Chapter 10
Changes in Resource Use and Subsistence Activities Under the Plantation Expansion in Sarawak, Malaysia

Yumi Kato

Abstract This chapter considers the effect of plantation development on human resource use and subsistence activities in Sarawak, Malaysia. With the demand for palm oil, natural forest has rapidly changed into plantations in tropical areas in recent decades. While the large-scale plantations expand dramatically, it is unclear how their resource use and subsistence activities change after plantations spread. This chapter examines the alteration of subsistence activities, including, shifting cultivation, hunting, gathering wild plants, and cash crop cultivation.

I found that shifting cultivation has not much changed in terms of work processes, cultivation areas, and crops. However, an increasing number of families have recently cultivated their paddy fields along roads. As for hunting, before plantation expansion the local population hunted various animals in the natural forest, but after it they mostly chase wild boar in the plantations at night. They used diverse wild plants of the natural forest before plantations spread, but these wild plants have sharply decreased around plantations. After the expansion of road networks and oil palm plantations, people now have new opportunities to cultivate oil palms as smallholders. This chapter illustrates how people try to continue the conventional way of livelihood even under the plantation expansion. They also adapt flexibly to the new environment by using resources available around the plantations.

Keywords Land use change • Livelihood • Oil palm plantation • Resource use • Riverine society

Y. Kato (✉)
Hakubi Center for Advanced Research, Kyoto University, Kyoto, Japan
e-mail: yumi.katou@gmail.com

S. Sakai and C. Umetsu (eds.), *Social–Ecological Systems in Transition*, Global Environmental Studies, DOI 10.1007/978-4-431-54910-9_10,

10.1 Introduction

The biodiversity of Borneo is one of the richest in the word. It has numerous endemic plants and animal species, including many that are threatened. This rich biodiversity has supported the subsistence activities of the local people for a long time. It has also been the base of the country's economic development, which depended on the trade in various forest products, such as sago palm, rattan, iron wood, bird's nests, and rubber, until the early twentieth century (Ooi 1995). At that time, the local people were active as collectors of or traders in such products along the river basins. However, export of logged timber became one of the main economic industry of the country from the 1960s. Since the 1980s, oil palm and acacia (*Acacia mangium*) plantations have expanded. At the same time, the social environment has also changed because of the demand of works in urban areas and expansion of road networks into inland Borneo. The local people have moved from riverside longhouses to urban areas and new settlements along roads.

Oil palm plantations have rapidly expanded, but few studies discuss the changes in the resource use and subsistence activities of the local population after plantations spread. This study seeks to understand these effects. First, I outline the land use changes and expansion of oil palm plantations in Sarawak, Malaysia. Second, I describe the change of people's living environments caused by expansion of road networks. Third, I investigate the alterations in subsistence activities, focusing on shifting cultivation, hunting, gathering wild plants, and oil palm smallholdings.

10.2 Land Use Changes on Inland Sarawak

In this section I describe the historical changes in land and resource use in Sarawak. Resource use in Sarawak has changed in the long term. Before the early twentieth century, the country's economic activity depended on the trade of various non-timber forest products, which had begun in the tenth century. Various forest products, such as rhinoceros horns, bezoar stones, bird nests, camphor, and incense wood, were exported to China in the Sung period of the tenth century (Tagliacozzo 2005). Until 1910 the trade in non-timber forest products was the main economic resource of Sarawak (Ooi 1995). The sago palm was the main export throughout the nineteenth century, followed by bezoar stones, gutta percha (*Palaquium gutta*), Indian rubber (*Ficus elastica*), and antimony. After 1900, wild rubber became the top export product, while others, such as gutta percha, jelutong (*Dyera costulata*), rattan, dammar, illipe nuts, and honey, were also exported. However, between 1920 and 1940, petroleum became the dominant export. The main export commodities in the first half of the 1940s were petroleum, rubber, pepper, timber, sago palm, and jelutong. The trade in non-timber forest products was still important until the middle of the twentieth century, although the ratio of timber grew in its final decades.

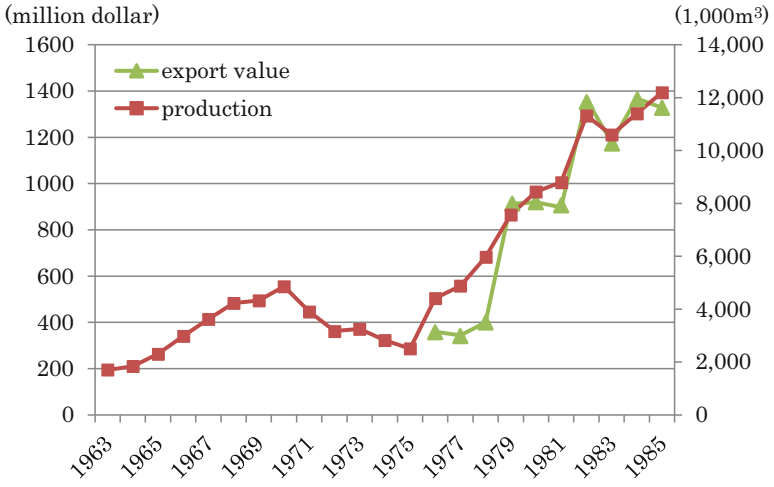

Fig. 10.1 Timber production and export in Sarawak. *Source*: Department of Statistics Sarawak, Forest Department Sarawak

Timber, such as Borneo iron wood (*Eusideroxylon zwageri*), was already being exported in the nineteenth century, but it accounted for only 2–3 % of the export revenue of Sarawak in the first half of the twentieth century (Ooi 1995; Smythies 1963). However, commercial logging has expanded toward the inland hilly areas since the 1960s with the introduction of heavy machinery. This initiated remarkable economic development, especially in the 1980s (Fig. 10.1). Timber became the second largest export commodity in 1980s, following petroleum. In 1983, Malaysian timber accounted for 58 % of the total exported timber of the world market. The export of logged timber was the most important economic revenue of the latter half of the twentieth century.

During the 1990s, oil palm production became the main agricultural product of Sarawak. The spread of oil palm cultivation has been astonishing in insular Southeast Asia over the past few decades. Previously found in Peninsular Malaysia and in Sumatra, Indonesia, the crop currently has one of its frontiers in Borneo (De Koninck 2011). Cultivation flourished from the 1970s to the 1980s in Peninsular Malaysia, where, with population increase and industrial development, land for oil palm cultivation has been insufficient. In Malaysia overall, the center of oil palm production moved from the peninsula to the state of Sabah in the 1990s and then to Sarawak by the latter half of that decade. The first oil palm plantation in Sarawak was established in the Miri Division in 1969. The publishing of the *Konsep Baru* (New Concept) also promoted the active use of native land for oil palm plantations through joint ventures of the government and private enterprise (Majid Cooke 2002; Ngidang 2002; Cramb and Sujang 2011). Figure 10.2 shows the expansion of estimated land for oil palm in Malaysia. Plantation has rapidly spread from the 1980s. In 2005, oil palm plantations occupied 543,399 ha in Sarawak (Department of Agriculture Sarawak 2005), and the total area grew to

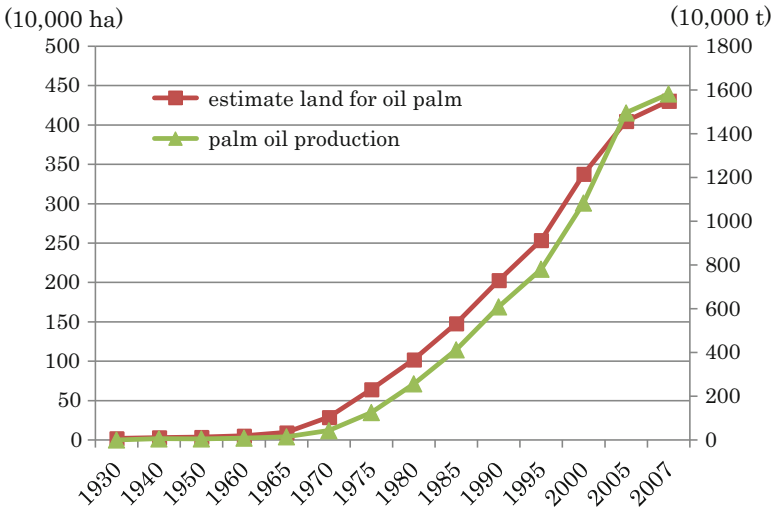

Fig. 10.2 Estimated land and production of palm oil in Malaysia. *Source*: Department of Statistics Malaysia, Malaysia Palm Oil Board

919,418 ha in 2010, representing a 1.7-fold increase over 5 years. In 2009, private companies farmed 82 % of the cultivated land of Sarawak, the government 13 %, and smallholders 5 % (MPOB 2010).

Recently, cultivated areas have expanded in other coastal areas, such as the Sibu and Bintulu Divisions. Plantation development in inland areas was late compared to coastal areas because of the inconvenient access to oil mills and inadequate road infrastructure. However, it is currently spreading to the inland hill areas, and oil palm cultivation by smallholders is diffusing to their post-swidden lands.

10.3 Migration from Riverside Longhouses to Roadside Settlements

From the 1970s, logging roads expanded from coastal to inland areas. Associated with this expansion, public road networks pushed into inland areas. Nowadays, roads cover all of Sarawak, and rural areas are directly connected to urban areas, a development which affects the spatial mobility patterns of the population. Previously, people lived in longhouses and cultivated their farms along rivers. Because of the hilly and mountainous topography of inland areas, rivers were the only means of transportation. However, after road networks were developed, people started to farm the land along roads. Recently, most of the people living in longhouses along rivers in the coastal areas have moved and reconstructed their longhouses along roads.

The same phenomenon exists in upper Rajang River of inland Sarawak, Malaysia. It is easier for people to use motorcycles than boats to access their farms.

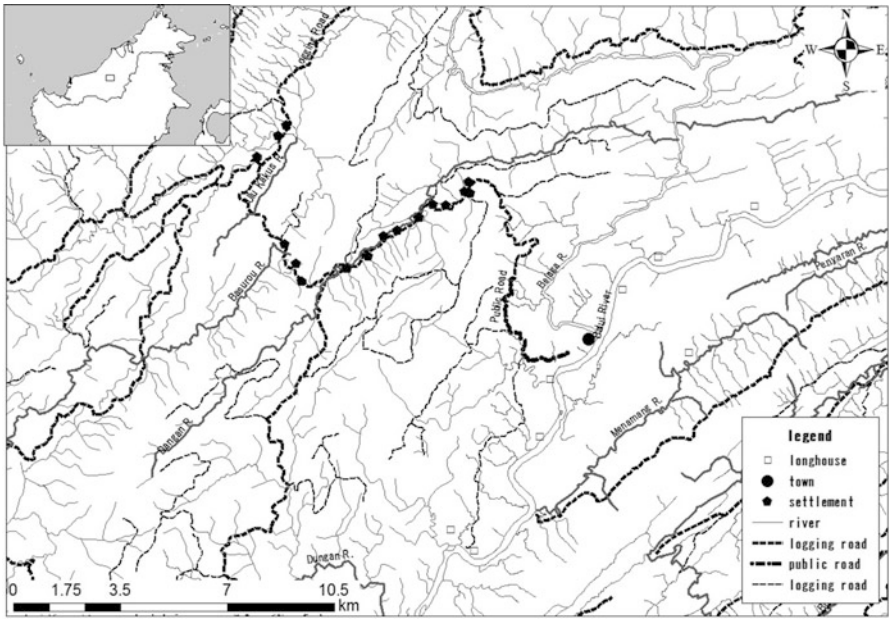

Fig. 10.3 Study Area

People have lived in scattered longhouse villages along the river. Most of these villagers have been swidden farmers. However, they started to cultivate paddy along the roads after road networks spread. The young generations have also migrated from inland riverside longhouses to urban areas because of the increasing availability of work in urban industrial areas (Soda 2007; Ichikawa 2011). The population outflow from longhouses to cities can be seen since the 1980s. Recently, the spatial patterns of inland population mobility expanded including riverside longhouses, urban areas, and roadside settlements. The frequency of their mobility also increased due to the use of motorcycles and cars between these plural residential sites.

I conducted my research in X village in upper Rajang River in 2008 and 2009. The people of X village originally lived in conventional longhouse located along a river. They gradually began to move to town because of the demands of construction works since the 1980s. Some of them also began to move to roadside settlements in the late 1990s, following other longhouse villagers who had moved earlier (Fig. 10.3). They established settlements and cultivated paddy along the road, a 1-h motorcycle trip from the town. More villagers joined them in the following years. They moved, first, because of insufficient primary forest around the conventional longhouse and, second, because of good accessibility from the town. They can gain access to their roadside farming sites by using motorcycles and cars from the town. It was more convenient for those who worked in the town, because they could engage in both agricultural work and waged labor. Recently they cultivated farms either near the longhouse or roadside settlements. The population flow from riverside longhouses to settlements along the roads greatly affected resource use and subsistence activities.

10.4 Changes in Local People's Resource Use and Subsistence Activities

How then have the spread of road networks and expansion of plantations affected people's subsistence activities? What are the differences in the subsistence activities of conventional riverside longhouse and new settlements along roadsides?

The historical change of people's subsistence activities in the case village is described below (Fig. 10.4). For a long time their lives basically relied on hunting and gathering in nearby forests, although they have also engaged in shifting cultivation and cash crop cultivation since the 1960s. Beside these basic subsistence activities, they also engaged in trade of several forest products. The international trade of forest products such as dammar and jeluton (*Dyera costulata*) resin was conducted until 1970s. However, economic impact of these trades was relatively low at that time. In contrast, the international trade of illipe nut and rattan cane flourished in 1970s and 1980s. It was continued until the 1990s. The cash income by these forest products was very important at that time. In addition, they also trade several forest products in a local market. It continues until today. They trade river fish, rattan handfcart such as basket or mat, wild plants such as bitter bean (*Parkia speciosa*) and rattan shoots, and fruits such as dorians in the local market. These trades are still main sources of their cash income. How do recent land use changes affect the local people's resource use and subsistence activities?

The vegetation around the longhouse consists of secondary forest and shifting cultivation. In comparison, the settlements along roads have been surrounded by oil palm and acacia tree plantations since 2005. Below, I describe the differences of resource use and subsistence activities between riverside longhouse and roadside settlements.

10.4.1 Shifting Cultivation

Shifting cultivation has been one of the main subsistence activities for them. Before the 1990s, most of the local residents opened primary and secondary forests around

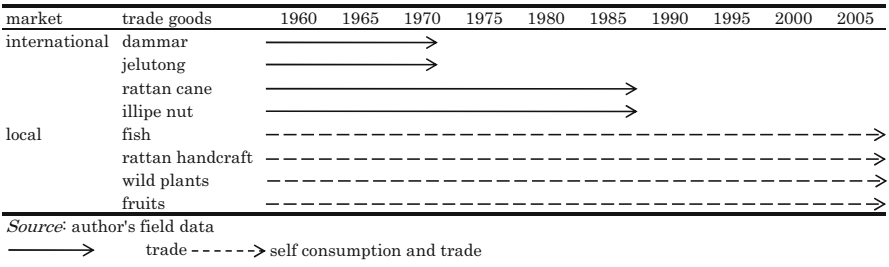

Fig. 10.4 History of forest product trade in the case village

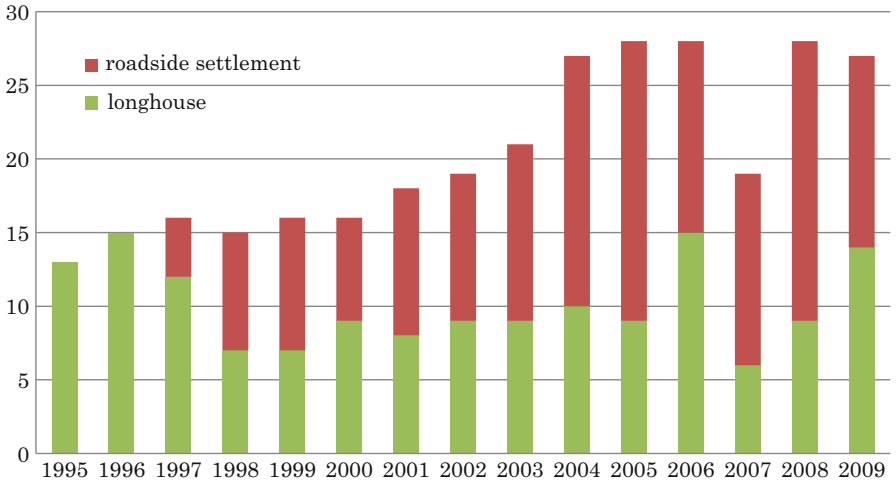

Fig. 10.5 Household number according to shifting cultivation sites. *Source*: author's field data

their riverside longhouse, where they cultivated paddy, corn, cassava, and other vegetables. However, after the expansion of road networks, people in the late 1990s moved to the roadsides, where their farming sites also shifted. In the X village I have recorded the farm sites of the villagers. Each household cultivated paddy, either near the longhouse or in the forest along the roads. In 1997, 12 households cultivated farms around the longhouse and only 4 households worked land along the road. In contrast, in 2008, only 6 households cultivated land around the longhouse and 13 households farmed along the roads (Fig. 10.5). Recently, households prefer to cultivate land along the roads.

The primary forests around the riverside longhouse had been cultivated for long time, so they claimed the soil became very poor. As seen in the figure, the numbers of households who cultivated their land along the logging roads increase from the 1990s. However, I found the crops in the two farming sites are almost the same. The average crop yield per household around the longhouse during the 11 years from 1997 and 2008 was 959 kg, and 955 kg along the roads. There were no clear differences in the process of cultivation. The people organized labor by exchange parties in both places. The area of cultivation land in both areas was almost the same. The vegetable species they cultivated differed only slightly (Table 10.1). They cultivated a larger variety of vegetables around the longhouse.

Villagers seem not to choose their farming sites based on crop differences but rather on the convenience of access to such sites. When they cultivate around the longhouse, they need to thresh crops manually. Furthermore, they must carry harvested crops on foot to the longhouse. It is also inconvenient for the households that engage in wage labor in town to carry the rice frequently from their longhouse. It is difficult to balance farming around the longhouse with work in the town. In contrast, people can use motorcycles to access their farming sites along the roads;

Table 10.1 Comparison of cultivated plants of longhouse and roadside settlements

Common name	Local name	Scientific name	Longhouse	Roadside settlement
Cassava	Kele	*Manihot esculenta*	+	+
Banana	Balat	*Musa* spp.	+	+
Amamesiva	Situn	*Sauropus androgynus*	+	+
Chili	Be	*Capsicum frutescens*	+	+
Sweet potato	Abai	*Ipomoea batatas*	+	
Taro	Sukai	*Colocasia esculenta*	+	
Lemon glass	Serai	*Cymbopogon citratus*	+	+
Galangar	Kua	*Languas galanga*	+	
Long bean	Beleta'	*Vigna sesquipedalis*	+	+
Dishcloth gourd	Kusut	*Luffa cylindrica*	+	+
Papaya	Medung	*Carica papaya*	+	+
Sugger cane	Tovu	*Saccharum officinarum*	+	+
Jack fruits	Badu'	*Artocarpus heterophyllus*	+	
Cacao	Koko	*Theobroma cacao*	+	
Lime	Limau	*Citrus microcarpa*	+	+
Pineapple	Aro'san	*Ananas comosus*	+	+

Source: author's field data

therefore the work is more effective. Furthermore, they can easily carry harvested crops by motorcycle and car to the settlement and to family members who live in town. These factors increase the household who cultivate their farms along the roadside recently.

10.4.2 Oil Palm Smallholding

The largest difference in the subsistence activities of the two sites concerns oil palm smallholdings, which are only available along the roads. When an oil palm plantation spreads around the village, some villagers started planting oil palm as smallholders. Oil palm smallholdings are becoming a significant subsistence activity along the road.

Although the people of Village X have engaged in the cultivation of various cash crops, none of these has become a stable subsistence activity. In the 1970s they were engaged in Para rubber trees (*Hevea brasiliensis*) cultivation. In the 1980s they cultivated coffee; in the 1990s, they undertook cacao and pepper cultivation (Table 10.2). However, none of these plantings provided sustainable cash income. Because of high prices and ease of cultivation, Cacao was once regarded as a golden crop. However, it was difficult to harvest because of the losses inflicted by squirrels in non-mass fruiting years in the case village.

With the road infrastructure, oil palm smallholding began. The smallholders must transport oil palm bunches to mills within 24 h of harvesting. People started

Table 10.2 Comparison of the number of households engaged in cash crop cultivation. The numbers on left sides indicate the number of plants of the households

Number of plants	Rubber	Coffee	Cacao	Pepper	Oil palm	Total
1–200	10	9	7	0	4	30
201–400	0	0	0	2	4	6
401–600	0	0	0	0	1	1
601–800	0	0	0	0	2	2
801–1,000	4	1	4	0	2	11
1,001–1,200	0	0	0	0	0	0
1,201–1,400	0	0	0	0	0	0
1,401–1,600	0	0	0	0	1	1
1,601–1,800	0	0	0	0	0	0
1,801–2,000	0	0	2	0	0	2
2,001–	0	0	0	0	1	1
Total	14	10	13	2	15	54

Source: author's field data

planting oil palms in 2008, following the lead of a farmer who lived near the settlement. When I conducted my survey in 2008, 58 % of the villagers were already cultivating them. They said they started planting oil palms because neighboring people had planted them and that they expected high incomes. Those who had not turned to the crop said that seeds and agricultural chemicals were too expensive, they were busy with other subsistence activities, or they were uneasy about growing and selling oil palms.

Most of the smallholders started planting palms within 10 years after the large scale plantation began operation in Sarawak. To start cultivation, they bought oil palm seeds from the nearby plantation company for 2.20 Malaysian Ringgit[1] (MYR) per seed in 2008. Of the 15 households who lived along the road, only 7 planted 50–750 of these oil palm seeds each, or 2,950 in total. The area they planted was usually less than 10 ha. Many people also took young sprouts from mother plants and grew them in a nearby gardens or planted seeds from fallen fruit. Palms grown from the latter are regarded as less fertile, but people with less funds still rely on them. The total number of palms in 15 households was about 5,000. Five household also planted jatropha (*Jatropha curcas*), 150 trees each, for a total a 750 trees.

Families did not open new secondary forest areas for oil palm gardens. They planted oil palms in paddy fields after harvests. Palm fruits are harvested within 3–4 years after planting. Therefore, in the next few years, oil palm smallholdings may become a more significant subsistence activity in this area if the current high market price is maintained. It may also attract people who live in riverside longhouses to turn to becoming oil palm smallholders in roadside locations. Within their

[1] One Malaysian Ringgit is about 0.3 US dollars.

subsistence activities, oil palm smallholding is a newly emerged option after the road connection was developed. It is also related to the current expansion of large scale plantations through out Malaysia.

10.4.3 Hunting

Hunting is one of the most important subsistence activities of the people in X village. Historically, people use various hunting methods, which are adapted to the habits and the characteristic of animals. Before the 1960s they used spears, blowpipes, spring traps, bamboo spears, and important game, such as bearded pig, barking deer, and sambar deer, were usually hunted using spears. They often took hunting dogs along with them to track and chase animals in the forest. The blowpipe was next in importance to the spear. They shot birds, and arboreal animals such as monkeys and tupai with blowpipes. Along with the spear and blowpipe, the local people employed spring traps to catch smaller mammals and birds, which were also snared in birdlime. Hunters had traditionally employed bamboo spears, which they don't use nowadays. Today, hunting has greatly changed. Hunters now use vehicles and guns to hunt animals, and hunting ranges are wider; they also hunt in the forest along roads.

Hunting methods, times, and target animals are no longer the same. When still living in longhouse, people generally hunted during the day, but now they hunt at night with torchlights in forests near plantations because wild boar frequently come to feed on oil palm fruit in the plantations along the roads only at night. In addition, they find hunting around the plantations more convenient, since they can use motorcycles on the roads. Moreover, many people stated that hunting around the plantations is easier than hunting in the natural forests. In fact, field data from 2008 reveal that more than half of all successful hunting took place around plantations. People hunted the bearded pig, mouse deer, or barking deer near longhouse, but now search mainly for bearded pig around the plantation.

10.4.4 Gathering Wild Plants

In the focal village, the gathering of wild plants has been very important for villager livelihoods for a long time. In total, the villagers have used 67 species of wild plants and fungi around the longhouse, including three species of the sago palm (*Arenga undulatifolia*, *Eugeissona utilis*, *Metroxylon sagu forma longispinum*), which they gathered in the secondary forest as staple foods. Forty species were employed as non-staple foods, 23 species for snacks, and a single species for drinks. The non-staple food included 15 species of fungi, 6 species of ferns, and 4 species of ginger, all gathered in the secondary forest near the longhouse.

Table 10.3 Comparison of edible wild plants of longhouse and roadside settlements

Common name	Local name	Scientific name	Longhouse	Roadside settlements
Gnemon tree	Sabung	*Gnetum genemon*	+	
Bamboo shoot	Tuvu'	*Dendrocalamus* sp.	+	
Red gingerwort	Tipu'	*Etlingera punicea*	+	+
Marang	Tahap	*Artocarpus odoratissimus*	+	
Aren gelora	Jemako	*Arenga undulatifolia*	+	
Durian burong	Lubo'	*Durio* sp.	+	
Kadjatoa	Bulong	*Eugeissaona utilis*	+	
Bitter bean	Pata	*Parkia speciosa*	+	
Rattan shoot	Poha'	*Calamus* sp.	+	
Blimbi	Belibit	*Averrhoa bilmbi*	+	
Johore jack	Lumu'	*Artocarpus odoratissima*	+	
Turkey berry	Ulom	*Solanum torvum*	+	
Torch ginger	Uhom	*Etlingera elatior*	+	+

Source: author's field data

Along the roads around the plantations the villagers continue shifting cultivation and hunting, but they do not collect wild plants, except for rattan, since many plant species are difficult to find there. Table 10.3 shows the 14 species of edible wild plants which were most used in longhouse. Only two species are used in the settlement along the road. It is inconvenient for them to collect edible wild plants along the road. There are several reasons that they cannot use edible wild plants along the road. First, the villagers claim the vegetation around the riverside longhouse and road side settlements are different. For instance, there are plenty of sago palms around the longhouse, however we cannot find any sago palms along the road. Second reason is the access to the forest. The longhouse is surrounded by forest. Therefore they can easily take wild edible plants in their daily diet. In contrast, the roadside settlements are surrounded by oil palm plantation. Therefore the distance to forest is farther. Access to the forest is also lesser compare to the life in longhouse. The third reason is effect of herbicides. Villagers say they are afraid of taking edible wild plants around the plantation. They think these plants are harmed by herbicides sprinkled in the plantation and not safe to eat. These reasons are related to the differences in the use of edible wild plants.

The only useful plant around roadside settlements is rattan, plentiful in primary forests around plantations but exhausted near longhouse due to decades of gathering (Figs. 10.6 and 10.7). Currently, people who live around plantations engage more in collecting rattan and making rattan handcrafts than those who live in the longhouse. The cash income generated by selling rattan handcrafts is very important for women. In both residential sites, 22 women make and sell rattan handcrafts; 16 of these women live along the road. The highest cash income from selling rattan handcrafts was MYR 780 a month, although, on average, the women earned MYR 278 per month. Figure 10.8 provides a comparison of the rattan handcrafts of women living in the longhouse (6 women) and women living in roadside settlements (16 women). Six handcraft weavers live in the longhouse, and each

Fig. 10.6 A woman collecting rattans in the forest around the longhouse

Fig. 10.7 People collecting rattans in the forest along the road. (They can collect more rattans in the forest along the road)

earns an average of MYR 257 per month from the sale of handcrafts. In contrast, 16 weavers live in roadside settlements and earn MYR 369 on average per month per person. Compare to wild plants gathering around the longhouse, they can hardly collect edible wild plants, however, they can collect rattans more actively around the road side settlements.

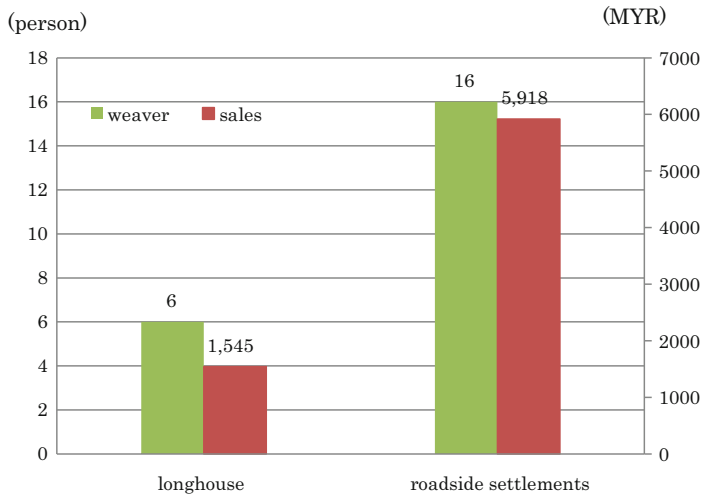

Fig. 10.8 Number of weaver and Sales of rattan handcrafts in longhouse and roadside settlements. (Total weaver were 22 people in both sites. Sales data was collected in June, November, and December 2008). *Source*: author's field data

Subsistence activities of X villagers in the longhouse and around the plantation in roadside settlements differ. While paddy cultivation and hunting are expected to continue in both sites, villagers cannot fish and collect edible wild plants around the plantation in roadside settlements. They can fish easily around the longhouse, because longhouse is located at riverside. In contrast, they can hardly fish around the settlement along road, because river is far from the settlement. In addition, they are afraid of the effect of herbicide flowing from plantation. However, they engage in hunting and gathering wild rattan more actively in the forests along the road. Furthermore, they plant oil palm on smallholdings.

10.5 Discussion

Palm oil production is becoming one of the most important industries in Insular Southeast Asia (Cramb and Curry 2012). Therefore, oil palm plantations are expected to expand continuously. In this situation, oil palm plantations become premise of local people's life. Local people also started to earn certain profit by planting as smallholder recently (Feintrenie et al. 2010; Kato and Soda 2012; Cramb and Sujang 2013). What is important here is how local people can control the stable livelihood under this situation. Another important background concerning to this point is expansion of road networks. The expansion of road networks changes local people's resource use. It became road based resource use.

This study considered the differences in the resource use and subsistence activities of the people who lived in conventional longhouse, surrounded by secondary forests along rivers, and those who dwelled in new settlements, surrounded by oil palm plantations along roads.

Subsistence activities and resource use differ according to the vegetation around settlements. There are vast secondary forests around the longhouse as a result of hill paddy cultivation. Even where some primary forests remain, they are far from longhouse or unfavorably placed. Under these conditions, people engage in shifting cultivation in secondary forests, where they gather wild plants, including many edible varieties, hunt, and fish. However, they do not collect rattan actively because these sites are exhausted. Similarly, they cannot plant oil palms around longhouse, given the lack of roads.

In contrast, the vegetation along roads consists of primary forest, secondary forest, and plantations. Although people cannot fish or collect edible wild plants, they can engage in shifting cultivation, hunt, and collect rattan. The people of village X regard hill paddy cultivation in the primary forest around the plantations as convenient because they can use motorcycles to transport harvested crops. They also claim that gathering rattan in the primary forest here is easier than in the forest around longhouse, where the soil is exhausted. The villagers think that hunting is easier near plantations because they can use motorcycles for transportation. In addition, they plant oil palms as smallholders. Thus, there are more livelihood alternatives along the road. However, primary and secondary forests remain very important, even for people living along road. If there is no forest around the plantation, they cannot continue paddy cultivation, hunting, and collecting rattan. The alternatives of several subsistence activities are very important for their stable livelihood. In coastal areas in Sarawak, some villages are more strongly affected by oil palm industry (Cramb 2011). In these areas, most of the villagers do not continue paddy farming, because oil palm smallholding becomes primarily important economic activities (Kato and Soda 2012). However, in inland Sarawak, the access to the palm oil mill is rather difficult, therefore they cannot concentrate only in oil palm smallholding. In this situation, the alternatives of other subsistence activities become comparatively significant.

The expansion of road networks in inland areas will continue to push the population from riverside longhouses to roadside settlements and urban areas. Conventionally, social space in Sarawak was centered around rivers, which is why it is called a riverine society. People built their longhouses and opened paddy fields along rivers. However, the expansion of logging into inland areas expanded road networks and the expansion of the oil palm industry has pulled the inland population to the roadsides. The expansion of road networks also changes local people's access to natural resources. They become able to access to new resources like rattans when the road networks arrive in the areas where they could not access by river based transportation before.

Urbanization is one of the other factors in this dynamic. Once inland areas were connected to coastal cities directly by road, access to the latter became easier. Young people were able to seek work in urban areas, and people moved more

frequently between longhouses and cities. These population flows are also related to resource use changes along roadsides.

Oil palm smallholdings have become very common in inland areas. If palm oil prices remain high, smallholdings will continue to prosper; if they fail, the population will have to turn to other economic activities. In this sense, multiple subsistence activities, based on the forest, bolster local livelihoods. However, resource use along roadsides will become more general as the road network increases in density. In this situation it is necessary to continue to consider the stable subsistence model, including the livelihood along roadside settlements.

Acknowledgments I thank Prof. Shoko Sakai and the Sarawak Development Institute for their considerable support for this study. I also thank the GIS unit of the Forest Department of Sarawak, Dr. Reiichiro Ishii, Dr. Izuru Saizen, and Dr. Hiromitsu Samejima for providing a base map of the study area.

References

Barney K (2004) Re-encountering resistance: plantation activism and smallholder production in Thailand and Sarawak, Malaysia. Asia Pac View 45(3):325–339

Cramb RA (2011) Reinventing dualism: policy narratives and modes of oil palm expansion in Sarawak, Malaysia. J Dev Stud 47(2):274–293

Cramb RA, Sujang PS (2011) "Shifting ground": renegotiating land rights and rural livelihoods in Sarawak, Malaysia. Asia Pac View 52(2):136–147

Cramb R, Curry GN (2012) Oil palm and rural livelihoods in the Asia-Pacific region: an overview. Asia Pac View 53(3):223–239

Cramb RA, Sujang PS (2013) The mouse deer and the crocodile: oil palm smallholders and livelihood strategies in Sarawak, Malaysia. J Pheasant Stud 40(1):129–154

De Koninck R (2011) Southeast Asian agricultural expansion in global perspective. In: De Koninck R, Bernard S, Bissonnette JF (eds) Borneo transformed: agricultural expansion on the Southeast Asian frontier. NUS Press, Singapore, pp 1–9

Department of Agriculture Sarawak (2005) Agricultural statistics of Sarawak. Department of Agriculture Sarawak, Kuching

Department of Statistics Sarawak Year book of Statistics 1970, 1975, 1985

Department of Statistics Malaysia Year book of Statistics 1970, 1980, 1990, 2000

Feintrenie L, Chong WK, Levang P (2010) Why do farmers prefer oil palm? Lessons learnt from Bungo district, Indonesia. Small Scale Forest 9(3):379–396

Forest Department Sarawak Annual Report 1965–1985

Ichikawa M (2011) Factors contributing to different rates of depopulation in rural villages in Sarawak. Borneo Res Bull 42:275–288

Kato Y, Soda R (2012) Emerging trends in oil palm smallholdings in Sarawak, Malaysia. Geogr Stud 87(2):26–35 (in Japanese)

Majid Cooke F (2002) Vulnerability, control and oil palm in Sarawak: globalization and a new era? Dev Change 33(2):189–211

Malaysia Palm Oil Board (2010) Malaysian palm oil statistics. Malaysia Palm Oil Board, Kajang

Ngidang D (2002) Contradictions in land development schemes: the case of joint venture in Sarawak, Malaysia. Asia Pac View 43(2):157–180

Ooi KG (1995) An economic history of Sarawak during the period of Brooke rule, 1841–1946. Dissertation, Hull University

Smythies BE (1963) History of forestry in Sarawak. Malayan Forest 26:232–253
Soda R (2007) People on the move: rural–urban interactions in Sarawak. Kyoto University Press and Trans Pacific Press, Kyoto and Melbourne
Tagliacozzo E (2005) Onto the coasts and into the forests; ramifications of the China trade on the ecological history of Northwest Borneo, 900–1900 CE. In: Wadley RL (ed) Histories of the Borneo environment. KITLV, Leiden, pp 25–59