TROPICAL FOREST AND THE CHEWONG IN PENINSULAR MALAYSIA

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ABSTRACT

This research examined the relationship between the Chewong, forest-dwellers, and the tropical forest of Krau Wildlife Reserve, Peninsular Malaysia. The three main focusses were the relationship between the Chewong and the variety of plants used in daily life, patterns of forest recovery following shifting agriculture by forest residents, and the Chewong's perception of their interaction with the forest of Krau utilizing mixed methods methodology. In total, the use of 243 plant species was documented, which the Chewong use based on traditional knowledge such as Klanyi (*Dialium indum* L., Leguminosae), used for food resource, medicine, construction material, and firewood, including the non-timber forest product for commercial trade. The agricultural system had variable effects on the trajectory of forest succession, depending on the main crops and trees planted. In contrast, managed fruit gardens had limited effects on forest structure and overall composition. Concerns have been expressed regarding the sustainability of forest product harvesting and the relative rights of group members residing inside or adjacent to the forest reserve. The Chewong population in the forest is relatively stable, but the shift from traditional practices to use of modern tools and increasing marketisation of particular commodities are driving changes in the manner in which the Chewong use the forest. These findings have implications for understanding the dynamics at macro levels of indigenous people and their relationship with forests, including its contribution to forest conservation.

Keywords: Chewong, Krau Wildlife Reserve, people-park relationship

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LIST OF ABBREVIATIONS

DWNP	Department of Wildlife and National Parks of Peninsular Malaysia or PERHILITAN
EPU	Malaysia Economic Planning Unit
FRIM	Forest Research Institute Malaysia
IUCN	International Union for Conservation of Nature
JAKOA	Department of Orang Asli Development of Malaysia
KWR	Krau Wildlife Reserve
NECC	National Elephant Conservation Centre
NTFPs	Non-timber forest products

CHAPTER 1 INTRODUCTION

1.1 Tropical rainforests

The complex land-based ecosystem called tropical rainforest houses over half of the earth's biodiversity, it has an important influence on the climate system, and provides abundant resources (Gardner et al., 2009). Tropical forests are found across the world between the tropic of Capricorn and Cancer. The climatic requirements of tropical forests are high temperatures, over 20˚c year-round, and rainfall, over 1,500 mm per year. The dense vegetation of high canopy trees with many saplings defines a typical tropical rainforest. However, the differences in climate, soil, drainage, and regeneration cause tropical rainforests to vary in vegetative structure, including epiphytes and lianas (Ghazoul and Sheil, 2010; Whitmore, 1998). Tropical forests are located in more than 80 countries, and in 1990, occupied 37% of the total land area of tropical regions, about one-third of the world's forest cover of which around 19% is located in Asia (FAO, 2012).

Southeast Asian tropical forests are dominated by the dipterocarp tree family, which arrived approximately 45 million years ago (Ashton and Seidler, 2014). The majority of them are found in

Indonesia, Malaysia and the Philippines. Other major plant families present in these forests include Fagaceae, Arecaceae, Rubiaceae, and Musaceae. The primary animal groups are primates such as apes and monkeys, ungulates, rodents such as porcupines, rats and squirrels and birds (Ghazoul and Sheil, 2010). Dipterocarp trees provide large biomass because they are the tallest and fastest growing tropical tree in the world, these qualities make them a prime choice timber for the logging industry. The specific characteristic of the Southeast Asian dipterocarp forests is the mast fruiting period, in which the dipterocarp trees and many other tree species produce flowers and fruits simultaneously only once every two to seven years over a large area (Corlett and Primack, 2011; King et al., 2006).

The tropical forests of Southeast Asia shaped the development of the Malay world of which Peninsular Malaysia is a part of (Kathirithamby-Wells, 2005). Peninsular Malaysia is hilly to mountainous with 23% of the land surface above 300 m, with a granite ridge following the north-south main range. Another 40% is above 150 m, leaving 37% at lowland level. Bridging island and mainland Southeast Asia, Peninsular Malaysia contains the conjunction of regional floras through processes of climatic and geological change dating back to the Tertiary period. The hyper-rich flora includes Burmese and Thai species in the North, the Sundiae species in the South and the main range. Continental taxa such as the Rhinoceros, Tiger, deer, and wild cattle have invaded the Sunda region and the archipelago in the Pleistocene period, with continued speciation from equatorial Africa and America, contributing to Malaysia's status as having some of the most complex and species-rich vegetation equal to that of Amazonia (Whitmore, 1998; Wyatt-Smith, 1963).

1.2 Anthropological effects on the forests

Although tropical forests are extremely robust and resilient ecosystems consisting of a complex construction, high species diversity and very complicated networks of species interactions, their loss is increasing around the world due to external factors such as logging and land conversion for plantations (Arroyo-Rodríguez et al., 2017; Costanza et al., 2014; Hansen et al., 2013).

In Southeast Asia, human activity has created 63% disturbed forest and secondary forest by many actors (Chazdon, 2014). A large proportion of deforestation drivers are caused by commercial agriculture or large-scale commercial enterprises followed by subsistence agriculture or small-scale farming operations. In Malaysia and Indonesia the primary driver of deforestation is logging or timber extraction. There are however still human populations who do not rely on such large-scale methods of commercial agriculture and instead use their traditional knowledge of forest ecosystems and cultivation techniques as a means of survival within the rainforest.

1.3 Indigenous people and tropical rainforests

According to the International Union for Conservation of Nature (IUCN) figures, about 70% of protected areas worldwide are inhabited. These biodiversity hotspots also tend to be located with high numbers of indigenous peoples whose land and resources have often been the targets of the conservation and development requirements at both national and global levels. Protected tropical forest areas have varied aspects associated with the relationship between itself and indigenous people, especially in Malaysia and these raise questions about the nature of the park-people relations at present. The goals of conservation efforts have, in many cases, over shadowed the treatment of indigenous communities, taking a more demanding and telling line rather than an asking and listening approach (Hance, 2016). Opting for resettlement as a method to solve conservation issues whilst showing regard for the indigenous community's rights are also paramount (Rakotonarivo and Hockley, 2017).

These human-forest relationships in Asia date back to over 40,000 years. In Southeast Asian forests, the history of human occupation only starts around 11,000 years ago (Hunt and Rabett, 2014; Mulder and Coppolillo, 2005; Steffen et al., 2007). Over this time the relationship between humans and the forest has been informed by traditional forest knowledge or traditional ecological knowledge which links long-term contextual understanding with management effects on the forest composition, structure, and function (Trosper and Parrotta, 2012). Traditional forest knowledge, sometimes also known as indigenous knowledge, includes the knowledge-practice-belief complex, reflecting the paradigm with which forest people refer to their own environments (Gadgil et al., 1993). For instance, knowledge of the complex ecology of resin formation in the genus *Aquilaria* of the Penan Benalui in Central Borneo, and the instruments for living in tropical woodland and forest of indigenous people in Malaysia (Donovan and Puri, 2004) have been developed and passed on over generations. This knowledge has allowed these indigenous populations to thrive entirely on naturally derived resources for food consumption, building materials, medicine and hunting.

In Peninsular Malaysia, there are 18 cultural and linguistic subgroups of indigenous people or Orang Asli (which means original people) numbering 178,132 in 2010, or 0.6% of the national population. The variety of traditional occupations and ways of life reflect their dependence on natural habitats for existence and economic maintenance. Most Orang Asli are agriculturalists, practicing swiddening or planting cash crops such as rubber, pepper, and bananas. Some still practice hunting and gathering. The customary lands and territories are fundamentally at the centre of their culture and the foundation of their worldview and societal structure which require protection and maintenance for future generations (Nicholas, 2006).

1.4 Thesis aims

Krau Wildlife Reserve (KWR) in Peninsular Malaysia contains several Orang Asli villages. The Chewong still practice a traditional shifting agriculture, hunting and gathering lifestyle, which provides a test case to consider park-people relations by focussing on indigenous people and the impact of their forest use on forest dynamics from an insider's perspective.

My aim is to explore the intimate relationships between biodiversity, indigenous, especially forest-dweller, livelihoods, and tropical forest ecosystems. Ecological and sociological information has been gathered on the Chewong such as; traditional forest knowledge, forest use, impacts on forest structure and conservation attitude. Multidisciplinary and mixed methods were applied through documentation of ethnobotany knowledge, traditional Chewong agricultural practices and effects on the forests, including, conservation and preservation of environmental attitudes. To highlight problems associated with integrating biodiversity conservation, customary resource use and sustainable development and provide data which may help to resolve these problems in future, investigations were made into how forest regeneration and composition is influenced by shifting cultivation. Interactions between the Chewong and other actors involved in local conservation are also explored. This research includes consideration of the subsistence needs and economic aspirations of the local people settled in the park, as well as respect for their community resource rights.

1.5 Thesis structure

The historical settings of the KWR and Chewong resettlements will be described in chapter 2, along with the background of this human-park relationship together with mixed methods analysis for this research. The forest use of the Chewong will be presented in chapter 3 which focuses on the relationship between plant species in the forest and the Chewong. The impacts of different traditional agrarian practices of the Chewong will be explored and discussed in chapter 4. Changes of societal and cultural contexts on the interaction between the Chewong and forests, including conservation attitude will be documented in chapter 5. The discussion and conclusion of findings in these multidisciplinary works and debates concerning tropical rainforest conservation and sustainability, which have been identified in this research will be considered in chapter 6.

Each chapter’s main aim and objectives of the thesis are as follows,

Chapter 2	Main aim:	to describe the historical settings of KWR, Chewong resettlements and research methodology
	Objectives:	1. to describe the main context of the historical settings of the KWR and Chewong resettlements 2. to present the research methodology behind mixed methods
Chapter 3	Main aim:	to describe the relationship and interactions of the Chewong with plants in KWR
	Objectives:	1. to describe how the Chewong use plant resources regarding the types of plants used and the range of functions they serve. 2. to compare Chewong plant resources between wild and cultivated species.

Chapter 4	Main aim:	to describe Chewong agriculture and its effects on tropical forest regeneration.
	Objectives:	1. to describe the main factors, which affect the forest regeneration process
		2. to compare the effects of different agricultural patterns on the structure and composition of recovering forest
Chapter 5	Main aim:	to describe the Chewong societal changes and attitudes towards forest conservation
	Objectives:	1. to describe the factors which are shaping Chewong society and changes
		2. to interpret Chewong conservation attitudes and impact on KWR
Chapter 6	Main aim:	to link chapters 3 to 5 to produce an overall picture of the thesis results
	Objectives:	to conclude thesis findings and implications for sustainable tropical forest management and conservation

CHAPTER 2

RESEARCH CONTEXTS AND MIXED METHODS

2.1 Krau Wildlife Reserve

Within Peninsular Malaysia, 40 protected areas have been set in all 11 states covering a total area of 751,413 ha or 10.8% of the mainland. Many local and Orang Asli communities who live in and around these parks depend on them for food, medicinal plants and tradable products (Kathirithamby-Wells, 2005; Sodhi et al., 2008).

Krau Wildlife Reserve is located in the central-west of Pahang state, the middle section of Peninsular Malaysia (northern and southern limit of 3º 35'-52' N, eastern and western limit of 102º 05'-17' E, see Figure 2.1). KWR is the largest wildlife reserve in Peninsular Malaysia covering an area of around 60,338 ha; the reserve is part of a network of protected areas of which the largest is Taman Negara (Taher et al., 2017). The highest peak within the reserve is Gunung Benom on Benom range in the Northwest and West with an altitude that ranges from 43-2,108 m.

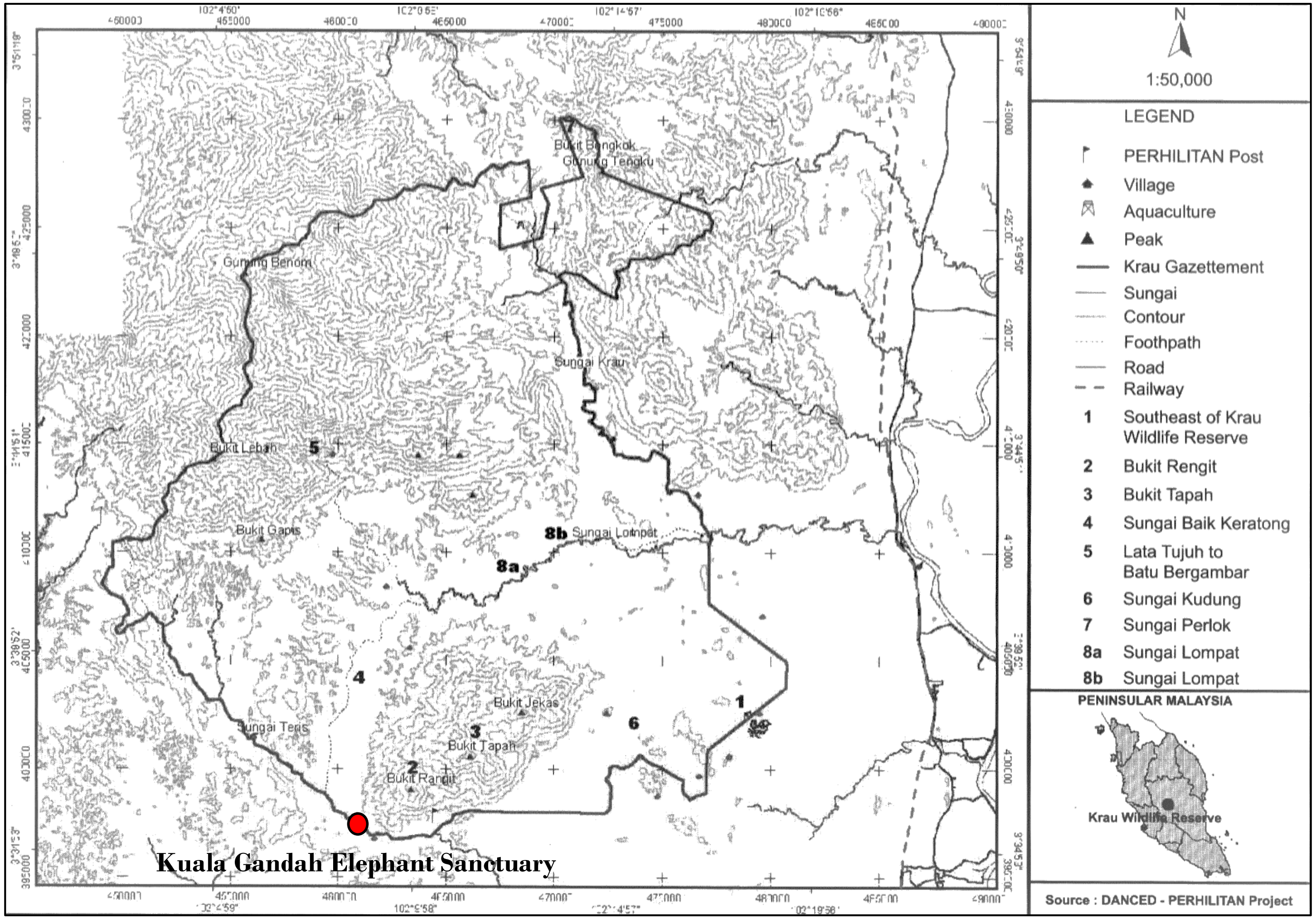


Figure 2.1 Map of KWR in Peninsular Malaysia (Chua and Saw, 2006)

KWR is drained by three central river systems, Sungai Krau in the East, Sungai Lompat in the centre and west, and Sungai Teris in the South and Southwest. The landscape ranges from flat lowlands and small swamp areas to undulating hilly terrain and many mountain zones, most of which are found in the northern region. The climate consists of a mean yearly rainfall of approximately 2,000 mm and daily temperature fluctuations between a minimum of 23°c and a maximum of 33°c (Chua and Saw, 2006).

The forest in KWR is classified into six distinct categories, the dipterocarp forest, which covers more than 92%, which consist of lowland dipterocarp forest with riparian vegetation, freshwater swamp forest, hill dipterocarp forest, and upper hill dipterocarp forest. Others forest types include oak-laurel forest, montane ericaceous forest, and secondary forest, which include cultivated or cleared land and some unclassified zones.

KWR has been classified as a natural forest where no major commercial forestry or land development has taken place (Ahmad et al., 2012). The region has minimal large-scale disturbance, has minimal disturbance to the natural ecology and harvesting of non-timber forest products (NFTPs) appear to be within a sustainable degree (Ahmad et al., 2013). A total of 1,527 taxa from 564 genera and 157 families of vascular plants were documented in 2006 by Chua and Saw.

A huge variety of faunal species have been documented through research into the biological diversity of this protected area. However, several large-bodied animal species which were documented in KWR in the past 20 years have disappeared entirely including; the Asian elephant (*Elephas maximus*) and Sumatra rhinoceros (*Dicerorhinus sumatrensis*) whos last detection occured at Gunung Benom in 1996. In 2000, gaur (*Bos gaurus*) and Malayan tiger (*Panthera tigris*) were recorded by Laidlaw and his team (Laidlaw et al., 2000). Alongside a reduction in numbers of dhole (*Cuon alpinus*), clouded leopard (*Neofelis nebulosa*), and Malayan tapir (*Tapirus indicus*) and serow (*Capricornis sumtraensis*). However, sambar deer (*Rusa unicolor*), barking deer (*Muntiacus muntjak*) and wild boar (*Sus scrofa*) are still present in high numbers within the reserve (Campos-Arceiz et al., 2012; Kawanishi, 2002; Moore et al., 2016; Yusof and Sorenson, 2000)

2.2 The history of Krau forest

KWR was gazetted under the state decree as Krau Game Reserve in 1923 with a total area covering 55,200 ha (DANCED, 2001). The reserve was initially built for hunting large game species such as gaur but re-gazetted twice in 1965 and 1968 extending the reserve border and changing the status to the management of threatened wildlife. In 2001, the reserve extended this protection to conserve all biological diversity.

From 1942 to 1989, KWR faced a black field due to communist activities known as the Malayan Emergency and was under military control during this period. The Department of Wildlife and National Park (DWNP) aimed for permission for inventory, research, and management purposes. In between the 1960s and 1970s, rubber and oil palm plantations were planted around KWR and forests around the reserve border were cleared. As a result, KWR became a fragmented forest, easily accessed, and exploited for NTFPs or hunting.

In 1989, the DWNP established an elephant management sanctuary named the National Elephant Conservation Centre (NECC) (at 3° 35.48' N and 102° 08.66' E, see a red dot in Figure

2.1). The Elephant Sanctuary was used as a permanent base for the elephant capture unit in Kuala Gandah village to be a protection and translocation centre for wild elephants whose original habitats have been logged for plantations (Lillegraven, 2006). The sanctuary was designed for the resettlement and translocation of elephants to other protected reserves and parks, which suit their natural habitat. In 1997, this Elephant Sanctuary opened to the public and has rapidly become a major ecotourism destination with over 178,600 people visiting in 2010 (Kaffashi et al., 2015).

KWR has never experienced a period without humans present, based on evidence from the Census in 1969 (Howell, 1981), which documented 53,000 Orang Asli distributed throughout all the Peninsular Malaysia except Perlis and Penang (see Figure 2.2a), including, the Chewong and Jah Hut which were recorded around the KWR area at that time. Moreover, Rambo's Orang Asli distribution map, which was presented in 1982, depicted Pahang state, including, the Krau protected area (see Figure 2.2b) which has been dominated by shifting agriculture from the Chewong and Jah Hut of the Senoi sub-group.

Over the coming years, the Jah Hut were resettled out of KWR to locations around the Northeast border which have developed into resettled villages such as Penderas village (location 3° 36' N and 102° 18' E). This was completed under the government's resettlement plan which was supervised by the Department of Orang Asli Development of Malaysia or JAKOA (Azliza et al., 2012).

Some of the Chewong were also resettled to new villages outside the park, located around the southern border such as Sungai Enggang (3° 35' N and 102° 8' E). However, inside KWR, some Chewong still practice swidden lifestyles such as hill rice cultivation and depend on the forest resources for their subsistence and cash income. Meanwhile, the Chewong who were relocated outside of the reserve have taken to permanent agriculture; managing their own rubber, oil palm and cocoa farms and have various paid jobs (Nicholas, 2000).

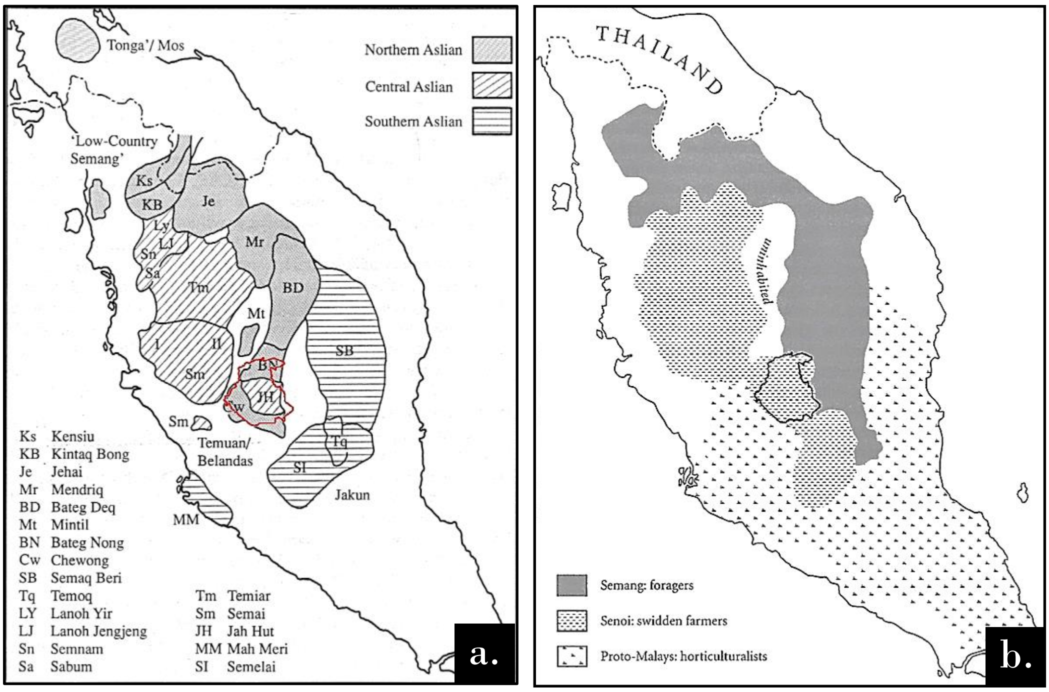


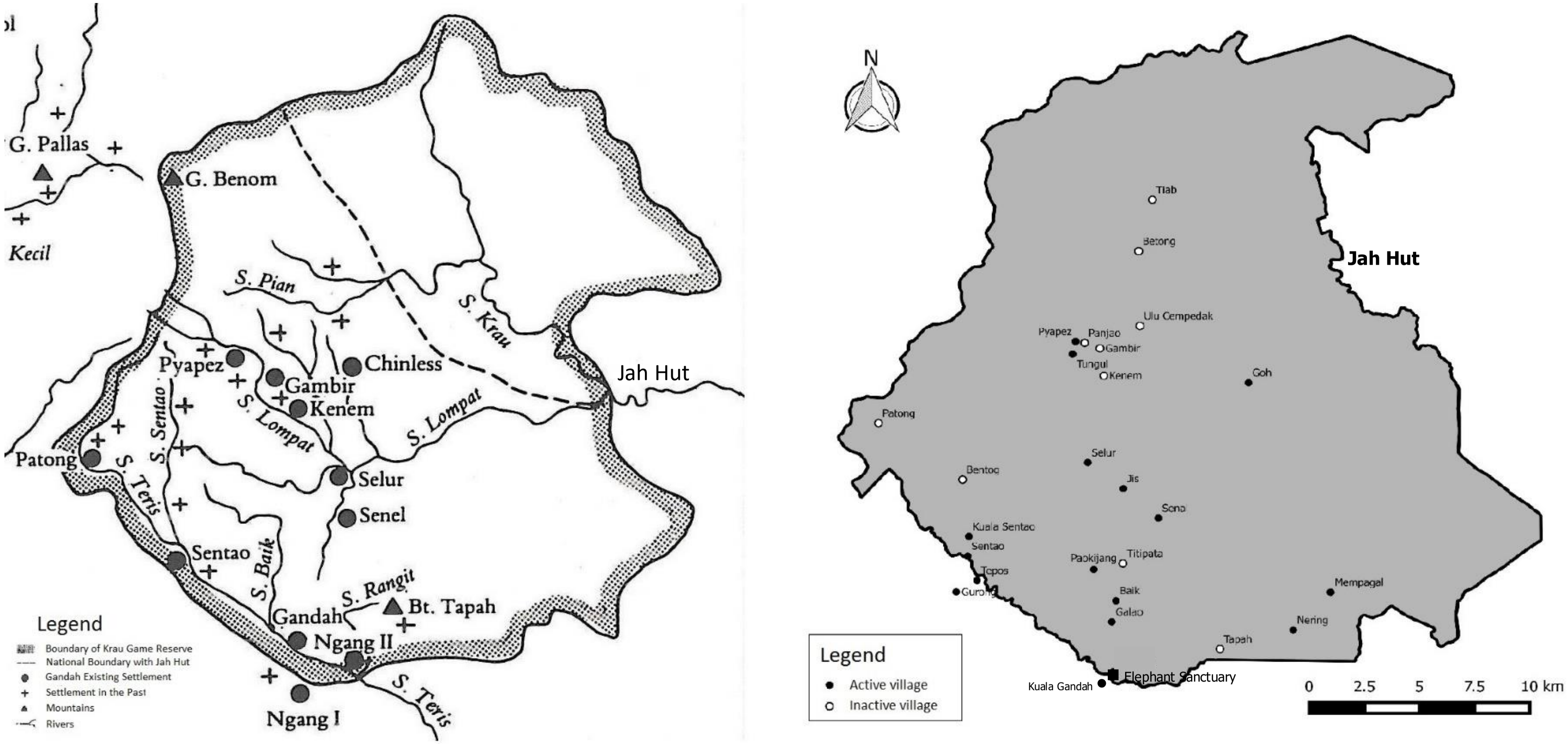
Figure 2.2 Map depicts a. Distribution of Aslian Languages (Census, 1969 cited in Howell, 1981) and b. Shifting agriculture (Kathirithamby-Wells, 2005) in Peninsular Malaysia with the location of KWR (relative scale).

2.3 The Chewong and resettlements

The ancestors of the Chewong moved along the tracks opened up by the emergence of gold-mining and other trading activities along the Pahang-Tembeling Valley. They then moved South along the Tanum-Tembeling route; this occurred approximately 2,000 years ago (Simon, 2006). During the establishment of the Krau Game Reserve, Charles Ogilvie was the first ethnographer who recorded and presented the Chewong language and society in 1940 (Needham, 1984). Additional ethnographic publications of the Chewong group also documented their resettlement and movement deeper into the forest (Redfield, 1947). Signe Howell is the researcher who has documented the Chewong lifestyle in great detail, focusing on fieldwork and regularly revisiting this group of people (Howell, 2015).

In the 1940s, the Chewong had large settlements high up on Pallas Mountain, (see Figure 2.3a), at a time when Chinese and Malays began their plantations in that district. The Chewong then split into two groups; the Western Chewong resettled around the Chinese and Malay plantations while the Eastern Chewong chose to go to resettle deeper into the forest. This history and root of the Chewong people is what this thesis based on, (see Figure 2.3b).

During the former part of the Malayan Emergency (1948-60), the Chewong were moved to settlements towards the North of Krau to ensure security measures in order to prevent the Orang Asli from giving financial backing to the communist insurgents hiding within the forest.



a. b.

Figure 2.3 A comparison between the Chewong settlements in KWR a.1980s (Howell, 1984) and b. Presented settlements surveyed in 2015.

In 1953, the Chewong were moved one further time where they cleared fields to plant cassava, although they were given rice, tobacco, cloth and sugar. In about 1956 they finally returned to the deeper parts of the forest inside KWR. By 1984, the Chewong villages were located around Lompat river and the southern half of KWR in Howell's map (Figure 2.3a), for example, Ngang I, Ngang 11, Gandah, Sentao, Gambir, Pyapez and Kenem (Howell, 1981).

In 1989, during the period when the NECC was being established, the Chewong were forced to move from their settlements at Kuala Gandah and relocated to the present-day Kuala Gandah village and Sungai Enggang village. The Elephant Sanctuary was built on the site of the Chewong settlement, forcing the inhabitants to move a couple of hundred meters across the river and establish a new settlement, today's Kuala Gandah (Lillegraven, 2006). This resettlement village has become the gateway village to the forest, many of the Chewong have abandoned their ancestral land in the forest and travelled to this village, which provides an interface between the Chewong who live in the forest and the outsiders, for example, merchants, government officers, tourists, and missionaries. Today, Kuala Gandah village is the largest Eastern

Chewong village, which contains about one hundred inhabitants and an essential local market for the Chewong to trade NFTPs and buy some goods. A small population of Chewong still choose to live within Krau forest, cultivating crops and fruit trees within the woodland which contains around 150-200 people (estimated number surveyed in 2015).

In 1991, the JAKOA had encouraged establishments of fruit and rubber orchards in order to promote cash economy among the Chewong, and had built six wooden houses and some latrines, provided piped water and promised electricity and healthcare in order to have the Chewong move out of the forest and settle permanently in Kuala Gandah. Many Chewong adhered to the JHEOA's request, but the orchards were soon left overgrown. By 1997, the village of Kuala Gandah was virtually abandoned, as people had moved back into the forest. Howell argued that the Chewong have performed and continue to perform a cultural choice to abandon the experiment of settling down on the fringes of the jungle (Baer, 2006; Howell, 2015; Lillegraven, 2006).

2.4 The forest inhabitant; Chewong

In general, Chewong people live in small villages usually, consisting of a group of 2-6 huts or one family and several cultivation areas. However, in the past, more than four families would live together to provide manpower for clearing land and cultivating hill rice and cassava (Howell, 1985). The huts make up the central part of the village, which are surrounded by multiple agricultural areas (see Figure 2.4) at varying distances depending on the surrounding resources such as the location of a river, soil fertility, terrain, and abandon age.

Each hut belongs to a builder which can be either a single male or female or belong to a family, the biggest hut will belong to the oldest couple of the family. All parts used to create a traditional hut come from a variety of plant materials from the forest, using necessary equipment such as a machete for construction. All shelters will be built at the highest level of the village area for two main reasons; to avoid flooding and to exclude wild animals.

Figure 2.4 A selection of Chewong shelter styles surrounded by agricultural areas such as cassava plantations and home gardens which are set within the villages of a. Senel b. Galao c. Mempegal d. Paokijang e.Pyapez, and d. Baik (January 2015)

Chewong villages are located within three main habitats; wetland river, lowland river and upland river. A wetland is an area that is saturated with water, either permanently or seasonally (ideal for rice cultivation), and is found alongside rivers, tributaries, and close to swamps. There are at least 14 rivers and branches in this protected forest such as Baik, Cempedak, Lompat, Lentai and Teris. Sediment and organic matter often settles on lowland areas from slow flowing rivers, making them ideal locations for cultivation due to their high nutrient content and productivity. In contrast, upland areas are rocky and have fast flowing rivers.

In 2015, at least 13 active villages were found in the Krau forest, some of which include; Senel, Tapoh, Baik, Selur, and Pyapez each settled close to a river or stream. Senel village which is close to Senel river and Tapoh which is close to Tapoh river.

Plantation areas are an integral part of the Chewong village supplying food, medicine, and commercial crops. There are four types of agricultural areas in Krau forest; crop rotation plantation which consist of two types, cassava and rice, fruit tree plantation areas and home gardens. Each village will have at least one crop rotation area and home garden for food security and trading. In traditional practice, an agricultural area must be set by the spiritual leader of the tribe before planting can occur (see Figure 2.5).

Many of the Chewong's activities are governed by the times of the year, particularly when it comes to cultivation (see Table 2.1). The period from April to June is when land is prepared for the next crop rotation and farmers will shift to a new location and slash and burn the forest for the next year. Setting out a new plantation area for rice begins by burning and removing several large trees whereas with the cultivation of cassava new logs are left in the field. Between July and August, crop plants are cultivated in cleared areas.

It is beneficial to plant crops before the wet season (around November to January) although, this process will usually start in September. Within a crop rotation area, several varieties of plants are cultivated with the main crop. For example, three types of cassava, sweet corn, and a few varieties of banana are planted in one of the agricultural fields.

The hunting of animals happens all year round, but the frequency increases from October to December when their preferred animals are fat after feeding on many fruits during the earlier months along with slower movement during the rainy period.

Figure 2.5 Shaman (Malay name - putao) performing a ritual to begin rice cultivation (February 2013)

Some activities can be performed every month (see Figure 2.6), for instance, the gathering of forest products such as resin, firewood, and medicinal plants, and hunting animals such as fish, frogs, birds, and wild pig with equipment which includes a mesh, spear, and blowpipe. Building huts, fishing camps and fencing around plantation areas occur year-round.

Table 2.1 The annual cycle of Chewong activities in KWR

Activities	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Plantation period	Harvesting in plantation area; cassava and rice			Preparing area for a rotation crops			Planting crops			Protecting crop fields from animals such as wild pig and deer with fences and traps		
Forest activity period	Collecting forest products, hunting, and fishing						Collecting wild fruits			Hunting big animals such as monkey		

The Chewong are a forest-dwelling tribe in KWR, who practice a traditional way of life, performing shifting agriculture. This is a complex environmental issue occurring within many forest reserves. By examining historical and cultural contexts, the current relationship between this indigenous group, their plant uses and the forest and the effects of their agricultural patterns on the forests, we can address this environmental issue phenomenon of the Chewong and contribute towards forest conservation.

Figure 2.6 A variety of Chewong activities. Fishing, b. Preparing boar meat, c. Making a fire for cooking, and d. Making poison darts for hunting (September-October 2014)

2.5 Research design using mixed methods

This research will employ both qualitative and quantitative methods addressing various types of data requiring the application of different research strategies related to a complex range of research questions. This will provide an opportunity to move away from theoretical work and across disciplinary boundaries, which will integrate research evidence within a field and relate that to complicated research questions (Bryman, 2016).

However, there are some disadvantages for example when a researcher fails to acquire a secure identity within a discipline which leads to a danger that the researcher is not sufficiently theoretically grounded before doing research requiring more skills to avoid mistakes when interpreting data. Mixed methods also offer a creative set of possibilities for addressing research questions regarding a range of methods but are required to be practically relevant and applicable to policy. Opportunity to learn new research skills is to be welcomed and is particularly facilitative of cross-disciplinary collaboration.

In order to address the main aims of this thesis, which involve both understanding the interaction between the Chewong people and the forest ecosystem of KWR and understanding Chewong society, a variety of methods must be used to collect information and data. Consideration of the research philosophies underlying the different approaches used aims to understand individuals in a society, which is to reflect transcendence of conceptually the micro and the macro levels or epistemological assumptions and a specific set of case or contexts. Complex and pluralistic social contexts demand analysis that is informed by multiple and diverse perspectives (Brannen, 2005).

2.5.1 Clarifying research philosophies

The definition of a research philosophy is "a belief about the way in which data about a phenomenon should be gathered, analysed and used. The term epistemology (what is known to be true) as opposed to doxology (what is believed to be true) encompasses the various philosophies of research approach" (Galliers, 1990).

The research phenomenon of focus is to understand both from an "insider" and "outsider" perspective how the indigenous community interact with and use the forest, what impact their presence has on forest structure, their belief system and potential conflict between indigenous ways of life and forest conservation. In order to understand these phenomena we must consider the research philosophies for all the types of methodology we might require to collect the necessary data to make conclusions about our research focus.

Our first area of research utilises an ethnobotanical approach to attempt to understand what plant species the Chewong interact with on a daily basis and how they are used. Our philosophical reasoning behind using this method is that we required a flexible approach which could combine both scientific names and classifications (quantitative) with local names and descriptions of use (qualitative) that is also comparable to methodologies used in similarly published studies within the literature.

Our second area of research utilises an ecological approach to attempt to understand how and what species the Chewong cultivate within the forest, the affect this has on forest structure and the recovery process of abandoned cultivation areas. Our philosophical reasoning behind using this method is that we require a systematic way (quantitative) of sampling, measuring and detecting differences between cultivation types and forest regeneration which is comparable to similarly published studies within the literature.

Our third area of research utilises a sociological approach to attempt to understand the complex issues surrounding Chewong society, changes in lifestyle and beliefs, impacts and pressure of the present world and forest conservation. For this we utilised a (qualitative) questionnaire and interview method which allows us to explore multiple variables surrounding real world issues. Our main aim is to use a neutral approach in terms of the questions we pose, attempting to avoid potential bias from our positionality (explained in further detail in section: 2.6), to obtain information from an "insider" perspective.

It is important to note that each method has its own strengths and weaknesses with regards to the way data is obtained and analysed. For example qualitative research is highly flexible when it comes to obtaining data with regards to a belief system or discussions and opinions shared by indigenous peoples but analysis and results can sometime be considered weak when compared to that of systematic quantitative methodology. This was all considered during the methodology development stage when considering the type of data we aimed to collect.

These methods will be clarified chapter by chapter and stem from specific fields of academic research, as seen in Figure 2.7

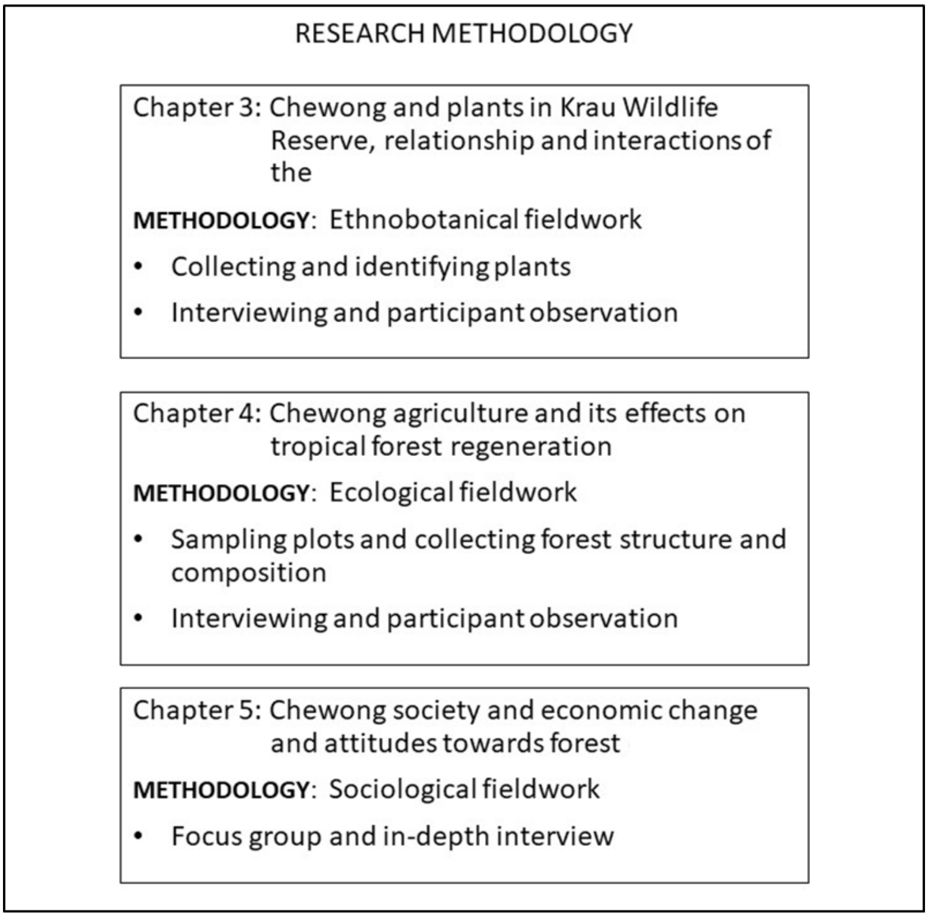


Figure 2.7 Mixed methods methodology

This thesis will use the term mixed methods research to cover all procedures collecting and analysing both quantitative and qualitative data in the context of a single study. The integrated approach uses a combination of botany, ecology and social science providing both quantitative and qualitative data and methods of analysis (Creswell and Creswell, 2017; Driscoll et al., 2007). Concern about forms of knowledge and ways of knowing for whom and for what clarify how the traditional way of life deals with nature and changes which will challenge both indigenous people and humans in society.

2.6 Addressing positionality

At this point it is important to clarify many important issues that arise when undertaking qualitative research such as this. In particular, the issue of positionality. Positionality is the social, political, hierarchical, sexual viewpoint from which a researcher builds a picture of the world around them and inherently can result in significant bias.

Bias stemming from a person's positionality can affect all aspects of research from the interpretation of results collected to bias introduced during the preparation stage when developing for example a questionnaire with loaded questions due to pre-existing assumptions of how a tribal community is "supposed" to live. The political aspect of a person's positionality can also influence a researcher's conclusions in terms of the conservation implications of the data obtained if for example a researcher is pro indigenous rights or pro relocation.

A quote by Maykut and Morehouse (1994) sums up positionality well – "the qualitative researcher's perspective is perhaps a paradoxical one: it is to be acutely tuned-in to the experiences and meaning systems of others—to indwell—and at the same time to be aware of how one's own biases and preconceptions may be influencing what one is trying to understand".

There are many examples within the literature of researchers struggling with the implications of their own positionality on their research outcomes from all disciplines of the social sciences, for example the implications of being a female western feminist (Mandel, 2003), or how being a straight, cisgender qualitative researcher influenced research in a LGBTQ study (Levy, 2013). These are examples of "outsider" positionality.

The concept of being either an "insider" or an "outsider" when it comes to positionality is also a big part of this thesis project. Work by Dwyer and Buckle in 2009, focussed on being an Insider-Outsider in qualitative research, in which a researcher occupies both some insider status and outsider perspective at the same time. They stress the importance of understanding that being an "insider" can draw bias by becoming too close to a study subject (Kanuha, 2000) and making decisions based on sympathetic views through their eyes. Or conversely being an "outsider" by which the study subjects have little trust or acceptance of the researcher and thus their responses and willingness to open up may produce significant bias due to a lack of connection preventing the researcher from capturing the true nature of the local people (Dwyer and Buckle, 2009).

It was clear after reading a vast array of research papers deliberating the implications of positionality bias that my research project would involve myself taking on an "insider-outsider" role where by it would be essential for me to develop a relationship with the local indigenous community to allow them to open up and discuss sensitive and sometimes sacred issues, which a complete outsider would be unable to obtain, while maintaining a neutral mindset at all moments with regards to the transcribing of data and questions asked.

2.7 Developing a working relationship with the Chewong

With my understanding of my positionality in mind I decided to utilise the "insider" connection of a local Malaysian guide named Azlan. Our Malaysian guide's background experience was as a commando soldier for 30 years before he received an early retirement and became a forest ranger, taking part in several tasks run by DWNP. He has a great deal of experience dealing with Malaysian indigenous people and foreigners; he can speak both English and Malay which helped the English research team communicate with the Chewong in Malay. His connection with the Chewong, although with its own bias, was the first step to developing a working relationship with the local Chewong community.

Acceptance from the Chewong people did not happen the first time we met. They, especially adult females, and children, normally avoided strangers and hid themselves in shelters when strangers came to visit their villages, as my Malaysian counterparts Khairul Nizam Bin Kamaruddin and Arsir Bin Abdul had informed us about Chewong people. However, after exploring the settlements, meeting family leaders and sharing dinner, we found these were the most effective ways of introducing the research team and the project. Taking part in their daily activities and learning Chewong words were the key to helping prepare a friendly relationship.

In order to build a functioning and trusting relationship with the Chewong we started the conversation by focusing on the scientific survey of plants which the Chewong use for cultivation and daily purposes. We also set up sampling plots for measuring the forest structure of cultivation areas around the Chewong settlements.

This allowed us to introduce the Chewong people to this research and me the researcher, while allowing the research team to become acquainted with the Chewong people gauging an understanding of their lifestyle through our interactions. Our research team explored all of the Chewong settlements in KWR, both active and inactive. The inactive settlements were relocated from the memory of locals. Thesis data collection took place yearly between June to September from 2012 to 2015, with some fieldwork periods lasting longer than others.

Our next step was to obtain an "insider" guide from within the indigenous community who was connected to our Malay guide. Our indigenous guide referred to as "respondent one" is part of both the Chewong tribe and another tribe known as the Jah Hut (following his mother tribe as traditional custom), while his father is Chewong. He became a member of the Chewong tribe after marrying with a Chewong girl 65 years ago and resettled within KWR until present. He can speak Malay fluently because of years of trading forest products with both Malaysian and Chinese merchants, working with international rangers and researchers as well as speaking the Chewong language. Our research guides also had prior experience participating with a research group, which studied amphibians around KWR.

After we had developed a trusting relationship gaining some "insider" status we moved on to the delicate task of creating a questionnaire keeping in mind out potential positionality bias with regards to the types of questions we might ask.

2.8 Designing a questionnaire and addressing translator bias

A Questionnaire (see APPENDIX 1) was used for both the focus group and individual interviewing as a survey instrument to collect data about plant utilisation, NTFPs, agriculture pattern and informants' attitude (Krosnick and Presser, 2010). Questions were translated from English to Malay version for our guides by Malay draft and group discussion which would direct our guides to understand the direction of works and described to informants.

Translation between English, Malay and Chewong languages was a continuous process during fieldwork in KWR between research guides and the Chewong. Bias management is one of the significant challenges for qualitative work employing interviewing as a data generation method. We attempted to minimise bias during interview and translation by double checking with other different languages word by word for understanding to reduce the effect on qualitative data and assumption. This research incorporates the values and beliefs of indigenous communities in its design, methods, and analysis. Data dissemination is handled in a way that is appropriate for the tribe (Agrawal, 2014; Chenail, 2011; Lavallée, 2009).

Guides working as translators needed to possess at least three criteria. Firstly, a strong language ability in English and Malay or Malay and Chewong for communicating with local people and us, especially the Chewong. Secondly, our guides needed prior experience with KWR. Finally, the guides needed a good relationship with the Chewong people. From these criteria two guides were employed, one Malaysian and one Chewong. The guides were vital for all fieldwork and data collection in this thesis. Our Malaysian guide did, however, have a limitation in that he is a member of the dominant ethnic group in Malaysian society known as Malay (Hirschman, 1987). The Orang Asli are a minority group of people in Malaysia who hold a 'perceived' lower status than other groups of people, especially Malay people.

CHAPTER 3 CHEWONG ETHNOBOTANY

3.1 Introduction

The human population that dominates the earth's surface can sometimes be seen as a single society, a "global village". This global society consists of many human groups which differ in everyday occupations, abundance of valuable resources and how they view and value the world around them (Berkes, 2012). As a part of nature, people's perceptions of and interactions with their environment and resources have been termed "traditional ecological knowledge" (Berkes, 1993; Pierotti and Wildcat, 2000).

As scientists have come to realise the real importance of this knowledge this has led to the development of an interdisciplinary study of these relationships called "ethnobiology" (Rist and Dahdouh-Guebas, 2006) which encompasses many fields for example, ethnoecology (Nazarea, 1999), ethnozoology (Seixas and Begossi, 2001), ethnoentomology (Posey, 1986), ethnoforestry (Pandey, 1998), ethnopedology (Barrera-Bassols and Zinck, 2003) and ethnobotany (Martin, 2010). These terms came into widespread use only in the 1980s or later, but traditional ecological knowledge is as old as ancient hunter-gatherer culture.

Indigenous forest knowledge in tropical rainforest habitats began to develop at least 20,000 years ago on the evidence of human reliance on forest resources in the late Pleistocene in Sri Lanka (Roberts et al., 2015). Interrelationships between people and plants have long been a part of human activity before the term "ethnobotany" was first coined in 1895 by John W. Harshberger to describe the uses of plants by primitive peoples of North American tribes (Nolan and Turner, 2011). Ethnobotany is based on scientific approaches to identify and classify plant species, and the methods for documenting traditional ecological knowledge of plants are derived from the social sciences (Huntington, 2000).

Ethnobotany of tropical indigenous people is faced with the current world situation including habitat destruction, declining biodiversity and loss of traditional knowledge of plants. Prance (1991) emphasised that the study of ethnobotany is far from complete at a time when the destruction of tropical forests and other natural habitats where indigenous peoples live has reached an unprecedented rate. The loss of forest brings the loss of indigenous cultures and their plant knowledge. Traditional plant knowledge is a significant part of indigenous cultures worldwide, and for many communities, there is a great urgency in recording this knowledge in written form (Kichu et al., 2015).

Orang Asli within Malaysia display a variety of cultures which survive in the present day. In the early 1960s, at least 500 local plants used by the indigenous peoples were documented for their economic or medicinal properties. Orang Asli communities rely on three basic principles for their use and control of resources. The first is collective ownership of resources within a village or tribe and sharing. For example, the Semai term "cak Samak" means "eating together or hunting game or harvesting fish with the neighbour, although individual rights do apply to agricultural produce, handicrafts and reared animals. The second principle is the concept that all natural resources belong to the "creator" and there must be respect for natural resources, including the plants and animals. Ceremonies such as "cenagoh" ask for permission from the friendly spirits before using the land for agriculture. Thirdly, land and its biodiversity are an intrinsic part of the Orang Asli's identity. The elders in the community take it upon themselves to ensure that traditional conservation and management practices of resources are passed down through the generations. Also known as the principle of "use and protect" in

Anak Negeri (or natives) of Sabah or other tribes such as the Semelai, Jah Hut, and Temuan (Hood, 1993; Howell et al., 2010; Kardooni et al., 2014; Nicholas and Lasimbang 2004; Ong et al., 2011a).

One such tribe is the Chewong who live within the forest of Krau Wildlife Reserve. This small hunter-gatherer-shifting cultivator society has been the subject of few investigations although they are recognised as having distinct language and culture which perceive themselves as a unique and separate society (Howell, 1984). They maintain their beliefs in the forest spirits and a traditional lifestyle which relies on wild plants for food, medicine and building material. This ethnobotanical knowledge is essential for developing community-based management to promote effective participatory forest management of KWR or other protected areas in the future.

3.2 Aim and objectives

Main Aim: to describe the relationship and interactions of the Chewong with plants in Krau Wildlife Reserve

Objective: 1. to describe how the Chewong use plant resources regarding the types of plants used and the range of functions they serve.

2. to compare Chewong plant resources between wild and cultivated species.

3.3 Ethnobotany work period

The ethnobotany of the Chewong was studied from June 2012 to June 2015. In 2012 this study started surveying KWR with two guides, we introduced ourselves and the aims of this research to the Chewong and related people. Interviews covering the uses of plants from Chewong who stay within the forest was undertaken in July-September 2013, and June-October 2014. Some Chewong who live outside the forest in Kuala gandah village were also interviewed.

3.4 Methods

Ethnobotanical fieldwork was applied for this study. Approaches from both anthropology and botany were used following a manual of ethnobotany methods (Martin, 2010).

3.4.1 Anthropological methods

Participant observation started with surveying the number and location of villages in KWR. How people put their knowledge into practice was observed during fieldwork periods of 5-21 days per trip around the study area. We lived within the Chewong communities to observe their plant uses and daily activities, including how the plants were cultivated, harvested, cooked and eaten. We sometimes joined these activities ourselves and participated in the activities of families or villages, such as harvesting forest products, bringing in the harvest, building houses and hunting animals.

Investigative and in-depth interviews were conducted with local people to familiarise ourselves with their use of language and how they think on general topics both in a group and personally, questioning a total of 88 informants. Open-ended conversations were typically used. In this approach, a wide range of plants and uses were observed, including how people select which species to cultivate. Some interesting issues were chosen for in-depth interviews. The objects made from plants were good topics to learn about the species associated with craft and usage. The ways Chewong people described their lives and their natural surroundings were also recorded. A botanical interview questionnaire was a part of the thesis questionnaire which can be seen in APPENDIX 1.

Information on useful species was collected from six local experts, each from different families evenly distributed in KWR. Groups and people who based their settlements on the main trail in KWR were chosen as interviewees to represent the Chewong. The informants' backgrounds were collected. Each group of selected informants were interviewed with the same set of questions about the Chewong's life and related plant species.

Interview and sociological variables were considered carefully. The time of interview followed the local schedule of the informants. The interviewing time was set in between or after the informant's daily tasks. These were usually in the evening or at night. Conversations, surveyed information, plants and plant uses and answers from informants were recorded by hand in field notebooks. Some photographs were taken to describe the villages, people, plant characteristics and uses. The informants' details and information were confidential, especially parts that referred to some illegal activities such as hunting rare species.

Explicit permission was acquired in advance from all respondents approached during the study in relation to taking and utilising photographic imagery of individuals their belongings/homes and land use techniques. The name of our local Malay guide and participating indigenous guides have been anonymised to protect their privacy and identity.

3.4.2 Botanical methods

Plant collection followed tropical plant collecting experiences of Mori et al. (2011). The plants along the forests trails or grown in crop fields or home gardens were surveyed, described and some unknown species were collected directly for identification.

Local names of plants which are used and collected by the Chewong were recorded, including information on distribution and usage. The local perception and classification of the natural environment was recorded, including concepts of forests, soil types, geographical landmarks and seasons. The Chewong language does not have a writing system, so the English letters used for Malay were used to transcribe all local plant names and other key terms. Our Malay and Chewong guides had an essential role in correcting these terms. Malay has a widely-accepted phonetic alphabet.

Plant identification was based on plant characteristics of species related to the Chewong, and those were collected and recorded in writing and images. Each plant was classified and identified by plant morphology into family, genus and species. Plant characteristics referred to the Kew plant identification terms (Beentje, 2012). Families and genus of trees were identified using field guides of Keller (2009) and LaFrankie (2010). Species comparisons were referenced using the Plant of Krau book (Chua and Saw, 2006), Plants of Southeast Asia (Slik, 2009) and The Plant List (2013).

Unknown collections were prepared in accordance with guidelines from Mori et al. (2011) and the Forest Research Institute Malaysia (FRIM). All specimens had a label for the botanists of FRIM; Mr Kamarudin bin Saleh and Dr Richard Chung Cheng Kong to classify and identify into family and species. All specimens were deposited within the FRIM herbarium, Malaysia.

3.5 Data collection

Data collection covers three main topics; habitat of the plant; plant habit, and plant use.

The habitat of the plant refers to the locations from which the Chewong collected plants, categorised into two main groups; wild plants from the forest and cultivated species grown and planted by the Chewong. Planted species found in this study were collected from four types of agricultural area. There are two types of crop fields; cassava plantation and paddy field. Fruit gardens, which contain both native species and introduced species and home gardens, whereby some plant species were chosen and cultivated near their shelter area.

Plant habit refers to the growth form of a plant such as a tree, shrub and herb or herbaceous plant including banana (Allaby, 2012). Some specific forms of plant such as bamboo were grouped in the type of cane and grass species were grouped in grass type or graminoid (grass-like plants) including rice. Fern species were classified into fern group or leptosporangiate ferns (Martin and Hine, 2015). The vine group included liana or woody-stemmed vine-like climbing plants (Allaby and Park, 2013). Eight forms of plant habits were found in total and classified as a tree, herb, vine, palm, shrub, fern, cane and grass.

The plant uses refer to how the Chewong uses plants; these were recorded and classified. The parts which were used were reported including some details which depended on how plants were used, for example, plants for making hunting equipment, the related hunting equipment will be presented, or ailments and treatments were recorded in medicinal plants data collection.

3.6 Results

In total, 420 uses of plants were documented from 243 taxonomic species of plants and 71 families. Dipterocarpaceae (16), Leguminosae (16), Moraceae (15), Arecaceae (14), Zingiberaceae (13) and Anacardiaceae (12) were the most species-rich families, corresponding to 215 Chewong plant names (see APPENDIX 2). For wild plants, 196 species were recorded (81%) while planted species accounted for 19% (47 species). The Chewong names for planted species were individual with 47 local names for the 47 planted species but for wild plant species of which we identified 196 species only 178 local names existed showing they group some plant types.

Out of the eight plant forms, the tree form contained the highest number of individual species (72 or 64%), followed by herb (26 species or 23%) while others such as vine, palm, were only 1-5 species each (1-4%). The most frequently used part was wood (28%) followed by fruit (22%), leaf (16%), stem (10%), shoot (6%), and others such as root, seed, and bark (1-5%).

Plant uses were divided into nine categories, food resources, medicine and hygiene, construction, firewood, hunting equipment and related species, handicrafts, ceremonial, animal feed and commercial harvest. Some species were placed in more than one category due to multiple types of use. The overall numbers of species within each category are shown in Figure 3.1.

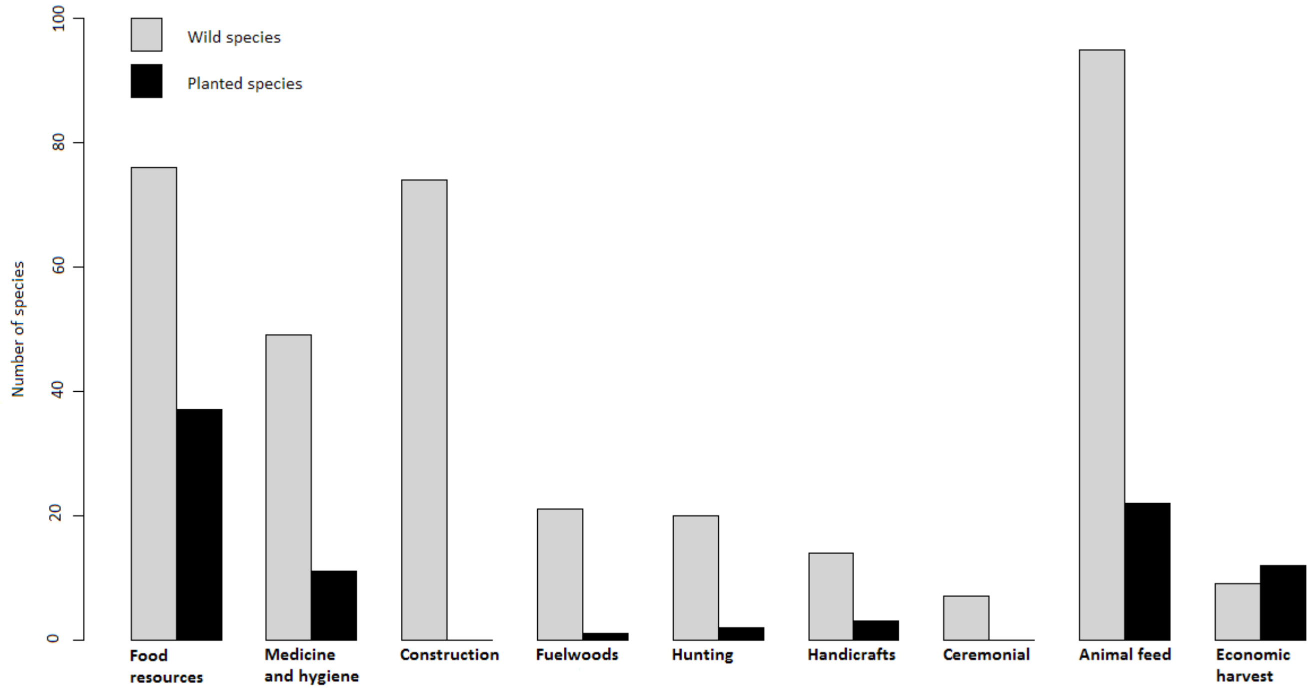


Figure 3.1 Comparison of number of species between wild and planted species

3.6.1 Food resources

A total of 111 species from 40 families were documented as used for food (see Table 3.1); Zingiberaceae (11), Moraceae (9), Anacardiaceae (8), Leguminosae (6), Phyllanthaceae (6), and Arecaceae (5) were the most species-rich families. These can be further subdivided into those which are directly cultivated within managed garden systems (36 species or 32%) and those which are harvested from the wild, 75 species or 68%.

The plant habit form for the food resources category consists predominantly of tree species (64%) and herb (23%). These food resources are based mainly on fruits and shoots (64% and 14% respectively). The remaining resources are split between seeds, leaves and roots (9%, 7% and 5% respectively).

Cassava (*Manihot carthaginensis*) and rice (*Oryza sativa*) were the two main staple species (2%) and only found in plantation areas.

Table 3.1 Plants used as food resources by the Chewong with notes on their cultivation, habit, food resource obtained and frequency of usage

Family	Species	Chewong name	Habit	Edible part	Component of diet
Wild 75 species					
Anacardiaceae	1.*Bouea macrophylla* Griff.	Hatal	tree	fruit	Occasional
	2.*Bouea oppositifolia* (Roxb.) Adelb.	Hatal	tree	fruit	Occasional
	3.*Dracontomelon dao* (Blanco) Merr. & Rolfe	Yerguang	tree	fruit	Occasional
	4.*Mangifera gracilipes* Hook.f	Pauh	tree	fruit	Occasional
	5.*Mangifera lagenifera* Griff.	Pauh kijang	tree	fruit	Occasional
	6.*Pentaspadon motleyi* Hook.f	Gelas	tree	fruit	Occasional
Apocynaceae	7.*Willughbeia angustifolia* (Miq.) Markgr.	Brambrao	vine	fruit	Occasional
Arecaceae	8.*Eleiodoxa conferta* (Griff.) Burret	Kelubi	palm	fruit	Occasional
	9.*Oncosperma horridum* (Griff.) Scheff.	Bayas	palm	shoot	Occasional
	10.*Oncosperma tigillarium* (Jack) Ridl.	Bayas	palm	shoot	Occasional
	11.*Salacca glabrescens* Griff.	Salak	palm	fruit	Occasional
Athyriaceae	12.*Diplazium esculentum* (Retz.) Sw.	Thenduwal	fern	leaf	Occasional
Burseraceae	13.*Canarium megalanthum* Merr.	Kupong jenung	tree	seed	Occasional
	14.*Canarium pseudodecumanum* Hochr.	Kupong	tree	seed	Occasional
	15.*Dacryodes rostrata* (Bl.) H.J. Lam	Ramil	tree	fruit	Occasional
Clusiaceae	16.*Garcinia atroviridis* Griff. ex T. Anderson	Gelugor	tree	fruit	Occasional
	17.*Garcinia bancana* Miq.	Gelas	tree	fruit	Occasional
	18.*Garcinia celebica* L.	Heb	tree	fruit	Occasional
Clusiaceae	19.*Garcinia parvifolia* (Miq.) Miq.	Yan	tree	fruit	Occasional
Cornaceae	20.*Alangium ridleyi* King	Jam	tree	fruit	Occasional
Cucurbitaceae	21.*Hodgsonia macrocarpa* (Blume) Cogn.	Hoot	vine	seed	Occasional
Dioscoreaceae	22.*Dioscorea hispida* Dennst.	Gejan	vine	root	Occasional
	23.*Dioscorea piscatorum* Prain & Burkill	Lenteh	vine	root	Occasional
Ebenaceae	24.*Diospyros pyrrhocarpa* Miq.	Kabui	tree	fruit	Occasional
Euphorbiaceae	25.*Elateriospermum tapos* Blume	Prae	tree	fruit	Occasional
Leguminosae	26.*Archidendron jiringa* (Jack) Nielsen	Kedas	tree	seed	Occasional
	27.*Dialium indum* L.	Klanyi	tree	fruit	Occasional
	28.*Koompassia excelsa* (Becc.) Taub.	Taulang	tree	seed	Occasional
	29.*Saraca thaipingensis* Prain	Tenglon	tree	seed	Occasional
Lythraceae	30.*Duabanga grandiflora* (DC.) Walp.	Layang	tree	fruit	Occasional

Table 3.1 (continue)

Family	**Species**	**Chewong name**	**Habit**	**Edible part**	**Component of diet**
Malvaceae	31.*Durio beccarianus* Kosterm. & Soegeng	Jarel	tree	fruit	Occasional
Melastomataceae	32.*Melastoma malabathricum* L.	Sedudu	shrub	fruit	Occasional
Meliaceae	33.*Lansium parasiticum* (Osbeck) K.C.Sahni & Bennet	Tigai	tree	fruit	Occasional
	34.*Sandoricum beccarianum* Baill.	Mindegal	tree	fruit	Occasional
	35.*Sandoricum koetjape* (Burm.f.) Merr.	Hatal	tree	fruit	Occasional
Meliosmaceae	36.*Meliosma sumatrana* (Jack) Walp	Yakmai	tree	fruit	Occasional
Moraceae	37.*Artocarpus elasticus* Reinw. ex Blume	Hook	tree	seed	Occasional
	38.*Artocarpus hispidus* F.M. Jarrett	Tegah	tree	seed	Occasional
	39.*Artocarpus kemando* Miq	Pulul	tree	fruit	Occasional
	40.*Artocarpus lanceifolius* Roxb.	Besil	tree	fruit	Occasional
	41.*Artocarpus lowii* King	Bingoh	tree	fruit	Occasional
	42.*Artocarpus nitidus* Trécul	Peradung	tree	fruit	Occasional
	43.*Artocarpus rigidus* Blume	Hatinapal	tree	fruit	Occasional
Musaceae	44.*Musa gracilis* Holttum	Halited	herb	shoot	Occasional
	45.*Musa violascens* Ridl.	Lok	herb	shoot	Occasional
Myrtaceae	46.*Psidium friedrichsthalianum* (O. Berg) Nied.	Jampu batu	tree	fruit	Occasional
	47.*Syzygium acuminatissimum* (Blume) A.DC.	Balang	tree	fruit	Occasional
	48.*Syzygium aqueum* (Burm.f.) Alston	Jampu	tree	fruit	Occasional
Olacaceae	49.*Ochanostachys amentacea* Mast.	Taring	tree	fruit	Occasional
Phyllanthaceae	50.*Baccaurea lanceolata* (Miq.) Mull.Arg.	Pahung	tree	fruit	Occasional
	51.*Baccaurea parviflora* (Mull.Arg.) Mull.Arg.	Jenal	tree	fruit	Occasional
	52.*Baccaurea pyriformis* Gage	Tamun	tree	fruit	Occasional
	53.*Baccaurea polyneura* Hook.f.	Kenem	tree	fruit	Occasional
	54.*Baccaurea racemosa* (Reinw. ex Bl.) Mull.Arg.	Tamungling	tree	fruit	Occasional
Poaceae	55.*Maclurochloa montana* (Ridl.) K.M. Wong	Loh sementan	cane	shoot	Occasional
Polygalaceae	56.*Xanthophyllum amoenum* Chodat	Gapas	tree	fruit	Occasional
	57.*Xanthophyllum stipitatum* A.W. Benn.	Gapas	tree	fruit	Occasional
Sapindaceae	58.*Nephelium costatum* Hiern	Gumpal wai	tree	fruit	Occasional
	59.*Nephelium cuspidatum* Blume	Reming	tree	fruit	Occasional
	60.*Nephelium mutabile* Blume	Belas	tree	fruit	Occasional
	61.*Nephelium ramboutan-ake* (Labill.) Leenh	Haquay	tree	fruit	Occasional
	62.*Xerospermum noronhianum* (Blume) Blume	Tiag	tree	fruit	Occasional

Table 3.1 (continue)

Family	Species	Chewong name	Habit	Edible part	Component of diet
Sapotaceae	63.*Madhuca longifolia* (J. Koenig ex L.) J.F. Macbr	Menglao	tree	fruit	Occasional
Torricelliaceae	64.*Aralidium pinnatifidum* (Jungh. & de Vriese) Miq.	Tengereng	tree	fruit	Occasional
Zingiberaceae	65.*Alpinia caerulea* (R.Br.) Benth.	Yel	herb	shoot	Occasional
	66.*Alpinia conchigera* Griff.	Tengu	herb	shoot	Occasional
	67.*Alpinia rafflesiana* Wall. ex Baker	Tengu geradah	herb	shoot	Occasional
	68.*Amomum conoideum* (Ridl.) Elmer	Tengu	herb	shoot	Occasional
	69.*Amomum uliginosum* J. Koenig	Tengu genti	herb	shoot	Occasional
	70.*Elettariopsis curtisii* Baker	Tengu	herb	shoot	Occasional
	71.*Etlingera elatior* (Jack) R.M.Sm.	Bunga kantan	herb	shoot	Occasional
	72.*Etlingera littoralis* (J. Koenig) Giseke	Tengu	herb	shoot	Occasional
	73.*Etlingera maingayi* (Baker) R.M.Sm.	Relek	herb	shoot	Occasional
	74.*Zingiber gracile* Jack	Langias	herb	shoot	Occasional
	75.*Zingiber puberulum* Ridl.	Tengu	herb	shoot	Occasional
Planted 36 species					
<u>In the crop field seven species</u>					
Convolvulaceae	1.*Ipomoea batatas* (L.) Lam.	Cila	herb	root	Occasional
				leaf	Occasional
Euphorbiaceae	2.*Manihot carthaginensis* (Jacq.) Müll.Arg.	Galor	shrub	root	Routine
				leaf	Occasional
Musaceae	3.*Musa acuminata* Colla	Tiab mas	herb	fruit	Occasional
	4.*Musa* × *paradisiaca* L.	Tiab tandoh	herb	fruit	Occasional
Solanaceae	5.*Capsicum annuum* L.	Pigoh liyao	herb	fruit	Occasional
Poaceae	6.*Oryza sativa* L.	Mum	grass	seed	Routine
	7.*Zea mays* L.	Jagong	herb	seed	Occasional
<u>In fruit garden 15 species</u>					
Achariaceae	1.*Pangium edule* Reinw.	Payong	tree	fruit	Occasional
Anacardiaceae	2.*Mangifera foetida* Lour.	Litmus	tree	fruit	Occasional
	3.*Mangifera indica* L.	Grening	tree	fruit	Occasional
Clusiaceae	4.*Garcinia prainiana* King	Jupu	tree	fruit	Occasional
Flacourtiaceae	5.*Flacourtia rukam* Zoll. & Moritzi	Rukam	tree	fruit	Occasional
Leguminosae	6.*Parkia speciosa* Hassk.	Heltal	tree	fruit	Occasional
	7.*Parkia timoriana* (DC.) Merr.	Heltal	tree	fruit	Occasional

Table 3.1 (continue)

Family	Species	Chewong name	Habit	Edible part	Component of diet
Malvaceae	8.*Durio oxleyanus* Griff.	Daon	tree	fruit	Occasional
Moraceae	9.*Artocarpus heterophyllus* Lam.	Nanga	tree	fruit	Occasional
	10.*Artocarpus integer* (Thunb.) Merr	Cempedak	tree	fruit	Occasional
Myrtaceae	11.*Syzygium pycnanthum* Merr. & L.M. Perry	Yampoo	tree	fruit	Occasional
Phyllanthaceae	12.*Baccaurea macrocarpa* (Miq.) Mull.Arg	Lala	tree	fruit	Occasional
	13.*Baccaurea motleyana* (Mull.Arg.) Mull.Arg.	Rambai	tree	fruit	Occasional
Rutaceae	14.*Citrus aurantiaca* Swingle	Limua	tree	fruit	Occasional
Sapindaceae	15.*Nephelium lappaceum* L.	God	tree	fruit	Occasional
In home garden 14 species					
Araceae	1.*Colocasia esculenta* (L.) Schott	Dalay	herb	root	Occasional
Amaranthaceae	2.*Amaranthus viridis* L.	Bayam	herb	leaf	Occasional
Arecaceae	3.*Cocos nucifera* L.	Yu	palm	fruit	Occasional
Bromeliaceae	4.*Ananas comosus* (L.) Merr.	Cenalak	herb	fruit	Occasional
Caricaceae	5.*Carica papaya* L.	Betek	herb	fruit	Occasional
Dioscoreaceae	6.*Dioscorea alata* L.	Kaitagob	vine	root	Occasional
Lamiaceae	7.*Ocimum americanum* L.	Rempah gatos	herb	leaf	Occasional
Myrtaceae	8.*Psidium guajava* L.	Jampu batu	tree	fruit	Occasional
Oxalidaceae	9.*Averrhoa bilimbi* L.	Belimbing	tree	fruit	Occasional
Pandanaceae	10.*Pandanus amaryllifolius* Roxb.	Pandan	herb	leaf	Occasional
Poaceae	11.*Cymbopogon citratus* (DC.) Stapf	Serai	herb	leaf	Occasional
	12.*Saccharum officinarum* L.	Tebu	herb	stem	Occasional
Solanaceae	13.*Solanum melongena* L.	Terong	shrub	fruit	Occasional
Zingiberaceae	14.*Zingiber officinale* Roscoe	Tengu	herb	shoot	Occasional
				leaf	Occasional

3.6.2 Medicine and hygiene

A total of 60 species from 34 families were documented as being used for treating 27 different ailments such as fever (13%), tiredness (8%), fresh cut wound (8%) (see Table 3.2). Leguminosae

(7), Myristicaceae (5), Zingiberaceae (4), Annonaceae (3), and Melastomataceae (3) were the most species-rich families. For wild plants, 49 species were recorded (82%) while planted plants were 11 species, 18%.

The main medicinal plant forms were trees and herbs, 40% and 37% respectively. Of which the most highly used plant part was the leaf (52%) followed by a mixture of other plant forms shoots, roots, the whole plant, sap, bark, fruits and seeds. The most common preparation and administration methods were to boil with water (35%), chew (13%), crush or paste (13%), and decoction (12%).

Table 3.2 Plants used for medicinal or hygiene purposes by Chewong with notes on their application

Family	Species	Chewong name	Habit	Part	Ailment	Uses
Wild 49 species						
Annonaceae	1.*Anaxagorea javanica* Blume	Termob	tree	whole plant	skin diseases and poisons	boil and bath
	2.*Xylopia hypolampra* Mildbr.	Kapang	tree	root	headache and chest pain	boil and drink
Araceae	3.*Anadendrum latifolium* Hook.f.	Yangler	vine	leaf	snake bite wounds	crush, apply and change when become black
Commelinaceae	4.*Amischotolype hispida* (A. Rich.) D.Y. Hong	Yab	herb	whole plant	past-partum (female)	boil and drink every day for a month
Compositae	5.*Ageratum conyzoides* (L.) L.	Gerlambu	herb	leaf	cuts	crush and apply
	6.*Chromolaena odorata* (L.) R.M. King & H. Rob.	Klamukli	herb	leaf	cuts	crush and apply
Connaraceae	7.*Cnestis palala* (Lour.) Merr	Libu	vine	leaf	stomach ache	boil and drink
Cucurbitaceae	8.*Alsomitra macrocarpa* (Blume) M.Roem	Sabun	vine	shoot or leaf	cuts and wounds	crush and apply
Dilleniaceae	9.*Tetracera macrophylla* Wall. ex Hook. f. & Thoms.	Aga mempis	vine	stem or leaf	skin diseases and poisons	boil and bath
Dipterocarpaceae	10.*Shorea bracteolata* Dyer	Belanti	tree	bark	vomit	burn and apply on back (child)
Ebenaceae	11.*Diospyros latisepala* Ridl	Mohplik	tree	root or bark	tired or fever	boil and drink
Euphorbiaceae	12.*Mallotus macrostachyus* (Miq.) Mull.Arg.	Balik angin	tree	leaf	giving birth	dry, burn, mix some water and apply on stomach (female)
				leaf	strengthen bone	dry, burn, put into warm water and bath (new born baby)
Gentianaceae	13.*Fagraea auriculata* Jack	Sereles	vine	fruit	itchy skin	collect decoction and apply
Gesneriaceae	14.*Codonoboea crinita* (Jack) C.L.Lim	Sermal	herb	whole plant	body heat	boil and bath
Hypoxidaceae	15.*Molineria latifolia* (Dryand. ex W.T. Aiton) Herb. ex Kurz	Rampah	herb	whole plant	fever	boil and drink
Lamiaceae	16.*Cinnamomum javanicum* Blume	Rempa kunung	tree	leaf	bruise	juice from crushing and apply
	17.*Cryptocarya ferrea* Blume	Langsen	tree	stem and leaf	cold	smoke
Lecythidaceae	18.*Barringtonia macrocarpa* Hassk	Jenbang beretam	tree	root	diarrhoea	boil and drink three times
Leguminosae	19.*Bauhinia bidentata* Jack	Duk	vine	leaf	weak and tired	boil and drink three times a day
	20.*Bauhinia integrifolia* Roxb	Duk	vine	leaf	strengthen bone	put into warm water and bath (new born baby)
	21.*Dialium indum* L.	Klanyi	tree	bark	clear throat	fine, boil and drink
	22.*Intsia palembanica* Miq	Marbao	tree	leaf	sneeze or fever	crush and smell
	23.*Koompassia excelsa* (Becc.) Taub.	Taulang	tree	leaf	sneeze or fever	crush and smell

Table 3.2 (continue)

Family	Species	Chewong name	Habit	Part	Ailment	Uses
Leguminosae	24.*Senna surattensis* (Burm. f.) H. S. Irwin & Barne	Lengeng	shrub	leaf	snake bite wounds	crush and apply
Malvaceae	25.*Hibiscus floccosus* Mast.	Baharu	tree	leaf	post-partum	heat and put on stomach for three days (female)
Marantaceae	26.*Angiopteris evecta* (G. Forst.) Hoffm.	Paku beretum	fern	stem or root	cuts	collect decoction and apply
Melastomataceae	27.*Clidemia hirta* (L.) D. Don	Peryuduk	shrub	leaf	cuts	crush and apply
	28.*Phyllagathis griffithii* King	Bel tangled	herb	root and leaf	joints or muscle ache	chew
	29.*Phyllagathis rotundifolia* (Jack) Blume	Bel	herb	root and leaf	joints or muscle ache	chew
Musaceae	30.*Musa gracilis* Holttum	Halited	herb	leaf	clear throat	smoke
Myristicaceae	31.*Gymnacranthera farquhariana* (Hook.f. & Thomson) Warb.	Narung	tree	sap	headache and fever	apply on forehead
	32.*Knema conferta* (King) Warb.	Yasong	tree	sap	headache and fever	apply on forehead
	33.*Knema laurina* (Blume) Warb	Penyara	tree	sap	headache and fever	apply on forehead
	34.Knema furfuracea (Hook. f. & Thomson) Warb.	Penyara	tree	sap	headache and fever	apply on forehead
	35.*Knema scortecchinii* (king) J. Sinclair	Penyara	tree	sap	headache and fever	apply on forehead
Primulaceae	36.*Marantodes pumilum* (Blume) Kuntze	Fatimah	herb	whole plant	weak and tired	boil and drink (female)
Piperaceae	37.*Piper porphyrophyllum* N.E.Br.	Sireh liyao	herb	leaf	digestive system	chew with inside seed of chewing palm (*Areca catechu*)
Poaceae	38.*Imperata cylindrica* (L.) Raeusch.	Lampa	grass	root	muscle pain	boil and drink
Rubiaceae	39.*Chassalia chartacea* Craib	Yerangin	herb	shoot	caugh	boil and drink
	40.*Ophiorrhiza discolor* R.Br. ex G. Don	Peremah	herb	leaf	insect bites	juice from crushing and apply
Rutaceae	41.*Melicope lunu-ankenda* (Gaertn.) T.G. Hartley	Sampoh bui	tree	leaf	weak (having fever)	boil and drink
Schisandraceae	42.*Illicium verum* Hook.f.	Rempah bunga	tree	stem or branch	cold	dry and smoke
Simaroubaceae	43.*Eurycoma longifolia* Jack	Tongka ali	tree	root	weak and tired	boil and drink (male)
Smilacaceae	44.*Smilax calophylla* Wall. ex A. DC.	Aga layang	vine	stem	arm or leg swelling	collect decoction, mix some water and drink
Theaceae	45.*Gordonia singaporeana* (Dyer) Wall. ex Ridl.	Lepel	tree	bark	neck, shoulder pain	boil and drink
Urticaceae	46.*Poikilospermum suaveolens* (Blume) Merr	Aga salae	vine	leaf	cuts	crush and apply
				leaf	cold or fever	boil and drink (child)
Zingiberaceae	47.*Alpinia rafflesiana* Wall. ex Baker	Tengu geradah	herb	leaf	body heat (fever)	boil and bath
	48.*Etlingera littoralis* (J. Koenig) Giseke	Tengu	herb	young shoot	ichy skin	crush and apply
	49.*Zingiber gracile* Jack	Langias	herb	leaf	weak and tired	boil and drink

Table 3.2 (continue)

Table 3.2

Family	Species	Chewong name	Habit	Part	Ailment	Uses
Planted 11 species						
Arecaceae	1.*Areca catechu* L.	Pinang	palm	seed	teeth	chew with betel (*Piper betle*) or wild betel (*P. porphyrophyllum*)
Araceae	2.*Colocasia esculenta* (L.) Schott	Dalay	herb	leaf stalk	wounds	skin leaf stalk and wrap or apply
Leguminosae	3.*Bauhinia purpurea* L.	Penak	tree	leaf	verruca	crush and apply
Musaceae	4.*Musa acuminata* Colla	Tiab mas	herb	leaf	clear throat	wrap fine tobacco leaves (*N. tabacum*) and smoke
	5.*Musa* × *paradisiaca* L.	Tiab tandoh	herb	leaf	clear throat	wrap fine tobacco leaves (*N. tabacum*) and smoke
Phyllanthaceae	6.*Baccaurea motleyana* (Mull.Arg.) Mull.Arg.	Rambai	tree	leaf	skin	boil and bath
Piperaceae	7.*Piper betle* L.	Sireh	herb	leaf	digestive system	chew with chewing palm (*A. catechu*)
Poaceae	8.*Cymbopogon citratus* (DC.) Stapf	Serai	herb	whole	stomach cancer	boil and drink
Rutaceae	9.*Citrus aurantiaca* Swingle	Limau	tree	leaf and fruit	sick body	boil and bath
Solanaceae	10.*Nicotiana tabacum* L.	Betong	herb	leaf	clear throat	cut into thin lines, wrap by leaf (*M. acuminata*, *M.*× *paradisiaca*, *Bauhinia bidentata* or *B. integrifolia*) and smoke
Zingiberaceae	11.*Curcuma longa* L.	Kunyit	herb	root	blood circulation	boil and drink

3.6.3 Construction materials

A total of 74 species from 25 families were used in construction all from the forests; Dipterocarpaceae (15), Arecaceae (10), Anacardiaceae (6), and Leguminosae (5) were the most species-rich families (see Table 3.3). The Chewong construction is based predominantly on wood. Moreover, most of the species were used for building houses (68%) of which the primary structure (48%), roof (10%) and floor (10%) and fencing.

Table 3.3 Plants used as materials for construction purposes by the Chewong with notes on their usage

Family	Species	Chewong Name	Habit	Part	Uses
Wild 74 species					
Anacardiaceae	1.*Bouea macrophylla* Griff.	Hatal	tree	wood	bridge
	2.*Bouea oppositifolia* (Roxb.) Adelb.	Hatal	tree	wood	bridge
	3.*Parishia insignis* Hook.f.	Beranti rasol	tree	wood	house (main)
	4.*Pentaspadon motleyi* Hook.f.	Gelas	tree	wood	house (main)
	5.*Swintonia floribunda* Griff	Yeryies	tree	wood	fence
	6.*Swintonia schwenkii* (Teijsm. &Binn.) Teijsm. & Binn.	Kepung	tree	wood	house (main)
Arecaceae	7.*Calamus caesius* Blume	seek rotan	palm	stem	house (floor)
				leaf	house (roof)
	8.*Calamus castaneus* Griff.	Sek	palm	stem	house (floor)
				leaf	house (roof)
	9.*Calamus manan* Miq.	Sek manau	palm	stem	house (floor)
				leaf	house (roof)
	10.*Calamus ornatus* Blume	Sek	palm	stem	house (floor)
				leaf	house (roof)

Table 3.3 (continue)

Family	Species	Chewong Name	Habit	Part	Uses
	11.*Calamus scipionum* Lour.	Sek rotan	palm	stem	house (floor)
				leaf	house (roof)
	12.*Calamus tumidus* Furtado	Sek	palm	stem	house (floor)
				leaf	house (roof)
	13.*Johannesteijsmannia lanceolata* J. Dransf.	Jujoh	palm	leaf	house (roof)
	14.*Oncosperma horridum* (Griff.) Scheff.	Bayas	palm	wood	bridge
	15.*Oncosperma tigillarium* (Jack) Ridl.	Bayas	palm	wood	bridge
	16.*Orania sylvicola* (Griff.) H.E. Moore	Hebul	palm	wood	bridge
Burseraceae	17.*Canarium littorale* Blume	Kupong	tree	wood	house (main)
	18.*Canarium megalanthum* Merr.	Kupong jenung	tree	wood	house (main)
	19.*Canarium pilosum* A.W. Benn.	Kupong	tree	wood	house (main)
	20.*Canarium pseudodecumanum* Hochr.	Kupong	tree	wood	house (main)
Combretaceae	21.*Terminalia subspathulata* King	Janos	tree	wood	fence
Cornaceae	22.*Alangium javanicum* (Blume) Wangerin	Meteh	tree	wood	house (main)
	23.*Alangium kurzii* Craib	Melas	tree	wood	house (main)
Ctenolophonaceae	24.*Ctenolophon parvifolius* Oliver	Linuk	tree	wood	fence
Dilleniaceae	25.*Dillenia excelsa* (Jack) Martelli ex Gilg.	Simpul betul	tree	wood	house (main)
	26.*Dillenia ovata* Wall. ex Hook.f. & Thomson	Simpul jungkal	tree	wood	house (main)
Dilleniaceae	27.*Dillenia reticulata* King	Simpul	tree	wood	house (main)
	28.*Dillenia sumatrana* Miq.	Simpul tayoh	tree	wood	house (main)
Dipterocarpaceae	29.*Anisoptera laevis* Ridley.	Belanti bunga	tree	wood	house (main)
Dipterocarpaceae	30.*Dipterocarpus baudii* Korth.	Kuwing bulu	tree	wood	house (main)
	31.*Dipterocarpus cornutus* Dyer	Luh	tree	wood	house (main)
	32.*Dipterocarpus costulatus* Slooten	Jaroh	tree	wood	house (main)
	33.*Dipterocarpus crinitus* Dyer	Kuwing pekat	tree	wood	house (main)
	34.*Dipterocarpus kunstleri* King	Jaroh	tree	wood	house (main)
	35.*Dipterocarpus verrucosus* Foxw. ex Slooten	Kuwing jah	tree	wood	house (main)
	36.*Dryobalanops sumatrensis* (J.F. Gmel.) Kosterm.	Kepong	tree	wood	house (main)
	37.*Hopea beccariana* Burck.	Kuwing	tree	wood	house (main)
	38.*Neobalanocarpus heimii* (King) P.S. Ashton	Jengal	tree	wood	house (main)
	39.*Shorea assamica* Dyer	Belanti betal	tree	wood	house (main)
	40.*Shorea bracteolata* Dyer	Belanti	tree	wood	house (main)
	41.*Shorea faguetiana* Heim	Pohang	tree	wood	house (main)
Dipterocarpaceae	42.*Shorea leprosula* Miq.	Seraya gabud	tree	wood	house (main)

Table 3.3 (continue)

Family	**Species**	**Chewong Name**	**Habit**	**Part**	**Uses**
Dipterocarpaceae	43. *Shorea macroptera* Dyer	Belanti	tree	wood	house (main)
	44. *Shorea parvifolia* Dyer	Belanti bunga	tree	wood	house (main)
Ebenaceae	45. *Diospyros buxifolia* (Blume) Hiern	Ganya	tree	wood	fence
	46. *Diospyros caluliflora* Blume	Kelamoh	tree	wood	bridge
	47. *Diospyros latisepala* Ridl.	Mohplik	tree	wood	fence
	48. *Diospyros sumatrana* Miq.	Tah	tree	wood	fence
Euphorbiaceae	49. *Croton argyratus* Blume	Megah	tree	wood	house (main)
Euphorbiaceae	50. *Macaranga gigantea* (Reichb.f. & Zoll.) Mull.Arg.	Mahang gajah	tree	wood	fence
	51. *Macaranga recurvata* Gage	Nek	tree	wood	fence
	52. *Mallotus floribundus* (Blume) Müll.Arg.	Tuwal	tree	wood	fence
	53. *Neoscortechinia nicobarica* (Hook.f.) Pax & K. Hoffm.	Dashalung	tree	wood	house (main)
Flacourtiaceae	54. *Hydnocarpus castanea* Hook.f. & Thomson	Tembaka	tree	wood	fence
Gentianaceae	55. *Fagraea racemosa* Jack	Sisil yameng	tree	wood	fence
Leguminosae	56. *Cassia javanica* L.	Beting breyong	tree	wood	bridge
	57. *Dialium indum* L.	Klanyi	tree	wood	house (main)
	58. *Intsia palembanica* Miq	Marbao	tree	wood	house (main)
	59. *Koompassia malaccensis* Benth.	Kempas	tree	wood	house (main)
	60. *Sindora coriacea* (Baker) Prain	Patil	tree	wood	house (main)
Malvaceae	61. *Pterospermum acerifolium* (L.) Willd.	Haowhao	tree	wood	bridge
	62. *Pterocymbium javanicum* R.Br.	Temrul	tree	wood	house (main)
	63. *Scaphium macropodum* (Miq.) Beumée ex K. Heyne	Temrul	tree	wood	house (main)
	64. *Sterculia parvifolia* Wall.	Kasai	tree	wood	fence
Marantaceae	65. *Donax canniformis* (G. Forst.) K. Schum.	Bemban	shrub	stem	house (floor/ roof)
Meliosmaceae	66. *Meliosma sumatrana* (Jack) Walp	Yakmai	tree	wood	fence
Moraceae	67. *Streblus elongatus* (Miq.) Corner	Maril	tree	wood	fence
Musaceae	68. *Musa violascens* Ridl.	Lok	herb	leaf	house (roof)
Myristicaceae	69. *Gymnacranthera farquhariana* (Hook.f. & Thomson) Warb.	Narung	tree	wood	house (main)
Penaeaceae	70. *Crypteronia griffithii* Clarke in Hook.f.	Tenglang	tree	wood	fence
Poaceae	71. *Maclurochloa montana* (Ridl.) K.M. Wong	Loh sementan	cane	stem	house (floor)

Table 3.3 (continue)

Family	Species	Chewong Name	Habit	Part	Uses
Rubiaceae	72.*Neolamarckia cadamba* (Roxb.) Bosser	Humpudu bume	tree	wood	fence
Sapotaceae	73.*Madhuca longifolia* (J. Koenig ex L.) J.F. Macbr	Menglao	tree	wood	fence
Theaceae	74.*Gordonia singaporeana* (Dyer) Wall. Ex Ridl.	Lepel	tree	wood	bridge

3.6.4 Fuelwoods

A total of 22 tree species from 7 families were used for fuelwood; Sapindaceae (5), Burseraceae (4), Leguminosae (4), Anacardiaceae (3), and Malvaceae (3) were the most species-rich families (see Table 3.4). Firewood is predominantly collected from wild growing species (96% compared with only (4%) planted species.

Table 3.4 Plants used for fuelwood by the Chewong with notes on their usage

Family	Species	Chewong name	Habit	Part
Wild 21 species				
Anacardiaceae	1.*Parishia insignis* Hook.f.	Belanti rasol	tree	wood
	2.*Pentaspadon motleyi* Hook.f.	Gelas	tree	wood
	3.*Swintonia schwenkii* (Teijsm. &Binn.) Teijsm. & Binn.	Kepung	tree	wood
Burseraceae	4.*Canarium littorale* Blume	Kupong	tree	wood
	5.*Canarium megalanthum* Merr.	Kupong jenung	tree	wood
	6.*Canarium pilosum* A.W. Benn.	Kupong	tree	wood
	7.*Canarium pseudodecumanum* Hochr.	Kupong	tree	wood
Cornaceae	8.*Alangium javanicum (Blume)* Wangerin	Meteh	tree	wood
	9.*Alangium kurzii* Craib	Melas	tree	wood

Table 3.4 (continue)

Family	Species	Chewong name	Habit	Part
Euphorbiaceae	10.*Croton argyratus* Blume	Megah	tree	wood
	11.*Neoscortechinia nicobarica* (Hook.f.) Pax & K. Hoffm.	Dashalung	tree	wood
Leguminosae	12.*Dialium indum* L.	Klanyi	tree	wood
	13.*Intsia palembanica* Miq	Marbao	tree	wood
	14.*Koompassia malaccensis* Benth.	Kempas	tree	wood
	15.*Sindora coriacea* (Baker) Prain	Patil	tree	wood
Malvaceae	16.*Pterocymbium javanicum* R.Br.	Temrul	tree	wood
	17.*Scaphium macropodum* (Miq.) Beumée ex K. Heyne	Temrul	tree	wood
Sapindaceae	18.*Nephelium mutabile* Blume	Belas	tree	wood
	19.*Nephelium ramboutan-ake* (Labill.) Leenh	Haquay	tree	wood
	20.*Nephelium costatum* Hiern	Gumpal wai	tree	wood
	21.*Nephelium cuspidatum* Blume	Reming	tree	wood
Planted one species				
Sapindaceae	1.*Nephelium lappaceum* L.	God	tree	wood

3.6.5 Hunting equipment and poisons

A total of 23 species from 10 families were used for hunting; Arecaceae (7), Dipterocarpaceae (5), Lecythidaceae (3), Dilleniaceae (2), and Poaceae (2) were the most species-rich families for hunting activities (see Table 3.5). Most plants are harvested from wild resources except *Schizostachyum latifolium* and *Merrillia caloxylon* which are cultivated (10% compared with wild species). The majority of these materials are from tree (56%) and palm (30%). Stems, wood and sap are the most used parts.

Blowpipe construction used the most species with (61%) follow by poison (21%), machetes (9%), and traps (9%).

Table 3.5 Plants used to create hunting equipment and poisons by the Chewong with notes on their usage

Family	Species	Chewong name	Habit	Part	Hunting equipment alternatively, poison
Wild 21 species					
Annonaceae	1.*Polyalthia cauliflora* Hook.f. & Thomson	Ewa	Tree	stem	Trap
Arecaceae	2.*Calamus caesius* Blume	seek rotan	Palm	stem	Blowpipe
	3.*Calamus castaneus* Griff.	Seek	Palm	stem	Blowpipe
	4.*Calamus manan* Miq.	Sek manau	Palm	stem	Blowpipe
	5.*Calamus ornatus* Blume	Sek	Palm	stem	Blowpipe
	6.*Calamus scipionum* Lour.	Sek rotan	Palm	stem	Blowpipe
	7.*Calamus tumidus* Furtado	Sek	Palm	stem	Blowpipe
	8.*Orania sylvicola* (Griff.) H.E. Moore	Hebul	Palm	seed	fish poison
Cornaceae	9.*Alangium kurzii* Craib	Melas	Tree	wood	machete or spear
Dilleniaceae	10.*Tetracera indica* (Christm. & Panz.) Merr.	Jedehut	Tree	leaf	Blowpipe
Dipterocarpaceae	11.*Shorea assamica* Dyer	Belanti betal	Tree	sap	Blowpipe
	12.*Shorea bracteolata* Dyer	Belanti	Tree	wood	Blowpipe
	13.*Shorea leprosula* Miq.	Seraya gabud	Tree	resin	Blowpipe
	14.*Shorea macroptera* Dyer	Belanti	Tree	wood	Blowpipe
	15.*Shorea parvifolia* Dyer	Meranti bunga	Tree	sap	Blowpipe
Lecythidaceae	16.*Barringtonia macrocarpa* Hassk.	Jenbang beretam	Tree	bark	fish poison
	17.*Barringtonia macrostachya* (Jack) Kurz	Janjijiab	Tree	bark	fish poison
	18.*Barringtonia scortechinii* King	Kikil	Tree	bark	fish poison
Lygodiaceae	19.*Lygodium flexuosum* (L.) Sw.	Paku ibu	Fern	stem	Trap
Moraceae	20.*Antiaris toxicaria* Lesch	Dok	Tree	sap	Blowpipe poison
Poaceae	21.*Maclurochloa montana* (Ridl.) K.M. Wong	Loh sementan	bamboo	stem	Blowpipe
Planted two species					
Rutaceae	1.*Merrillia caloxylon* (Ridl.) Swingle	Penah	Tree	wood	machete or spear
Poaceae	2.*Schizostachyum latifolium* Gamble	Blaoh	bamboo	stem	Blowpipe

3.6.6 Handicrafts

A total of 17 species in 9 families were used in the production of handicrafts; Arecaceae (6), Marantaceae (3), Malvaceae (2), and Poaceae (2) were the most species-rich families (see Table 3.6). Plants species used for creating Chewong handicrafts were 82% wild compared with 18% planted species. The Chewong craftworks consist predominately of palm (35%) and tree (29%) along with herb 18%, bamboo 12% and vine such as climbing fern (*Lygodium flexuosum*) only 6%. Stem and bark are the most used parts for their craftwork which are 65% and 12% respectively. Basketwork used the most species (88%) compared with children's toys (6%) and beddings (6%).

Table 3.6 Plants used to create handicraft items by the Chewong with notes on their usage

Family	Species	Chewong name	Habit	Part of usage	Type of handicraft
Wild 14 species					
Anacardiaceae	1.*Pentaspadon motleyi* Hook.f.	Gelas	Tree	wood	children toy
Arecaceae	2.*Calamus caesius* Blume	seek rotan	Palm	stem	basketwork
	3.*Calamus castaneus* Griff.	Sek	Palm	stem	basketwork
	4.*Calamus manan* Miq.	Sek manau	Palm	stem	basketwork
	5.*Calamus ornatus* Blume	Sek	Palm	stem	basketwork
	6.*Calamus scipionum* Lour.	Sek rotan	Palm	stem	basketwork
	7.*Calamus tumidus* Furtado	Sek	Palm	stem	basketwork
Malvaceae	8.*Hibiscus floccosus* Mast.	Baharu	Tree	bark	basketwork
Moraceae	9.*Ficus schwarzii* Koord.	Hara air	Tree	bark	basketwork

Table 3.6 (continue)

Family	Species	Chewong name	Habit	Part of usage	Type of handicraft
Lygodiaceae	10.*Lygodium flexuosum* (L.) Sw.	Paku ibu	Fern	stem	basketwork
Marantaceae	11.*Donax canniformis* (G. Forst.) K. Schum.	Bemban	Herb	stem	basketwork
	12.*Phrynium pubinerve* Blume	Tungu	Herb	leaf stalk	basketwork
	13.*Schumannianthus dichotomus* (Roxb.) Gagnep.	Breman	Herb	stem	basketwork
Poaceae	14.*Maclurochloa montana* (Ridl.) K.M. Wong	Loh sementan	Cane	stem	basketwork
Planted three species					
Bixaceae	1.*Bixa orellana* L.	Ken	Tree	seed	basketwork
Malvaceae	2.*Bombax anceps* Pierre	Kapas	Tree	seed fibre	beddings
Poaceae	3.*Schizostachyum latifolium* Gamble	Blaoh	Cane	stem	basketwork

3.6.7 Ceremonies and rituals

A small number of species, 7 species in 6 families, were used in Chewong ceremonies and rituals; Annonaceae (3), Amaryllidaceae (1), Dipterocarpaceae (1), Rubiaceae (1), Styracaceae (1), and Thymelaeaceae (1) were the most species-rich families (see Table 3.7). Trees (57%) are the primary source, and other plant habits such as herb, shrub, and climber are occasionally used when they are available. Resin and flower are used in the same number (3 species or 43%) while leaf will be collected from only one species or 14%.

Table 3.7 Plants used for ceremonies and rituals by the Chewong with notes on their usage

Family	Species	Chewong name	Habit	Part
Wild 7 species				
Amaryllidaceae	1.*Crinum asiaticum* L.	Lebak	herb	leaf
Annonaceae	2.*Maasia sumatrana* (Miq.) Mols, Kessler & Rogstad	Kabui	vine	flower
	3.*Maasia sumatrana (Miq.) Mols, Kessler & Rogstad*	Tah punae	tree	flower
Dipterocarpaceae	4.*Neobalanocarpus heimii* (King) P.S. Ashton	Jengal	tree	resin
Rubiaceae	5.*Pavetta graciliflora* Wall. ex Ridl.	Jing	shrub	flower
Styracaceae	6.*Styrax tonkinensis* Craib ex Hartwich	Kelulu	tree	resin
Thymelaeaceae	7.*Aquilaria malaccensis* Lam..	Gegaras	tree	resin

3.6.8 Animal food resources

This category relates to the Chewong knowledge of animal foraging behaviour and food preferences. A total of 114 species from 33 families were documented as plants consumed by animals within the forest; Dipterocarpaceae (15), Moraceae (14), Leguminosae (9), Anacardiaceae (8), Phyllanthaceae (7), Dilleniaceae (5), and Myristicaceae (5) were the most species-rich families (see Table 3.8). Of these species, the majority are wild food resources (92 species) for mammals, such as tapirs, sun bears, monkeys, rodents and birds (including hornbills). Around 80% of plants consumed by animals were wild species (92 species) while the other 20% were from human cultivation.

Animal resources consist mainly of a tree with (86%), and the remaining 14% are herb, vine, and grass. The main animal foods are fruits which total (92%). Of the species that make up the animal resources, 60% are used in planning for hunting, 23% are for fruit sharing during the fruiting season, some will be collected for human's food and some will be left for the other animals' food, and 17% for keeping for future use.

Table 3.8 Animal food resource knowledge used for multiple purposes by the Chewong

Family	**Species**	**Chewong Name**	**Type**	**Edible part**	**Related animals**	**Usage**
Wild 92 species						
Anacardiaceae	1.*Bouea macrophylla* Griff.	Hatal	Tree	fruit	bird	hunting plan
	2.*Bouea oppositifolia* (Roxb.) Adelb.	Hatal	Tree	fruit	bird	hunting plan
	3.*Dracontomelon dao* (Blanco) Merr. & Rolfe	Yerguang	Tree	fruit	bird	hunting plan
	4.*Mangifera gracilipes* Hook.f	Pauh	Tree	fruit	deer	fruit sharing
	5.*Mangifera lagenifera* Griff.	Pauh kijang	Tree	fruit	deer	fruit sharing
	6.*Pentaspadon motleyi* Hook.f	Gelas	Tree	fruit	deer	fruit sharing
Apocynaceae	7.*Willughbeia angustifolia* (Miq.) Markgr.	Brambrao	Liana	fruit	bird	hunting plan
Burseraceae	8.*Canarium megalanthum* Merr.	Kupong jenung	Tree	fruit	deer	fruit sharing
	9.*Canarium pilosum* A.W. Benn.	Kupong	Tree	fruit	deer	fruit sharing
	10.*Canarium pseudodecumanum* Hochr.	Kupong	Tree	fruit	deer	fruit sharing
	11.*Dacryodes rostrata* (Bl.) H.J. Lam	Ramil	Tree	fruit	deer	fruit sharing
Cannabaceae	12.*Gironniera nervosa* Planch.	Yakmi	Tree	fruit	rodent	fruit sharing

Table 3.8 (continue)

Family	Species	Chewong Name	Type	Edible part	Related animals	Usage
Cornaceae	13.*Alangium ridleyi* King	Jam	Tree	fruit	monkey	hunting plan
Cucurbitaceae	14.*Hodgsonia macrocarpa* (Blume) Cogn.	Hoot	Liana	fruit	rodent	fruit sharing
Dilleniaceae	15.*Dillenia excelsa* (Jack) Martelli ex Gilg	Simpul	Tree	fruit	tapir	keeping
	16.*Dillenia ovata* Wall. ex Hook.f. & Thomson	Simpul	Tree	fruit	deer	keeping
	17.*Dillenia ovata* Wall. ex Hook.f. & Thomson	Simpul jungkal	Tree	fruit	deer	keeping
	18.*Dillenia reticulata* King	Simpul	Tree	fruit	deer	keeping
	19.*Dillenia sumatrana* Miq.	Simpul tayoh	Tree	fruit	deer	keeping
Dipterocarpaceae	20.*Anisoptera laevis* Ridley.	Belanti bunga	Tree	fruit	monkey	hunting plan
	21.*Neobalanocarpus heimii* (King) P.S. Ashton	Jengal	Tree	fruit	monkey	hunting plan
	22.*Dipterocarpus baudii* Korth.	Kuwing bulu	Tree	fruit	monkey	hunting plan
	23.*Dipterocarpus cornutus* Dyer	Luh	Tree	fruit	monkey	hunting plan
	24.*Dipterocarpus costulatus* Slooten	Jaroh	Tree	fruit	monkey	hunting plan
	25.*Dipterocarpus crinitus* Dyer	Kuwing pekat	Tree	fruit	monkey	hunting plan
	26.*Dipterocarpus kunstleri* King	Jaroh	Tree	fruit	monkey	hunting plan
	27.*Dipterocarpus verrucosus* Foxw. ex Slooten	Kuwing	Tree	fruit	monkey	hunting plan
	28.*Hopea beccariana* Burck.	Kuwing	Tree	fruit	monkey	hunting plan
	29.*Shorea assamica* Dyer	Belanti betal	Tree	fruit	monkey	hunting plan
	30.*Shorea bracteolata* Dyer	Belanti	Tree	fruit	monkey	hunting plan
Dipterocarpaceae	31.*Shorea faguetiana* Heim	Pohang	Tree	fruit	monkey	hunting plan
	32.*Shorea leprosula* Miq.	Seraya gabud	Tree	fruit	monkey	hunting plan
	33.*Shorea macroptera* Dyer	Belanti	Tree	fruit	monkey	hunting plan
	34.*Shorea parvifolia* Dyer	Meranti bunga	Tree	fruit	monkey	hunting plan
Ebenaceae	35.*Diospyros pyrrhocarpa* Miq.	Kabui	Tree	fruit	rodent	keeping
Euphorbiaceae	36.*Elateriospermum tapos* Blume	Prae	Tree	fruit	monkey	hunting plan
	37.*Neoscortechinia nicobarica* (Hook.f.) Pax & K. Hoffm.	Dashalung	Tree	fruit	porcupine	hunting plan
Fagaceae	38.*Lithocarpus cantleyanus* (King ex Hook.f.) Rehder	Gles	Tree	fruit	monkey	hunting plan
	39.*Lithocarpus rassa* (Miq.) Rehder	Gles	Tree	fruit	monkey	hunting plan
Leguminosae	40.*Archidendron jiringa* (Jack) Nielsen	Kedas	Tree	fruit	monkey	hunting plan
	42.*Dialium indum* L.	Klanyi	Tree	fruit	monkey	hunting plan

Table 3.8 (continue)

Family	Species	Chewong Name	Type	Edible part	Related animals	Usage
Leguminosae	43. *Entada spiralis* Ridl	Gemni	Liana	fruit	monkey	hunting plan
	44. *Koompassia excelsa* (Becc.) Taub.	Taulang	Tree	fruit	monkey	hunting plan
Leguminosae	45. *Koompassia malaccensis* Benth.	Kempas	Tree	fruit	monkey	hunting plan
	46. *Saraca thaipingensis* Prain	Tenglon	Tree	fruit	monkey	hunting plan
Lythraceae	47. *Duabanga grandiflora* (DC.) Walp.	Layang	Tree	fruit	rodent	keeping
Malvaceae	48. *Durio beccarianus* Kosterm. & Soegeng	Jarel	Tree	fruit	bear	route avoiding
Marantaceae	49. *Angiopteris evecta* (G. Forst.) Hoffm.	Paku beretum	Fern	leaf	tapir	keeping
Melastomataceae	50. *Melastoma malabathricum* L.	Sedudu	Shrub	fruit	bird	fruit sharing
	51. *Phyllagathis griffithii* King	Bel tangled	Herb	leaf	tapir	keeping
	52. *Phyllagathis rotundifolia* (Jack) Blume	Bel	Herb	leaf	tapir	keeping
Meliaceae	53. *Lansium parasiticum* (Osbeck) K.C.Sahni & Bennet	Tigai	Tree	fruit	boar	hunting plan
	54. *Sandoricum beccarianum* Baill.	Mindegal	Tree	fruit	boar	hunting plan
	55. *Sandoricum koetjape* (Burm.f.) Merr.	Hatal	Tree	fruit	boar	hunting plan
Meliosmaceae	56. *Meliosma sumatrana* (Jack) Walp	Yakmai	Tree	fruit	rodent	keeping
Moraceae	57. *Artocarpus elasticus* Reinw. ex Blume	Haook	Tree	fruit	bear	fruit sharing
	58. *Artocarpus hispidus* F.M. Jarrett	Tegah	Tree	fruit	bear	fruit sharing
	59. *Artocarpus kemando* Miq	Pulul	Tree	fruit	bear	fruit sharing
Moraceae	60. *Artocarpus lanceifolius* Roxb.	Besil	Tree	fruit	bear	fruit sharing
	61. *Artocarpus lowii* King	Bingoh	Tree	fruit	boar	fruit sharing
	62. *Artocarpus nitidus* Trécul	Peradung	Tree	fruit	bear	fruit sharing
	63. *Artocarpus rigidus* Blume	Hatinapal	Tree	fruit	boar	fruit sharing
	64. *Ficus schwarzii* Koord.	Hara air	banana	fruit	bird	hunting plan
	65. *Ficus glandulifera* (Wall. ex Miq.) King	Hara	Tree	fruit	bird	hunting plan
	66. *Ficus grossularioides* Burm.f.	Hara	Tree	fruit	bird	hunting plan
	67. *Ficus punctata* Thunb.	Aga hara	climber	fruit	bird	hunting plan
	68. *Streblus elongatus* (Miq.) Corner	Maril	Tree	leaf	rodent	hunting plan
Musaceae	69. *Musa gracilis* Holttum	Halited	banana	fruit	bird	keeping
	70. *Musa violascens* Ridl.	Lok	banana	fruit	bird	keeping
Myristicaceae	71. *Gymnacranthera farquhariana* (Hook.f. & Thomson) Warb.	Narung	Tree	fruit	rodent	keeping

Table 3.8 (continue)

Family	Species	Chewong Name	Type	Edible part	Related animals	Usage
Myristicaceae	72.*Knema conferta* (King) Warb.	Yasong	Tree	fruit	bird	keeping
	73.*Knema laurina* (Blume) Warb	Penyara	Tree	fruit	bird	keeping
	74.*Knema scortecchinii* (king) J. Sinclair	Penyara	Tree	fruit	bird	keeping
	75. *Knema furfuracea* (Hook. f. & Thomson) Warb.	Penyara	Tree	fruit	bird	keeping
Myrtaceae	76.*Psidium friedrichsthalianum* (O. Berg) Nied.	Jampu batu	Tree	fruit	monkey	hunting plan
	77.*Syzygium acuminatissimum* (Blume) A.DC.	Balang	Tree	fruit	monkey	hunting plan
	78.*Syzygium aqueum* (Burm.f.) Alston	Jampu	Tree	fruit	monkey	hunting plan
Olacaceae	79.*Ochanostachys amentacea* Mast.	Taring	Tree	fruit	monkey	hunting plan
Phyllanthaceae	80.*Baccaurea lanceolata* (Miq.) Mull.Arg.	Pahung	Tree	fruit	porcupine	hunting plan
	81.*Baccaurea parviflora* (Mull.Arg.) Mull.Arg.	Jenal	Tree	fruit	porcupine	hunting plan
	82.*Baccaurea pyriformis* Gage	Tamun	Tree	fruit	monkey	hunting plan
	83.*Baccaurea polyneura* Hook.f.	Kenem	Tree	fruit	monkey	hunting plan
	84.*Baccaurea racemosa* (Reinw. ex Bl.) Mull.Arg.	Tamungling	Tree	fruit	monkey	hunting plan
Polygalaceae	85.*Xanthophyllum amoenum* Chodat	Gapas	Tree	fruit	tapir	hunting plan
	86.*Xanthophyllum stipitatum* A.W. Benn.	Gapas	Tree	fruit	tapir	hunting plan
Sapindaceae	87.*Nephelium costatum* Hiern	Gumpal wai	Tree	fruit	monkey	hunting plan
Sapindaceae	88.*Nephelium cuspidatum* Blume	Reming	Tree	fruit	monkey	hunting plan
	89.*Nephelium mutabile* Blume	Belas	Tree	fruit	monkey	hunting plan
	90.*Nephelium ramboutan-ake* (Labill.) Leenh	Haquay	Tree	fruit	monkey	hunting plan
	91.*Xerospermum noronhianum* (Blume) Blume	Tiag	Tree	fruit	monkey	hunting plan
Torricelliaceae	92.*Aralidium pinnatifidum* (Jungh. & de Vriese) Miq.	Tengereng	Tree	fruit	bird	hunting plan
Planted 22 species						
Achariaceae	1.*Pangium edule* Reinw.	Payong	Tree	fruit	rodent	fruit sharing
Anacardiaceae	2.*Mangifera foetida* Lour.	Limus	Tree	fruit	civet	fruit sharing
	3.*Mangifera indica* L.	Grening	Tree	fruit	civet	fruit sharing
Caricaceae	4.*Carica papaya* L.	Betek	Tree	fruit	bird	keeping
Clusiaceae	5.*Garcinia prainiana* King	Jupu	Tree	fruit	monkey	hunting plan
Convolvulaceae	6.*Ipomoea batatas* (L.) Lam.	Cila	Herb	root	boar	hunting plan
Euphorbiaceae	7.*Manihot carthaginensis* (Jacq.) Müll.Arg.	Galor	Shrub	root	boar	hunting plan
Flacourtiaceae	8.*Flacourtia rukam* Zoll. & Moritzi	Rukam	Tree	fruit	monkey	hunting plan

Table 3.8 (continue)

Family	Species	Chewong Name	Type	Edible part	Related animals	Usage
Leguminosae	9.*Parkia speciosa* Hassk.	Heltal	Tree	fruit	rodent	hunting plan
	10.*Parkia timoriana* (DC.) Merr.	Heltal	Tree	fruit	monkey	hunting plan
Malvaceae	11.*Durio oxleyanus* Griff.	Daon	Tree	fruit	bear	fruit sharing
	12.*Durio zibethinus* L.	Haubu	Tree	fruit	bear	fruit sharing
Moraceae	13.*Artocarpus heterophyllus* Lam.	Nanga	Tree	fruit	bear	fruit sharing
	14.*Artocarpus integer* (Thunb.) Merr	Cempedak	Tree	fruit	bear	fruit sharing
Musaceae	15.*Musa acuminata* Colla	Tiab mas	banana	fruit	rodent	fruit sharing
	16.*Musa × paradisiaca* L.	Tiab tandoh	banana	fruit	rodent	fruit sharing
Myrtaceae	16.*Psidium guajava* L.	Jampu batu	Tree	fruit	monkey	hunting plan
	17.*Syzygium pycnanthum* Merr. & L.M. Perry	Yampoo	Tree	fruit	monkey	hunting plan
Phyllanthaceae	18.*Baccaurea macrocarpa* (Miq.) Mull.Arg	Lala	Tree	fruit	monkey	hunting plan
	19.*Baccaurea motleyana* (Mull.Arg.) Mull.Arg.	Rambai	Tree	fruit	monkey	hunting plan
Poaceae	20.*Oryza sativa* L.	Mum	Rice	seed	bird	hunting plan
	21. *Zea mays* L.	Jagong	Herb	seed	rodent	hunting plan
Sapindaceae	22.*Nephelium lappaceum* L.	God	Tree	seed	monkey	hunting plan

3.6.9 Non-timber forest products (NTFPs)

A total of 21 plant species from 10 families were used for trading; Dipterocarpaceae (6), Euphorbiaceae (3), Bombacaceae (2), Leguminosae (2), Musaceae (2), and Phyllanthaceae (2) were the most species-rich families (see Table 3.9). These include rattans from sek manau (*Calamus manan*) and fruits of payong (*Pangium edule*). Thirteen species (62%) were directly planted and cultivated around the settlements, while eight species (38%) were harvested from the wild. Some of the wild-harvested products are widely available, such as damar (hard resin) from kuwing (*Hopea beccariana*) and *Shorea* spp., while others are regarded as high-value products with restricted distributions and require substantial time investment or risk to obtain them, such as gaharu from gagaras (*Aquilaria malaccensis*).

Gaharu trees nicknamed locally as "black gold" are difficult to find at present because of their high-value, gaharu trees will be cut to get the resin, which resides inside the tree. However, the main aim of planted species is not for trading but consumption; these products will only be sold when production exceeds consumption and when market prices are higher.

Table 3.9 Plants used for economic activity by the Chewong with notes on their trading rate in Lanchang city, Pahang in 2015, 1 Malaysian Ringgit (MYR) equalled 0.18 British Pound

Family	Species	Chewong name	Habit	Harvest product		Unit	MYR
Wild 8 species							
Dipterocarpaceae	1.*Hopea beccariana* Burck.	Kuwing	tree	damar	1	kg.	0.5-1
	2.*Shorea assamica* Dyer	Belanti betal	tree	or			
	3.*Shorea bracteolata* Dyer	Belanti	tree	resin			
	4.*Shorea faguetiana* Heim	Pohang	tree				
	5.*Shorea leprosula* Miq.	Seraya gabud	tree				
	6.*Shorea macroptera* Dyer	Belanti	tree				
Arecaceae	7.*Calamus manan* Miq.	Sek manau	palm	stem	12	m.	3
Thymelaeaceae	8.*Aquilaria malaccensis* Lam.	Gagaras	tree	gaharu	10	g.	200

Table 3.9 (continue)

Family	Species	Chewong name	Habit	Harvest product		Unit	MYR
Planted 13 species							
Achariaceae	1.*Pangium edule* Reinw.	Payong	tree	fruit	1	kg.	2
Bombacaceae	2.*Durio oxleyanus* Griff.	Daon	tree	fruit	1	fruit	4
	3.*Durio zibethinus* L.	Haubu	tree				
Euphorbiaceae	4.*Elateriospermum tapos* Blume	Prae	tree	fruit	1	kg.	3
	5.*Hevea brasiliensis* (Willd. ex A. Juss.) Müll.Arg.	Getah	tree	gum	1	kg.	20
	6.*Manihot carthaginensis* (Jacq.) Müll.Arg.	Galor	shrub	root	1	kg.	2
Leguminosae	7.*Parkia speciosa* Hassk.	Heltal	tree	fruit	10	fruit	50
	8.*Parkia timoriana* (DC.) Merr.	Heltal	tree				
Musaceae	9.*Musa acuminata* Colla	Tiab mas	banana	fruit	1	kg.	2
	10.*Musa* × *paradisiaca* L.	Tiab tandoh	banana	fruit			
Phyllanthaceae	11.*Baccaurea macrocarpa* (Miq.) Mull.Arg	Lala	tree	fruit	1	kg.	2
	12.*Baccaurea motleyana* (Mull.Arg.) Mull.Arg.	Rambai	tree				
Poaceae	13.*Oryza sativa* L.	Mum	rice	seed	1	kg.	3

3.7 Discussion

3.7.1 Food resources and food security of forest inhabitants

Acquiring food resources for any indigenous population or forest-dwelling tribe is always one of the highest priorities. Knowledge of edible plant species is vital for both calorific intake, to sustain daily energy expenditure, and nutritional intake of vitamins and minerals to keep the body healthy.

Edible plants consumed by the Chewong was the largest group from all nine categories (111 species or 46%). One-third of these species were from plantations especially hill rice and cassava agriculture practice. These species were one-fifth of plants that are known to produce edible fruits or seeds in Malaysia (Milow et al., 2014). The Chewong have a broad knowledge of species which are edible and palatable within the forest compared with some tribes such as Temuan (Ong et al., 2011b), but not all of these are routinely eaten. Species such as cassava (*Manihot carthaginensis*) and rice (*Oryza sativa*), grown within the crop field, form the central component of their diets. Other species such as spinach (*Amaranthus viridis*), coconut (*Cocos nucifera*) and papaya (*Carica papaya*) are harvested opportunistically from agricultural areas. Some species such as payong (*Pangium edule*) and durian (*Durio oxleyanus*) are seasonally available (June-September) forming an important nutritional component during these periods. A further set of foods that are not routinely eaten but are reserved for emergencies include plants such as wild yam (*Dioscorea piscatorum* and *D. hispida*), known to be edible but are not favourite foods and are likely to be used mostly as reserve food in the event of crop failure.

It is clear that the Chewong have an in-depth knowledge of both edible and most critically inedible species acquired over generations of experience. Surviving in a tropical forest is generally difficult due to the low nutrient availability, carbohydrate and protein sources particularly in a Dipterocarp dominated forest with a mast fruiting reproductive strategy, limiting both food availability and reducing mammal densities (Andreas and Schöne, 1996; Corlett and Primack, 2011; King et al., 2006).

Although the Chewong do rely on a large number of wild growing species on a day to day basis, compared with a smaller number of cultivated species, the cultivated species of rice and cassava are grown in high volumes and supply the majority of the Chewong's daily carbohydrate source as seen in many indigenous cultures around the world (Bailey et al., 1989). The fruit garden species also provide essential nutrients and a stable yearly supply. These stable food sources are reliable and readily available, small scale, reduce pressure on the surrounding forest and based on a recent study by (Moore et al., 2016), can have positive effects on the residing animal community (see APPENDIX 3).

3.7.2 Medicine and hygiene

Medicinal plant species accounted for one-fourth of recorded plants (60 species or 25%). Activities related to medicine and hygiene are infrequently performed so wild growing populations are sufficient to sustain Chewong needs. Some of the wild-harvested species which are widely available including *Bauhinia bidentata* and *Poikilospermum suaveolens*, while others are regarded as high-value medicines with restricted distributions and require substantial time investment or risk to obtain them. For examples *Angiopteris evecta* and *Zingiber gracile* which both have specific habitat requirements and are rare to find in the forest but provide very effective treatments.

The primary uses of these medicines are the treatment of illness, external injuries (e.g. cuts), internal injuries, domestic and personal hygiene. Most plants can be used as a single species for treatment of illness. Knowledge of the active part of the plant is also necessary. The habitat of each plant needs to be learnt, especially those close to settlements, pathways or hunting areas which might be very useful when needed in the Malayan Emergency.

Chewong men know how to apply these medicinal plants and techniques including how to help their wives or daughters give birth. There was only one Chewong child who was born in a hospital in Pahang while other Chewongs who still stay in the forest were born naturally using wild medicines.

The most common part of the plant used for medicinal purposes is the leaf (52%) which can be ground to release the compounds associated with curing the type of injury or boiled for consumptions to cure a variety of internal problems. The plant parts used by the Chewong are similar to many indigenous practices around the world, although they use a diverse array of different species for different treatments (Ahmad et al., 2014; Kichu et al., 2015; Polat et al., 2015; Tribess et al., 2015).

It is clear that traditional medicinal knowledge is also essential to an indigenous community's survival in a forest setting. Humans within a rainforest are exposed to many potential injuries which are prone to infection, encounter poisonous animals and consume many substances raw or undercooked with the potential to cause internal problems. This knowledge is developed over generations and will become an essential part of the next generation's learning at an early age.

3.7.3 Construction for temporary forest settlements

Seventy-four plant species (30%) were used for construction purposes with 15 species in the Dipterocarpaceae family which related to the dominant species of Dipterocarp forest, the source of good timber. Construction is one of the most common daily activities performed by the Chewong, either when they are merely patching a leak in their hut roof, preparing darts for their blowpipes or performing large scale construction of a new settlement. It is clear from our work that most species used in construction are from wild growing species, even during the initial stages of cultivation when land is cleared the Chewong will use many trees, rattan and palms for building their huts.

Timber used in the construction of the main frames of houses consisted mainly of the Dipterocarpaceae family, rattan (*Calamus* spp.) and bamboo species (*Maclurochloa montana*) used in the construction of roofs and flooring, bridges, and fencing for protection of clearings from deer and pigs. Almost all of these species are trees. Houses are the main building that the Chewong will create, maintain and rebuild every 2-3 years following their resettlement plans. The main house built in a settlement will be the biggest for the settlement leader's family (5x5 m^2 is the biggest hut found in Pyapoz village) and will be surrounded by other families' huts or daughter's and son's huts (1x1.5 m^2 is the smallest hut found in Senel village).

Wood materials are used for the main house's structural components such as poles, pillars and timber frame of roofing, wall, floor, door or stairs. The house wall can be made from rattan leaves for temporary shelters or fibrous barks from large trees such as *Shorea* spp. which can provide a strong wall for 3-4 years. The roof is generally made from woven rattan leaves and stems; different species will provide different durability depending on the thickness and shape of leaves such as the umbrella leaf palm (*Johannesteijsmannia lanceolata*) which is the favourite species for roofs lasting 1-2 years. In addition banana (*Musa violascens*) leaves can provide a temporary roof for temporary camping shelters.

3.7.4 Chewong fuelwoods

Twenty-two species of fuelwoods (9%) were essential for the Chewong's cooking, boiling water, boiling herbal medicine and keeping warm, many of which are collected from wild growing species. Five species in the Sapindaceae family are preferentially used as fuel resources because they provide a high temperature, longer burning and less smoke. Furthermore, planted rambutan trees (*Nephelium lappaceum*) provide both fruit and valued firewood which similar to traditional Indonesian firewood (Leksono et al., 2014). A large number of species used for construction are also used for fuel, such as *Intsia palembanica* and *Koompassia malaccensis*.

Dried woods from broken branches or stem were the most useful firewoods. Although wood in the forest may all seem very similar, some species have a higher resinous content perfect for starting a fire, while other species burn slowly and longer for keeping warm. This basic technique is essential for survival in the forest, particularly when it comes to the rainy season when the majority of wood in the forest is damp. Through trial and error, the ancestors of the Chewong developed an understanding of the most useful species for this activity.

3.7.5 Hunting equipment and poisons for wild meat

Twenty-three plant species (9%) related to materials used for creating hunting equipment are particularly valuable and important as they are essential for obtaining wild meats, the only source of dietary protein for the Chewong. These are used in various ways for the manufacture of items such as blowpipes (*Schizostachyum latifolium*), darts (*Maclurochloa montana*), blowpipe poisons (*Antiaris toxicaria*), fish poison (*Barringtonia scortechinii*) and traps (*Polyalthia cauliflora*). The majority of plants are harvested directly from wild resources except for *S. latifolium* and *Merrillia caloxylon*, which are cultivated.

The blowpipe created by the Chewong is complicated to make but provides a powerful and useful tool for hunting animals, requiring a combination of 15 species of plants to create including poisonous sap from the Ipoh tree (*Antiaris toxicaria*). The blowpipe is usually used for hunting monkey species such as long-tailed macaque (*Macaca fascicularis*) and birds such as the rhinoceros hornbill (*Buceros rhinoceros*). There are many Orang Asli communities which base their hunting on blowpipe similar to the Chewong such as Semai, Jakun, Batek, and Jahai (Baer, 2006).

Traps, machetes and spears are also used to hunt some bird species such as the Great argus pheasant (*Argusianus argus*), wild boar or Eurasian wild boar and Malayan porcupine (*Hystrix brachyura*). These types of equipment, the knowledge of wood properties needed and how to create an effective blowpipe will be transferred to group members.

3.7.6 Handicraft, skill of the Chewong

Only 17 species (7%) were related to making handicrafts which are used for family and personal adornment, as basketworks, toys for children, beddings or equipment decorations. All of these creations are considered disposable, and their use is temporary, a way of passing the time or creating something useful to use in the forest.

Example handicrafts include basketwork for carrying resources from harvesting, cultivation and camping deep in the forest which accounts for the majority of creations, also for bedding such as pillows (*Bixa orellana*) and making toys for children (*Pentaspadon motleyi*).

3.7.7 Ceremonies and rituals for great spirits

Species used for ceremonies and rituals are the smallest group of seven plant species which include young leaves for head decorations from *Crinum asiaticum* and resin for burning fire when chanting or singing to contact to spirit-guides (Howell, 1994) from

Neobalanocarpus heimii of these, the majority are used for spiritual ceremonies especially offerings to the spirits of the forest and siwang (a traditional performance). All plants are harvested from wild resources, and there is a taboo about harvesting to minimise damage to plants especially *C. asiaticum* which they must leave this species to grow after collecting some leaves. Many of the Chewong still keep the areas of *C. asiaticum* as sacred zones and do not clear these areas for any activities.

3.7.8 Animal food resources

This category is one of the largest accounting for (114 species or 47%). Of these species, the majority are wild food resources (94 species) for mammals, such as tapirs, sun bears, monkeys, rodents and birds (including hornbills).

Species such as *Neoscortechinia nicobarica* and *Koompassia malaccensis* are favourites for monkeys from July to August or *Dipterocarpus verrucosus,* and *Artocarpus lanceifolius* are only occasionally available (June-September). The Chewong start hunting in the subsequent period (October-December).

Other uses of these plant and animal relationships are to avoid or carefully pass through possible routes which have food resources of some dangerous animal species, such as sun bears. The Chewong also keep some plant species such as *Dillenia* spp, which are not consumed by humans but are essential for deer species (e.g. sambar deer) as they believe that deer are symbolic of forest spirits which they do not hunt.

The Chewong also believe that it is crucial to share fruits such as *Meliosma sumatrana* and *Pangium edule* with the surrounding animal community, so one day they will collect fruits to consume, and another day they will leave the area for animals such as squirrels and birds to consume the fruits sharing resources.

This category overlapped the Chewong food resource category. Species such as cassava and rice, grown within the crop fields, attract many wild boars, which will be trapped and eaten. These cultivated plant species have become food resources for some animals, such as wild boar, deer and birds, the Chewong then have to create fences to protect their crops and cultivation areas.

Of the species that make up the animal resources, many are used in planning for hunting, for fruit sharing and for keeping for animals which demonstrates their idea of coexisting in the same habitat.

3.7.9 Economic harvest for cash

Twenty-one plant species (9%) were collected for commercial harvest relying more on a combination of planted and wild occurring species. The main aim of planted species is not for trading but consumption; these products will only be sold when production exceeds consumption and when market prices are higher. Some of the wild-harvested products are widely available, such as damar from *Hopea beccariana* and *Shorea* spp., while others are regarded as high-value products (200 Malaysian ringgit per 10 gram) with restricted distributions and require a substantial time investment. Gaharu from *Aquilaria malaccensis* is an example of a high-value forest product which is difficult to find in the forests at present because in order to collect this resin the tree must be cut down to access the resin residing inside, a favoured technique used by the Chewong and outsiders. These recorded plant species are one part of non-timber forest products which the Chewong can collect and gain money from which will be informed more data and discussion of the Chewong NTFPs in chapter 5.

3.7.10 Chewong ethnobotany and traditional forest knowledge

A total of 243 species were recorded relating to the traditional knowledge of the Chewong which is passed down through generations, allowing them to perform a range of functions necessary for survival in the forest setting. Comparable with the traditional knowledge of many other Orang Asli in Malaysia such as Jah Hut, Semai, and Temuan (Azliza et al., 2012; Lin, 2005; Ong et al., 2012; Samuel et al., 2010). Focussing on medicinal plants, the number of plants found to be used by other tribes in this category were much lower than that of the Chewong ethnomedicinal knowledge. Hmong of Laos (Corlett et al., 2003), the Penan of Malaysia (Brosius, 1991), and the Dayak tribes of Indonesia (Crevello, 2004; Mulyoutami et al., 2009) all continue to live in and primarily rely upon the forests. Their usage of the forest for fuel, building material, and an assortment of other products from resins to rattan to mushrooms, has always been heavy. Ethnobotanical knowledge of indigenous people in the tropical forest of the other parts of the world was found. For example, the Amazon forest (Reyes-García et al., 2006; Riu-Bosoms et al., 2015), India and Bangladesh (Islam et al., 2014; Yabesh et al., 2014; Prabhu et al., 2014), China (Ju et al., 2013;

Yuming et al., 2004) and Africa (Mapara, 2009; Urso et al., 2016) still requires further research to understand the intimate relationship between humans and plants.

The original naming system employed by the Chewong is simple and very effective at classifying plant species and highly diverse. It is however unique and different from the modern day scientific taxonomic naming system as pointed out by (Berlin et al., 1966). The Chewong do not have unique names for each species but instead, group plants based on similar characteristics, for example, the name Penyara describes some trees species which have red sap (*Knema laurina*, *K. scortecchinii* and *Myristica furfuracea*) and these are found only in wild plant names.

This makes sense for survival in the forest as naming individual trees is time-consuming and memory exhaustive. The plant grouping which has similar characteristics likely to have similar properties for use are more efficient. Also, as the Chewong are known to have no written form of communication, the only way to pass on this plant knowledge is verbal, so collating names for similar trees allows knowledge to be passed quickly to the younger generation.

The original naming system is unique to this tribe. The names for plants of many groups are all stored in the elder's memories and makes documenting such information highly important as information can be lost between generations particularly as an indigenous culture such as the Chewong is exposed to increasing economic and social pressure from the 'outside world'.

3.7.11 Unexpected pressures on the forest

From the collected and analysed data, there are some interesting plants which the Chewong rely heavily on and require further research to determine the impact on the forest such as *Dialium indum* (tree), *Maclurochloa montana* (bamboo), *Pentaspadon motleyi* (tree) and *Shorea bracteolata* (tree). These species are utilised in five categories of the Chewong plant uses which are all from the wild. There are another nine species utilised in four categories, six of which are wild species, such as *Calamus manan* (rattan), *Canarium megalanthum* (tree), *C. pseudodecumanum* (tree) and *Shorea* spp. (e.g. *S. leprosula* (tree)) and three which are planted species such as *Baccaurea motleyana* (tree), and banana (*Musa acuminata* and *M.*× *paradisiaca*).

Some activities rely more heavily on wild forest species than others depending on the frequency in which they are performed and the quantity of the products required daily. Plants used for medicines and hygiene, construction, fuelwoods, hunting, handicrafts and ceremonial events are all collected from predominantly wild growing populations within the forest. In contrast, activities related to the gathering of food resources and commercial harvest rely much less on wild plant species but more on planted species.

3.7.12 Conservation implications

Understanding the traditional knowledge held by the Chewong is essential, particularly for gauging an idea on the potential impacts this community might have on the forest ecosystem. Our results show they have a firm reliance on wildly occurring plant species for many of their activities. However, when their activity exceeds the capacity at which the forest can provide, such as with sources of carbohydrates, they have developed ways of sustainably acquiring this resource as with the creation of cultivation areas.

The Chewong also show a tendency to use forest products efficiently, for example during the clearing process of cultivation they will use many species for building material rather than merely burning away the vegetation. This demonstrates an affinity for the importance of nature and an understanding of its limits.

By understanding the species utilised by the Chewong, the regularity of use and intensity, conservation policy can be developed to work with the Chewong supporting their way of life while also developing safeguards to prevent excess and unsustainable resource extraction in the forest. Mainly associated with the increases in modern-day pressure and temptations for the younger generation to exploit their forest knowledge to aid NTFP extraction for monetary gain.

Traditional knowledge case studies of Australia suggested in the same way that globally, the inclusion of biocultural values in broader biological conservation agendas necessitates enhanced engagement of indigenous people and their knowledge in new knowledge construction and decision-making that incorporates multiple perspectives (Ens et al., 2015). A shift towards the inclusion of indigenous biocultural knowledge in environmental conservation could enable more holistic socio-ecological systems approaches to managing the earth's resources that moves beyond tokenistic indigenous involvement (Leurs, 2010).

3.8 Conclusion

From our data collection, it is clear that the Chewong rely predominantly on wild-growing species for the majority of their activities within the forest. They possess an in-depth traditional knowledge of plants in a society which they practice every day. Knowledge ranges from edible plant species, medicinal treatments, construction and hunting to creation of handicrafts, performing ceremonies and rituals and fuelwoods.

It is essential to document and understand traditional knowledge of indigenous tribes such as the Chewong. The way in which they live sustainability, coexisting with nature, provides valuable lessons for modern lifestyles with little interest in a sustainable way of life, as well as benefiting conservation in understanding the plant and animal communities within the rainforest.

Despite this trend, traditional knowledge has positive implications for conservation policy. The Chewong know how to live in a sustainable low impact way. Thus integration into forest management practice is essential. It may be possible that by working with the Chewong, particularly the younger generations, to maintain their way of life, in turn reducing traditional knowledge loss and retaining enough knowledge to know how to use all these plant species in the future, this might reduce unsustainable and damaging activities within the forest in the future.

Traditional ecological knowledge and shared systems of beliefs can facilitate collective responses to crises and contribute to the maintenance of long-term resilience of social-ecological systems.

Simple resettlement outside of the reserve is no longer an option. It has the potential to increase tension between the governmental authorities and the Orang Asli communities and with increased economic pressure can drive a community to perform intensive NTFP resource extraction from the forest to meet economic needs.

Next Chapter

The planted species in the Chewong agricultural areas affect the forest structure and species composition especially forest regeneration this is discussed in the next chapter: the forest regeneration following shifting agriculture.

CHAPTER 4 FOREST REGENERATION FOLLOWING SHIFTING AGRICULTURE

4.1 Introduction

Human intervention has occurred in Southeast Asian tropical forests for over 11,000 years (Hunt and Rabett, 2014). Shifting agriculture in Southeast Asia has been researched and debated widely in the fields of social and natural sciences since the 1950s, for example, the ethnoecological approach to shifting agriculture (Conklin, 1954) studies expanded into other areas such as cultivation systems and their relation to social, economic, cultural or political systems (Li et al., 2014).

In Krau Wildlife Reserve, Pahang, the forest continues to be inhabited by several villages of the indigenous people of Peninsular Malaysia. There has been a gradual trend of declining numbers of villages within the forest through periodic resettlement. This has left a chronosequence of forest stands, from those being actively maintained, through those in various stages of recovery, to the intact forest. KWR thus offers an excellent context to study the impact of traditional shifting cultivation on the dynamics of Southeast Asian tropical rainforests.

The Chewong have three different types of cultivation; cassava plantation, paddy field, and fruit garden (see Figure 4.1). Home gardens are also found within residential areas, but these are not included as a type of cultivation because the area overlaps the settlement zone and products are low in quantity compared with other plantation areas.

Some former settlements with home gardens such as Gambir, Panjao and Pyapoz have become fruit gardens at present. Chewing palm (*Areca catechu*) is typically found in or around the Chewong settlements as a land marker, fruits can be harvested up to five times a year. Species chosen for cultivation can be both wild species from the forest and outside sources such as Kuala Gandah village or the town of Lanchang. For example, tobacco (*Nicotiana tabacum*), which is planted around Nering village, originates from Ulu Cempedak area and has also been planted in Senel village. Rambutan (*Nephelium lappaceum*) found in a Senel fruit garden is from Kuala Gandah.

Fruit garden, cassava plantation and paddy field areas are separated from each other and can be found around the Chewong settlements at distances up to 1 km (see Figure 4.2 a-h for images of the village centre and locations of agricultural areas).

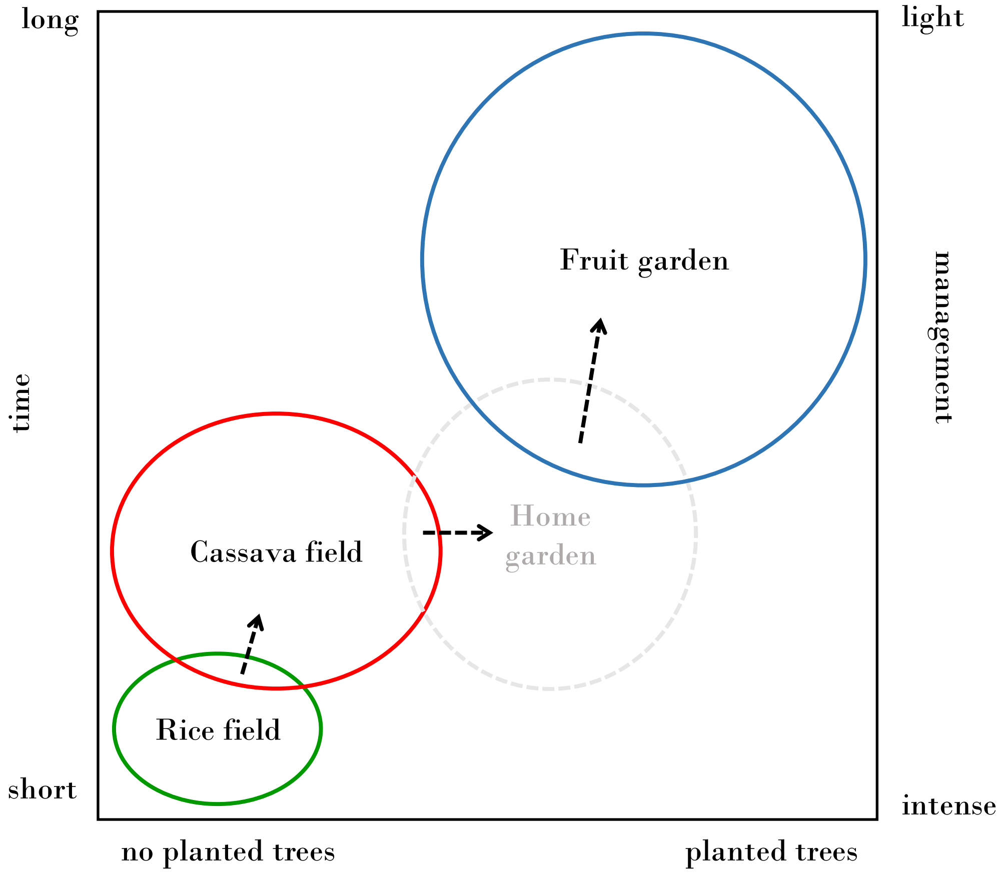


Figure 4.1 The Chewong cultivation systems arranged by the duration of a plantation, number of planted trees and management intensity, arrows indicate development to the next stage of cultivation or plots can be abandoned and left to regenerate back to natural forest

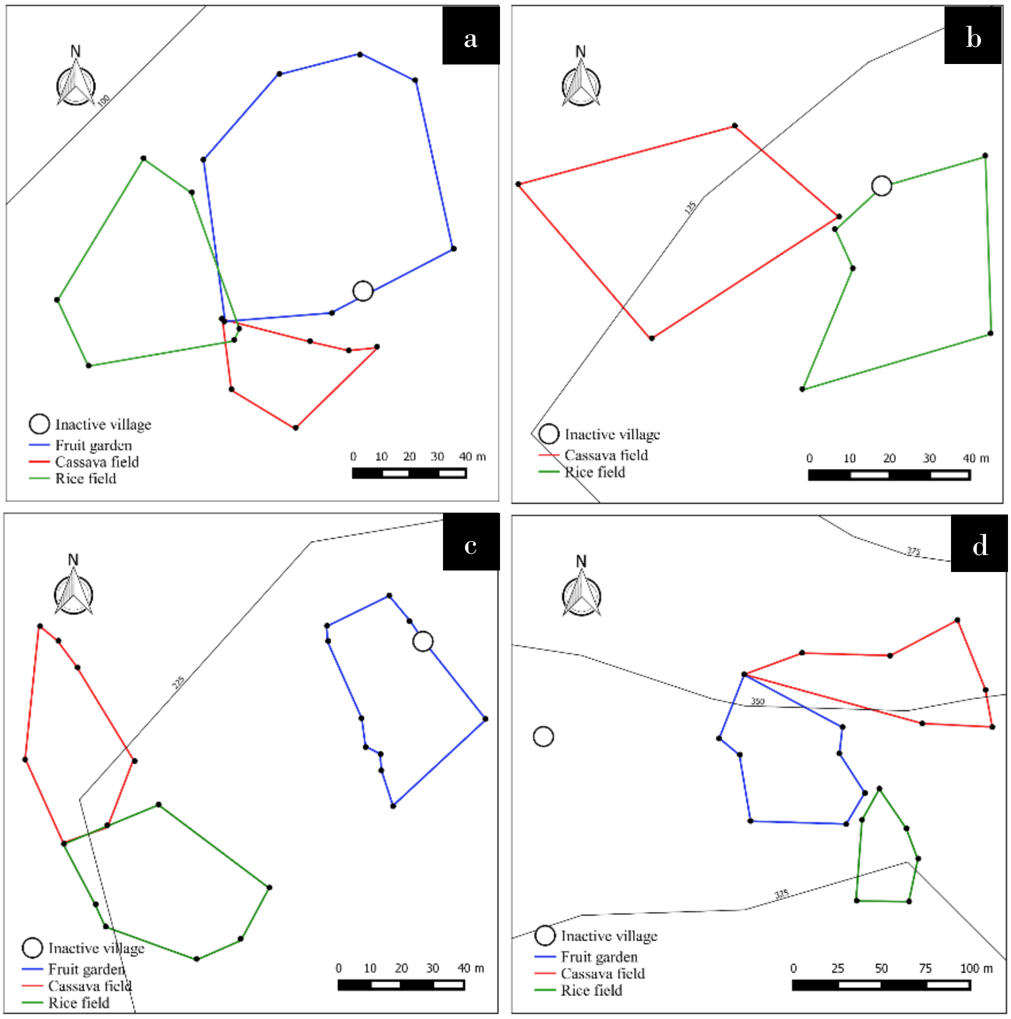


Figure 4.2 Example maps of the Chewong settlements and agricultural areas in 2015, four inactive villages were a. Titipata, b. Kenem, c. Gambir and d. Ulu Cempedak

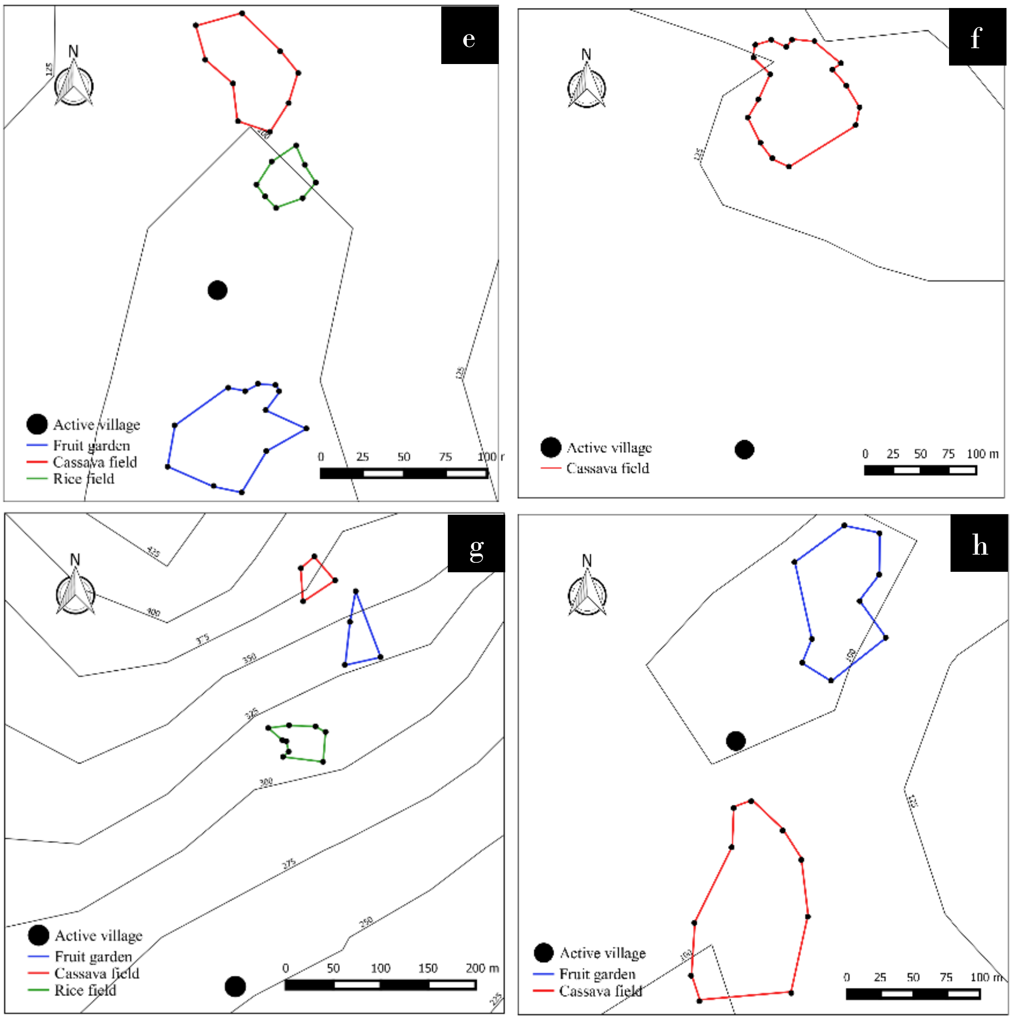


Figure 4.2 (continue) and four active villages were e. Senel, f. Selur, g. Pyapez and h. Baik

The main criteria for identifying the agricultural type of the land are based on the species planted along with the management techniques and planting period. These agricultural plots can be developed further into other agricultural types after their initial use has ended, moving from rice fields to cassava fields and eventually leading to fruit gardens.

Several criteria are followed by the Chewong for selecting areas suitable for cultivation. The presence of large trees such as *Hopea* spp. Indicates the ability to grow cultivated crops, also soil which is dark in colour and with the presence of sand, and a location close to a river system which is essential for building a settlement.

In the past only shamans could make decisions as to where to clear the forests for agricultural areas, asking for support and protection of their crops and fruit trees from the natural spirits of the forest. At present, most of the Chewong choose their new rice and cassava plantations in areas which were previously used to plant crops, following traditional beliefs and keeping traditional fruit tree gardens from their grandparent's generation while creating their home gardens.

Fruit gardens

A brief history of Chewong fruit gardens and cultivation methods

This type of agriculture is created for promoting edible fruit trees, usually found at low densities throughout the forest, extending Chewong food resources. The main families of tree, which are often planted within fruit gardens, include Bombacaceae (*Durio* spp.), Phyllanthaceae (*Baccaurea motleyana*), Moraceae (*Artocarpus* spp.), Sapindaceae (*Nephelium* spp.) and Achariaceae (*Pangium edule*). The six surveyed fruit gardens varied in size from 1,500 – 6,000 m^2 (see Figure 4.2 a, c-e and g-h).

The forest ground is thinned for planting each selected species, maintaining some of the original forest species. The species incorporated depend on the gardeners' selection. Most of the Chewong prefer durian (*Durio* spp.), payong (*Pangium edule*) and cempedak (*Artocarpus integer*). Some durian trees are more than 60 years old, for example, durian trees in the fruit garden of Tiab village where many Chewong settled 70-80 years ago. A large variety of durian are planted by the Chewong such as tebager, kijang, halaeluper, tuang, sangker, dauon, sawun and burong.

Seed planted fruit trees require several years to grow before the first fruiting event and harvesting period, especially durian. The fruiting season in Krau is generally from June to August. The Chewong will build temporary shelters in these areas to protect the fruits from other animals such as bears or monkeys for 3-4 months. Several edible species of seeds are also collected from the wild and planted such as *Saraca thaipingensis* and *Hodgsonia macrocarpa*.

The vegetation of fruit gardens is a combination of large trees (most are fruit tree species) and a thin understorey composed of saplings, seedlings, some palms and herbaceous plants such as *Alpinia* spp., See Figure 4.5, showing panoramic images of two fruit gardens aged 18 (Figure 4.3a) and 45 years (Figure 4.3b).

a

b

Figure 4.3 Panoramic photos of fruit garden plots; a. plot code: KBK1, elevation: 109 m, location: N3° 37.328' E102° 08.744' and b. plot code: KJK2 elevation: 350 m, location: N3° 43.868' E102° 07.702'.

Cassava field

A brief history of Chewong cassava fields and cultivation methods

Cassava is the main staple for many Chewong families in the forest of the KWR. Preferred varieties of cassava include Goh, roh, pastig, lang and gebuh. Every Chewong settlement has at least one cassava field ranging from 950 to 9,000 m^2 (Figure 4.2 a-h) depending on the number of family members and duration of stay in the area.

Planting cassava is a natural process, and cassava roots can be harvested from six months up to six years. After the forest is cleared and ground litter is burnt, many logs will be left in the field to act as both a fertiliser and to keep the ground temperature low. Cassava fields can be expanded by cutting 30 cm lengths off of the green stalks from one-year-old cassava plants and burying them in the soil with 1 m separations.

The best period for planting cassava is during the rainy season, although it can be performed all year round. The Chewong plant two or three varieties of cassava together in a single field to boost cassava productivity, continually replanting every year. The variety of cassava provides the Chewong with a stable carbohydrate source throughout the year, harvesting around 1-2 kg of roots per day to sustain a five-member family. Usually, cassava roots can be harvested around 2-4 years. However, some fields produce up to 6 years, depending on management and the number of pests. In some new cassava fields, wild banana trees such as *Musa gracilis* are found as well as commercial banana species such as *Musa acuminata*, which may be a new trend in planting crops in this area.

Many shelters are built around the fields, providing a place to rest while tending the cultivated plots. These structures can be developed further into large settlements if family members decide to stay in the area. Besides, many fences and traps are made to protect fields from deer and wild boar. The cassava field will be abandoned when the family owner resettles in another area.

Some villages which are close to the outside of the forest such as Kuala Gandah or Engang will trade cassava roots for additional supplies, especially during Islamic celebrations such as feast holidays. See Figure 4.4 for pictures of abandoned cassava fields aged 20 years (Figure 4.4a) and 40 years (Figure 4.4b). There are some large trees found in these recovering forests. However, the understorey remains thin with few saplings, seedlings and some palms. Many banana trees are found in current cassava fields and young regenerating forest plots aged six years.

Paddy fields

A brief history of Chewong paddy fields and cultivation methods

The Chewong at Tungul settlement cultivated a variety of hill rice more than 60 years ago, supporting at least three families, before replanting cassava in 2012. At Mempegal in around 1960, 15 Chewong from five families built five rice storage shelters but had to abandon these areas because of elephants. The Senel settlement area used to have a large tree (*Hopea* spp.) which was cut in a day in order to cultivate rice. Sizes of paddy field vary from 1,300 to 4,700 m^2 (Figure 4.2 a-e and g). More than three varieties of rice seeds such as nibong, langsad and queng are kept year by year to sustain the next few cycles of paddy field cultivation.

a

b

Figure 4.4 Panoramic photos of abandoned cassava fields; a. plot code: KKK2, elevation: 233 m, location: N3° 43.808' E102° 08.262' and b. plot code: KJK3 elevation: 373 m, location: N3° 43.908' E102° 07.685'.

Preparations before cultivating paddy fields begin one or two months before the ideal planting period in September by clearing and burning the forest. Temporary shelters are built during this clearing period and kept until harvesting time, which generally occurs in January or February. The Chewong paddy fields are maintained by family members performing maintenance and sometimes trapping pests such as boars, birds or other wildlife which attempt to consume the rice.

The estimated productivity of a Chewong rice paddy per half a hectare of land is around 1,000-2,500 gantang (the traditional rice weight measurement unit used in Malaysia, a gantang, is a mass of about 2.54 kg). Natural pests can sometimes limit this to about 625 gantang in some years. 1,250 gantang of rice can feed five family members for three to four years alongside an additional small cassava field.

After harvesting the crop, the field is then abandoned or shifted to cultivate chilli, banana and cassava if some family members want to live in this area longer. The majority of the product will be used as staple carbohydrate, but some will be shared with other families, and some will be traded to acquire additional items such as salt, sugar and batteries.

Not all Chewong villages have current or abandoned rice fields. In 2015 there was only one family who continued to plant hill rice while the others relied predominantly on cassava plantations for their staple carbohydrate source. One reason for this is that paddy fields require more workers and maintenance than cassava fields and can only be harvested once per year. Examples of abandoned rice fields are shown in Figure 4.5, ordered by time since abandonment at three years (Figure 4.5a) and 15 years (Figure 4.5b). The young recovering forest contained no trees, dense shrubs and many bananas while old abandoned rice fields have few trees and very thin understorey with a few seedlings, palms and some plots have lots of *Alpinia* spp.

a

b

Figure 4.5 Panoramic photos of abandoned paddy fields; a. plot code: KSK2, elevation: 101 m, location: N3° 39.494' E102° 09.752' and b. plot code: KKK3 elevation: 222 m, location: N3° 43.787' E102° 08.278'.

4.2 Aim and objectives

Main aim: to describe Chewong agriculture and its effects on tropical forest regeneration.

Objective: 1. to describe main factors which affect the forest regeneration process

2. to compare the effects of different agricultural patterns on the structure and composition of recovering forest

4.3 Method

Ecological fieldwork was applied for this study. Approaches from forest ecology and techniques were used following a manual of forest ecology methods (Newton, 2007).

4.3.1 Land use classification-mapping and labelling

Preliminary fieldwork in July 2012 collected details of study sites to plan further work in agricultural areas and other sampling sites. The aim was to test survey techniques and record all details which could affect forest structure and composition, such as type of agricultural areas, agricultural area size, the pattern of cultivation, the topography of study sites, and land use history.

Plots, villages and routes were surveyed using a GARMIN 62s GPS and BaseCamp® program, recording points and tracks for area mapping. QGIS was used to present GPS data and maps. Details were recorded about each village along with the type and status of agricultural areas, whether active or abandoned. Location data included details of resettlement of some Chewong families to indicate active and inactive villages. These were documented from July 2012 to July 2015; see Figure 4.6.

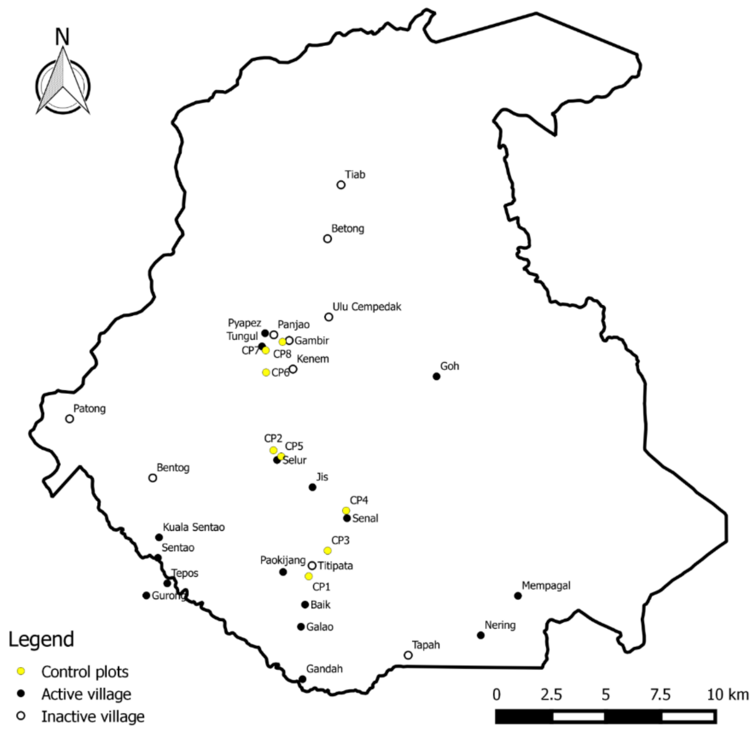


Figure 4.6 Location of control plots in KWR, following the main trail of Chewong settlements

4.3.2 Sampling plots

Plot selection

The eight natural forest sites used as control sampling plots were selected using Chewong criteria for agricultural plots; see Figure 4.6 for the location of control plots, see Figure 4.7 for panoramic photos of control plots.

Plot size

Plantation area size was estimated from the marked boundaries by the Chewong guides and the plantation owners. The straight line from a central point to each corner was measured, and Heron's formula was used to calculate the area (Alperin, 1987).

Plot age

Plot age information was derived from interviewing the Chewong guides and related families who have resettlement at present or were the last abandoners. The age of fruit garden referred to who opened the land for planting fruit trees and when, but the age of crop plantation areas, both cassava and paddy field, were included when these areas have been abandoned. Several repeat plantation time were recorded, but these were different from different interviewees. Moreover, the owners did not have confidence about the exact times and period of their cultivations, so a rough estimation of numbers was made.

Vegetation measurements

A circular plot was placed at the centre of each cultivation and control plot, defined as either control, fruit garden, cassava field or paddy field. Varying radii (r) were used for measuring different functional groups; r = 2.25 m for seedlings, r = 4.5 m for *Alpinia* spp. (Zingiberaceae), shrubs and palms, r = 9 m for banana and saplings (1 cm < dbh < 10 cm) and r = 18 m for trees (dbh ≥ 10 cm), referred to dbh measurement techniques using a diameter tape (Husch et al., 2002; Newton, 2007). Several plants within each functional group were recorded. Distance from the plot centre to each sapling and tree were also recorded. Also, *Alpinia* spp. and banana trees were counted in the sample plots because they were found in high numbers when cultivation area plots were set.

a

b

Figure 4.7 Panoramic photos of natural forest plots; a. plot code: CP5, elevation: 111 m, location: N3° 40.951' E102° 08.113' and b. plot code: CP7 elevation: 202 m, location: N3° 43.567' E102° 07.728'.

Logs were recorded using a 50-m line transect (North-South direction). Log diameter, length and decay status were recorded. The decay class of logs was designed, following the decay class of Eaton and Lawrence's study in 2006; see Table 4.1.

Table 4.1 The decay class of Eaton and Lawrence's woody debris study (Eaton and Lawrence, 2006)

Class	Debris characteristics
1	Coarse woody debris is in the least decayed state, with tremendous and fir bark, and twigs and leaves still attached.
2	Woody debris is still solid, have great bark that may have been peeling or burned, and generally lacked fine twigs and leaves.
3	Debris is typified by the absence of bark, occasional spongy surface, firmness when the pressure was applied by foot, and solid branch stubs.
4	Debris lacks bark and branches, the outer surface may have been case-hardened, and the inner wood was spongy or powdered.
5	Lacked shape and is predominantly powdered wood.

Between 2013 and 2014, 25 agricultural areas were selected to set sampling plots. For reference to the natural forest, eight control plots were chosen in locations and possible for use as future cultivation areas follow the Chewong criteria for selecting plantation areas.

4.3.3 Recording and identifying tree species

Local names of plants within plots were collected by surveying, interviewing Chewong plant specialists such as shamans and village leaders. Text and photographs recorded the specific details of each plant species such as bark, stem, leaves, flowers and fruits.

Plants were sorted by morphology into family, genus and species using plant characteristics (Beentje, 2012). Families and genera of trees were identified using the field guides of Keller (2009) and LaFrankie (2010). Species identities were checked against Chua and Saw (2006), Plants of Southeast Asia (Slik, 2009) and The Plant List (2013).

4.4 Data analysis of vegetation structure and composition

Analysis of variance (ANOVA) was used to test for differences between the plots. Coverage was calculated to assess the completeness of sampling, defined as the proportion of the total number of individuals in a community that belong to the species represented in the sample (Chao and Jost, 2012). A species accumulation curve was used to show the rate at which new species were found using the cumulative number of species as a function of effort.

Following the current consensus for analysing species diversity (Tuomisto, 2010), Hill's numbers were calculated to provide complementary information on the richness and evenness of assemblages (Hill, 1973). Hill's numbers are defined to the order q (^{q}D), with estimated species richness (^{0}D) weighted towards rare species due to its insensitivity to relative frequencies, exponential of Shannon's entropy (^{1}D) weighted towards common species, and inverse of Simpson's diversity (^{2}D) weighted towards highly abundant species.

Non-metric multidimensional scaling (NMDS) was used based on a Bray–Curtis dissimilarity matrix to assess how the composition of species changes between agricultural plots, displaying pairwise dissimilarity between objects in a low-dimensional space. An analysis of similarity (ANOSIM) was performed to test for a difference among plot species composition and abundance. This grouped samples according to the a priori hypothesis that they would differ among habitat types. Sorensen Index of dissimilarity was used to calculate turnover between plots and assess the similarity between plant communities using presence and absence data.

Regression analysis was used to estimate the relationship between a dependent variable from the plant community data and an independent variable such as the age of plots.

All data analysis was performed using R version 3.2.2 and package vegan 2.3-4 (Oksanen et al., 2016; R Development Core Team, 2016)

4.5 Results

4.5.1 General plot data

In total, 33 circular plots were surveyed; 8 control plots in natural forest areas, six fruit garden plots aged 18-55 years old, 11 cassava field plots in current and abandoned cassava fields aged 6-40 years old and eight paddy field plots in current and abandoned rice field aged 1-50 years old. These were sampled to study the structure and composition of regenerating forest.

The average size of cultivation areas was 3370 ± 2280 m^2 (± SD) and did not differ among plot types (F = 1.2, P = 0.314). The average distance to the nearest village for controls was 840 ± 590 m, fruit gardens 130 ± 130 m, cassava fields 140 ± 150 m, paddy field 160 ± 140 m and did not differ among cultivation types (F = 0.1, P = 0.945).

4.5.2 Floristic composition

In total, among all four types and plots, 206 species of tree were documented, of which 90 were identified to species, and 116 were identified to family or genus or could not be identified and were considered as morphospecies. Families with the highest number of species in the natural forest are Leguminosae, Moraceae, Dipterocarpaceae, Phyllanthaceae and Burseraceae while in the cultivation fallows are Leguminosae, Moraceae, Malvaceae Dipterocarpaceae and Euphorbiaceae.

4.5.3 Structural composition

Number of trees (per plot) in control plots is three times greater than in all agricultural plots (F = 11.8, P < 0.001), however, fruit garden plots have a slightly higher number of trees than cassava field and paddy field (see mean±SD of number of every functional group per plot in Table 4.2). The sapling stem density (per plot) in control plots is double that in agricultural fields (F = 8.2, P < 0.001). The number of seedlings is four times greater in control plots than cassava or paddy fields (F = 5.4, P = 0.004). The number of palms in control plots is greater than in all agricultural plots (F = 10.2, P < 0.001). The number of *Alpinia* spp., in abandoned paddy fields and fruit gardens is greater than in control plots where they are largely absent (F = 3.7, P = 0.05). The number of shrubs in all cultivation plots is greater than in control plots (F = 10.2, P < 0.001). The number of bananas is not different among plot types (F = 1.2, P = 0.324).

The basal area in control plots is similar to fruit gardens, but twice that in cassava and paddy fields (F = 6.2, P = 0.002).

The number of logs (F = 1.1, P = 0.346) and the biomass of logs (F = 2.2, P = 0.114) does not differ among controls and cultivation plots. However, the log decay class of control and fruit gardens are greatly different from that of cassava field and paddy fields ($F_{3,110}$ = 17.43, P < 0.001); all mean±SD of log data were shown in Table 4.3.

Table 4.2 Mean±SD of a number of different functional groups per plot and basal area of trees and sapling in square metres per plot

Functional group	Control	Fruit garden	Cassava field	Paddy field
Tree	608.9±39.3	281.5±91.8	185.7±200.7	223.4±214.6
Sapling	3127.8±1142.7	2068.8±1649	1146.3±1059.7	412.5±680.1
Seedling	48473.7±39351.4	23150.0±15128.2	11827.4±9363.8	10920.3±11327.8
Palm	4006.7±2910.6	890.4±1509.3	299.9±602.2	176.8±499.9
Shrub	19.6±55.6	0±0	385.7±1279.1	1453.4±3686.6
Alpinia spp.	196.4±555.5	3378.2±3870.2	999.9±1974.1	3731.8±4176.4
Banana	0±0	52.4±77.2	264.3±478.6	112.9±303.9
Basal area (m^2)	4.1±1.1	4.4±3.5	1.5±1.5	1.3±1.2

Table 4.3 Mean±SD number of logs, log biomass in square metres, and decay class per plot

Per ha	Control	Fruit garden	Cassava field	Paddy field
Number of log	0.5±0.2	0.2±0.1	0.5±0.6	0.1±0.1
Log biomass (m^2)	4.3±7.7	0.6±1.3	0.3±0.4	0.2±0.2
Decay class	3.4±1.0	3.2±1.6	1.8±1.0	2.1±1.2

4.5.4 Effect of time since abandonment on structural composition

A significant positive correlation was found between the basal area of plots and abandonment age ($r2 = 0.151$, $t = 2.2$, $P = 0.031$); see Figure 4.8.

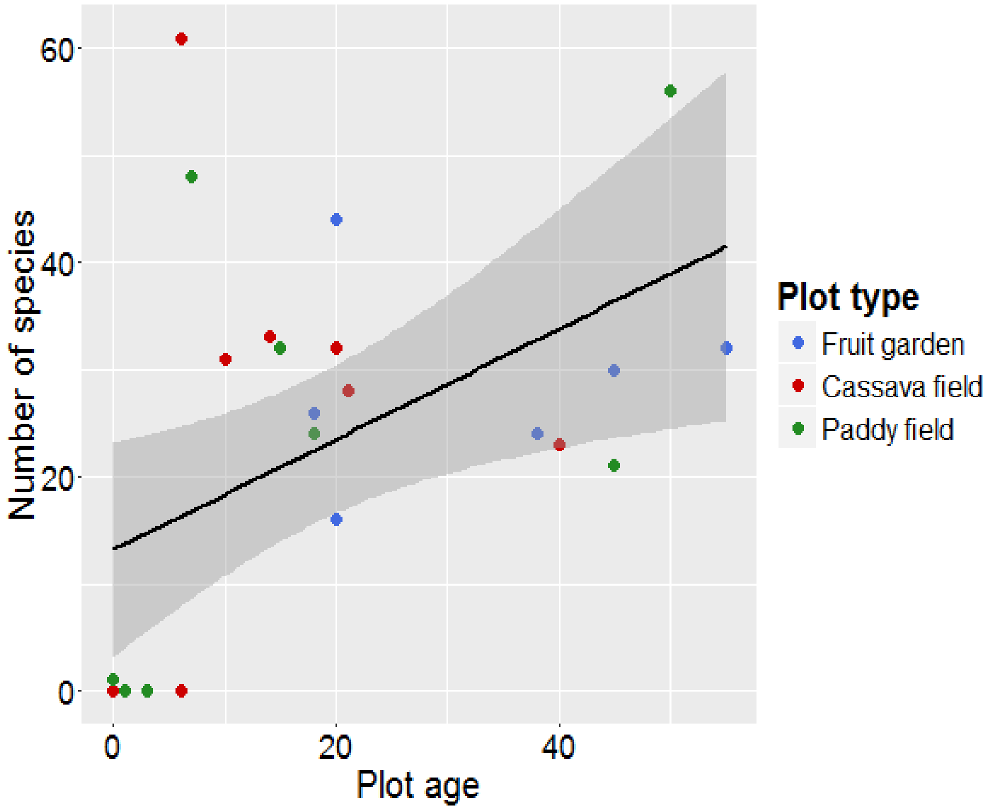


Figure 4.8 Regression analysis of plot age and number of tree species with a shaded confidence region.

A significant positive correlation was found between the basal area of plots and abandonment age ($r^2 = 0.151$, $t = 2.2$, $P = 0.031$); see Figure 4.9.

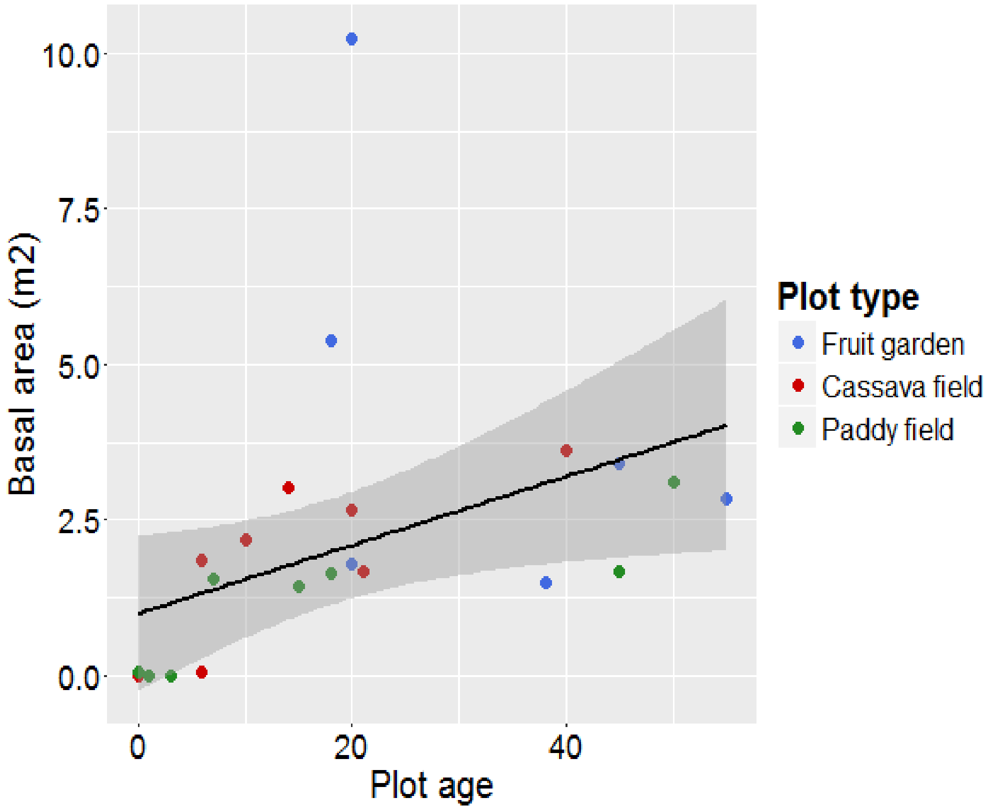


Figure 4.9 Regression of time since abandonment against basal area, with a shaded confidence area.

No correlation was found between the number of saplings and time since abandonment in agriculture areas (r^2 = 0.028, P = 0.423) and between the number of species and time since abandonment in agricultural areas (r^2 = 0.127, P = 0.089).

4.5.5 Species composition

Sample coverages in control, fruit garden, cassava field and paddy field plots (0.8754, 0.7800, 0.7901 and 0.8513 respectively) is high which indicates that there is consistent data for diversity analysis.

The species accumulation curve (Figure 4.10) suggests that there are further species to be detected within control, which has the highest observed species richness, while fruit garden, cassava and paddy field are lower.

Types of sampling plots and species abundance distributions are presented as Preston plots (Figure 4.11). Species relative abundances from different data sets show similar overall patterns with a predominance of singletons.

Diversity demonstrated significantly greater values in control plots relative to all other types in observed species richness and estimated species richness ^{0}D levels (F = 18.2, P < 0.0001 and F = 9.5, P < 0.001). Additionally, diversity indices revealed significantly greater values in control plots at both ^{1}D level (F = 9.7, P < 0.001) and ^{2}D level (F = 8.9, P < 0.001). This signifies that natural forest contains a greater effective number of species than other plantation areas, suggesting greater evenness in abundance of tree species (Table 4.4).

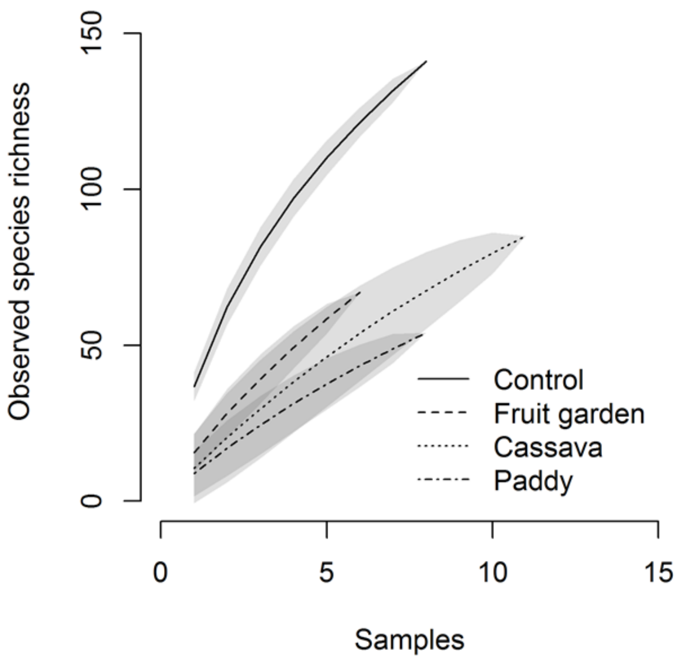


Figure 4.10 Species accumulation curves for control natural forest and three types of agriculture; fruit garden, cassava plantation and paddy field. The shaded areas represent standard deviation

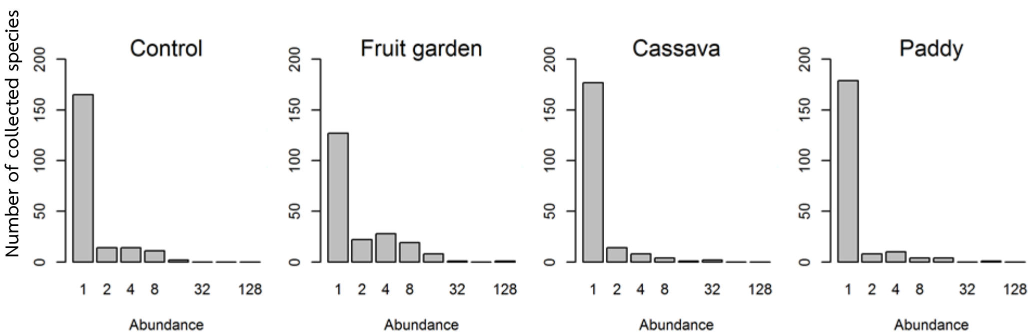


Figure 4.11 Preston plots of species abundance in control plots, fruit gardens, cassava fields and rice fields

Table 4.4 Diversity indices of documented tree species for control plots, fruit gardens, cassava fields and rice fields, mean±SE (S_{Obs}, observed species richness; S_{Chao}, estimated species richness; $e^{H'}$, exponential of Shannon's entropy H; 1/D, the inverse of Simpson's diversity index)

^qD	Metric	Control	Fruit garden	Cassava field	Paddy field
	S_{Obs}	36.7±1.7	15.5±2.7	10.5±3.5	8.8±2.7
^0D	S_{Chao}	80.8±9.6	34.5±5.1	22.9±9.4	23.4±7.9
^1D	$e^{H'}$	5.6±0.7	2.7±0.5	1.8±0.4	2.1±0.5
^2D	1/D	5.2±0.7	2.4±0.6	1.2±0.4	1.6±0.6

A Hill series plot demonstrated the relative abundance of species for all agricultural plots, with lower diversity compared to the control area which have the highest number of effective species at all levels (Figure 4.12).

An analysis of similarity (ANOSIM) indicated the difference between types of plots ($R = 0.5223$, $P < 0.0001$). Sørenson's Index of dissimilarity calculated greater β diversity for intra-habitat diversity of control plots than intra-habitat diversity of all cultivation types; see Table 4.5. Likewise, inter-habitat diversity was higher between cultivation types and lower between control and all cultivation types suggests natural forests are more different from agricultural plots than they are from each other as natural forests have higher β diversity.

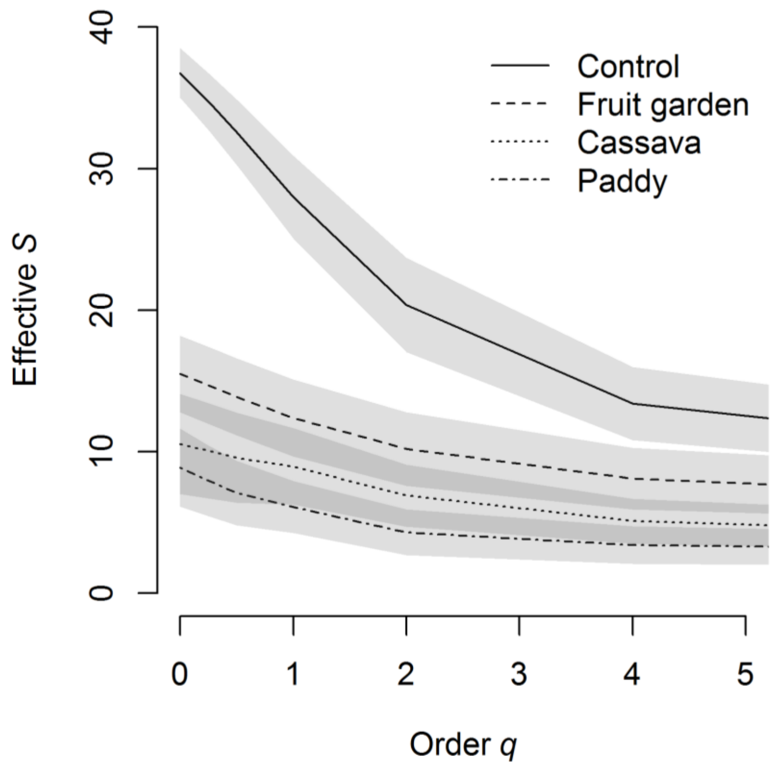


Figure 4.12 Hill series plot is indicating species diversity for control, fruit garden, cassava field and paddy field plots, mean±SD (shaded area)

Besides, NMDS (Figure 4.13) demonstrated the similarity of plant communities in control natural forest plots, which were distinct from other plot types.

Table 4.5 Sørenson's Index of dissimilarity; mean±SD of β diversity

Plot type	mean	SD
Control vs Control	0.70	0.07
Control vs Fruit garden	0.95	0.05
Control vs Cassava field	0.92	0.07
Control vs Paddy field	0.93	0.04
Fruit garden vs Fruit garden	0.81	0.08
Fruit garden vs Cassava field	0.87	0.11
Fruit garden vs Paddy field	0.88	0.09
Cassava field vs Cassava field	0.90	0.11
Cassava field vs Paddy field	0.89	0.09
Paddy field vs Paddy field	0.85	0.09

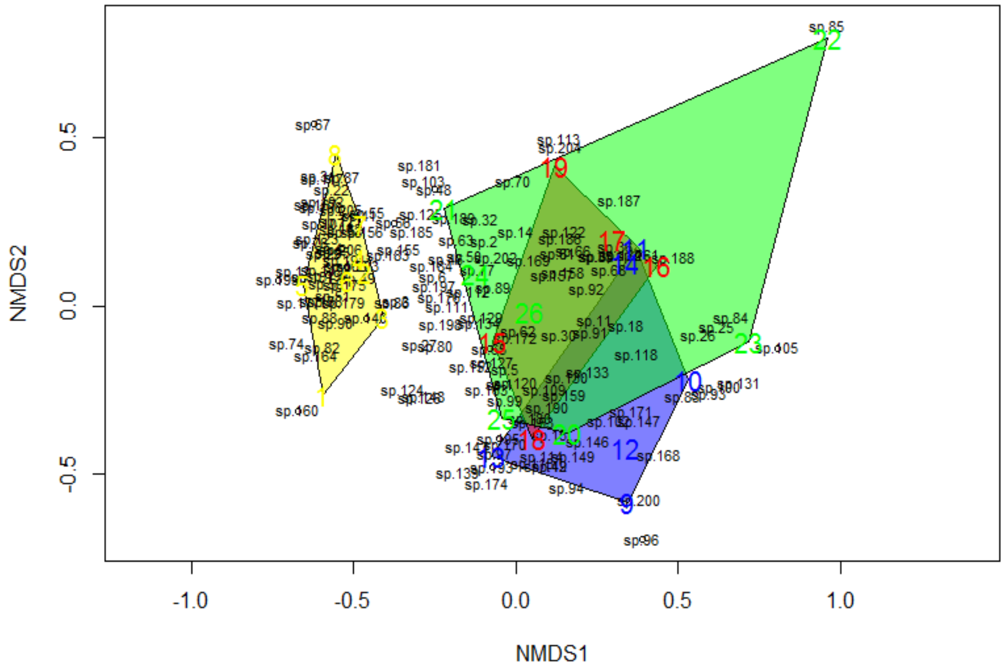


Figure 4.13 NMDS similarity plot of tree species in different types of plots; controls, fruit gardens, cassava fields and paddy fields

4.6 Discussion

4.6.1 Cultivation areas and natural forest structure and composition

Rice and cassava fields, cultivated to provide the Chewong with a sustainable, readily available carbohydrate source, both had variable effects on the trajectory of forest succession. Rice and cassava fields both had very different species composition to that of natural forests with much lower species diversity and reduced structural composition with a reduction in the number of trees, saplings, seedlings and palms while having a greater abundance of *Alpinia* spp. and shrubs.

Basal area levels within rice and cassava fields were also much lower than that of fruit gardens, however basal area was seen to increase with time since abandonment. Comparable results can be seen by work studying the recovery of swidden cultivation fallows in Laos which showed an increase in basal area ($p < 0.0001$) with increasing fallow age (Sovu et al., 2012). Suggesting the recycling and abandonment strategy employed by the Chewong allows some steady recovery towards a natural forest ecosystem.

Regeneration patterns in Laos also revealed a high number of bamboo clumps increasing significantly by 45% as the crop-fallow rotation cycle increased from one to three where as in Krau we saw an increase in *Alpinia* spp. and shrubs. Moreover, community characteristics of early recovery vegetation showed a significant role affecting the quantitative characteristics of tree and shrubs, as seen in abandoned land in South China (Ding and Zang, 2005).

In contrast, managed fruit gardens had limited effects on the structural composition of the forest. Fruit gardens had similar basal area to natural forest and an intact canopy but had lower numbers of trees, saplings, seedlings and palms. However, species composition was largely different between fruit gardens and that of natural forest plots, containing a lower diversity of tree species, with a distinct difference in the composition of the residing plant community.

4.6.2 Species diversity and conservation

Plantation areas are shown to have lower diversity than that of natural forest, using a multitude of comparative tests. These findings follow the same tend of regenerating forest following shifting agriculture all around Southeast Asia and globally. For example, slash-and-burn agriculture in eastern Madagascar and secondary forests on swidden cultivation fallows in Laos (Klanderud et al., 2010; Tigabu et al., 2009).

However, the regeneration pattern of KWR forest which includes human activities needs more data for analysing the potential for species conservation (Gardner et al., 2009), biodiversity conservation and agricultural sustainability in an eco-agriculture landscape. Alternatively, to discuss more regarding biodiversity conservation of the secondary forests (Scherr and McNeely, 2007) and increasing adaptations of shifting agricultural systems to an agroforestry system, the forest gardens which will create sustainability of swidden systems (Padoch and Pinedo-Vasquez, 2010).

Fruit gardens showed a positive trend in basal area recovery and tree regeneration similar to natural forest, whereas in cassava and paddy fields this recovery is much lower. Several trees, saplings and seedlings in natural forest tended to regenerate better than all agricultural areas although fruit garden plots are slightly higher than cassava and paddy field.

4.6.3 Effect of time on forest regeneration

The relationship between time since abandonment and number of trees, saplings, species and basal area are not clear, and it is possible that more time is required to see a recovery effect in these areas. Many studies have reported similar recovery patterns with fast pioneer species recovery but slow recovery of woody biomass taking decades before an effect is seen (Karthik et al., 2009).

However, there are some significant functional species in regenerating fallows such as *Alpinia* spp., which are found in high numbers in abandoned paddy fields and fruit gardens and absent in control plots, the number of shrubs in all cultivation plots is also higher than controls. These can refer to specific factors such as increased light in gap areas in tropical forest and probably high water in the soil. In regenerating fallows in Laos, the number of bamboo clumps increased significantly by 45% as the crop-fallow rotation cycle increased from one to three (Sovu et al., 2012).

4.6.4 Potential factors affecting the recovery process

Many aspects related to the cultivation technique employed will affect how a cultivated plot might recover. For example, the number of previous cultivation cycles along with the number of years spent cultivating will affect recovery (Lawrence, 2004; Uhl, 1987).

The microclimate of the recovering cultivation plot can also have adverse effects on recovery, low soil nutrients from years of cultivation, competition from existing vegetation and high levels of seedling herbivory and seed predation all potentially reducing the level of regenerating plant material (Aide and Cavelier, 1994; Uhl, 1987). The rodent seed predation and seedling herbivory are particularly relevant as our recent publication (Moore et al., 2016) found a very high percentage of rodent species from their camera trap study, indicating Krau may be a highly defaunated ecosystem with implications for seed dispersal.

Some forests can take up to 200 years to fully recover particularly in Asian rainforests due to the mast fruiting nature of the forest. Seeds required for recovery of an open area are only produced once every 2-7 years thus slowing the recovery speed of an area (Kennard, 2002; Van Gemerden et al., 2003).

Short fallow cycles up to 4-5 years also suit weedy species which prevent woody pioneer species from growing and saturating the soil seed bank with weedy species (Raharimalala et al., 2010)

4.6.5 Agriculture techniques and impacts on log decay process

Burning of logs and plant removal techniques are likely to result in a reduced number and biomass of logs in cultivation areas which were expected to be higher after clearing techniques. However, most of the excess vegetation cut in the clearing process can be used for construction material reducing the number of logs and the biomass. Logs were more decayed in both fruit garden and natural forests than rice or cassava fields. This decay process is affected by cultivation history (Eaton and Lawrence, 2006).

4.6.6 Shifting agriculture system and forest conservation

The Chewong agriculture system is a combination between shifting agriculture and fruit garden management each affecting the tropical forest by delaying the successional process and promoting human and animal foods which increase the basal area of forest stands (Moore et al., 2016). Thus forests can be viewed as processes of interaction between human and forest management systems which is the perspective of resilience system and human-forest coevolution.

Also, forest management systems of this combination between shifting agriculture and complex agroforestry systems have been found around the world (Messerschmidt, 1993; Warner, 1995; Wiersum, 1997). These are based on indigenous accumulative knowledge, the relationship of their behaviour and complex ecological systems in their localities (Gadgil et al., 1993). These knowledge-practice-belief complexes which relate to conservation of biodiversity, ecosystems and promote the community-based resource-management system are highly valuable. Maintaining a community's resource base by limiting access and imposing restrictions on the forest use should be considered.

There are influential factors of shifting agriculture which leave effects on the forest population densities and increased land pressures which result in shorter fallow periods, increasing numbers of weeds, pests and decreases in soil nutrients. These cause land productivity to decline, making the agricultural system unsustainable (Baudron and Giller, 2014; Cramb et al., 2009; Mertz et al., 2009). Balancing shifting agricultural systems with forest conservation for sustainable cultural and livelihood depends on people and forest management. Requiring knowledge of how agricultural land use evolves in landscapes with forest conservation (Dalle et al., 2011).

4.7 Conclusion

Chewong cultivation techniques have varying effects on both the structure and composition of the residing vegetation when compared to that of natural forests. Out of the three types of cultivation, fruit gardens appear to have the lowest impact on forest structure and composition, whereas rice and cassava fields are distinctly different to natural forest.

However, correlations were found between increased basal area and time since abandonment for all three types of cultivation plot suggesting recovery is taking place potentially over an extended time period. Some studies for example have found evidence that a fully recovered forest can take up to 200 years to reach levels resembling that of natural forest (Saldarriaga, 1987). In addition, these areas are occasionally reopened for cultivation which is shown to affect the recovery process (Lawrence, 2004; Uhl, 1987), with many additional factors affecting the recovery rates of these plots. This is in fact a highly efficient technique to reduce the need to open up fresh forest stand for cultivation.

This information is essential for developing conservation policy; it is clear some forms of agriculture such as rice paddy alter forest composition quite considerably whereas fruit gardens are a very sustainable form of agriculture. As long as cassava and rice fields are performed on a small-scale basis as they are currently, integration into conservation policy is viable with possible limitations on several new cultivation areas per every five years, unless it is a previously cultivated area, to reduce further damage in the reserve.

CHAPTER 5 CHEWONG IN A PROTECTED AREA

5.1 Introduction

Humans are active participants in both the disturbance and the recovery of natural systems. The accumulated knowledge based on complex natural resource use has developed a broad knowledge base of systems to understanding many important roles of biological diversity in the function of ecological services and natural resources (Gadgil et al., 1993). Human occupation can have a significant, long-term and lasting effect on local diversity. Resilience is a feature combining the socioecological system that includes both ecological and human components (Berkes et al., 2000; Gadgil et al., 1993)

The human overexploitation of forest resources was and still is the primary reason for the loss of forest cover (FAO, 2010). A deeper understanding of the dependency of society on forests is necessary (Ritter and Dauksta, 2013). This knowledge intimately involves and relates to the belief system and sustainable management. Evaluating the resilience of tropical forests involve more than merely understanding the ecological process of forest regeneration but include social partnership relationship (Buttoud, 2002). A cultural history bonds between people and forests relationships and forest values have changed, and new functions have emerged. The idea of sustainable forestry is no longer about securing a continuous wood supply; it includes the utilisation of other forest goods and ecosystem services (Wiersum, 1997).

The Orang Asli are the indigenous peoples of Peninsular Malaysia who rely on their natural environment and resources. More than 18 culturally and linguistically different sub-groups exist at present. The Chewong is one such sub-group who have been based on tropical forest around the central part of Pahang for more than 2,000 years (Simon, 2006). Their forests habitat was gazetted in 1923, and now they live under the government management system of the Krau Wildlife Centre, which is under DWNP and JAKOA. Chewong resettled themselves in, and around the Krau forest, before the Krau Game Reserve was set in 1923, the Emergency period in 1942-1989 occurred and before the creation of Kuala Gandah Elephant Sanctuary in 1989.

KWR is their homeland in which they have interacted and adapted themselves to fit with this ecosystem preferring the forest life (Howell, 1984). They are hunter-gathers, perform shifting agriculture, and plant fruit trees in this wildlife protected area, which raises arguments about deforestation and sustainability forest conservation in the future.

5.2 Aim and objectives

Main aim: to describe the Chewong society and economic change and attitudes towards forest

Objective: 1.to describe the factors which are shaping Chewong society and economy

2.to interpret Chewong attitudes and impact on Krau Wildlife Reserve

5.3 Methods

Fieldwork for this section of this study related with the Chewong ethnobotanical work (chapter 3) and fieldwork of forest regeneration examination (chapter 4) which are all related with the Chewong's way of life in the forest and changes in their society and economy. However, this part focused on ethnographic research which used both participant observation and informal interviewing techniques (Saukko, 2003) based on a questionnaire (Simon, 2006) seen in APPENDIX 1.

The questionnaire design followed the research questions, which focused on the Chewong ethnobotany, agricultural systems, and Chewong society and economy with forest relationships in mind. Besides, the questionnaire design will base on the concept of dealing between a socio-ecological system with interactions among the components for sustainability of indigenous livelihoods and the forest (Iwamura et al., 2014).

Our interviewees were randomly selected following the route, which brings us to the Chewong settlements and allowing us to meet some of the interviewees. Five active settlements were selected (see Figure 5.1); Kuala Gandah, Baik, Senel, Selur and Pyapoz. Firstly, because these villages were active within the few years of which this research covered, secondly, the distance from the interface village (Kuala Gandah) to an inside location was different for each village and thirdly, all members of a village accepted to be informants and supported this study. A focus group and in-depth interview technique were employed. This research interview occurred in June-September 2014. However, the participant observation of the Chewong culture and society started since June 2012.

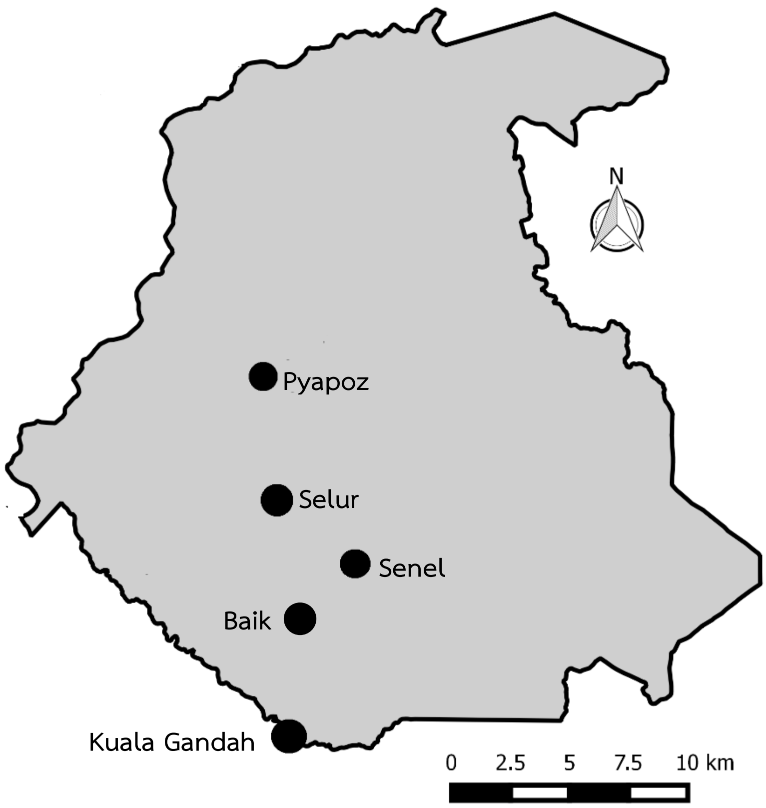


Figure 5.1 Location of four sampling villages in Krau Wildlife Reserve, following the two main trails from the south part to the north; Kuala Gandah-Baik Senel-Pyapoz and Kuala Gandah-Baik-Selur-Pyapoz

Our Malay and Chewong guides were very important communicators who reduced the language boundary between the Chewong and the researcher. English, Malay and Chewong words were kept as records in field notebooks during the fieldwork, both from observations and interviews.

5.4 Results

5.4.1 Informants of five villages

Samples (respondents by gender; see Table 5.1) were taken randomly from five selected active villages along the main trail from Kuala Gandah village at the Elephant Sanctuary to Pyapoz village with a total distance of 15 km. Age of informants ranged between 10 – 72 years old. Male and Female informants were 56% and 44% respectively. The female members of the Chewong do not generally experience meeting strangers unlike that of the males in the group who keep contacting outsiders especially traders such as Malaysian middleman. Also, some Chewong females declared that they were shy, and therefore our data possibly has some male bias.

Table 5.1 Number of informants who participated in observations, participated focus groups, and some of each village had in-depth interviews especially family leaders and males

Village name	male	Female
Kuala Gandah	18	10
Baik	10	8
Senel	7	8
Seluh	9	6
Pyapoz	5	7
Total	**49**	**39**

5.4.2 Five villages and unique characteristics

Kuala Gandah is the largest Chewong settlement close to the Elephant Sanctuary. The settlement consists of around 18 families and more than one hundred individuals, of these individuals 29 Chewong informants accepted our request for participation in this research. The village is frequently visited by outsiders such as missionaries, health workers, tourists, and others. In the village, there is a preschool, a Muslim prayer hall, and a small shop. Some of the children go to school, either Preschool in the village or Primary School in Bolok. Of the 18 families in Kuala Gandah, nine have converted to Islam and six to Christianity. Gandah is the name of a small stream running nearby the village. People in Kuala Gandah practice hunting, gathering and cultivation less than those inside, and rely more on purchased food goods. The dependency on purchased goods has increased such as an increased number of electrical devices are now present in many households. Their traditional house was built by various materials such as rattan and bamboo, which collected from the forest, attached the house built by the government. Many males in the village have their motorbikes, and some have cars.

Baik is a settlement located inside KWR located within an hour's walk from the Elephant Sanctuary. A family of Tamier, 18 individuals, accepted to research informants and supported accommodations and foods for us. The village is frequently visited by the outside Chewong and visitors from outsiders such as the Krau Center patrolling staffs, rangers, and researchers of forest and conservation studies. In the village, there are a few shelters, a home garden, fruit garden and cassava plantation area with fencing and traps around. None of the children go to school, neither Preschool in the village nor Primary School in Bolok. Of the Termier families in Baik, all continue to follow the Chewong beliefs. Baik is the name of a small stream running nearby the village. People in Baik practice hunting, gathering and cultivation every day, and rely on non-timber forest products and cash for the purchase of goods. The monetisation has increased, for example, Tamier has occasionally joined the other Orang Asli tribe the Jah Hut for activities to collect some types of NTFPs and cassava, which are sold to outsiders especially during big ceremonies such as Hari Raya celebration. Their house was traditionally built by various materials such as rattan and bamboo collected from the forest. They have at least two motorbikes for their NTFPs business such as collecting in the forest and bringing to the city such as Lanchang.

Senel is the Chewong settlement set far from the Elephant Sanctuary around four hours by hiking, consisting of around 15 individuals in one of the families of respondent 1 who are familiar with many researchers and is a shaman of his family and relatives. All family members accepted and participated to be informants of this research. The village is frequently visited by other Chewong, outside researchers, rangers, and the Krau Centre staffs. The village can be reached using motorbikes. In the village, there are several shelters, a home garden, cassava plantation zone and hilly rice fields. Around one hundred rubber trees used to be planted around this village in the past but only limited numbers can survive from many deer and wild boars. Some of the children had experiences of going to Primary School in Bolok but stopped because of some circumstances such as lack of money for transportation and difficulties of learning in the school system. Some family members have converted to Islam following outside Orang Asli villages such as the Jah Hut. Senel is the name of a small stream running nearby the village. People in Senel practice hunting, gathering and cultivation every day, males have their motorbikes especially teenagers. They rely on forest food and heavily collect NTFPs such as resin, gaharu and honey. Also, they have electrical devices such as a mobile and often visit Kuala Gandah and participate in parties with relatives there. The dependency on purchased goods has increased continuously.

Selur is the Chewong settlement of respondent two and his family, which takes around five hours to reach by walking from the Elephant Sanctuary. 15 Chewong informants accepted and participated in this research. The village is rarely visited by outsiders. In the village, there is a home garden, big cassava plantation area with solid fencing and not for hunting. No children go to school; all prefer to learn how to live inside the forest and perform agriculture and collection of NTFPs. Respondent two and other males have their motorbikes and mobile.

Respondent two and his wife converted to Christianity in 2001 and often participate in the Christians' Saturday night activity in Kuala Gandah. Selur is the name of a small stream running nearby the village. People in Selur practice hunting, gathering and cultivation intensively and rely on selling NTFPs.

Pyapoz is the deepest active Chewong settlement which is very far from the Elephant Sanctuary, around 8 hours walk. No motorbike can reach this area because there are several large rivers and streams along the way and the area is a hilly location. Respondent 3 and his family accepted and participated in this research with 12 informants. Outsiders rarely visit the village except for some Chewong, especially those who collect NTFPs deep in the forest. There are at least three cassava plantation areas, home garden and a 60 years old fruit garden. None of the children go to school or attend activities outside KWR. Every family members practice Chewong beliefs in their daily life. Pyapoz is the name of their ancestor land nearby the village. People in Pyapoz intensively practice hunting, gathering and cultivation and rely more on NTFPs. Searching for money is one of the main goals for the family to purchase goods and benzene for their chain saw. The dependency on purchased goods has slightly increased continuously especially in teenagers. Some brought new mobile phones after they were able to sell a large amount of honey in 2014 which was the year of mast fruiting in the KWR.

5.4.3 The Chewong sharing concept

All family members, especially those who stay inside the forest have equal roles in agricultural work and does not relate to their status in the family. Some children start helping family activities whenever they become old or strong enough to do so. There is no order or rule from parents or older brother or sister to do so. The foods they harvest or hunt will be shared equally among the family members regardless of whether someone has helped in the planting of the crops or not. Sharing product follows the rule of punen in the Chewong cosmology (Howell, 1984; Howell, 1985; Lillegraven, 2006). We once witnessed a man who performed hard work collecting medicinal herbs for three weeks to gain enough money to purchase a new family chain saw for faster forest clearing for cassava fields. However, the Chewong in Kuala Ganda have changed their interpretation of this rule, from initially that from every Chewong will follow the punen sharing rule, so they will not share their collection NTFPs from the forest if no one sees them and all can be shared excepted money (Lillegraven, 2006). Also, a development towards decreased sharing can be detected.

The produce of planted crops will belong to the family. They do not have a specific system for sharing crops within the family. It does not matter who plants the cassava, as long as they were planted in their ancestral land those will belong to the family, the crops are equally shared after picking mainly for eating. The Chewong collect cassava-based on the number of months after they have planted the crop.

The money is different from products of nature or fruits from trees. When some Chewong earn money that will belong to them, not for the family, however, the head of the family typically shares money and will use it to buy needed supplies and household goods, sometimes when a family member gets some money, they will share with their family members too. However, this does not implicitly mean that it is their responsibility to share the money they earned for the family.

5.4.4 Agriculture systems and forest traditional knowledge

The land of Krau forest is their ancestral lands, which means it belongs to them. Their traditional way of life created a behaviour of abandonment and relocation of their settlement around the forest every few years related to this tropical forest regeneration pattern. One Chewong male said that "these lands were belonging to the Chewong, passing to them from their ancestors and he would keep that way of belief. He had to pass them to his children as his ancestors did".

Choosing the right place for a plantation is an important step. Firstly, they will look for good soil which must have some sand and a dark colour. Secondly, finding healthy plants and tall trees growing in that land indicating suitability soil for planting rice or cassava. Rice plantation cannot be located on the hills because the land is hot and has less water for rice.

Three types of agricultural plantation were found in the Chewong agriculture systems, which are cassava plantation, hill rice plantation and fruit garden. These are integrated into the Chewong forest management. They have accumulated knowledge about their homeland, which they transfer from generation to generation if the next generation decides to continue this traditional way of life. The Chewong learn to perform agricultural tasks whenever they feel they are ready. One Chewong said that he started planting crops when he was only eight years old. Every year, this skill is practised again and again, including learning to collect fruits, NTFPs and hunting animals.

Learning to choose and use plants is also complicated and challenging, but they need these skills to survive in the forest. They plant cassava trees because they are the primary source of carbohydrate which will give them food security for their family more than finding wild roots. Some families choose to plant rice, but this needs more labour and field maintenance and pest protection.

Fruit gardens are built around their abandoned settlements for cultivating their favourite fruit species such as durian adding a variety of nutrients in their diets. Their ancestors grew the trees in fruit gardens. They do not intensively maintain the trees, which are growing up but will collect the fruits once they are fruiting. Fruit gardens will be revisited every year, especially during the fruiting season.

However, it is difficult to predict the fruiting time. If there are many flowers, usually this means there will be many fruits following. Fruiting season is a celebration for the Chewong during which they will meet, chat and eat around fruit trees. They believe in sharing, especially foods from nature. However, trading these kinds of food are accepted.

No Chewong could answer. They only mention that cassava is their main foods and the techniques for crop plantations were transferred from generation to generation. Planting crops is hard work, but this is for their food security. Moreover, Chewong prefer to rely on their knowledge. This reliance on their traditional knowledge can be demonstrated during pregnancy, the husband or grandfather will be the one who helps his wife or daughter give birth and all of the forest-dweller Chewong, they were born in their village settled in KWR. They know that there is an Orang Asli hospital in Gombak, but the Chewong are unwilling to go there and base on their forest, which provides all their necessities including medicines.

The Chewong men and women have the same roles in any duty, which they want to do, for example, in agricultural areas both men and women have similar responsibilities. Women can help men to plant crops and can also collect the crops for cooking. Alternatively, when they start clearing new plots, women can join and help with no condition. However, the man who is the head of the family will be the primary person to make decisions and selecting the land for planting crops.

This accumulative agricultural knowledge is transferred from parent to child and from husband to wife. Women can go hunting or manufacture their own blowpipe. Children can make their own decisions about what they want to do if they want to go fishing they do by themselves. However, the role of caregiving to the children usually belongs to the mother of the child.

5.4.5 Beyond ethnobotanical knowledge

Regarding ethnobotanical knowledge, focusing on treatments of the physical body, the Chewong beliefs of the body and mind are not separable into unconnected parts. The many possible causes of illness can be caused by a lost soul or inappropriate emotionality which symptoms are not informative in themselves. The cooperative character and unity expressed in the ritual corresponds to the way health and illness is connected, the same way as the individual is intimately connected to the environment, the Orang Asli's desire for healing to be integrated within their local sociocultural context (Nicholas and Baer, 2007).

However, new western medical systems challenge the understanding of interconnectedness, as they treat sickness as a purely physical and individual matter. For example, when respondent two was coming out of the forest to attend the regular Saturday ceremony in the church, he had been bitten by a snake on his way. His foot was swollen, but respondent two said he was doing fine and he knew the reason for this accident. Earlier the same day, he had craved for a cigarette, but he did not have any to share. The unfulfilled desire broke the rule of punen, and the repercussion was the snake bite. In other words, in the traditional health system, mental and physical states are intimately entwined. Also, the Chewong has the nopoh curing ceremony which we were able to witness in Pyapoz. In preparation, young and old helped in plaiting leaves and making head ornaments. Some prepared musical instruments out of bamboo. Respondent three acted as the shaman (named locally as "Putao"). The women performed a chorus and made drumming music with bamboo poles when the ceremony was in progress.

5.4.6 Forest and NTFPs

Trading in forest products involves a relationship between the Chewong and local shopkeepers, mediators or private people outside the village. The resources exploited vary according to the season; three main NTFPs were exploited for sale, which are rattan, gaharu and honey. For example, some of the men put all other work on hold once the honey season started in May. Only a few of the men exploited this possibility, as the work was hard and dangerous. A group of men working together always collected the honey. The hives were found in the top of very high trees, and to be able to reach them the men built tall ladders out of wood. When the night came, and it was completely dark, one of the men brought a burning bundle of bark to the top of the tree where the hive was. He then shook the bark over the hive to make sparks. When the sparks fell towards the ground, most of the bees followed them, attracted by the light. He could then start to cut the hive and put it into a bucket, which was taken to the ground by a long rattan rope. One or two buckets of wax and honey could be filled from each hive. The men would generally spend a whole night on one or two hives, in addition to earlier preparations such as collecting materials and building ladders. The wax had to be squeezed and removed before the honey could be sold. The buyers were local shopkeepers and other neighbours outside the village (Lillegraven, 2006). In June 2014, the price of honey varied between 35-45 RM per kilogram. One male group, which had around eight members from Selur and Pyapoz could make money up to 6,000 RM per week. However, the way of collecting honey went to the way of using at least five motorbikes per group and clear the land around honey trees around five meters radius, which will leave clear gaps on the forest ground more than the traditional way.

5.4.7 The Chewong and outsiders

Increased contact with the outside societies imposes restrictions and provides opportunities for the Chewong, who consequently have ambivalent feelings towards the changes. Whereas proximity to the Malays - the politically dominant majority group in Malaysia, and the Chewong's most significant other are generally abhorred, the new opportunities arising from increased interaction are also recognised. Some of the Chewong grasp this chance by getting paid work, entering into trade relations, taking advantage of medical facilities and sending their children to school. Others choose to avoid outsiders as much as possible. The majority, though, pragmatically balance contact and avoidance.

In the Chewong situation, such ideas of cultural and epistemological superiority can above all be recognised among the missionaries, in the school system, and the public health system, but also among private people such as the Malay neighbours of Kuala Gandah.

The developments on equal terms with the dominant groups, this can lead to a willing submission to agents and institutions associated with the larger world. Some of the Chewong seem to follow such a pattern, while others hold their autonomy high and continue their lives in the thick forest only to come out for trade and purchase of goods.

5.5 Discussion

5.5.1 Pressure on the forest dwellers

The Chewong that are using this ethnobotanical knowledge in the forest face pressure from multiple sources. Firstly, their residing habitat, KWR, is a protected area that is under conservation policy of the Malaysia government. This policy aims to protect only natural resources which do not include these indigenous people which have the potential to increase conflicts between the Chewong and the government following conservation laws (Nicholas, 2000).

However, the Chewong have been granted to stay and perform traditional activities in the forest. For example, hunting with a blowpipe or performing agriculture in the forest under monitoring and control of the Krau Wildlife Centre. Also, the Krau Wildlife Centre is under the control of DWNP and JAKOA. They have a permit to stay inside the forest, collect forest products for their daily lives but do not have rights on the land. The project that has had the most significant direct impact on Chewong traditional life and knowledge is the resettlement project, moving them outside the forest. The resettlement project began when setting the Krau Game Reserve in 1923, during the Emergency period in 1942-1989 and setting Kuala Gandah Elephant Sanctuary in 1989.

Nowadays, only half of the Chewong tribe lives inside KWR while the other half of them mostly live in nearby villages such as Kuala Gandah and Engang village where the government still maintain a policy of resettling Orang Asli outside the forest. The latest project attempts to resettle the Chewong around Kuala gandah Elephant Sanctuary for expanding the Elephant Sanctuary within the next five years.

Moreover, the young generation of the Chewong is also faced with the pressure of attending compulsory education (primary school level) which will move them far from the forest, the older Chewong and their traditional knowledge.

The second primary source of pressure comes from the modernisation and development paradigm. The outside world has provided new technologies and equipment to apply and use in Chewong activities such as chainsaws and motorcycles and most of the Chewong families in Krau now have them. Respondent three said "I clear the land, enough to support my family for many years in the future by planting Cassava. Using a chain saw saves time and energy allowing me to expand quickly".

The new equipment provides faster and more effective techniques especially for forest clearing and transportation of forest products to the outside market. However, most of them still have beliefs of gods such as the spirit guide which is related to some species of plants and animals. These beliefs might not be the main factors for the Chewong to choose how to evaluate and use each species of plants exactly.

Finally, there is the pressure which stems from the population growth of the Chewong and whether their current population growth is at stable levels for sustainable resource extraction. However, this depends on a combination of other significant driving forces affecting the tropical deforestation which are demographic factors, cultural factors, agricultural expansion, technology factors, economic factors, political and institutional factors, infrastructure extension, wood extraction and other factors, e.g. war (Geist and Lambin, 2002).

5.5.2 Threats and opportunities for the near future

The Chewong lifestyle has changed from that of their ancestors. Previously the Chewong lead a more nomadic lifestyle moving to new locations in the forests of Malaysia regularly. The Chewong would even make their clothes from tree bark from some tree species such as *Ficus schwarzii* in the photos of Howell's book (Howell, 1984). However, as forests have become increasingly fragmented, this type of lifestyle can no longer be maintained. It was likely while establishing new settlements and cultivating new crops the Chewong would need to utilise many wild species for sustenance. Modern-day Chewong have more permanent settlements and larger populations.

The loss of knowledge and use of plants can be driven by changes in social and political policies, even with increases in forest cover and biodiversity (D'Ambrosio and Puri, 2016). The traditional knowledge retention from a study by (Müller et al., 2015), suggests considering how age and gender effects ethnobotanical knowledge. For example, food plant knowledge increased with age for women only, the interaction of age and gender was strongest on fodder plant knowledge where mid-aged men scored highest and medicinal plant knowledge was the highest among elders. The Chewong elderly are the traditional knowledge holders who need to transfer the biocultural knowledge to the Chewong children and teenagers while this new generation faces modernisation, government resettlement and conservation policy. A quote by respondent two regarding loss of traditional knowledge in the younger generation states that "the Chewong know how to use many plants in the forest and the locations where to find them. But only a small number of the new generation know about plants as they are too busy to go to the forest."

An indigenous community, which uses motorbikes extracts large quantities of NTFPs for sale instead of for subsistence, will have negative consequences for the protected area in which they reside. Respondent two, who is one of the main and most successful collectors of honey during the mast flowering season, said "Collecting honey requires man power for many duties, one person who can clear the area and set camp, a person who can prepare equipment for collecting honey and two people who climb up and collect the honey. We are able to sell lots of honey to support our families earning over 5000 MYR." A future forest impact analysis requires more information to estimate the impact of used species reliably and relying heavily on wild or planted species can impact the forests in different ways. Cassava and rice in the Chewong agriculture areas are low impacts for some beneficial species such as *Dialium indum* or *Maclurochloa montana*. Particular of their most used and relied upon plant species and how this might affect plant populations and distribution.

The conservation management should integrate this indigenous community with the conservation management plan for the reserve as well as perform research such as this to see how the Orang Asli community is changing and evolving.

A big question is "do the Chewong perform over consumption or not?" Maybe the species they use are commonly found within the forest with fast reproductive rates so the Chewong may be having little effect on them. Moreover, these might cause deforestation and relate to invasive species.

It is particularly critical to identify thresholds for rapid forest decline because it can take many decades for forests to restore the services that they provide (Trumbore et al., 2015).

The government's policies towards the Orang Asli [domination-paternalism-integration-assimilation] take control of the other, governs the other in what it views as being the other's best interest, single institutions are developed, and ethnic origin ceases to be recognized, and turn involves an internalization of the values of the dominant or majority group (Nicholas, 2000).

Take as an example the current schooling-situation in Kuala Gandah. Whether the children go to school partly depends on economy and transportation possibilities. Through simple means, the government could have encouraged attendance.

5.5.3 Changes and effects on the Chewong

The Chewong are sure that there will be enough land for plantation in the future but are unsure if the new generation of Chewong wants to continue their traditional lifestyle. They are learning about other cultures and modernity. Some Chewong feel proud of their identity and blending Chewong with other races is uncomfortable because their ways of thinking are different or perhaps the rivalry sentiment is still extreme. However, many Chewong have accepted a new lifestyle at Kuala Gandah village which accommodates around 100 inhabitants at present. Respondent one's oldest son who works at Kuala Gandah elephant sanctuary said "my work is very busy and in my spare time I like to party with my friends. The parties take place at Kuala Gandah village leaving me less to time to enter the forest".

Many Chewong need more money for new stuff. The modern world paradigm from the outside world has provided new technologies and equipment to apply and use in Chewong activities such as chainsaws and motorcycles and most of the Chewong families in Krau have them.

The new equipment provides faster and more effective techniques especially for forest clearance and transportation of forest products to the outside market. However, most of them still have beliefs in gods such as spirit guide which is related to some species of plants and animals. These beliefs might not be the main factors for the Chewong to choose how exactly to evaluate and use each species of plants.

The Chewong are vulnerable minority population of about 250 individuals who have also faced serious challenges after the creation of the Elephant Sanctuary and some outsiders, for example, tourists, health care officers, researchers, merchants or missionaries come to their area.

KWR gate is still closed for outsiders because special permits from the Malaysia Economic Planning Unit (EPU) and JAKOA are required for entering. However, they have been mixed into the larger society, and this is an invasion of their territory (Howell, 2015). They are animists, who see their forest environment as made up of many non-human but conscious which they can interact on a daily (Howell, 1984).

Some Chewong do ritual by burning damar and singing for telling their life or ask for protection. The forest and everything in it belongs to everyone, but except produce collected for sale, all forest products must be brought to the settlement and shared equally, these values, whose meaning is constituted in their understanding and their relationship with the environment.

Employment in the outside world is difficult for the Chewong because that relies on education status. Meanwhile, cash from the sale of NTFP is more accessible and a practical skill which they possess. A relative of respondent three who now lives in Kuala Gandah stated that “My main focus is now towards finding money to support my family, finding a good job is difficult due to my lack of education so I find products from the forest to sell. My husband also has the same problems. I also have a rubber tree plantation but the income is unreliable”. Many references about local uses of forest products-communities rely on forests for food, medicine, construction materials and products for sale (Howell et al., 2010; Lin, 2005). People in the forest have a different meaning for outsiders who use commodities for sale.

The changing of the modern world influences the Chewong; for example, their diet has shifted from natural produce, fruits and animals to food purchased from shops around Kuala Gandah (Haemamalar et al., 2010). Indigenous people manage their ecosystems to ensure that a wide variety of useful species are available (planted and protected). This level of plant knowledge and interest in maintaining useful species is generally typical of indigenous forest dwellers around the world. Forest owners have increased opportunities to share insights with others and participate in decisions about forest futures, both locally and at a global level (Alcorn, 1996).

The traditional practice of shifting cultivation in Southeast Asia has been declining, and this system is being replaced by permanent cropping and commercial plantations (Padoch and Pinedo-Vasquez, 2010). These commercial enterprises are linked to urban markets and global demand for agricultural commodities, unlike subsistence farmers (Rudel et al., 2009). Migration to cities and urban population growth and subsequent urban demand for agricultural products are related to increasing tropical deforestation, particularly in Asia and Latin America (see Chapter 2)

5.6 Conclusion - Chewong and forest relationship

Interviews revealed that the majority of the Chewong share similar beliefs and social norms between one another. The Chewong display immense pride in maintaining traditional ways of life, using forest knowledge passed down from their ancestors. They also display great respect for one another, and in particular respecting gender equality and child freedom and may be why the Chewong has very little tension or conflict between one another, working more as a sympatric group.

Cultivation is also a critical aspect of their entire lives. They are learning from a young child the specific techniques required to produce highly productive cassava, rice field or fruit garden, and importantly the previous ancestral areas where the Chewong may have previously cultivated. They are also taught to respect someone's cultivation area and resisting the temptation to steal fruit or crops, which would be easily accessible with no boundary markings or fences.

People insisted that conversion was done mainly of pragmatic considerations and did not influence them much. However, the children are now growing up with regular religious education, and they are receiving new impulses by watching television and going to school. All these features are influencing the trajectory of change in the village, which seems to include a decline of indigenous traditions. A striking element in the process of change as regards religion and cosmology is the seemingly growing detachment from the previously essential localities. Respondent two who converted from traditional Chewong animism/cosmology to Chritianity said "I want to be a good Christian. To do that I must attend church every Sunday in Kuala Gandah village. And I cannot practice any traditional ceremonies".

The Chewong cosmology is based on their ancestors' localities in the forest. "There is a large body of myths which are well-known to all Chewong. They all contain some cosmological information, and they demonstrate the intimate entanglement of humans and forest". Contrastingly, the new religions take as a departure point the writings of a holy book. Facts, rules, and guidelines for living all derive from these writings and are carried forward to the Chewong as imposed formalities by outsiders which is a far cry from the traditional cosmology which was embedded in everyday practices and localities. Although the elders firmly uphold many of these beliefs and customs, the younger generation demonstrates a shift in thinking towards modernisation as depicted by a quote from respondent one “young Chewong love TV, they love magazines, they love the lifestyle of the modern world.” Implications for the future, with traditional knowledge and potential for changes in cultivation techniques and intensity, with this knowledge conservation management plans can consider addressing this issue, finding a way to support the younger generation to maintain this traditional knowledge and way of life.

CHAPTER 6 THESIS CONCLUSION

6.1 Overview of findings

After extensive documentation and discussions with the Chewong elders regarding their ethnobotanical knowledge, it is clear this knowledge is essential to their survival within Krau and a core value of their identity. Previous work by Mohamad (2010) in Pahang, Peninsula Malaysia also concluded that plants and the environment play a crucial role and function in the Semelai community, determining and shaping their lifestyle.

The Chewong rely on both wild and planted species, have in-depth traditional knowledge of plants and environments which they use every day and have economic income based on NTFPs from the forest which indicate a variety of relationships and effects on their tropical forest habitat. They rely particularly on wild-growing species for the majority of their activities within the forest compared with that of commercially grown species. Knowledge ranges from edible plant species, medicinal treatments, construction and hunting to the creation of handicrafts, performing ceremonies and rituals and fuelwoods. Ethnobotanical knowledge has been documented around the world from many indigenous populations (Azliza et al., 2012; Cunningham, 2014); Lin, 2005; Ong et al., 2012; Samuel et al., 2010).

Chewong cultivation techniques are another core part of the Chewong identity and essential for food security. Food security is a vital part of any indigenous community (Cairns and Garrity, 1999) particularly within an ecosystem dominated by mast flowering dipterocarps such as in Malaysia (Corlett and Primack, 2011) where fruit resources can be scarce between mast fruiting events. We found that the Chewong obtain most of their carbohydrate requirements using a shifting cultivation method clearing small plots of land for rice and cassava while producing fruit gardens with annually fruiting species for nutrient rich species.

These methods we found to have varying effects on both the structure and composition of the residing vegetation when compared to that of natural forests. Out of the three types of cultivation, fruit gardens appeared to have the lowest impact on forest structure and composition. Whereas the other cultivation types are distinctly different from that of natural forest. Although cassava and rice have a particularly pronounced effect on the structure and species composition. They occur at small scales, and many locations are re-cultivated by future generations utilising the same area rather than opening fresh plots of land in the forest. In addition, we found evidence that recovery of even the most invasive cultivation methods, that of rice and cassava, were in process with an increase in biomass over time. Fruit gardens however had the most exciting result as they produced a relatively small impact to the forest structure, maintaining a connected canopy and similar biomass levels while providing food security and may even provide net benefits to conservation regarding the mammal species they attract, based on our research (Moore et al., 2016).

This information of agriculture effect on the forest structure and composition is vital for developing conservation policy; it is clear some forms of agriculture such as rice paddy alter forest composition quite considerably whereas fruit gardens are a very sustainable form of agriculture. As long as cassava and rice fields are performed on a small-scale basis as they are currently, integration into conservation policy is viable with possible limitations on the number of new cultivation areas per every five years, unless it is a previously cultivated area, to reduce further damage in the reserve.

Finally we have the Chewong cosmology and beliefs which are the central core of their paradigm and behaviour are practised in every life. They have a close and intimate relationship with the forest both in the past and at present. Their reliance on ethnobotanical knowledge, shifting agriculture and collection of NTFPs all have effects on the ecological succession process in the forest leading to questions of sustainability and conservation on KWR.

In addition the Chewong are experiencing many external and internal pressures from government resettlement, modernisation using new technology, social changes, demographic and economic pressures and intensification of agricultural land for commercial harvest including protected area policy. This pressure is affecting the younger generation more than, the older generation as they are more susceptible and inquisitive than their elders and are more likely to be influenced by new technology and what money can buy. Respondent one said "The younger Chewong are less hardworking, I need help to clear land for planting rice and cassava but sometimes I get less manpower". However, a quote by the son of respondent one, who works as a truck driver for a rubber plantation, clarified "I am still hard working but I need money for my hard work to support my family for their education”.

An indigenous community provides important messages for conservation practitioners. Combining forest knowledge and the changes of Chewong and incorporating their way of life with protected area management plans may have a positive effect by maintaining traditional knowledge within the younger generation, sharing knowledge of effects on the forest and forest regeneration and prevent future degradation and unsustainable practices for the tropical forest.

6.2 Implications of traditional knowledge for conservation policy

Traditional knowledge has positive implications for conservation policy. Chewong people have to investigate and understand their situation clearly, understanding both traditional knowledge and their present life situation to know how to live in a sustainable low impact way, thus integration into forest management practice is essential. It may be possible that by working with the Chewong, particularly the younger generations, to maintain their way of life, and retaining enough knowledge to know how to use all these plant species in the future, this might reduce unsustainable and damaging activities within the forest in the future.

Cultivation is also an essential aspect of their entire lives. They are learning from a young child the specific techniques required to produce highly productive cassava, rice field or fruit garden, and importantly the previous ancestral areas where the Chewong may have previously cultivated. They are also taught to respect someone's cultivation area and resisting the temptation to steal fruit or crops which would be easily accessible with no boundary markings or fences.

Although the elders firmly uphold many of these beliefs and customs, the younger generation is demonstrating a shift in thinking towards modernisation. Implications for the future, with a traditional knowledge and potential for changes in cultivation techniques and intensity and knowledge conservation management plans, can consider addressing this issue, finding a way to support the younger generation to maintain this traditional knowledge and way of life.

One of the ongoing conservation strategies has been to relocate Chewong individuals to Kuala Gandah in an attempt to remove all influence of humans from within the forest. However, what I have found from my questionnaire and discussion with some of the members of the tribe, both inside and outside the forest, is that the situation is not as simple as removing them from the forest.

Once removed from the forest an individual is faced with all the complications that come with the modern world. The need to find money to pay for food rather than growing and collecting wild plants as would be the traditional way. The tough prospect of finding employment with limited education and writing skills as a previous quote by one of my respondents depicts: "My main focus is now towards finding money to support my family, finding a good job is difficult due to my lack of education so I find products from the forest to sell. My husband also has the same problems. I also have a rubber tree plantation but the income is unreliable". Some individuals resort to the only way they know of obtaining money, by collecting and selling NTFPs. However, instead of these NTFPs being used to supplement their diets and provide small amounts of additional income, many extract large amounts to sell at local markets in order to generate enough money to live at places like Kuala Gandah.

Previous research has shown that the exclusion of indigenous inhabitants from a protected area does not always have the desired and expected ecological and conservation consequences (Brandon and Wells, 1992; Clay et al., 1985; Wells and Brandon, 1992). It can in fact have a multitude of negative impacts on the residing indigenous community such as marginalisation, food insecurity, landlessness and joblessness (Mahapatra et al., 2015). A quote from Cernea and Schmidt-Soltau (2003) describes the issue of indigenous exclusion well, "Summing up decades of experiences with displacement as a mainstream approach … this strategy has exhausted its potential and its credibility, produced much damage and did not fulfil expectations placed on it". Malaysian re-settlement schemes have been known to cause issues with access to natural resources as new settlements can be far from traditional forests (Mohamad, 2010).

One possible solution to this problem we suggest is to consider taking an opposite approach. Integrating those who still remain within the forest and empowering them with a sense that they are responsible for maintaining the balance of nature, which is already a large part of their belief system. Collaborating with local conservation organisations to protect the natural resources for themselves and for conservation purposes. This idea was first realised by the IUCN at the 3rd World Congress on National Parks back in 1982 (Brandon, 1997).

A quote from researchers with extensive knowledge of this type of situation "Project personnel recruited from the local population who demonstrate qualities of leadership and commitment, who receive regular hands-on training that empowers them to take responsibility for the management of their natural resources, are the formula proven to sustain long term conservation efforts under difficult conditions. The combination of a few dedicated individuals, together with the support of a non-governmental organization (independent of political constraints) with a long-term commitment to conservation, is the best recipe for achieving lasting success in countries where political stability is in question, or perhaps anywhere" (Hart et al., 1997).

Previous work by Mohamad (2010) in Pahang, Malaysia studying the ethnobotanical knowledge of the Semelia community also suggested an integrative approach between the conservation objectives of the local reserve and the local knowledge that the indigenous population possess. Similar programs have been successful with other indigenous tribes around the world but it is essential that they participate in the planning and management process, utilising their skills and knowledge of the forest and making long term guarantees regarding their rights which in turn will boost their commitment to any conservation agendas (Sodhi et al., 2008, McLean and Stræde, 2003).

It is essential to document and understand traditional knowledge of indigenous tribes such as the Chewong. The way in which they live sustainability, coexisting with nature, provides valuable lessons for modern lifestyles with little interest in a reasonable, sustainable way of life. As well as benefiting conservation in understanding the plant and animal communities within the rainforest.

6.3 Future research

Further research is needed focussing on the Chewong population that now resides outside the reserve. Areas to explore could include looking at their population size, distance between people and product resources and distance to local markets. Attempting to understand how an indigenous population copes when removed from the forest, how they generate income, does this increase the number of NTFPs extracted from the forest in turn negatively affecting wild species populations? This point was hinted at by a quote from respondent two who said, "at the moment it can be very difficult to find gaharu within the forest we must hike deeper and longer to find it". This resin is extremely valuable and often an NTFP of choice for making money at local markets (Paoli et al., 2001). How much ethnobotanical and cultivation knowledge resides within the Kuala Gandah population versus inside the forest. What type of cultivation techniques do they utilise outside the forest and whether they draw on traditional knowledge to help them? How they supplement their daily food intake and medicinal requirements? Do they still hunt for subsistence or sale?

Further work is also needed to understand some additional impacts of the Chewong cultivation methods. In particular if conservation practitioners at Krau were concerned by the impacts of rice and cassava in terms of their ability to regenerate, we suggest research into techniques to replant and speed up the recover process of these forest gaps. This could include looking at the abiotic drivers of forest recovery such as soil fertility (Saldarriaga et al., 1988), climate (Quesada et al., 2012) and biotic affects such as vegetation functional traits including dispersal type and ability (Chazdon et al., 2006), tree species diversity

(Hector et al., 2011) and past disturbance events (Muller-Landau 2009). It should involve working with the Chewong who have extensive knowledge regarding the forest, providing them with tools and discussing new ways they can boost this recover process increasing the conservation value of their cultivation methods.

At present the elders of the Chewong hold a wealth of traditional knowledge, built over generations regarding important species particularly those used for medicinal purposes. Previous research has found ethnobotanical knowledge from other indigenous tribes to be incredibly important in the development of new drugs (Heinrich, 2000; Gurib-Fakim, 2006; Shelley, 2009). One possible avenue of research to pursue in the future might be to focus particularly on the medicinal uses of plant species by the Chewong to determine if any species hold some important chemicals or properties that could benefit new drugs and modern medicines. It is critical to perform this kind of research soon as we documented that some of the younger generation are beginning to lose this in depth knowledge of the forest as more individuals move outside to areas like Kuala Gandah.

The people-park relationships should be studied as an integrated, complex system, and grounded in physical relationships such as heavily used plants (e.g. NTFPs) and impacts on forest structure, composition and ecological process, and perceptions of the reserve areas of other stakeholders in disciplinary parameters to promote sustainable use of natural resources, considering ecological, economic and social dimension. Finding the integration of other cultural approaches, belief systems and world-views within a range of social and economic approaches to nature conservation is necessary to contribute to developing and maintaining a more balanced relationship between humans and the rest of nature.

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APPENDIX 1 Questionnaire in English and Malay version

Questionnaire 1: Chewong [1]-[5] **English version**

[1] Personal information

1.1 Gender: Male (M), Female (F)

1.2 What is your full name?

1.3 How old are you?

1.4 Where are you from [village]?

1.5 Did you go to school? Y (1.5.1) / N (1.6)

1.5.1 How many years did you spend in school?

1.6 Can you read and write? **read** Y / N **write** Y / N

1.7 What is your religion?

1.8 Do you work in the plantation area? Y / N

1.8.1 Do you do any work apart from working in the plantation area? Y / N

[2] Family information

2.1 How many people in your household?

2.2 Are you head of the household?

2.3 Who are your father and mother?

2.4 Are you married? Y (2.4.1) / N (3.1)

2.4.1 How many wives/husbands do you have?

2.4.2 Where are she / he / they from [village]?

Questionnaire 1 (continue)

2.4.4 How long have you been married?

2.4.5 How many children do you have?

2.4.5.1 Did/do your children go to school? Y / N

2.4.5.2 When does a Chewong child become an adult who can make their own decisions about plantation areas or forest products?

[3] Forest

3.1 As well as your plantation area, what products do you get from the forest? When and how?

3.2 How do you use it to eat or use at home, or do you sell it? Sell Y (3.2.1) / N (3.3)

3.2.1 If you sell it, how much can you earn from it?

3.2.2 Who do you sell it to?

3.3 Do Chewong have any rules about how you can use the forest? Y/ N

3.3.1 Who makes these rules? How do they work?

3.3.2 Do you use those rules in your daily life? Y (why?)/ N (why?)

3.3.3 Do you have other rules for using the forest? (such as rules from Krau Centre?) How do they work?

[4] Krau wildlife Reserve

4.1 Do you have experience of Krau Wildlife Reserve and how (if yes)? (people, forest, others)

Questionnaire 1 (continue)

[5] Personal opinions

5.1 What do you think will make young Chewong people have a good life in the future?

5.2 If you could change one thing in your life what you would change?

Questionnaire 2 Agriculture (name of the village)

1. How many plantation areas does your family have and how many are yours?

    1.1 How many old plantation areas does your village have?

        1.1.1 For how many years have you left this plantation area since the last planting? When was it opened?

        1.1.2 How many times will you repeat planting crops in this plantation area?

        1.1.3 Where is the plantation area?

        1.1.4 How many acres is the plantation area?

    1.2 How many current plantation areas does your village have?

        1.2.1 For how many years will you grow this (these) plantation area (s)? When was it (were they) opened?

        1.2.2 How many times will you repeat planting crops in this plantation area?

        1.2.3 Where is the plantation area?

        1.2.4 How many acres is the plantation area?

Questionnaire 2 (continue)

2. Where do you choose to plant crops?

3. Which type of soil do you choose to plant your crops?

4. Who do you work with when you start your cultivation?
(Responsibility-gender, age)

5. What are the main things you grow in your plantation area?

    5.1 How do you plant? [when, what parts of the plant, techniques and harvest]

    5.2 Why do you choose to plant them?

    5.3 Where you get the plants/seeds from?

    5.4 How do you know techniques of planting them?

    5.5 How long do you plant in one area?

6. What produce do you get from your plantation area and how many kilograms per ha?

    6.1 What do you do with produce from your plantation area?

        6.1.1 If you sell it, who do you sell it to?

            6.1.1.1 How much can you earn from it? Is this your primary source of income?

            6.1.1.2 Do you feel you have enough to support your whole family or do you need to earn more?

        6.1.2 What factors (or things) affect your production? [pests, natural disasters or others?]

Questionnaire 2 (continue)

[5] Personal opinions

7. Will you leave your plantation area after harvesting? Y / N

8. Will you return to cultivate in the same place again? Y (When and why?) / N

Soal 1 Chewong **Malay version**

[1] Maklumat peribadi

1.1 Jantina Lelaki (M) / Perempuan (F)

1.2 Apakah nama penuh anda?

1.3 Berapa usia anda?

1.4 Di manakah kamu berasal daripada? [kampung]

1.5 Adakah anda pernah ke sekolah? Y (1.5.1) / N (1.6)

1.5.1 Berapa tahun kamu bersekolah?

1.6 Adakah anda membaca dan menulis sekarang? membaca (Y/N) tulis (Y/N)

1.7 Apakah agamamu?

1.8 Adakah anda bekerja di Kebun? Y (1.4.1) / N (1.4.2)

1.8.1 Adakah anda melakukan kerja selain daripada bekerja di Kebun ini?

[2] Maklumat Keluarga

2.1 Berapa ramai orang dalam rumah tangga anda?

2.2 Adakah anda ketua di rumah?

2.3 Siapakah bapa dan ibu anda?

2.4 Adakah anda berrumahtangga? Y (2.5.1) / N (3.1)

Soal 1 (teruskan)

2.4.1 Berapa isteri anda?

2.4.2 Dari manakah dia / mereka berasal dari [kampung]

2.4.3 Berapa usia anda apabila anda bernikah?

2.4.4 Berapa lama anda berrumahtangga?

2.4.5 Berapa banyak anak-anak anda?2.4.5.1 Adakah anak-anak anda pergi ke sekolah? Y / N

2.4.5.2 Bilakah anak Chewong menjadi orang dewasa yang boleh membuat keputusan tentang kebun atau produk hutan?

[3] Hutan

3.1 Selain Kebun anda, apa hasil yang anda dapatkan dari hutan? Bila dan bagaimana?

3.2 Bagaimana anda menggunakannya - untuk makan atau menggunakan di rumah, atau adakah anda menjualnya? menjual Y (3.2.1) / N (3.3)

3.2.1 Jika anda menjualnya, berapa banyak yang anda boleh peroleh daripadanya?

3.2.2 Dengan siapa yang anda menjual hasil itu?

3.3 Adakah Chewong mempunyai peraturan tentang bagaimana anda boleh menggunakan hutan? Y / N

3.3.1 Siapa yang membuat peraturan-peraturan ini? Bagaimana ia berfungsi?

3.3.2 Adakah anda menggunakan peraturan-peraturan dalam kehidupan harian anda? Y (mengapa) / N (mengapa)

Soal 1 (teruskan)

3.3.3 Adakah anda mempunyai peraturan-peraturan lain untuk menggunakan hutan? (seperti peraturan dari Krau Pusat?) Bagaimana ia berfungsi?

[4] Krau wildlife reserve (Tempat Perlindungan Kehidupan liar Krau)

4.1 Apakah pengalaman kamu di Perlindungan Kehidupan liar Krau? (bersama manusia, hutan, lain-lain)

[5] Pendapat peribadi

5.1 Apakah yang anda fikir akan membuat anak-anak muda Chewong mempunyai kehidupan yang baik pada masa akan datang?

5.2 Jika anda boleh mengubah satu perkara dalam hidup anda, apa yang akan anda mengubahkan?

Soal 2 Pertanian (kampung)

1. Berapa Kebun adakah keluarga anda memiliki dan berapa banyak adalah milik anda?

1.1 Berapa Kebun tua yang kampung anda ada?

1.1.1 Untuk berapa tahun anda meninggalkan Kebun ini sejak penanaman yang terakhir? Bilakah kebun ini dibuka?

1.1.2 Berapa kali akan anda mengulangi menanam tanaman di Kebun ini?

1.1.3 Di manakah Kebun itu?

1.1.4 Pada waktu sekarang berapa kebun yang kampung kamu memilikki?

1.2 Berapa ekar Kebun itu?

Soal 2 (teruskan)

1.2.1 Berapa kali akan anda mengulangi menanam tanaman di Kebun ini?

1.2.2 Di manakah Kebun itu?

1.2.3 Berapa ekar adalah Kebun itu?

2. Di mana anda memilih untuk menanam tanaman?

3. Apakah jenis tanah yang anda memilih untuk menanam tanaman anda?

4. Siapa yang anda bekerja dengan apabila anda memulakan penanaman anda? (Tanggungjawabjantina, umur)

5. Apakah perkara utama yang anda tumbuh di Kebun anda?

5.1 Bagaimana anda menanam? [bila, apa bahagian tumbuhan, teknik dan menuai]

5.2 Mengapa anda memilih untuk menanam mereka?

5.3 Di mana anda mendapatkan tanaman / benih dari?

5.4 Bagaimana anda tahu teknik-teknik penanaman mereka?

5.5 Berapa lama anda menanam di satu kawasan?

6. Apakah hasil yang anda dapat dari Kebun anda dan berapa kg per ha?

6.1 Apa yang anda lakukan dengan hasil dari Kebun anda?

6.1.1 Jika anda menjualnya, siapakah yang anda menjual hasil kebun anda kepada?

6.1.1.1 Berapa banyak anda boleh mendapat daripadanya? Adakah ini sumber utama pendapatan anda?

Soal 2 (teruskan)

6.1.1.2 Adakah anda rasa anda mempunyai cukup untuk seluruh ahli keluarga anda atau adakah anda perlu untuk mendapatkan lebih banyak?

6.1.2 Apakah faktor (atau perkara) yang menjejas pengeluaran anda? [perosak, bencana alam atau lain-lain?]

6.1.2.1 Bagaimana anda melindungi tanaman anda daripada mereka?

7. Adakah anda akan meninggalkan Kebun anda selepas penuaian? Y / N

8. Adakah anda akan kembali untuk memupuk di tempat yang sama? Y (bila dan mengapa) / N

APPENDIX **2** Plant Species List arranged into three categories; Family, Scientific name and Chewong name. All scientific names have been cross-referenced with The Plant List (2013), the majority of which are accepted and some are still unresolved pending further classification [http://www.theplantlist.org, October 2017]

Family	**Scientific name**		**Chewong name**
Achariaceae	1	*Pangium edule* Reinw.	Payong
Amaranthaceae	2	*Amaranthus viridis* L.	Bayam
Amaryllidaceae	3	*Crinum asiaticum* L.	Lebak
Anacardiaceae	4	*Bouea macrophylla* Griff.	Hatal
	5	*Bouea oppositifolia* (Roxb.) Adelb.	Hatal
	6	*Dracontomelon dao* (Blanco) Merr. & Rolfe	Yerguang
	7	*Mangifera foetida* Lour.	Limus
	8	*Mangifera gracilipes* Hook.f	Pauh
	9	*Mangifera indica* L.	Grening
	10	*Mangifera lagenifera* Griff.	Pauh kijang
	11	*Parishia insignis* Hook.f.	Belanti rasol
	12	*Pentaspadon motleyi* Hook.f	Gelas
	13	*Swintonia floribunda* Griff	Yeryies
	14	*Swintonia schwenkii* (Teijsm. &Binn.) Teijsm. &Binn.	Kepung
	15	*Anaxagorea javanica* Blume	Termob
Annonaceae	16	*Maasia sumatrana* (Miq.) Mols, Kessler & Rogstad	Tah punae
	17	*Polyalthia cauliflora* Hook.f. & Thomson	Ewa
	18	*Polyalthia jenkinsii* (Hook.f. & Thomson) Hook.f. & Thomson	Kabui
	19	*Xylopia hypolampra* Mildbr.	Kapang
Apocynaceae	20	*Willughbeia angustifolia* (Miq.) Markgr.	Brambrao
Araceae	21	*Anadendrum latifolium* Hook.f.	Yangler
	22	*Colocasia esculenta* (L.) Schott	Dalay
Arecaceae	23	*Areca catechu* L.	Pinang
	24	*Calamus caesius* Blume	sek rotan
	25	*Calamus castaneus* Griff.	Sek
	26	*Calamus manan* Miq.	Sek manau
	27	*Calamus ornatus* Blume	Sek

APPENDIX **2** (continue)

Family	Species		Chewong name
Arecaceae	28	*Calamus scipionum* Lour.	Sek rotan
	29	*Calamus tumidus* Furtado	Sek
	30	*Cocos nucifera* L.	Yol
	31	*Eleiodoxa conferta* (Griff.) Burret	Kelubi
	32	*Johannesteijsmannia lanceolata* J. Dransf.	Jujoh
	33	*Oncosperma horridum* (Griff.) Scheff.	Bayas
	34	*Oncosperma tigillarium* (Jack) Ridl.	Bayas
	35	*Orania sylvicola* (Griff.) H.E. Moore	Hebul
	36	*Salacca glabrescens* Griff.	Salak
Athyriaceae	37	*Diplazium esculentum* (Retz.) Sw.	Thenduwal
Bixaceae	38	*Bixa orellana* L.	Ken
Bromeliaceae	39	*Ananas comosus* (L.) Merr.	Cenalak
Burseraceae	40	*Canarium littorale* Blume	Kupong
	41	*Canarium megalanthum* Merr.	Kupong jenung
	42	*Canarium pilosum* A.W. Benn.	Kupong
	43	*Canarium pseudodecumanum* Hochr.	Kupong
Cannabaceae	44	*Dacryodes rostrata* (Bl.) H.J. Lam	Ramil
	45	*Gironniera nervosa Planch.*	Yakmi
Caricaceae	46	*Carica papaya* L.	Betek
Clusiaceae	47	*Garcinia atroviridis* Griff. ex T. Anderson	Gelugor
	48	*Garcinia bancana* Miq.	Gelas
	49	*Garcinia parvifolia* (Miq.) Miq.	Yan
	50	*Garcinia celebica* L.	Heb
	51	*Garcinia prainiana* King	Jupu
Combretaceae	52	*Terminalia subspathulata* King	Janos
Commelinaceae	53	*Amischotolype hispida* (A. Rich.) D.Y. Hong	Yab
Compositae	54	*Ageratum conyzoides* (L.) L.	Gerlambu
	55	*Chromolaena odorata* (L.) R.M. King & H. Rob.	Klamukli
Connaraceae	56	*Cnestis palala* (Lour.) Merr	Libu
Convolvulaceae	57	*Ipomoea batatas* (L.) Lam.	Cila
Cornaceae	58	*Alangium javanicum* (Blume) Wangerin	Meteh
	59	*Alangium kurzii* Craib	Melas

APPENDIX **2** (continue)

Family	Species		Chewong name
Cornaceae	60	*Alangium ridleyi* King	Jam
Ctenolophonaceae	61	*Ctenolophon parvifolius* Oliver	Linuk
Cucurbitaceae	62	*Alsomitra macrocarpa* (Blume) M.Roem	Sabun
	63	*Hodgsonia macrocarpa* (Blume) Cogn.	Hoot
Dilleniaceae	64	*Dillenia reticulata* King	Simpul
	65	*Dillenia sumatrana* Miq.	Simpul tayoh
	66	*Dillenia excelsa* (Jack) Martelli ex Gilg.	Simpul betul
	67	*Dillenia ovata* Wall. ex Hook.f. & Thomson	Simpul
	68	*Tetracera macrophylla* Wall. ex Hook. f. & Thoms.	Aga mempis
	69	*Tetracera indica* (Christm. & Panz.) Merr.	Jedehut
Dioscoreaceae	70	*Dioscorea alata* L.	Kaitagob
	71	*Dioscorea hispida* Dennst.	Gejan
	72	*Dioscorea piscatorum* Prain & Burkill	Lenteh
Dipterocarpaceae	73	*Anisoptera laevis* Ridley.	Belanti bunga
	74	*Dipterocarpus baudii* Korth.	Kuwing bulu
	75	*Dipterocarpus cornutus* Dyer	Luh
	76	*Dipterocarpus costulatus* Slooten	Jaroh
	77	*Dipterocarpus crinitus* Dyer	Kuwing pekat
	78	*Dipterocarpus kunstleri* King	Jaroh
	79	*Dipterocarpus verrucosus* Foxw. ex Slooten	Kuwing jah
	80	*Dryobalanops sumatrensis* (J.F. Gmel.) Kosterm.	Kepong
	81	*Hopea beccariana* Burck.	Kuwing
	82	*Neobalanocarpus heimii* (King) P.S. Ashton	Jengal
	83	*Shorea assamica* Dyer	Belanti betal
	84	*Shorea bracteolata* Dyer	Belanti
	85	*Shorea faguetiana* Heim	Pohang
	86	*Shorea leprosula* Miq.	Seraya gabud
	87	*Shorea macroptera* Dyer	Belanti
	88	*Shorea parvifolia* Dyer	Belanti bunga
Ebenaceae	89	*Diospyros buxifolia* (Blume) Hiern	Ganya
	90	*Diospyros caluliflora* Blume	Kelamoh
	91	*Diospyros latisepala* Ridl	Mohplik
	92	*Diospyros pyrrhocarpa* Miq.	Kabui
	93	*Diospyros sumatrana* Miq.	Tah

APPENDIX 2 (continue)

Family	Species		Chewong name
Euphorbiaceae	94	*Croton argyratus* Blume	Megah
	95	*Elateriospermum tapos* Blume	Prae
	96	*Hevea brasiliensis* (Willd. ex A. Juss.) Müll.Arg.	Getah
	97	*Macaranga gigantea* (Reichb.f. & Zoll.) Mull.Arg.	Mahang gajah
	98	*Macaranga recurvata* Gage	Nek
	99	*Mallotus floribundus* (Blume) Müll.Arg.	Tuwal
	100	*Manihot carthaginensis* (Jacq.) Müll.Arg.	Galor
Fagaceae	101	*Lithocarpus cantleyanus* (King ex Hook.f.) Rehder	Gles
	102	*Lithocarpus rassa* (Miq.) Rehder	Gles
	103	*Neoscortechinia nicobarica* (Hook.f.) Pax & K. Hoffm.	Dashalung
Flacourtiaceae	104	*Flacourtia rukam* Zoll. & Moritzi	Rukam
	105	*Hydnocarpus castanea* Hook.f. & Thomson	Tembaka
Gentianaceae	106	*Fagraea auriculata* Jack	Sereles
	107	*Fagraea racemosa* Jack	Sisil yameng
Gesneriaceae	108	*Codonoboea crinita* (Jack) C.L.Lim	Sermal
Hypoxidaceae	109	*Molineria latifolia* (Dryand. ex W.T. Aiton) Herb. ex Kurz	Rampah
Lamiaceae	110	*Ocimum americanum* L.	Rempah gatos
Lauraceae	111	*Cinnamomum javanicum* Blume	Rempa kunung
	112	*Cryptocarya ferrea* Blume	Langsen
Lecythidaceae	113	*Barringtonia macrocarpa* Hassk	Jenbang beretam
	114	*Barringtonia macrostachya* (Jack) Kurz	Janjijiab
	115	*Barringtonia scortechinii* King	Kikil
Legiminosae	116	*Archidendron jiringa* (Jack) Nielsen	Kedas
	117	*Archidendron jiringa* (Jack) I.C.Nielsen	Jengal
	118	*Bauhinia bidentata* Jack	Duk
	119	*Bauhinia integrifolia* Roxb	Duk
	120	*Bauhinia purpurea* L.	Penak
	121	*Cassia javanica* L.	Beting breyong
	122	*Dialium indum* L.	Klanyi
	123	*Entada spiralis* Ridl	Gemni
	124	*Intsia palembanica* Miq	Marbao
	125	*Koompassia excelsa* (Becc.) Taub.	Taulang
	126	*Koompassia malaccensis* Benth.	Kempas
	127	*Parkia speciosa* Hassk.	Heltal

APPENDIX 2 (continue)

Family	Species		Chewong name
Leguminosae	128	*Parkia timoriana* (DC.) Merr.	Heltal
	129	*Saraca thaipingensis* Prain	Tenglon
	130	*Senna surattensis* (Burm. f.) H. S. Irwin & Barne	Lengeng
	131	*Sindora coriacea* (Baker) Prain	Patil
Lygodiaceae	132	*Lygodium flexuosum* (L.) Sw.	Paku ibu
Lythraceae	133	*Duabanga grandiflora* (DC.) Walp.	Layang
Malvaceae	134	*Bombax anceps* Pierre	Kapas
	135	*Durio beccarianus* Kosterm. & Soegeng	Jarel
	136	*Durio oxleyanus* Griff.	Daon
	137	*Durio zibethinus* L.	Haubu
	138	*Hibiscus floccosus* Mast.	Baharu
	139	*Pterocymbium javanicum* R.Br.	Temrul
	140	*Pterospermum acerifolium* (L.) Willd.	Haowhao
	141	*Scaphium macropodum* (Miq.) Beumée ex K. Heyne	Temrul
	142	*Sterculia parvifolia* Wall.	Kasai
Marantaceae	143	*Angiopteris evecta* (G. Forst.) Hoffm.	Paku beretum
	144	*Donax canniformis* (G. Forst.) K. Schum.	Bemban
	145	*Phrynium pubinerve* Blume	Tungu
	146	*Schumannianthus dichotomus* (Roxb.) Gagnep.	Breman
Melastomataceae	147	*Clidemia hirta* (L.) D. Don	Peryuduk
	148	*Melastoma malabathricum* L.	Sedudu
	149	*Phyllagathis griffithii* King	Bel tangled
	150	*Phyllagathis rotundifolia* (Jack) Blume	Bel
Meliaceae	151	*Lansium parasiticum* (Osbeck) K.C.Sahni & Bennet	Tigai
	152	*Sandoricum beccarianum* Baill.	Mindegal
	153	*Sandoricum koetjape* (Burm.f.) Merr.	Hatal
Meliosmaceae	154	*Meliosma sumatrana* (Jack) Walp	Yakmai
Moraceae	155	*Antiaris toxicaria* Lesch	Dok
	156	*Artocarpus elasticus* Reinw. ex Blume	Haook
	157	*Artocarpus heterophyllus* Lam.	Nanga
	158	*Artocarpus hispidus* F.M. Jarrett	Tegah
	159	*Artocarpus integer* (Thunb.) Merr	Cempedak
	160	*Artocarpus kemando* Miq	Pulul

APPENDIX 2 (continue)

Family	Species		Chewong name
Moraceae	161	*Artocarpus lanceifolius* Roxb.	Besil
	162	*Artocarpus lowii* King	Bingoh
	163	*Artocarpus nitidus* Trécul	Peradung
	164	*Artocarpus rigidus* Blume	Hatinapal
	165	*Ficus schwarzii* Koord.	Hara air
	166	*Ficus glandulifera* (Wall. ex Miq.) King	Hara
Moraceae	167	*Ficus grossularioides* Burm.f.	Hara
	168	*Ficus punctata* Thunb.	Aga hara
	169	*Streblus elongatus* (Miq.) Corner	Maril
Musaceae	170	*Musa* × *paradisiaca* L.	Tiab tandoh
	171	*Musa acuminata* Colla	Tiab mas
	172	*Musa gracilis* Holttum	Halited
	173	*Musa violascens* Ridl.	Lok
Myristicaceae	174	*Gymnacranthera farquhariana* (Hook.f. & Thomson) Warb.	Narung
	175	*Knema conferta* (King) Warb.	Yasong
	176	*Knema laurina* (Blume) Warb	Penyara
	177	*Knema scortecchinii* (king) J. Sinclair	Penyara
	178	*Knema furfuracea* (Hook. f. & Thomson) Warb.	Penyara
Myrtaceae	179	*Psidium friedrichsthalianum* (O. Berg) Nied.	Jampu batu
	180	*Psidium guajava* L.	Jampu batu
	181	*Syzygium acuminatissimum* (Blume) A.DC.	Balang
	182	*Syzygium aqueum* (Burm.f.) Alston	Jampu
Olacaceae	183	*Ochanostachys amentacea* Mast.	Taring
Oxalidaceae	184	*Averrhoa bilimbi* L.	Belimbing
Pandanaceae	185	*Pandanus amaryllifolius* Roxb.	Pandan
Penaeaceae	186	*Crypteronia griffithii* Clarke in Hook.f.	Tenglang
Phyllanthaceae	187	*Baccaurea lanceolata* (Miq.) Mull.Arg.	Pahung
	188	Baccaurea macrocarpa (Miq.) Mull.Arg	Lala
	189	*Baccaurea motleyana* (Mull.Arg.) Mull.Arg.	Rambai
	190	*Baccaurea parviflora* (Mull.Arg.) Mull.Arg.	Jenal
	191	*Baccaurea polyneura* Hook.f.	Kenem
	192	*Baccaurea pyriformis* Gage	Tamun
	193	*Baccaurea racemosa* (Reinw. ex Bl.) Mull.Arg.	Tamungling

APPENDIX 2 (continue)

Family	**Species**		**Chewong name**
Piperaceae	194	*Piper betle* L.	Sireh
	195	*Piper porphyrophyllum* N.E.Br.	Sireh liyao
Poaceae	196	*Cymbopogon citratus* (DC.) Stapf	Serai
	197	Imperata cylindrica (L.) Raeusch.	Lampa
	198	*Maclurochloa montana* (Ridl.) K.M. Wong	Loh sementan
	199	*Oryza sativa* L.	Mum
	200	*Saccharum officinarum* L.	Tebu
	201	*Schizostachyum latifolium* Gamble	Blaoh
Poaceae	202	*Zea mays* L.	Jagong
Polygalaceae	203	*Xanthophyllum amoenum* Chodat	Gapas
Polygalaceae	204	*Xanthophyllum stipitatum* A.W. Benn.	Gapas
Primulaceae	205	*Marantodes pumilum* (Blume) Kuntze	Fatimah
Rubiaceae	206	*Chassalia chartacea* Craib	Yerangin
	207	*Neolamarckia cadamba* (Roxb.) Bosser	Humpudu bume
	208	*Ophiorrhiza discolor* R.Br. ex G. Don	Peremah
	209	*Pavetta graciliflora* Wall. ex Ridl.	Jing
Rutaceae	210	*Citrus aurantiaca* Swingle	Limau
	211	*Melicope lunu-ankenda* (Gaertn.) T.G. Hartley	Sampoh bui
	212	*Merrillia caloxylon* (Ridl.) Swingle	Penah
Sapindaceae	213	*Nephelium cuspidatum* Blume	Reming
	214	*Nephelium lappaceum* L.	God
	215	*Nephelium mutabile* Blume	Belas
	216	*Nephelium ramboutan-ake* (Labill.) Leenh	Haquay
	217	*Nephelium costatum* Hiern	Gumpal wai
	218	*Xerospermum noronhianum* (Blume) Blume	Tiag
Sapotaceae	219	*Madhuca longifolia* (J. Koenig ex L.) J.F. Macbr	Menglao
Schisandraceae	220	*Illicium verum* Hook.f.	Rempah bunga
Simaroubaceae	221	*Eurycoma longifolia* Jack	Tongka ali
Smilacaceae	222	*Smilax calophylla* Wall. ex A. DC.	Aga layang
Solanaceae	223	*Capsicum annuum* L.	Pigoh liyao
	224	*Nicotiana tabacum* L.	Betong
	225	*Solanum melongena* L.	Terong
Styracaceae	226	*Styrax tonkinensis* Craib ex Hartwich	Kelulu

APPENDIX 2 (continue)

Family	Species		Chewong name
Theaceae	227	*Gordonia singaporeana* (Dyer) Wall. ex Ridl.	Lepel
Thymelaeaceae	228	*Aquilaria malaccensis* Lam.	Gagaras
Torricelliaceae	229	*Aralidium pinnatifidum* (Jungh. & de Vriese) Miq.	Tengereng
Urticaceae	230	*Poikilospermum suaveolens* (Blume) Merr	Aga salae
Zingiberaceae	231	*Alpinia rafflesiana* Wall. ex Baker	Tengu geradah
	232	*Alpinia caerulea* (R.Br.) Benth.	Yel
	233	*Alpinia conchigera* Griff.	Tengu
	234	*Amomum conoideum* (Ridl.) Elmer	Tengu
	235	*Amomum uliginosum* J. Koenig	Tengu genti
	236	*Curcuma longa* L.	Kunyit
Zingiberaceae	237	*Elettariopsis curtisii* Baker	Tengu
	238	*Etlingera maingayi* (Baker) R.M.Sm.	Relek
	239	*Etlingera elatior* (Jack) R.M.Sm.	Bunga kantan
	240	*Etlingera littoralis* (J. Koenig) Giseke	Tengu
	241	*Zingiber gracile* Jack	Langias
	242	*Zingiber officinale* Roscoe	Tengu
	243	*Zingiber puberulum* Ridl.	Tengu

APPENDIX 3 Related publication (Moore et al., 2016), research publication was studying the effects of fruit gardens on the mammal community. Title and abstract of the paper included.

Fruit gardens enhance mammal diversity and biomass in a Southeast Asian rainforest

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ABSTRACT

Protected areas are frequently inhabited by people and conservation must be integrated with traditional management systems. Cultivation of fruit gardens is a low-impact agroforestry technique which alters the structure and composition of forest stands and has the potential to thereby influence animal communities. This is of particular interest in the rainforests of Southeast Asia, where limited fruit availability between intermittent mast fruiting events results in low mammal densities. We assessed how agroforestry practices of an indigenous community affect terrestrial mammal abundance, diversity and assemblage composition within Krau Wildlife Reserve, Pahang, Malaysia. We used baited camera traps to compare mammal abundance and diversity between seven fruit gardens and eight control sites. Fruit gardens contained similar species richness and abundance levels but higher diversity and almost threefold higher mammal biomass. Fruit gardens contained five times as many fruit-producing trees, and a positive correlation was found between the number of fruit trees and total mammal biomass. Mammal community composition differed between the two habitats, with fruit gardens attracting nine species of conservation concern. These results suggest that traditional agroforestry systems may provide additional resources for mammals and therefore their net effects should be considered in conservation policy.

Keywords: Agroforestry, indigenous practices, fruit availability, frugivory, camera trapping