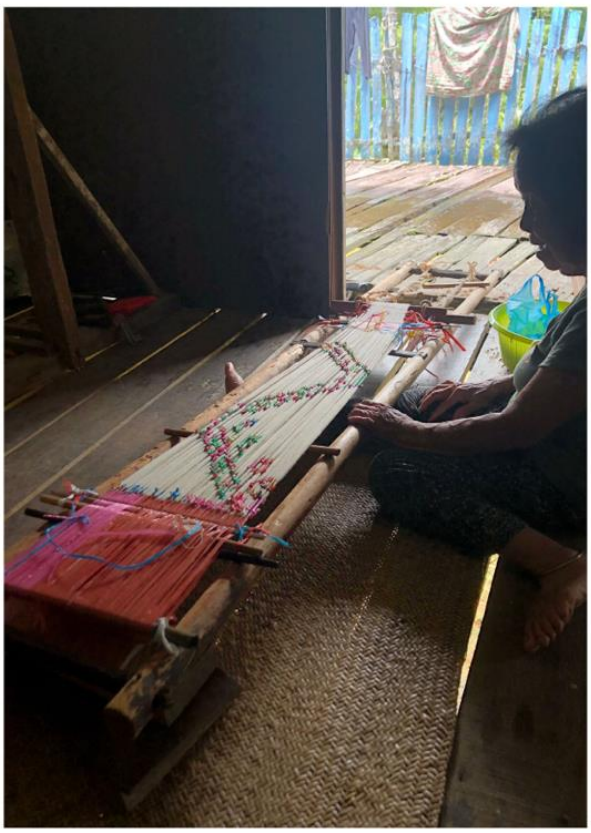


Image 8: Resident crafting a Pua Kumbu and showing one of her finished product

Discussion

The Ulu Poi community continues to largely rely on its surrounding natural resources, yet the ways in which the community perceives and relates to such resources appears at times paradoxical and differs significantly from what was initially hypothesised. Indeed, whereas the community alluded that natural resources are of minimal relevance to their livelihoods, especially when compared to other assets as agricultural crops, observations and data collected during the fieldwork indicate the opposite. This contradiction might be explained in terms of blurred boundaries: in particular, the domestication and cultivation of NTFPs, previously collected from nearby forests, is blurring the boundaries between subsistence agriculture and NTFPs collection as two distinct livelihood strategies for the community. As the two sources of livelihoods become inextricably intertwined, the very distinctions made during the data collection process between agricultural activities and NTFPs collection become redundant. Similarly, the study finds that differentiation between farms, gardens, and forest is not immediately evident to an outside observer, as the community's agricultural practices consist of integrated rather than monoculture farming, including components of agroforestry and forest gardens.

The same blurred boundaries apply to the agricultural produce itself, particularly vegetables, and NTFPs: during the ranking exercises, as well as in the survey, it became increasingly clear that the community did not differentiate between cultivated vegetables and foraged wild plants, as the same species were being categorised as both cultivated vegetables and NTFPs. Interestingly, during the ranking exercises vegetables were ranked relatively high in most regards whereas NTFPs were ranked low in almost all regards. This finding was contradicted by the fact that the community was observed consuming edible NTFPs daily; this contradiction might be explained in terms of the mentioned undifferentiation between the two categories, as well as the difficulty in reconciling the community's understanding of NTFPs with the academic definition.

The high value ascribed to the category "vegetable" during the asset ranking as well as the high value given to the category "food" during the resource ranking show the centrality of both agricultural crops and domesticated NTFPs to the livelihoods of the Ulu Poi community. Indeed, one of the livelihood outcomes NTFPs collection and especially domestication largely contribute to is *food security*. As discussed in the previous chapter, edible NTFPs do not only

constitute a majority of the mentioned forest products but are also highly valued by both men and women in the community. Given the distance from the closest market, possible fluctuations in market prices, and relative ease in accessibility and abundance of domesticated NTFPs, edible forest products become of foremost importance especially when food is scarce. But even when there is no immediate necessity, domesticated and wild NTFPs widely contribute to dietary diversity, providing a sizeable portion of the vegetable intake for the community. Not only do NTFPs allow the community to consume safe and nutritious food that meets their dietary needs, but also allow them to pursue their food preferences. And indeed, the community expressed a preference for edible NTFPs: as stated by a survey respondent, "*when I'm in the longhouse, I want to eat Iban forest-food"*. Moreover, in their providing free food that would have otherwise had to be purchased at the market, edible NTFPs allow the community to direct their (sometimes scarce) resources into other goods and services not available via harvesting, such as agricultural inputs or hunting gear. This finding confirms what literature on the contributions of NTFPs to rural livelihoods has often found.

Another finding supported by existing literature is that a second key contribution of NTFPs to the livelihoods of the Ulu Poi community is via s*afety-net,* or self-insurance: even when NTFPs are not valued in terms of income generation, as the effort required to collect and sell is often greater than the profitability of forest products, NTFPs can still provide quick income opportunities in case of cash shortages. Rattan mats, sellable on the market for 500-600 Malaysian Ringgit according to the informants, as well as traditional hand-made costumes, whilst in most instances made for their use in the longhouse, can always be sold by community members in case of necessity. In an analogous manner to rubber trees, which the community stated can always be tapped when market prices become more favourable, NTFPs represent a stable and valuable asset which can help reduce vulnerabilities in the face of adversities.

Interestingly, it was found that the relevance of NTFPs to food security and self-insurance is not limited to any gender group or socioeconomic status. And in fact, whilst it was expected that patterns of collection and use of NTFPs would likely differ based on factors such as gender and income, the findings of this report contradict this hypothesis. No correlation between gender and NTFPs collection and use nor between income and collection was found. Put in the context of broader academic discussions, these findings differ from the reiterated argument that it is especially women and poorer individuals within rural communities who collect forest

products. In order to explain this finding, further research on the nuanced gender roles and socioeconomic hierarchy within the Ulu Poi community would be needed.

The successful achievement of food security and self-insurance as livelihood outcomes is dependent on the knowledge that people hold. And indeed, within the Ulu Poi community, TEK constitutes a relevant asset, which is used daily and is directly related to the community's use of natural resources. Nonetheless, its depth and perceived relevance vary from individual to individual, according to intersectional factors. Given the importance of TEK in allowing the community to meet its needs, this knowledge is being shared through modelling, imitation, and active teaching and learning. Moreover, aside from its utility, TEK is also key to Iban customs and way of life by defining, shaping, and allowing for the maintenance of their cultural identity.

However, the ageing of the population, modernisation, and outmigration trends –among other factors - are inevitably changing the ways in which maintenance and production of TEK occur in the longhouses. Yet, while it was expected that a reduced immersion in the Iban longhouse cultural milieu along with limited interaction with the surrounding natural environment would negatively impact knowledge maintenance and transfer, this study finds that knowledge is a collective resource that is in fact preserved, but not as readily put to practice. As the Ulu Poi community depends on collective sharing in order to maintain TEK, intersectional factors affect how that TEK is put to practice over time.

The study also found evidence of the dynamic nature and adaptability of the Iban TEK system, as exemplified by the replacement of rattan with plastic in creating woven handicrafts. This allows for the maintenance of traditional craftmanship while reducing the labour and time investment necessary to collect and process organic fibres. These findings suggest that, in some cases, the community places greater value on the maintenance of the end-products than on the rigour with which the product is created by traditional inputs and means. Interestingly, this dynamism does not apply to all Iban practices. Further research might shed light on why certain practices are maintained according to traditional protocol while others are not.

Conclusively, it is necessary to note the state of the environment as to assess whether there might be any negative impacts of NTFPs collection. The study found that the Ulu Poi community is in an area of high biodiversity; when disturbed and undisturbed secondary forested areas are compared, there is no significant difference or decrease in biodiversity. This

seems to be due to a combination of factors: the reduction in frequent collection from forested areas; an increase in NTFPs domestication; outmigration; and adaptation of TEK surrounding NTFPs. All together, these factors might be reducing environmental pressure and preventing observable negative impacts on biodiversity, according to the study's albeit limited sampling. To a lesser extent, the community's concern for the state of the environment might also be a contributing factor, as stated by one informant who replants to conserve NTFPs diversity. In fact, even though the study finds that the community relies on the abundant natural resources, paradoxical activities which might degrade natural resources were also observed, including disposing of refuse in the river and forested areas as well as the use of chemical agricultural inputs. Further studies are needed to explore the contributing factors influencing the community's complex relationship with their environment.

Conclusion

This research sought to shed light on the diverse contributions of NTFPs to the livelihoods of the Ulu Poi community, focusing especially on their relevance as a natural asset to ensure *food-security* and provide a *safety-net*; this paper also aimed to explore how traditional ecological knowledge of NTFPs is maintained, utilised, and transferred, as well as how demographic changes might be impacting these. A final aspect of the research has been to assess the state of the environment from which the community harvests NTFPs and the impacts forest products collection might be having on biodiversity.

Results suggest that permanent residents of the Ulu Poi community mainly engage in two livelihood strategies, namely agriculture and NTFPs collection, yet the boundaries between the two are not as clearly defined as initially hypothesised. And in fact, this study finds the *domestication* of selected NTFPs species in locales nearer the longhouses and farm plots to be a broad trend within the community; the process of integration of NTFPs species as agricultural crops is to be understood largely in terms of *convenience*: as the population ages and their mobility is reduced, the topography of the land curtails accessibility of natural resources. The process of domestication of wild plants appears to be a widespread strategy the community adopts to ensure the desired livelihood outcomes. While these findings provide insights on how NTFPs can be, and in fact are, integrated into agricultural systems, the way NTFPs are academically conceptualised as only being extracted from forested area is being challenged; this suggests the need for a more flexible understanding, accounting for how forest dwelling communities define and utilise NTFPs.

This study also finds that the first livelihood outcome NTFPs collection and domestication contribute to is *food security*, especially considering the Ulu Poi community's isolation from urban areas. Results suggests that regardless of status and gender, individuals within the community have access to and rely on rich natural resources for sustenance. The second livelihood outcome NTFPs contribute to is via *safety-net*: even when the contribution to income generation is mostly insignificant, forest products can be understood as an asset that helps the community cope with financial adversities. In this light, NTFPs appear to contribute significantly to the community's resilience, in the context of an ageing and decreasing population who lacks access to basic infrastructures.

The successful achievement of the mentioned livelihood outcomes is facilitated by the maintenance and implementation of TEK. Whilst the level of knowledge held by individuals varies according to intersectional factors, this study suggests that TEK is preserved as a communal resource, from which individuals can draw upon. Inter-community and familial ties emerge as crucial means of knowledge transfer. An additional finding of this research is that the Iban TEK system appears to be highly dynamic, being prone to adaptability and innovation; this dynamism is further contributing to the resilience of the Ulu Poi community.

Finally, when considering the impacts that NTFPs collection might have on the environment, this paper suggests that the harvesting of forest products does not negatively impact biodiversity. This finding, however, is to be explained in terms of at least two factors reducing pressure on the environment: the domestication of NTFPs and a limited number of collectors – due to a decreased population. Unexpectedly, this study found that other human activities, such as agricultural practices, coupled with a lack of a waste management system, might be negatively impacting environmental quality. As the relationship of forest-dwelling communities with their natural environment is complex and nuanced, care must be taken as not to romanticise the reality of living in an isolated, rural community lacking basic infrastructure.

Overall, this research contributed to a broader academic discussion on the role of NTFPs in the livelihoods of rural communities by shedding lights on the ways in which NTFPs contribute to the livelihoods of a forest-dwelling community in Sarawak, Malaysia, as well as how the management of the harvesting of forest products is impacting the environment. Whilst some of the findings of this paper are supported by pre-existing literature, others seem to contradict what research on the topic has argued, as it is the case for the contention that is especially women and poorer individuals to rely on forest products. In order to better make sense of these novel findings, further research would be needed.

Conclusive Reflection

Overall, the outcome of this project has been influenced by many factors, and the complex dynamics of group-work within a field setting might have impacted the quality of the data collected. The community was very welcoming and accommodating, opening their homes and sharing their knowledge and insights with the research team. This made for a positive experience and helped to build strong relationships between the research team and the community. Additionally, the interdisciplinary nature of the research team allowed for diverse perspectives and knowledge to be brought to the project, which could have been enriching for all involved. Nevertheless, some challenges were faced during the research process. It appears that there might have been a lack of balance in the integration of disciplines and research approaches, with a few members being dominating. Consequently, the group faced internal communication issues, which could have contributed to some of the challenges faced during the research process. Language barriers and interpretation issues, including the unavailability of an adequate number of assigned interpreters, might have also hindered the meaningful participation of a few research group members. This might have affected the very way data collection activities were carried out. Examples include a lack of rigor in executing methods in the field, such as the missing implementation of a sampling strategy for the focus group discussion and leading questions during participatory exercises, which might have impacted the quality of data collected. Furthermore, the short ten-day timeframe for fieldwork might have made it difficult to collect sufficient data whilst also negotiating a common topic, especially given unexpected findings that needed to be accounted for. Overall, there were both positive and negative aspects of the research experience. Moving forward, it might be helpful to ensure a more balanced integration of disciplines, avoid leading questions, and ensure rigor in executing methods. Additionally, the research team might need to adjust their approach to account for unexpected findings and possibly extend the fieldwork timeframe to ensure sufficient data is collected.

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Appendices

Appendix 1: Final synopsis

Exploring the role of Non-Timber Forest Products in Ulu Poi, Sarawak, Malaysia

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Context:

The large, Southeast Asian Island of Borneo is divided between three countries: Malaysia, Indonesia, and Brunei. The Malaysian states of Sarawak and Sabah are located in north Borneo, with the relatively tiny country of Brunei between them. With two monsoon seasons, Sarawak is hot and humid year-round. From November until February, heavy rain occurs during what is known as the northeast monsoon season. Comparatively less rainy, the southwest monsoon occurs between March and October. Sarawak's equatorial climate provides ideal conditions for its biodiverse tropical rainforests, rich in natural resources sought after by rural communities and modern industrial companies.

Sarawak is designated into 12 land divisions, 40 districts, and 26 sub-districts (ESIA, 2021). The Nanga Sebetong longhouse is located in Ulu Poi, within the Kanowit District of Sibu Division. A 2020 census revealed Sarawak's population to be 2.4 million, of which 59 percent are of the indigenous ethnicity of Dayak - which includes Iban communities. Known for territorial migration and shifting agricultural practices, the Iban people traditionally reside in and belong to particular longhouses - which are not only shelter, but also serve as administrative centres around which communities organise themselves. In this context, rice farming is one of the most widespread agricultural practices, even though recent development policies strongly influenced local communities into adopting new cash crops - such as pepper, rubber and oil palms - both for self-sustenance and as income generators. The harvesting and utilisation of non-timber forest products (NTFPs)[11] by all indigenous peoples of Borneo predates western contact (Jones, et al., 2016) and continue to constitute an important part of the livelihood[12] portfolio of many communities. Currently, there is assumption that the gathering of NTFPs is for the purpose of supplementing income, but this may not be the only case (Sakai, et al., 2016). Literature on NTFPs reveals that they also serve a number of diverse functions for the livelihoods of rural and forest dwellers.

[11] de Beer and McDermott (1996) define NTFPs as 'all biological materials other than commercial timber extracted from forests for human use', including wood products ; this definition can be expanded to include the following characteristics: consumptive and non-consumptive uses; local use and benefit; all habitats; self-replicating wild species (for a detailed discussion see Shackleton, 2015)

[12] "A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household. " (Allison & Ellis, 2001, p. 379)

Problem area:

The relevance of NTFPs in rural livelihoods in developing countries has become widely acknowledged within research and policy arenas over the last decades. “Scherr et al. (2004) estimate that 1.4–1.6 billion people worldwide make use of NTFPs at least to some degree, while 350 million people depend on NTFPs for their livelihood either as a safety net or as supplementary income” (Sakai et al., 2016, p. 341). Despite the importance of NTFPs in the livelihoods of rural communities, government agencies in many countries place considerable restrictions on which NTFPs can be harvested and in which quantities. Shackleton et al. (2015) interprets this as being a result of one or more of the following three reasons: “the legacy of colonial restrictions and central government controls during much of the nineteenth and early twentieth centuries”; the fact that “Countering the calls for increased devolution of control and management of forests and NTFPs to indigenous peoples are the widely publicized concerns related to global biodiversity loss”; and, finally, the fact that “There are relatively few studies on the approaches to and impacts of harvesting and guidelines for promoting ecological sustainability,” hence governments adopt most often a precautionary rather than adaptive approach (p. 4). This can have, needless to say, severe negative implications for the livelihoods of millions of rural as well as urban poor.

Indeed, there are various roles that NTFPs take on in the livelihoods of rural communities. Millions of the rural poor, as well as a significant number of the urban poor, use NTFPs daily to provide a portion or all of their food, shelter, and medicine needs. This has been termed by Shackleton and Shackleton (2004) the *daily net* and equates to subsistence uses or household provisioning. In their providing food that might not have otherwise been available, NTFPs appear to play a crucial role in increasing households’ *food security* and *dietary diversity*. Moreover, the free provision of significant quantities of food, energy, construction material, medicines, and fibres means that “scarce cash resources can be saved or directed to goods and services not available via harvesting that poor households might otherwise struggle to acquire” as for instance agricultural inputs, school fees or books, small assets such as radio or bicycle etc. (Shackleton et al., 2015).

Not all NTFPs harvested are used within the household: many are sold in raw form or after some value-added processing. Unfortunately, there are hardly any statistics reporting on the proportion of households that do trade in one or more NTFPs. Some researchers have suggested that the number of people engaged in NTFP trade is steadily increasing. Trade in NTFPs takes place at multiple scales, from inter-household trade between neighbours to trade in local markets within villages or communities up to regional, national, and international markets. The magnitude and nature of trade chains, and the benefits and incomes accruing along the chains, varies markedly between these different scales. However, some generalisations can be made: "Richer households tend to dominate trade in high value NTFPs, whereas poor households lead trade in high volume, low value NTFPs with low capital requirements (…). Local-level trade between households or in local markets can be substantial and provides an income equalising role as poorer households sell NTFPs to richer ones, who rather buy than collect their own (…) International trade networks in NTFPs are worth billions of dollars annually, but could be several orders of magnitude higher with appropriate vision and support" (ibid., p. 18).

Another substantial contribution of NTFPs to local livelihoods is via *safety nets*, or self-insurance. This refers to using NTFPs as a fall-back option or coping mechanism during household stress or misfortune. Indeed, even when the contribution of NTFPs to the overall household income is small, these products play significant roles in reducing risk and vulnerability of poor households. NTFPs are, in fact, generally most extensively used to supplement household income during particular seasons in the year and to help meet dietary shortfalls (Arnold & Pérez, 1998).

Alongside their role in food security, income generation, and safety net, NTFPs harvesting is said to be well embedded in the cultures of using communities. Indeed, particular NTFP species are often used for certain rituals or ceremonies, and, in turn, there may be specific rituals that have to be observed before some NTFPs can be harvested (such as first fruit or first harvest rituals). Many NTFPs and their uses may be components of local symbolism, folklore and even children's stories. NTFPs may also add to local appreciation of landscapes and natural systems because local people view their presence as a sign of a healthy or productive system, or they might simply appreciate them for their aesthetics. Such cultural values attached to certain NTFPs may also afford income generating opportunities through the sale of cultural artefacts, foods and drinks derived from NTFPs to locals, tourists, or urban dwellers or through

ecotourism enterprises to observe traditional harvesting and crafting techniques or attendance at local ceremonies.

Finally, a dimension hardly considered in the NTFP literature is the role of NTFP species in providing supporting or regulating services to local livelihoods; some NTFP species provide habitat, food, or nesting/living sites to other important species, both NTFPs and non-NTFP species. As research suggests, NTFP species as a whole constitute a significant proportion of overall species richness and biomass. Hence, they play a significant role in general community ecology and resilience. Their loss or mismanagement would undermine ecosystem functioning or resilience.

Generally speaking, patterns of use of NTFPs are likely to differ among groups or households and within households by gender and age. One relationship that has been widely observed is that where people have had relatively unrestricted access to forests, forest foods and forest products, income is significant for poorer groups within the community (Arnold & Pérez, 1998.). Nonetheless, there seems to be a paradoxical relationship between the gathering of NTFPs and incomes: whilst a study by Svarrer et al. (2005) found that development of modern infrastructure has increased access to wage-labour for rural communities of Sarawak and as incomes increase, the gathering of NTFPs decreases, another study by Sakai, et al. (2016) found that gathering of NTFPs had a positive relationship with incomes.

The role of NTFPs in the livelihoods of rural households is said to be changing due to various factors and external forces, such as increasing access to purchased foods, improved supplies of food crops, or new opportunities to engage in more profitable income-generating activities. A decline in forest food use can also reflect reduced traditional ecological knowledge (TEK), especially of species infrequently used, or result from changes in demand of these products (Arnold & Pérez, 1998.). However, the nature of these changes is yet to be clearly defined.

Similarly, research exploring the impacts on the environment of NTFPs harvesting is yet to reach a unanimous understanding. Some studies have argued that the harvesting of NTFPs is a sustainable practice that does not negatively impact forests, as their extraction is seen as less destructive than the logging of timber products. Nevertheless, some ecologists suggest that the collection of NTFPs has a more significant environmental impact than we might think, and that negative externalities happen over time. If uncontrolled, the harvesting of NTFPs can lead to

the depletion of wild plants and animals in the forest. As Arnold and Pérez explain, "almost any form of resource harvest produces an impact on the structure and function of tropical plant populations" (1998, 19), but also on animal populations - playing a key role in the forest and the provision of ecological services. External market forces should also be considered, as they might significantly impact harvesting levels. The market increasing demand for specific products might result in increasing NTFPs harvesting and lead to over-exploitation in some instances. Nonetheless, it can be argued that focusing on the prevention of NTFP harvesting as a means to limit change or potentially negative impacts to populations or species ignores all the other pressures and changes that populations and ecosystems are exposed to, some human mediated, some not, and with sometimes detrimental impacts whilst at other times positive ones. The trick is therefore, rather than viewing all harvesting as inevitably negative, to understand which species (or functional traits), which harvesting regimens and which contexts are likely to result in negative impacts on NTFP populations and species, and in which situations such adverse outcomes are unlikely.

In the light of the foregoing and given the diverse contribution of NTFPs to the livelihoods of rural communities, the research group is interested in exploring which are the roles that NTFPs play in the livelihoods of the Nanga Sebetong longhouse, Ulu Poi, Sarawak, Malaysia, if there have been relevant changes over time, and how the harvesting of such products is impacting the environment.

Research question:

What is the role of NTFPs in the livelihoods of the Nanga Sebetong longhouse, Ulu Poi, Sarawak, Malaysia?

Sub-questions:

a) What are the main NTFPs collected by the community, and where are they collected from?

b) Who collects, uses, and benefits from which forest products?

c) What is the perceived relative contribution of NTFPs to different forms of capital, particularly cultural and financial?

d) How does the management of NTFPs collection impact the environment?

Hypothesis:

The Ulu poi community relies on NTFPs to improve and diversify their livelihoods, have a safety net, increase food security as well as maintain a connection to culture and the land.

Methodology:

For the group to address the above research questions, a mixed methods approach will be adopted. The methods chosen include: survey, transect walk, inventory, participatory ranking exercise, focus group interview, and biodiversity assessment. The survey will be used to gather, firstly, ′background' knowledge about the involved community (e.g., age and gender of community's members, livelihood strategies, sources of income, market integration, etc.) as well as knowledge about the different species harvested, and who collects, uses (for what purposes), and benefits (what kind of benefit) from which kind of NTFPs. The transect walk will, similarly, allow us to explore which are the products collected and where they are collected from; particular attention will be paid during the transect to the question of ownership of the forest and community's access and withdrawal rights as well as to whether the community has experienced any changes in NTFPs collection practices and availability. The participatory ranking exercise will allow us to assess the relative contribution of NTFPs to food security, income generation, safety net, and maintenance of cultural practices. It will be followed by a discussion during which we will expand on the different contributions of NTFPs to the community's livelihood strategies. Semi-structured, focus group interviews will be used to expand on the themes that emerged from the survey as well as to explore current changes and trends related to NTFPs collection, in particular to understand how external social-economic and environmental factors (such as, e.g., cash crop price fluctuations, outward migration, increasing number of pests, etc.) might be affecting NTFPs collection practices. Lastly, the biodiversity assessment, focussing on plant diversity, will be carried out using the strip transect technique as for the group to calculate and compare the Gini-Simpson biodiversity indexes for areas where collection of NTFPs takes place and areas where no collection occurs.

Unit of analysis:

Individuals → Longhouse inhabitants (everyone that is a member of the community).

Data Collection Timeframe:

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11
Getting to know our partners and community	Observations Finishing drafting survey and interview guidelines	Transect walk Finishing drafting survey and interview guidelines	Survey (2 groups, 5/6 per group) Data cleaning	Survey (2 groups, 5/6 per group) Data cleaning	Data cleaning Preparing ranking exercise	Participatory ranking exercise and discussion Revising interview guidelines	Focus group interview	Biodiversity assessment Data cleaning	Data cleaning/ coding Preparing presentation for the community	Presentation to the community of preliminary results

Planned collaboration:

In the process of scheduling a meeting with the Malaysian counterparts to establish how to go about our collaboration.

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Data Matrix

Overall research question: **What is the role of NTFPs in the livelihoods of the Ulu Poi community in Sarawak, Malaysia?**

Sub-questions	Hypothesis	Data Needed	Sampling strategy	Method	Data Analysis Strategy	Possible Pitfalls
What are the main NTFPs collected by the community, and where are they collected from?		Knowledge about the NTFPs collected and used by the community and knowledge of the locations where products are collected from (including knowledge of ownership, access, and withdrawal rights, management)	Stratified sampling based on belonging to different genders, age groups, and socioeconomic status Purposeful sampling of key informants	Survey Transect walk (GPS) with key informants Inventory	Descriptive statistics Visualisation of information from a transect in a map	Having to carry out two different surveys could be very time consuming Might be unable to translate plant/animal species from the Iban name.
Who collects, uses, and benefits from which forest products?	Individuals are differently involved in NTFPs collection activities, according to gender, age, and occupation; Their usage and relevance can also vary	Knowledge about *who* collects (age, gender, occupation, etc.), uses (for what purposes), and benefits (what kind of benefit) from which kind of NTFPs	Stratified sampling based on belonging to different genders, age groups, and socioeconomic status* Purposeful sampling of key informants* *Same respondents as for previous survey/same key informants	Survey Focus group interviews with key informants	Descriptive statistics, testing of correlation between different age groups/genders/occupations, and NTFPs collection Coding of interviews for themes	Need to be careful about group selection to consider Iban social constructs (e.g., social hierarchy, men-women interactions), which might hinder meaningful participation.

	according to the same factors					
What is the perceived contribution of NTFPs to different forms of capital, particularly cultural and financial?	NTFPs contribute, to different degrees, to income generation, food security, and maintenance of traditional knowledge	Knowledge about the perceived contribution of NTFPs to income, dietary diversity, and maintenance of traditional knowledge/cultural practices	Stratified sampling based on belonging to of different genders, age groups, and socioeconomic status* Purposeful sampling of key informants *Same respondents as for previous surveys/same key informants	Survey Participatory ranking exercise with key informants	Testing of correlation between NTFPs collection and perceived higher income, between NTFPs collection and perceived greater dietary diversity, and between NTFPs collection and maintenance of traditional practices	Data cleaning might be messy
How does NTFPs collection impact the environment?		Knowledge about the state of the environments where NTFPs are collected		Biodiversity assessment: Strip transect focusing on plants species	Comparison of Gini-Simpson indexes for areas where NTFPs are collected and for areas where no collection takes place	Lack of a meaningful baseline

Interview guidelines:

1) How do you think forest products contribute to your way of living?
2) Do you think you are collecting more or less forest products than in the past?
3) Why do you think you are collecting more or less?
4) Do you think the importance of forest products has changed over time?
5) What are the factors you believe to be influencing these changes?
6) Are there products you used to collect that are no longer available?
7) How do you explain this decline in availability?
8) How has the decline in availability impacted you?

Survey Draft:

https://docs.google.com/forms/d/1zvdFIc5Nd91fS8NXE1csx9NbY5E12ib-Z09bKvHPxXg/edit

Appendix 2: Methods overview table

How do NTFPs contribute to the livelihoods of the Ulu Poi community in Sarawak, Malaysia?

Sub-questions	Method	Data	Data Analysis Strategy	Pitfalls
What are the main livelihood strategies the community is engaged in?	Survey Focus Group Discussion Informal Interviews	Survey with 38 respondents Interview notes	Descriptive statistics, testing for correlations, visualisation of data in charts/graphs Coding of interview responses into relevant themes	Issues with translating and recalling information Underdeveloped survey leading to difficulty in coding for analysis Too many interviewees and lack of enough human resources (e.g. interpreters) Lack of sampling strategy Unequal power relations between respondents
What are the main NTFPs the community relies on, where are they collected from, and who collects and uses which NTFPs?	Transect walks with GPS Survey Inventory	GPS tracks of 4 transect walks, with waypoints Survey with 38 respondents	Visualisation of information from transect and inventory in a map with ArcGIS Descriptive statistics, testing for correlations, visualisation of data in charts/graphs	Possible biases in guide preferences (both in term of locations and forest products) Issues with translating and recalling information

	Resource mapping	Identification of useful plant species Men's and women's maps and associated notes (respectively)	Categorisation: domesticated, wild, usage Visualisation of maps and coding of notes	Possible guiding questions during mapping exercise. Presence of headman at both men's and women's exercise Issues with translating and recalling information Underdeveloped survey leading to difficulty in coding for analysis Lack of diversity amongst respondents Survey of children
What is the perceived relative contribution of NTFPs to income generation and food security?	Ranking exercises Focus group discussion Survey	Men and women groups 2 ranking exercises: assets and resource rankings Interview notes Survey with 38 respondents	Coding of interview responses into relevant themes Descriptive statistics, testing for correlations, visualisation of data in charts/graphs	Format of the ranking exercise (i.e., listing categories from top to bottom) Lack of involvement of participants in developing categories for ranking Issues with translating and recalling information

				Underdeveloped survey leading to difficulty in coding for analysation Lack of diversity amongst respondents Survey of children when survey was meant for adults
How do recent demographic trends impact the use and transfer of traditional ecological knowledge (TEK) about NTFPs?	Surveys Focus Group Discussion Informal Interviews Ranking Exercises Transect walks	Survey with 38 respondents Interview/Transect notes Men and women groups 2 ranking exercises: assets and resource rankings	Descriptive statistics Coding of interview responses into relevant themes Visualisation of ranking into a table Visualisation of information from transect and inventory in a map with ArcGIS	Issues with translating and recalling information Underdeveloped survey leading to difficulty in coding for analysis Format of the ranking exercise (i.e., listing categories from top to bottom) Lack of involvement of participants in developing categories for ranking
What is the impact of NTFPs collection on the environment?	Biodiversity assessment	Quantified useful plants list from three plots of 20x20 m	Calculation of the plant biodiversity using Gini-Simpson index	Incorrect plant identification Inaccurate plots delimitation

Appendix 3: Survey questions

Exploring the Use of Natural Resources in Ulu Poi, Sarawak, Malaysia

This survey is presented to you as part of our SLUSE course: an international collaborative course between the University of Copenhagen and the University of Malaysia Sarawak (UNIMAS). This survey aims to get to know you better. The information given will be treated confidentially and your name will not be used; instead, we will refer to you with pseudonym. We thank you in advance for your time, patience, and help!

Pintu Number: Gender:

1. How often do you live in the longhouse?

   Permanently

   Commuter

   Occasionally (festivals, ceremonies etc)

   1. (a) How many people excluding yourself live permanently in your household? _____

   1. (b) How many people in your household do not live in your household? _____

2. How old are you? _____

3. What is your level of education? _____

4. Are you engaged in agriculture? (**If no, go to question 9**)

   Yes

   No

   Other _____

5. What are the crops that you cultivate?

   _____

6. How much time you spend cultivating?

Fulltime

Part time

Seasonally

None

7. Do you consume/sell/trade what you cultivate?

Consume

Sell

Trade

All the above

8. If you sell, what are the crops you sell?

---

8. (a) If yes, how often do you sell your crops?

Daily

Weekly

Monthly

Sometimes

9. Do you make handicrafts?

Yes

No

Sometimes

8. (a) If yes, what kind of handicraft do you make?

---

8. (b) If yes, do you sell your handicrafts?

Use

Sell

Both

10. Is there somebody including yourself in your household who receives an income?

Yes

No

9. (a) If yes, what kind of income do you receive?

No. _____Engage in paid work

No. _____Pension

No. _____ Remittances

10. (b) If you are engaged in paid work, what type of paid work is it?

Government

Private

Self Employed

10. (c) If you are engaged in paid work, how often?

Full time

Part time

Short term contract

Occasionally

11. What do you do in your spare time?

---

12. Based on your answer, which activity generates income for you?

---

13. Do you collect products (e.g., edible plants, medicinal plant, game meat, mushrooms, building material, firewood) from the forest? (**If no, go question no. 14**)

Yes

No

13. (a) If yes, can you list the product that you usually collect in the forest?

13. (b) how often do you collect products from the forest?

Everyday

On a weekly basis

On a monthly basis

Every few months

13. (c) where do you collect this product?

---

13. (d) do you always collect from the same place?

Yes

No

13. (e) How far do you have to go to collect these products?

---

13. (f) do you replant anything that you harvest?

Yes

No

13. (f) (i) If yes, what do you replant?

_____

13. (f) (ii) Why do you replant?_____

13. (g) How did you learn to recognise the products you listed?

---

13. (h) How did you learn to collect the products you listed?

---

13. (i) How did you learn to use the products you listed?

---

13. (j) Do you collect alone or in a group?

Alone

In a group

Both

13. (k) If you do not collect alone, who do you collect with?

---

13. (l) What do you do with these products?

Consume them

Sell them

Exchange them

Create handicraft

14. If no, did you collect in the past? **(If answered the previous questions go to question no. 15)**

Yes

No

14.(a) Why did you stop?

---

14. (b) can you list the product that you usually collected in the forest?

14. (c) how often did you collect products from the forest?

Everyday

On a weekly basis

On a monthly basis

Every few months

14. (d) where did you collect this product?

---

14. (e) did you always collect from the same place?

Yes

No

14. (f) How far did you have to go to collect these products?

---

14. (g) did you replant anything that you harvest?

Yes

No

14. (g) (i) If yes, what did you replant?

_____

14. (g) (ii) Why did you replant?_____

14. (h) How did you learn to recognise the products you listed?

---

14. (i) How did you learn to collect the products you listed?

---

14. (j) How did you learn to use the products you listed?

---

14. (k) Did you collect alone or in a group?

Alone

In a group

Both

14. (l) If you did not collect alone, who did you collect with?

---

14. (m) What did you do with these products?

Consume them

Sell them

Exchange them

Create handicraft

15. Are there any forest products that you use to collect that are no longer available?

    Yes

    No

    15.(a) If yes, what are the products that are no longer available?

16. Did you teach your children how to recognise and collect these products?

    Yes

    No

17. Have you share this knowledge with others?

    Yes

    No

Appendix 4: Plant inventory

Iban Vernacular Name	Common names	Scientific name	Family	Cultivated, Wild, or Domisticated (NTFP)	Use
karah		*Albizia procera*	Fabaceae	wild	
kucai	chives	*Allium schoenoprasum*	Amaryllidaceae	cultivated	edible
nanas	pineapple	*Ananas comosus*	Bromeliaceae	cultivated	edible fruit
durian belanda	soursop	*Annona muricata*	Annonaceae	cultivated	edible fruit
	perennial peanut	*Arachis glabrata*	Fabaceae	cultivated	soil building, grown around black pepper vine plants
jering	dog fruit	*Archidendran pauciflorum*	Fabaceae	domesticated NTFP	edible seeds
pinang	betel tree	*Areca catechu*	Aracaceae	cultivated	medicinal fruit chewed with betel leaf
aping		*Arenga brevipes*	Arecaceae	wild	edible heart of palm
nangka	jackfruit	*Artocarpus heterophyllus sp.*	Moraceae	cultivated	edible fruit, big
temedak	jackfruit	*Artocarpus heterophyllus sp.*	Moraceae	wild	medicinal
cempedak, temedak	jackfruit, chempadak	*Artocarpus integer*	Moraceae	cultivated	edible fruit; medicinal bark salve
lumok	breadfruit sp.	*Artocarpus odoratissimus*	Moraceae	domesticated NTFP	edible fruit
tarap	marang	*Artocarpus ordoratisssimus*	Moraceae	domesticated NTFP	edible fruit, large
sukun	breadfruit	*Artocarpus sp.*	Moraceae	cultivated	edible fruit, large
belimbing buluh	bilimbi, pickle tree	*Averrhoa bilimbi*	Oxalidaceae	cultivated	edible fruit
marau	semambu, neem	*Azadirachta indica*	Meliaceae	cultivated	medicinal skin salve; timber used to make "funny" chairs
buah geruming	wild star fruit	*Baccaurea angulcita*	Phyllanthaceae	domesticated NTFP	edible fruit
tampoi, buah tampoi	larah, kapul	*Baccaurea macrocarpa*	Phyllanthaceae	domesticated NTFP	edible fruit
rambai		*Baccaurea motleyana*	Phyllanthaceae	cultivated	edible fruit, can be fermented to make wine
buloh, tubuk, rebung	bamboo	*Bambusa sp.*	Poaceae	domesticated NTFP	edible shoots; stalks utilized tool, building
	begonia	*Begonia sp.*	Begoniaceae	wild	edible leaves good in fish dishes
pokok sembung		*Blumea balsamifera*	Asteraceae	wild	medicinal
bisa bong, sambong		*Blumea camphor*	Asteraceae	domesticated NTFP	medicinal
kuci	ladies finger	*Boesenbergia rotunda*	Zingiberaceae	cultivated	spice rhizome
kijang	antelope	*Bovidae sp.*		wild	edible

buah mak, buah makasar		*Brucea Javanica*	Simaroubaceae	domesticated NTFP	diabetes medicine
puak		*Butea monosperma*	Fabaceae	domesticated NTFP	edible fruit
rotan	rattan	*Calamus rotang*	Arecaceae	wild	handicrafts
rotan balu	rattan	*Calamus sp.*	Arecaceae	wild	handicrafts
wi tunggal	blue eye	*Calamus ssp.*	Arecaceae	wild	handicrafts stems used for mat weaving
wi segak	rattan	*Calamus ssp.*	Arecaceae	wild	handicrafts stems used for mat weaving
bintangor		*Calophyllum pulcherrimum*	Guttiferae	wild	timber
dabai	Sarawak olive	*Canarium odentophyllum*	Burseraceae	cultivated	edible fruit
cabik	red chili pepper	*Capsicum annuum*	Solanaceae	cultivated	spice
	ghost pepper	*Capsicum chinense*	Solanaceae	cultivated	spice
betik	papaya	*Carica papaya*	Caricaceae	cultivated	edible fruit
ruan		*Carruanthus ringens*	Aizoaceae	wild	
berangan	chinquapin, chinkapin	*Castanopsis sp.*	Fagaceae	wild	timber
limau purut	kaffir lime	*Citrus hystrix*	Rutaceae	cultivated	spice leaves used to flavor stews
limau	lemon	*Citrus limon*	Rutaceae	cultivated	edible fruit
limau susu	citron	*Citrus medica*	Rutaceae	cultivated	edible fruit, rind used as spice
limau lemantak	calamansi, calamondin	*Citrus microcarpen*	Rutaceae	cultivated	edible fruit
limau madu	mandarin sp.	*Citrus reticulata*	Rutaceae	cultivated	edible fruit
kelapa	coconut	*Cocos nucifera*	Aracaceae	cultivated	edible fruit
puding	croton	*Codiaeum variegatum*	Euphorbiaceae	domesticated NTFP	ornamental leaves
kopi	coffee	*Coffea sp.*	Rubiaceae	cultivated	edible
keladi, yam	taro	*Colocasia esculenta*	Araceae	cultivated	edible corm
sabang	ti leaf plant	*Cordyline fruticosa*	Asparagaceae	domesticated NTFP	ornamental leaves
	costus	*Costus sp.*	Costaceae	domesticated NTFP	ornamental flowers
rampuk	cucumber	*Cucumus sativus sp.*	Cucurbitaceae	cultivated	edible fruit
canko, chanko	pumpkin	*Cucurbita maxima sp.*	Cucurbitaceae	cultivated	edible fruit
kunyit	turmeric	*Curcuma longa sp.*	Zingiberaceae	cultivated	spice
serai	lemongrass	*Cymbopogon citratus*	Poaceae	cultivated	edible leaves
buan		*Dendrocnide sp.*	Urticaceae	wild	medicinal
resam kalindong		*Dicranopteris linearis*	Gleicheniaceae	wild	utility stems used to make fish traps
buah isau, isau	Sarawak green longan	*Dimocarpus longan spp. malesianus var. ma/esianus*	Sapindaceae	domesticated NTFP	fruit
kayu malam	night tree	*Diospyros borneensis*	Ebenaceae	wild	young stems pliable, used for lashing/rope

paku pakis, paku	fern shoots	*Diplazium esculentum*	Athyriaceae	wild	edible shoots
		Dipterocarpus longifolius	Dipterocarpaceae	wild	
rian nyekak, durian pulu	durian	*Durio kutejensis*	Malvaceae	cultivated	edible fruit
rian isu, durian burung, buah isu	durian	*Durio oxleyanus*	Malvaceae	cultivated	edible fruit
durian	durian (common)	*Durio zibethinus*	Malvaceae	cultivated	edible fruit
tepus		*Etlingera coccinea*	Zingiberaceae	domesticated NTFP	edible flowers
kantan, bunga kantan, kecala, kechala	wild torch ginger	*Etlingera elatior*	Zingiberaceae	domesticated NTFP	edible flowers and seed pods; ornamental flowers
upak pantu, pantu	wild sago	*Eugeissona utilis*	Arecaceae	domesticated NTFP	edible roots, heart of palm; handicrafts, stem fiber
sabai		*Eulaliopsis Binata*	Poaceae	cultivated	textiles
belian	ironwood of Borneo	*Eusideroxylon zwageri*	Lauraceae	domesticated NTFP	timber hardwood
pokok ara	wild fig	*Ficus carica*	Moraceae	wild	edible fruit
ara	river fig	*Ficus obpyramidata*	Moraceae	cultivated	edible fruit
lankan	wild fig	*Ficus sp.*	Moraceae	wild	edible fruit
salam	mangosteen	*Garcinia mangostana*	Clusiaceae	cultivated	edible fruit
daun sabong, daun sabong akal, sabong	melinjo	*Gnetum genmon*	Gnetaceae	domesticated NTFP	edible young leaves
selukai		*Goniothalamus sp.*	Annonaceae	domesticated NTFP	medicinal; bark burned to repel bugs
sabung	longevity spinach, water spinach	*Gynura procumbens*	Asteraceae	cultivated	edible leaves
getah	rubber	*Hevea brasiliensis*	Euphorbiaceae	cultivated	latex sap; edible young leaves
senggang		*Hornstedtia reticulata*	Zingiberaceae	wild	edible fruit; handicrafts fibre
kumpang	darah-darah, pendarahan	*Horsfieldia sucosa*	Myristicaceae	wild	timber, firewood
buah naga	dragon fruit, pitaya	*Hylocereus undatus*	Cactaceae	cultivated	edible fruit
	sweet potato	*Ipomoea batatas*	Convolvulaceae	cultivated	edible tubers
tapang	tualang, mangaris, bangris	*Koompassia excelsa*	Fabaceae	wild	timber for furniture
duku		*Lansium domesticum*	Meliaceae	cultivated	edible fruit
langsat	lanzones	*Lansium parasiticum*	Meliaceae	cultivated	edible fruit
jelantang		*Laportea stimulans*	Urticaceae	wild	timber
pokok buruk, palas gajah	Chinese fan palm	*Licuala cordata*	Arecaceae	wild	handicrafts fibre and leaves used to make hats

	lychee	*Litchi chinesis*	Sapindaceae	cultivated	edible fruit
engkalak	Borneo avocado	*Litsea agrciae*	Lauraceae	domesticated NTFP	edible fruit, medicine (bark and seeds), timber
palak patang	butter tree	*Madhuca longifolia*	Sapotaceae	cultivated	medicinal
nyatoh ketiau		*Madhuca motleyana*	Sapotaceae	wild	timber, oil cooking
bacang	wild mango, horse mango	*Mangifera foetida*	Anacardiaceae	domesticated NTFP	edible fruit
mangga, empelam	mango	*Mangifera indica*	Anacardiaceae	cultivated	edible fruit
asam embanga, embawang, bambangan	wild mango	*Mangifera panjang*	Anacardiaceae	domesticated NTFP	edible fruit
ubi kayu, ubi, empasak	cassava, tapioca	*Manihot esculenta*	Euphorbiaceae	cultivated	edible tuber
semukau		*Meiogyne virgata*	Annonaceae	wild	timber with narrow diameter bole, used for poles and sticks
	mint	*Mentha sp.*	Lamiaceae	cultivated	edible leaves
sagu	sago palm	*Metroxylon sagu*	Aracaceae	domesticated NTFP	edible trunk pith processed for starch
buah lapanga, empari, peria	bitter melon, bitter gourd	*Mommordica charantia*	Cucurbitaceae	wild	edible fruits, shoots; medicinal
malberi	black mulberry	*Morus nigra*	Moraceae	cultivated	edible fruit
pisang	banana	*Musa acummata*	Musaceae	domesticated NTFP	edible fruit
	wild banana	*Musa sp.*	Musaceae	wild	edible fruit
kayu ubah	bur tree, canary wood	*Nauclea orientalis*	Rubiaceae	wild	timber
rambutan	rambutan	*Nephelium lappaceum*	Sapindacea	cultivated	edible fruit
tembakau	tobacco	*Nicotiana tabacum*	Solanaceae	cultivated	ritual use
empitat		*Ochreinauclea maingayi*	Rubiaceae	wild	timber, edible fruit
nibong		*Oncosperma tigillarium*	Arecaceae	wild	edible; handicrafts. Very rare
asi, beras	rice	*Oryza sativa L.*	Poaceae	cultivated	edible seeds
kepayang	pangi, football fruit	*Pangium edula*	Achariaceae	cultivated	edible fruit, after fermentation due to poison
petai	bitter bean	*Parkia speciosa*	Fabaceae	cultivated	edible seeds ('beans')
letup-letup	stinking passion flower	*Passiflora foetida*	Passifloraceae	wild	edible fruit
	avacodo	*Persea americana*	Lauraceae	cultivated	edible fruit
mahkota dewa	crown of god	*Phaleria macrocarpa*	Thymelaeaceae	wild	medicinal
daun sirih, sirih hutan, sirih, namat	betel vine	*Piper betle*	Piperaceae	cultivated	medicinal
lada	black pepper	*Piper nigrum*	Piperaceae	cultivated	spice
upak lalis, umbut rotan	rattan	*Plectocomiopsis geminiflora*	Arecaceae	wild	medicinal, called "good health plant"
kasai, longan kristal	metoa, Fijian longan	*Pometia pinnata*	Sapindaceae	cultivated	edible fruit; timber

jambu batu	guava	*Psidrum guajava*	Myrtaceae	cultivated	edible fruit
		Psychotria sp.	Rubiaceae	wild	
lobak	daikon, radish	*Raphanus sativas*	Brassicaceae	cultivated	edible
kemunting	rose myrtle	*Rhodomyrtus tomentosa*	Myrtaceae	wild	medicinal leaves for high blood pressure; edible fruit
tebu	sugarcane	*Saccharum officinarum*	Poaceae	cultivated	edible
langbak		*Saguerus langbak*	Arecaceae	wild	edible fruit
ridan	red salak, red snakefruit	*Salacca affinis*	Arecaceae	wild	edible fruit, leaf stems used to make fishing rods
salak	snakefruit	*Salacca zalacca*	Aracaceae	cultivated	edible fruit
cangkuk manis	katuk	*Sauropus androgynus*	Phyllanthaceae	cultivated	edible fruit, leaves
bemban	cool mat	*Schumannianthus dichotomus*	Marantaceae	domesticated NTFP	handicrafts mats crafted feel cool to touch; rituals (death)
engkabang	candlenut	*Shorea macrophylla*	Dipterocarpaceae	domesticated NTFP	edible
tekam		*Shorea sp.*	Dipterocarpaceae	wild	timber
terung asam	Sarawak apple, sour eggplant	*Solanum lasiocarpum Dunal*	Solanaceae	domesticated NTFP	edible fruit
terung cina	eggplant	*Solanum melongena*	Solanaceae	cultivated	edible fruit
kedondong	ambarella	*Spondias dulcis*	Anacardiaceae	cultivated	edible fruit
ouchung		*Stachytarpheta cayennensis*	Verbenaceae	cultivated	medicinal
kemiding, miding	midin	*Stenochlaena palustris*	Blechnaceae	wild	medicinal
bungkang		*Syzygium polyanthum*	Myrtaceae	wild	edible, medicinal root-bark
	cacao	*Theobroma cacao*	Malvaceae	cultivated	edible fruit
		Timonus flavescens		wild	medicinal
dandi	tridax daisy	*Tridax procumbens*	Asteraceae	wild	medicinal
terung tung	tung tree	*Vernicia fordii*	Euphorbiaceae	wild	timber; oil from seeds
kacang panjang	long bean	*Vigna unguiculata ssp. sesquipedalis*	Fabaceae	cultivated	edible fruit
	civet	*Viverridae sp.*		wild	edible
panawan lilin		*Xanthophyllum amoenum*	Polygalaceae	wild	timber - long and straight wood good for construction
jangung	maize, corn	*Zea mays*	Poaceae	cultivated	edible fruit
lia, halia	edible ginger	*Zingiber officinale*	Zingiberaceae	cultivated	spice

bucai				cultivated	utility: bark burned to repel bugs
nyempulut	bird species			wild	edible
empuluk	bird species			wild	edible
bulbul	bird species			wild	edible
merbah	bird species			wild	edible
ikan	fish			wild	edible
	frogs			wild	edible
	kakan tree			wild	
	lady fingers			cultivated	edible
ensabi kayu	leafy greans species			wild	edible
kulat taun	mushrooms			wild	edible
tekoyong	snails			wild	edible
kemantik				cultivated	
mambong				domesticated NTFP	medicinal leaves and stems
anat kalabu				wild	
japang, jakan				wild	timber for furniture
sukong				wild	timber non-structural
tekalong				wild	bark used for flat lashing/straps (eg. backpack)
dabai pukit				wild	
sengkayun				wild	
merakubang				wild	utility - used as bait for takyong
gerimis				domesticated NTFP	timber
mangariis				wild	timber for furniture
ensabi kampura				wild	edible leaves
pendok				wild	bark fibre used to make lashing/rope
kampai				wild	timber, firewood
kakus				wild	
kuong				wild	
langkek				wild	
lanki				wild	
purang				wild	useless
ranegas				wild	
rangel				wild	

retakchit				wild	
takuong paian				wild	
tekolong				wild	
ponanga				wild	ritual use
celo				cultivated	edible
seri				cultivated	edible
sungai sabong				wild	edible