FACULTY OF SCIENCE
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A study of the economic importance of oleoresin *(Dipterocarpus)* for the rural population in Prey Lang forest, Cambodia.

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Summary

The genus *Dipterocarpus* is the main source of liquid (oleoresin) and solid resin. *Dipterocarpus* are native to the mainland of Southeast Asia. The *Dipterocarpus* genera are mainly growing in the semi-evergreen and evergreen areas of Prey Lang. *Dipterocarpus* is of high importance for the local communities in Prey Lang, Cambodia. Oleoresins are used at the local level to waterproof baskets, boats, fishing traps, and generate cash income. They also serve industrial purposes (Ankarfjärd & Kegl, 1998). This survey focuses on the resin tapping practice in Prey Lang forest, Cambodia. The aim of the present study is i) to estimate the economic importance of resins for the local communities in four villages sited in the vicinity of Prey Lang forest and ii) to study selected ecological factors and their impact on the resin yield from the species *Dipterocarpus alatus*[1].

The study consisted of an interview survey based on 43 interviews. The information gathered focused on data on liquid and solid resin extraction. The second part is a quantitative study based on a field survey in Prey Lang making selected ecological measurements on 100 resin trees of the species *Dipterocarpus alatus.*

The main findings showed that an average family used 9.2 days per month on liquid resin tapping. Averagely 1044 tapping events were carried out every month in the target villages. This gave a monthly collection of 392 litres of liquid resin. The average monthly income derived from liquid resin was 252 USD, which was 3083 USD in a year. The income from resin in the rainy season was 74 % higher compared with the dry season. One resin tree contributes with 0.98 USD per month. The yearly costs regarding resin tapping were 156 USD. Cash-income from solid resin was significant only in the village Spong. There, the yearly income from solid resin ranged from 395-1200 USD. Trees located near streams tended to produce a higher resin yield than trees not located near streams, approximately 38 % more. It takes 12 hours to collect from 100 resin trees, which is an hourly earning of 3 USD.

This present report demonstrates that harvest of liquid resin is a significant source of income for the Prey Lang communities. The results will contribute to the global lack of literature on this matter and also state the importance of forest products for rural livelihoods not only in Cambodia but also on a global scale.

[1] The resin tree genus *Dipterocarpus* is in local terms called ”Cheuteal”.

Preface

This study is a project, which is a part of a bachelor programme in natural resources with specialization in nature management on the Faculty of Science, University of Copenhagen. The project corresponds to 15 ECTS points. The overall aim with this project is to study the economic importance of resin trees for the thousands of families who live in and around Prey Lang forest in the northern part of Cambodia. Resin trees are tapped and managed through many generations within the families and is a vital source of income. Resin tapping is considered as being equally as important as farming in the provinces that stretches Prey Lang (Community Peace-Building Network, 2014). This kind of study is not made in Prey Lang today and will therefore contribute remarkably to the existing knowledge on resin trees and their local importance. The findings of this study will be related to similar studies made in Cambodia and other countries in Southeast-Asia. This report consists of two parts. Firstly, the results from the interview survey are presented and discussed. The three central elements in the interview survey will be i) time-use on collecting resin, ii) cash-income generated from resin and, iii) costs related to the resin tapping practice. Different species from *Dipterocarpaceae* are encompassed in the interview survey. Secondly, the results from the field study on resin trees will be presented and discussed. The main element in the field study is to examine selected ecological factors and their impact on the resin yield from the species *Dipterocarpus alatus* and to make an estimate on the hourly earning for a resin collector. The collected data are examined through mean-based statistical analysis. I hope that this study will draw attention to the last large intact lowland evergreen rainforest in Indochina and to its severe economic importance for the communities living in and around Prey Lang forest.

Acknowledgements

I would like to express my sincere thanks to my supervisor Senior Researcher Ida Theilade and Associate Professor Henrik Meilby who has provided comprehensive guidance for this study. I am very grateful for the supervision they have provided forming the questionnaire, the measuring scheme and how to manage the collected data. I would like to thank the local communities in Prey Lang (the informants) to contribute with their knowledge to this study. A special thanks to Mrs. Phork Hong who arranged all practicalities and made the interview survey and the fieldtrip to run smoothly and her husband Mr. Don Chann and Mr. Toern who was guiding us through the forest on the field trip. I would also like to thank Mrs. Long Hay who did a brilliant job planning the field trip and translating and organising the interviews. Finally, I would like to thank PhD student, Nerea Turreira Garcia, and MSc student Christian Pedersen for their analytical and statistical contributions to the present report.

Date: ____________________ Signature: ____________________

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1. Introduction

1.1 Background

Prey Lang is the largest lowland evergreen forest complex in Cambodia and in the Indo-Burma biodiversity hotspot[2] (Olsson & Emmet, 2007). The forest of Prey Lang is characterised by seven unique types of vegetation and these vegetation types are roughly classified by the leaf behaviour, i.e. evergreen, semi-evergreen or deciduous forests. The three categories differ significantly from each other on the basis of dominant trees, species composition and plant community structure (Mcdonald, 2004). The focus in this study is the tall evergreen forest, where species from *Dipterocarpaceae* are dominant and are the main species of the canopy closure. *Dipterocarpaceae* is one of the most important resin-yielding families. *Dipterocarpus alatus* along with the rest of the *Dipterocarpus* species contain oleoresin and is a species restricted to the mainland of Southeast Asia. Accordingly, Burma, Thailand, Malaysia, Laos, Vietnam and Cambodia (Ankarfjärd & Kegl, 1998). *Dipterocarpus* trees are also important timber genera for use in construction and therefore favoured by loggers. Logging of large *Dipterocarpus* trees often includes trees actively tapped for resin (Evans, Piseth, Phaktra, & Mary, 2003). A baseline study made in Prey Lang shows that resin trees are cut every day. In that particular study more than 17.000 large resin trees have been reported logged (Community Peace-Building Network, 2014).

Lowland forests have been the most common vegetation type in Cambodia. Now this forest type is poorly protected and highly threatened (McDonald 2004). In the 1990s forests in Cambodia were described as being the country's most developmentally important resource by the World Bank. The political elite has now sold off most of the valuable timber species to national and foreign private companies or individuals to make large and quick profits. In a Cambodian context known as economic land concessions (ELC[3]) (Global Witness, 2009). Logging concessions have historically been granted for lowland evergreen forests due to their accessibility and their richness of high value timber. In the 1990s the government of Cambodia granted around 30-40 logging concessions, which stretched more than seven million hectares equal to 39 % of Cambodia's land area (Global Witness, 2009). Numbers from 2013 shows that 2.6 million hectares had been leased to private companies in the form of ELCs, equivalent to 73 percent of Cambodia's arable land. An increase of 16.7 percent since 2011 (Global Witness, 2015).

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[2] The Indo-Burma biodiversity hotspot is one of the worlds´ 35 hotspots, which represent areas of exceptionally high biodiversity. The Indo-Burma hotspot encompasses more than 2 million km^2 covering Burma, Thailand, Laos, Vietnam, Cambodia, Southern China and part of the Indian West Bengal. More information on biodiversity hotspots, see following link (www.cepf.net/resources/hotspots/Pages/default.aspx).

[3] An economic land concession, or ELC, is a long-term lease that allows the beneficiary to clear land in order to develop industrial agriculture. The MAFF is responsible for granting ELCs, and no other authority can legally grant an ELC. (Read more: http://www.opendevelopmentcambodia.net)

Although Cambodia has a system of protected areas, it reveals a clear lack of protection for lowland evergreen forests because of unrestrained logging activities, both legal and illegal (Olsson & Emmet, 2007).

Prey Lang evergreen and semi-evergreen forest areas are considered as being forest of high economic importance because of its logging interests (commercial timber species), rich biological diversity and the fact that it provides forest products and cash-income for the local families (McKenney, Chea, Tola, & Evans, 2004). Prey Lang is an integral part of the indigenous peoples culture and survival. Resin is one of the most important non-timber-forest-products (NTFP)[4] that the rural communities in and around Prey Lang depend on. Families use resin for waterproofing baskets, boats, fishing traps etc. and most importantly it is a central source of cash income (Ankarfjärd & Kegl, 1998).

Forest products are important resources in order to sustain rural economies and thus play an important role in poverty alleviation in rural areas. This study is important because knowledge on the economic value of resin trees are lacking in the exiting literature, both in Cambodia and on a global scale. The results from the present study emphasize the importance of conserving tropical forests, not only to benefit rural livelihoods, but also it will benefit the climate, biological diversity and the broader population globally.

1.2 Project objectives

The overall aim of this study is to quantify the socio-economic value of resin trees *(Dipterocarpaceae)* to local households in Prey Lang forest, Cambodia.

1.3 Research questions

The following research questions are to be answered in the present study:

Socio-economic study (Interview survey)

- How much time do resin tappers use on collecting resin?
- How much cash-income do resin tapper families in Prey Lang forest derive from liquid and solid resin?
- What costs are related to the resin tapping practice?

Ecological study (Field study)

- What impact do selected ecological factors have on the resin yield that *Dipterocarpus alatus* produce?
- What is the hourly wage for a resin collector?

[4] NTFP: Non Timber Forest Product

2. Methodology

This study was drawn on the basis of a combined socio-economic and ecological study carried out in Prey Lang forest in Cambodia. All data were collected on a nine-day field trip to Preah Vihear and Stung Treng province in December 2014.

The socio-economic study (interview survey) was carried out in four villages in the vicinity of Prey Lang. Accordingly, *Thmea*, *Phneak Roulek*, *Spong* and *Srae Veal,* cf. annex 4 (north-western part of demarcated area). 43 interviews were completed. The resin tappers were interviewed individually. A local women arranged all the interviews. The respondents were divided in three wealth classes. The three wealth classes were defined by what kind of roof the respondents have on their house. The reason for this income distribution is that one of the first things the families acquire when they have saved up enough money is a new roof. This wealth distribution is also used in a similar BSc. study cf. by (Lægaard, 2010), cf. photo no. 1.

Photo 1: This photo shows the three different roof kinds in a village in Choam Svay. From the left leaf, steel and tile (Lægaard, 2010).

The ecological study (field study) was carried out in the evergreen part of Prey Lang. Measurements were made on 100 trees. We followed two male resin tappers and made measurements on trees owned by one of the resin tappers.

The combined qualitative and quantitative study made it possible to cross check the results and increases the scientific validation of the whole dataset. The interview survey provided a broad view of the resin tappers practice in the chosen area and gave detailed knowledge on collection amounts and the cash-value of resin. The field study gave concrete yielding data on a sample of resin trees and furthermore added ecological findings to the study. Findings in both the interview survey and the field study were exposed to mean-based statistical analysis and related to results from similar studies.

2.1 Study area

Prey Lang is the largest lowland evergreen forest located west of the Mekong River in the north-central plains of Cambodia (Olsson & Emmet, 2007). The forest landscape of Prey Lang covers about 520,000 hectares, where the most biologically important part covers 135.000 hectares, cf. annex 4 (Theilade & Holger, 2011; Mcdonald, 2004). Prey Lang extends in four provinces. Stung Treng, Kratie, Preah Vihear and Kampong Thom, accordingly (See figure 1). Prey Lang is chosen for this particular study because it is currently exposed to severe unrestrained logging and is a controversial issue in Cambodian politics.

Figure 1: Map of Cambodia. Map shows provinces within Cambodia (Open Development, n.y.)

The interview survey was carried out in four villages; *Thmea*, *Srae Veal*, *Phneak Roulek* located in Preah Vihear province and the fourth village, Spong, is located in the core area of Prey Lang in Stung Treng Province. The main occupation in both provinces is farming, resin collection, fishing and extraction of NTFPs (Community Peace-Building Network, 2014).

The field study on resin trees was carried out in the core area of Prey Lang. This particular area is characterized as tall evergreen forest. The measured trees were located in Preah Vihear province near the border of Kampong Thom and Stung Treng, cf. figure 2. Prey Lang provides building materials, medicine, cash-incomes and food for the local communities. Most indigenous Kuy live in and around Prey Lang. More than 250.000 people live in 340 villages within 10 kilometers of the forest and depend on the forest for their livelihoods. With resin being a fundamental source of cash income (Olsson & Emmet, 2007; Theilade & Holger, 2011).

2.2 Species description

The key resin producing species in this survey is *Dipterocarpus alatus (Dipterocarpaceae)* also called *Cheuteal* in Khmer.

The 43 respondents (+2 pilot) tap from the resin tree species shown in table 1. The species are listed according to their abundance in the interview survey, with *D. alatus*, *D. intricatus* and *D. costatus* being of major importance in Prey Lang (Evans, Piseth, Phaktra, & Mary, 2003). The observations from the field study were of the species *Dipterocarpus alatus* and only three observations on *Dipterocarpus intricatus.*

Figure 2: This map shows GPS coordinates for the 100 resin trees in the field study. The picture is a screenshot from Google Earth.

Table 1: Information on resin tree species present in the interview survey. Here of, scientific species name, local name, resin type and the abundance of species tapped by the respondents. Results from pilot interviews are included in this table (Evans, Piseth, Phaktra, & Mary, 2003).

Scientific name	*Local/Khmer name*	*Liquid (L) or Solid (S)*	*No. of respondents tapping resin from the particular species*
(1) *Dipterocarpus alatus* (Dipterocarpaceae)	Cheuteal	L	30 (67 %)
(2) *Dipterocarpus intricatus* (Dipterocarpaceae)	Trach	L	16 (36 %)
(3) *Dipterocarpus* costatus (Dipterocarpaceae)	Cheuteal Kreuh	L	10 (22 %)
(4) *Shorea guisu* (Dipterocarpaceae)	Chor chong	S	5 (10 %)
(5) *Dipterocarpus costatus* (Dipterocarpaceae)	Cheuteal Bang Koye	L	5 (10 %)
(6) *Shorea obtusa* (Dipterocarpaceae)	Pchuek Odorm	S	1 (2 %)

3. Interview survey

The interview survey was carried out in four villages. Three located in Preah Vihear province and one village in the neighbouring province Stung Treng. The interviews were conducted in the villages in the following order; Thmea (*Preah Vihear*), Phneak Roulek (*Preah Vihear*), Spong (*Stung Treng*) and Srae Veal (*Preah Vihear*). In this chapter I present the interview data. The focus are on these three elements; i) time-use on collecting the resin, ii) cash-income generated from resin and, iii) costs related to the resin collecting practice.

3.1 Interviewers

The interviews were primarily led by a Cambodian interpreter Mr. Long Hay and arranged by a local woman and core PLCN member Mrs. Phork Hong. A pilot survey was conducted in Stung Treng in November 2014. After pilot testing the questionnaire was revised. I have included the pilot data in this survey to some extent, because parts of the data are comparable with the primary results.

The interviewer for the pilot interviews is different from the interviewer in the primary interview survey. Both interviewers work with Prey Lang communities and natural resource issues in their carriers. Mr. Yothin carried out the pilot interviews. Mr. Yothin works at the NGO CPN (Community Peace-Building Network). CPN is a movement that works with communities in Cambodia that deals with natural resource conflicts. Mr. Long Hay carried out the primary interview survey. He has worked with resin tapper communities in Prey Lang and now he works for RECOFT[5] with Community Forestry. So both interviewees were able to navigate in the questionnaires because of their professional backgrounds. This fact is important in order to get as realistic and precise data from the local resin tappers.

3.2 Sampling

Mr. Long Hay and Mrs. Phork Hong selected the four target villages. The villages were selected because of their i) proximity to Prey Lang and ii) extensive resin dependency. Mrs. Phork Hong organized all practicalities and sampling of villagers for the interviews. She asked all resin tappers in each village to meet at a certain place and then all resin tappers who had time and wanted to participate showed up for the individual interviews. Respondents were interviewed one by one. When we carried out the interviews most respondents were present. This circumstance may have influenced the answers if there was any sensitive information the respondent would not share. But since the content of the questionnaire was about tapping habits and income information, it is assessed not being a problem for the validation of the answers. The results and information from all 43 interviews were compatible.

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[5] RECOFT: An organization that seek to empower local people and their engagement in managing forests in a sustainable way. Also known as *Community Forestry*. See (www.recoftc.org).

Mr. Long Hay wrote the answers in Khmer to ensure that the information was written down in the way that the respondent answered the questions in order not to miss any details. Thmea was the first village where we carried out interviews. The first couple of interviews took more than one hour to carry out because Mr. Long Hay and I discussed the answers after every question to check if either the respondent or the interviewee misunderstood anything. After we agreed upon a uniform interviewing method Mr. Long Hay carried out all interviews with only a little of my interference. Every interview ended up taking 20-30 minutes.

3.3 Results

3.3.1 Demographic data

The distribution of the 43 (+2 pilots) respondents between the four villages was not equal. The initial thought was to interview 10 resin tappers in each village. But since it is only possible to interview the people who have time and want to participate voluntarily, the distribution is as follows, cf. table 2:

Table 2: Number, age and gender information on respondents.

Village	*No. of respondents (n)*	*Distribution of respondents (%)*	*Average age*	*Gender distribution (Female/Male) (n)*
Thmea	8	18	48.8	3/5
Phneak Roulek	12	27	40.0	5/7
Spong	13	29	48.4	1/12
Srae Veal	10	22	45.1	1/9
Pilot	2	4	56	1/1

According to gender distribution the initial thought was to interview 50/50 men and women. Tapping resin is a physically demanding job and for that reason it is mostly men who collects liquid resin in the families. Some women collect solid resin because it is less physically demanding than collecting liquid resin. Therefor the gender distribution was not 50/50. There were 34 (76 %) male respondents and 11 female (24 %) respondents. All respondents in this study were liquid resin collectors. Thirteen % of the respondents also collect solid resin. The average age of the resin tappers was 45.6 years. The youngest was 17 years old and the oldest respondent is 68. Average age in each village is shown in table 2. The age of the resin tappers had a standard deviation of 11 years.

Demographic data on population numbers, family numbers and numbers of households in each of the four target villages is shown in table 3. The numbers were retrieved from a baseline survey in 2014 carried out in all four provinces that stretches Prey Lang (Community Peace-Building Network, 2014). According to Mrs. Phork Hong, Srae Veal and Spong were the two villages with most resin tapping families and also the most resin tree dependent villages.

Table 3: Information on population numbers, number of families and households in the four target villages. Preah Vihear = PV, Stung Treng = ST (Community Peace-Building Network, 2014; Evans, Piseth, Phaktra, &

Villages	*Population*	*Families*	*Households*	*Interviewed households (%)*
Thmea (PV)	2024	472	358	2.2 %
Phneak Roulek (PV)	578	127	94	12.8 %
Srae Veal (PV)	803	199	163	6.1 %
Spong (ST)	497	218	218	6.0 %

The respondents were divided in three wealth classes, cf. methodology section. The three wealth classes and how the numbers of respondents were distributed in each wealth class is shown in table 4. How the wealth classes were distributed in each village is shown in figure 4.

Table 4: Distribution of respondents in three wealth classes.

Wealth classes	*Number of respondents (n)*	*Distribution of respondents (%)*
Leaf	13	29
Steel	29	64
Tile	3	7

The interview survey showed that the lowest wealth class owned most trees per family in average, cf. figure 4. Though the dataset demonstrated that families with a leaf roof in average owned more resin trees on average, the dataset was also more disperse (larger standard deviation) compared with the steel and tiled roof households.

Figure 3: Distribution of the three wealth classes in each of the four villages.

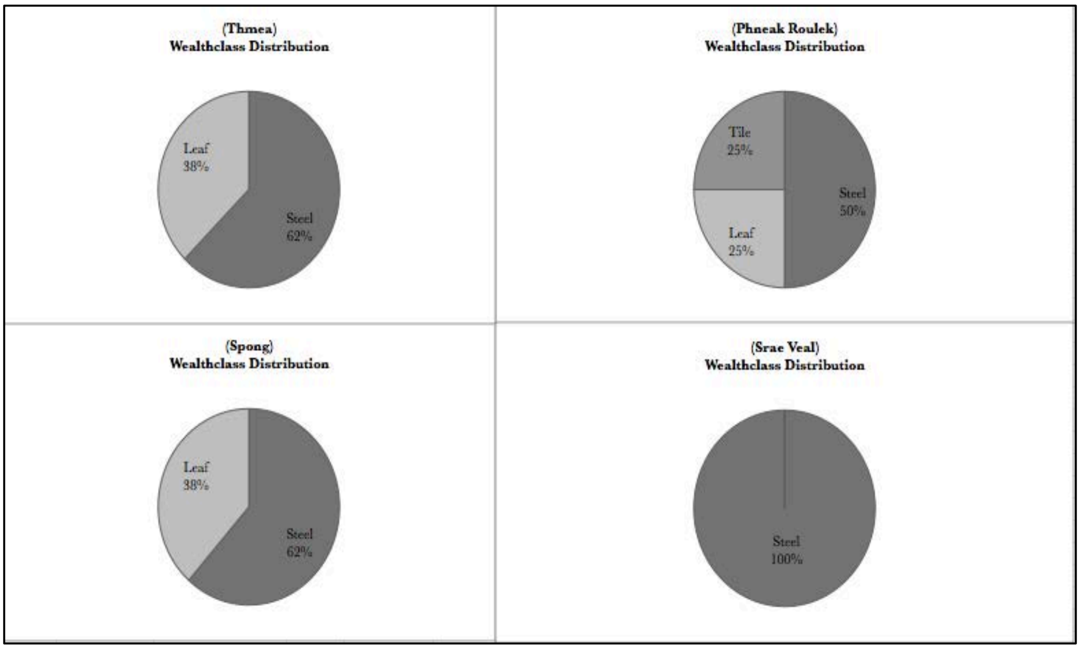


Figure 4: Number of resin trees which a family in average owns in each of the three wealth groups. Bars indicates standard deviation.

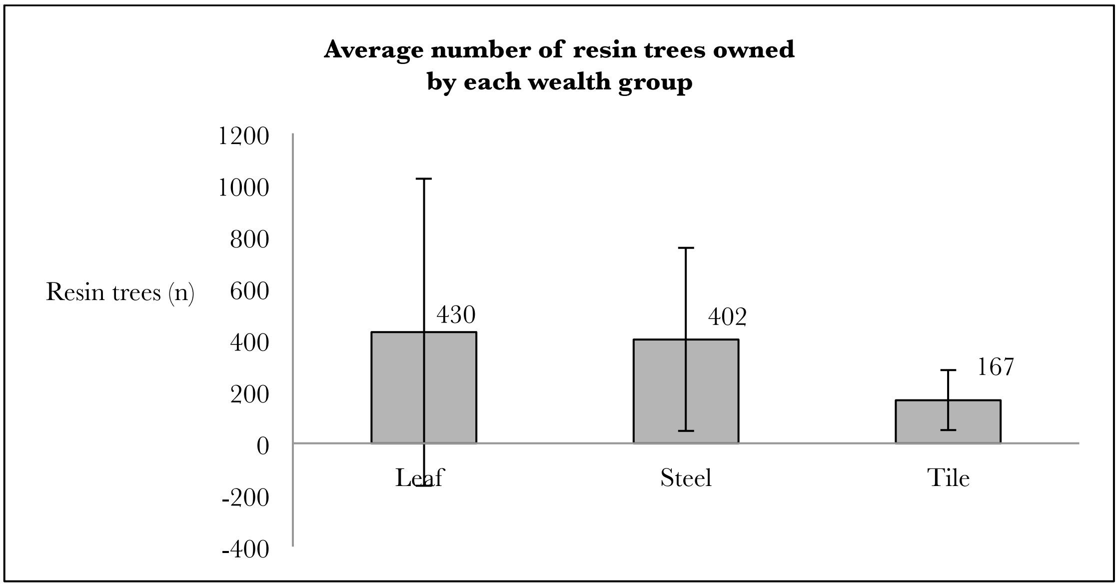
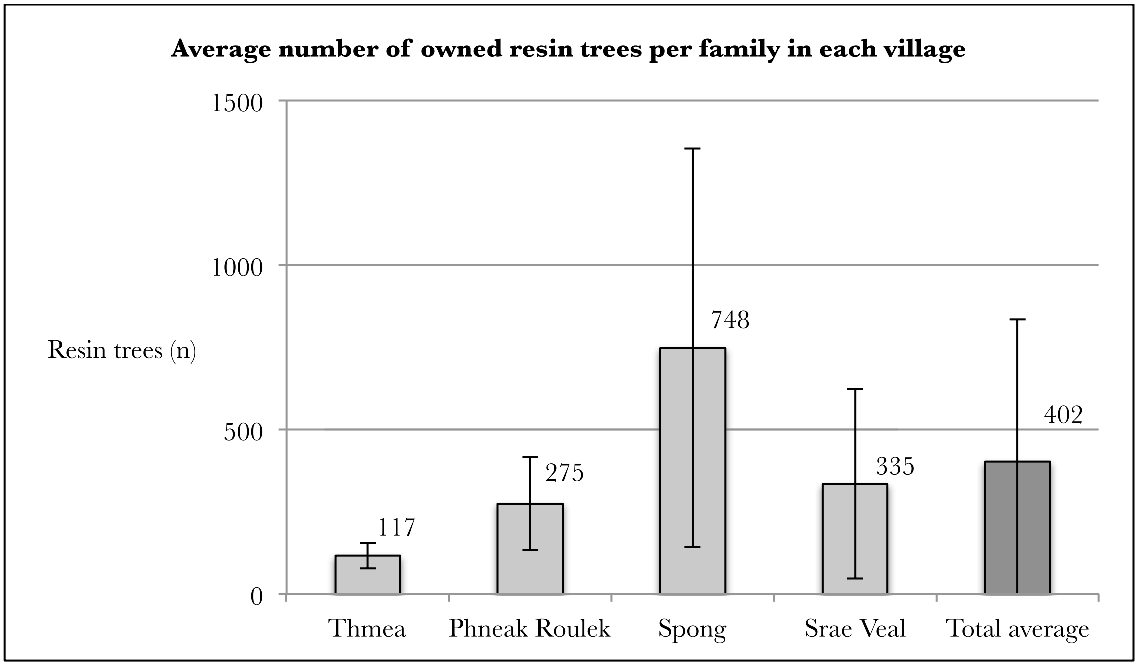


Figure 5 shows the number of trees each family in average owned in every village. It shows that a household in Spong in average owned 748 resin trees and in Thmea the number was 117. The family who owned the lowest number of resin trees lived in Thmea *(Min.=35 trees)* and the highest number of trees owned was in Spong *(Max.=2200 trees)*. The average number of trees owned per family across all four villages was 402 trees.

Figure 5: Average number of owned resin trees per family in each of the four target villages. Bars indicate standard deviation.



3.3.2 Time use

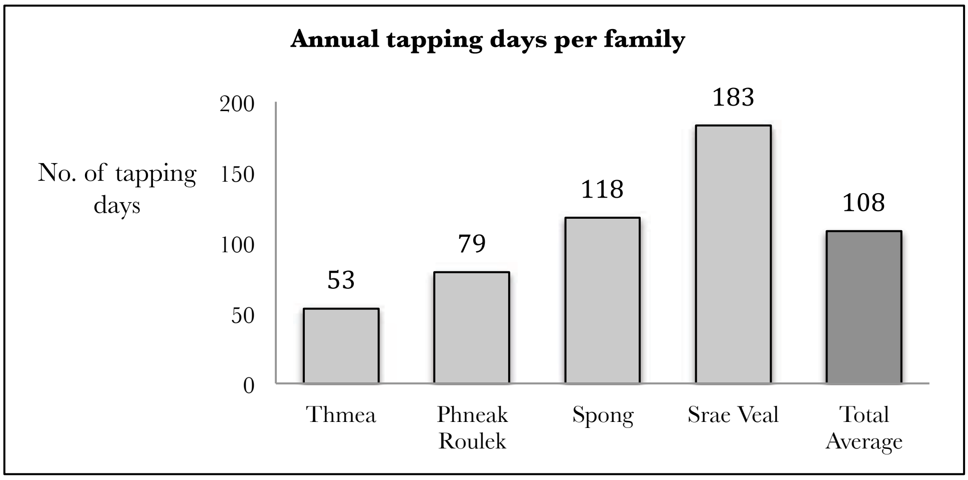
The respondents have answered in hole and half days according to how much time they use on collecting resin on one collecting trip. According to the respondents, the number of days they usually use on one collecting trip depends on how far the family's resin block is from their home and if resin collection is their main source of income or not. Table 5 shows how many days the resin tappers use on their collection trips in average in each village. In average a resin tapper(s) use 2.2 days on one collecting trip and there is in average 2.2 collectors on the trips. Furthermore, there are 4.2 resin-collecting trips per month, which makes 9.2 tapping days per month in average.

Table 5: Number of days used on one resin collection trip in average in the four villages.

Villages	*Time spend*
Thmea	1.2 days
Phneak Roulek	1.8 days
Spong	2.8 days
Srae Veal	2.5 days

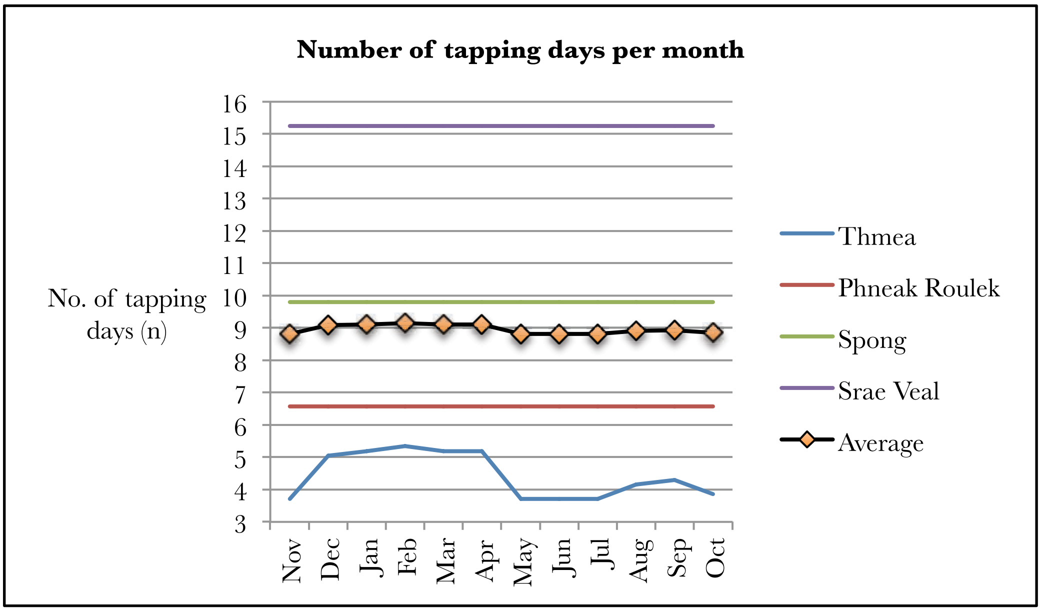
Spong is the village closest to the core area of Prey Lang and very isolated from other villages and markets, because of long distance and very bad roads. Our results show that Spong is a village, which is very dependent on forest products for self-sustainability. Figure 6 shows that Spong and Srae Veal use more time on their collection trips than Thmea and Phneak Roulek. Likewise Spong and Srae Veal conduct more collection trips annually. Figure 6 shows that Spong collect resin 118 days annually and Srae Veal collect 183 days annually. Resin tappers in Thmea only collect resin 53 days per year.

Figure 6: Number of tapping days per year per family in each of the four target villages.



The collected resin yields are higher in the rainy season (May-October), cf. figure 9. Regardless, the families tapping frequency (how many days they tap each month) are more or less constant throughout the year. Some of the respondents told during the interview that they would like to use more time on resin collection, especially in the rainy season when the trees produce more resin and resin of better quality. But since most of them are rice farmers, they simply do not have time to expand their resin business. That might be a reason for the stabil frequency of collecting days. Figure 7 shows that Srae Veal and Spong collect more days per month. Accordingly, 15.3 days per month in Srae Veal and 9.8 days per month in Spong. According to some of the respondents in Srae Veal, they want to collect more days at a time, because they use many hours to travel from the village to their resin trees.

Figure 7: Number of tapping days the families in each village use on collecting resin.

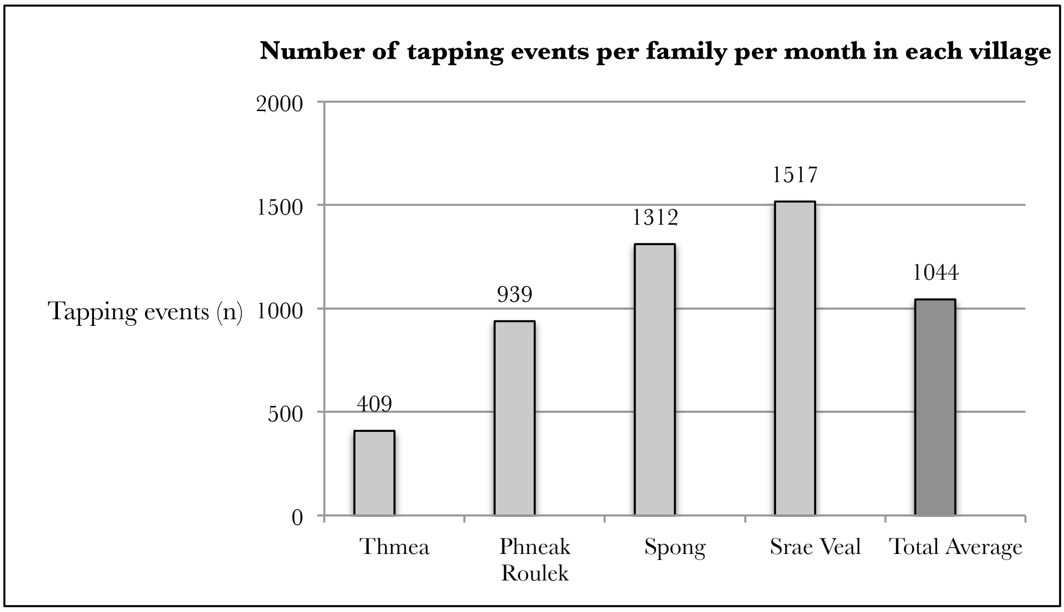


3.3.3 Numbers of resin trees tapped per family

This section elaborate on how many trees the families usually tap from. There are a few factors that need to be taken into account. Firstly, there are sometimes more people on the collecting trips. This is originally not a question in the questionnaire, but we decided to include this question during the interviews. So there is no information on this matter in 12 interviews. Secondly, people use different transportation methods. Some are collecting by foot, some are biking and others use a local tractor (a "*goh yun*" in Khmer). Thirdly, the distance between every tree is very different from resin tapper to resin tapper. Their resin trees can be spread over a large area or closely located in a block. Fourthly, the terrain can vary and is therefore an important factor in the time spending on collecting.

In average the respondents conduct 1044 tapping events every month, cf. figure 8. With the lowest number of trees per month in Thmea (409 tapping events/month) and the highest number in Srae Veal (1517 tapping events/month).

Figure 8: Average number of tapping events every month in each of the four target villages.



This number depends on several factors as mentioned. One of them is the number of tappers on the trips. So there is no information from Thmea on this matter except from one respondent. Table 6 shows the number of trees tapped per day on a collecting trip in each village (1), the number of tappers on the collecting trips in average (2) and, the number of trees one person taps from on one collecting day (3). The respondents in Spong tap most trees per day per person (64 trees/day/person), cf. table 6.

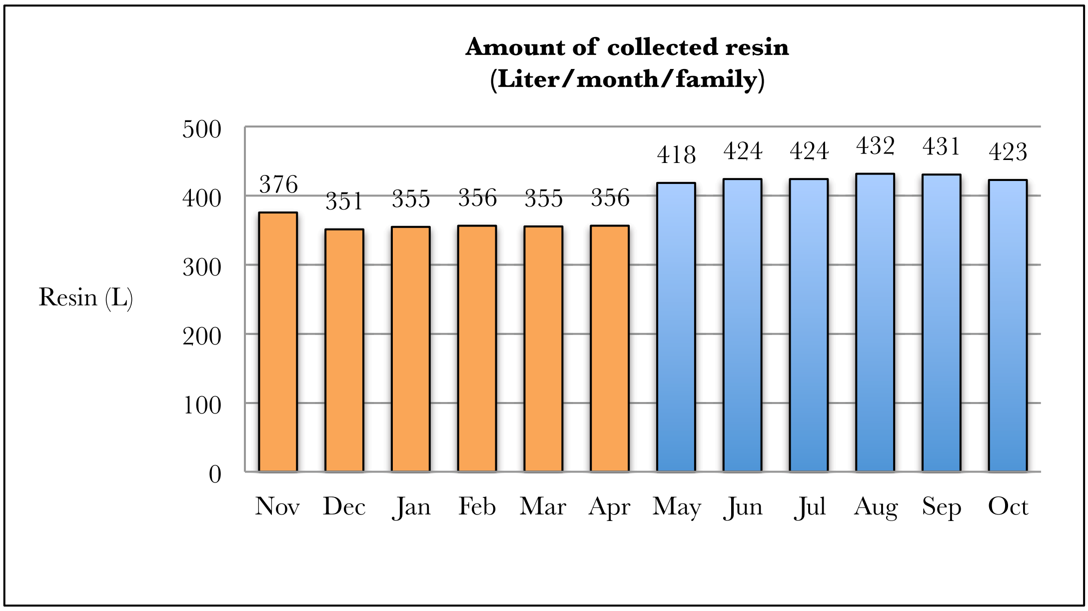
Table 6: (1) the number of tapped trees per day per on an average collecting trip in each of the four target villages, (2) average number of tappers on each tapping trip and, (3) number of tapped trees per person.

Villages	*(1) No. of tapped trees per day*	*(2) No. of tappers*	*(3) No. of tapped trees per person per day*
Thmea	92	No info	No info
Phneak Roulek	143	3.0	48
Spong	134	2.1	64
Srae Veal	100	1.7	59
Total Average	121	2.2	55

3.3.4 Amount of collected resin

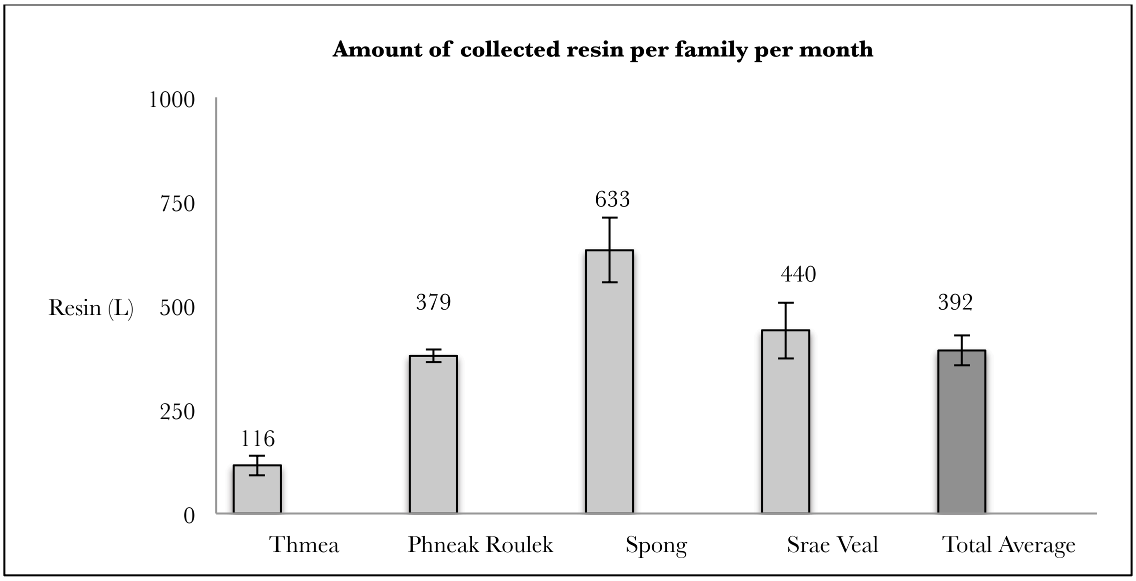
In this section we calculate how much resin the respondents collect. Common to all respondents is that they store the liquid resin in the same type of 30 litre containers. So all answers is according to how many containers they usually bring home from the trips. Common for all four villages is that they are able to tap more resin from the trees in the rainy season than in the dry season, cf. figure 9. The explanation for this is that the resin trees have more leaves in the rainy season and therefore the trees produce more resin. Most of the respondents gave this exact reason for the yield fluctuations during the year. The month with the lowest amount of collected resin is December with 351 litres for one family. The highest was in August with a collected amount of 432 litres in one month. In average the resin tappers collect 19% more resin in the rainy season than in the dry season. It is important to mention that these numbers is from 2014 and not necessarily a general view.

Figure 9: The amount of collected resin each month of a year (2014) in litres. Data from all four villages are included. The orange columns represent the dry season and the blue columns represent the rainy season.



The average amount of collected resin per month is 392 litres per family across all interviewed respondents, which equals to 13.1 resin containers. If we take a look at each village, families in Spong collect 633 litres per family per month and Thmea with the lowest amount of 116 litres per month, cf. figure 10.

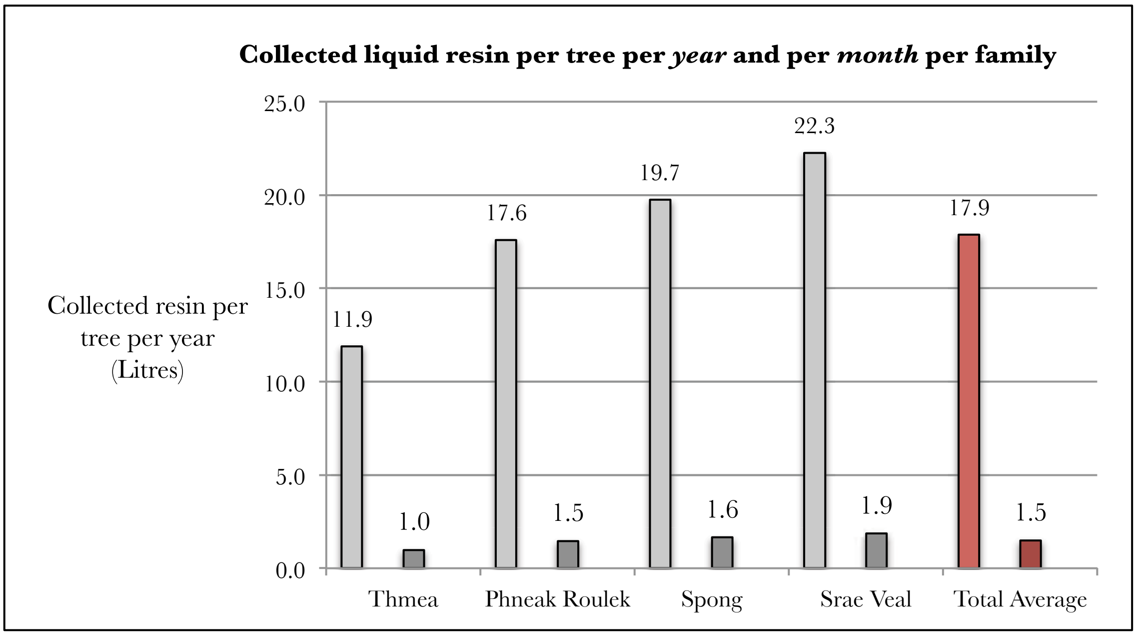
Figure 10: Amount of collected resin in litres per family per month in each of the four target villages.



We have calculated the amount of liquid resin each resin tree gives each month. In average a family collects 1.5 litres of resin per month from one resin tree, cf. figure 11. Where as, one tree is tapped 3.9 times per month and 50.9 times per year. One tapping event provides 375 mL in average. The highest amount is in Srae Veal with 1.9 litres and the lowest amount in Spong with 0.9 litres per month. Figure 11 shows that Srae Veal gets most resin yield from every tree and Thmea gets the lowest yield from every tree. Figure 11 also shows the amount of collected resin on an annual basis. In average a resin tapper collects 17.9 litres of resin per tree per year. In Srae Veal the amount is 22.3 litres and in Thmea 11.9 litres. An average family in Srae Veal are able to collect almost double the amount of resin per tree than a family in Thmea.

In the field study there is an example of a large high-yielding resin tree (observation no. 88, cf. appendix 2) located near a stream with a DBH of 157 cm. The tree had 3 active tapping holes and where yielding 2500 mL in total and tapped every 5 day all year round and exposed to 73 tapping events per year. According to the resin tapper this particular tree is always producing a high yield of resin, even in the dry season (December) where the production of resin is generally low. Potentially this tree can produce 182.5 litres of resin per year, which is a cash-income of 120.5 USD (0.66 USD per litre, cf. section 3.3.6). The yearly price and yield fluctuations are not taken into account in this example. Only means are used.

Figure 11: Amount of liquid resin collected per tree per month and per year per family. The large columns show the annual amount and the small columns show the monthly amount.

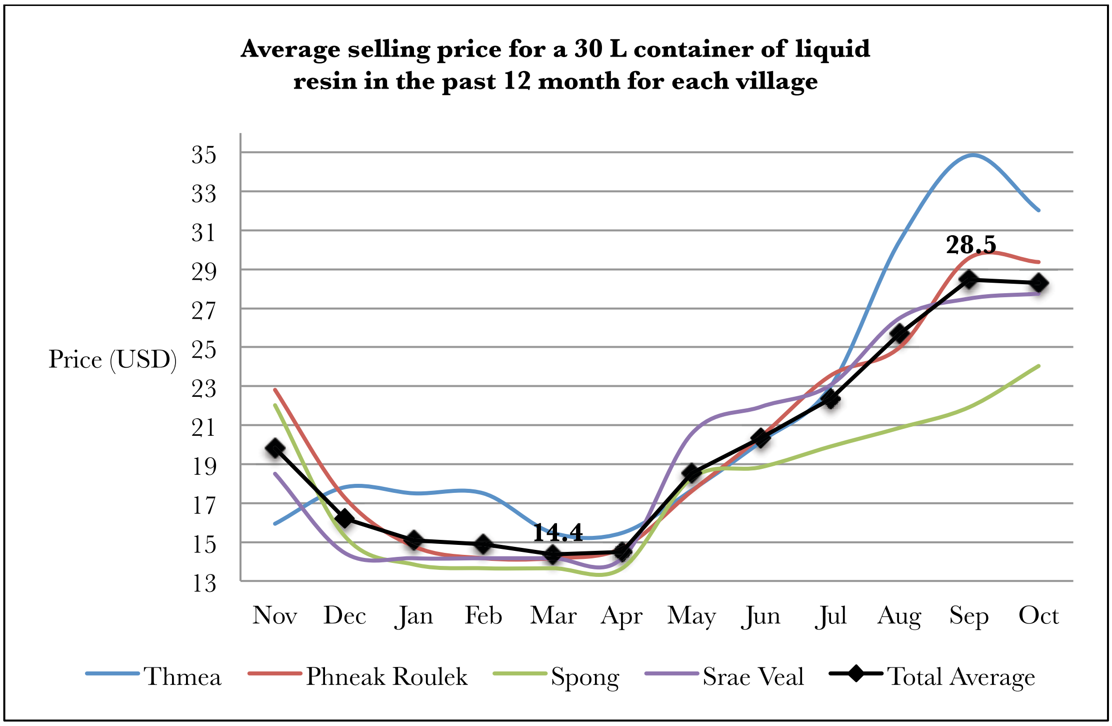


3.3.6 Income from liquid resin

In this section income from liquid resin is estimated. The income data is presented as the family's income instead of the resin tappers income, because the resin trees belong to the family through several generations and not a personal ownership.

The average selling price across all four villages and all 12 months for one 30 litres container is 19.88 US dollars, which is 0.66 USD per litre. If we take a look at the fluctuations throughout 2014 the lowest price is in March (14.4 USD/30L, 0.48 USD/L) and the highest is in September (28.5 USD/30L, 0.95 USD/L), cf. figure 12.

Figure 12: The present fluctuations in the selling price for a 30 litres container of liquid resin in 2014. The four coloured curves represent each of the four villages and the black curve is a total average of the four curves.



Thmea has the highest minimum price for one container (15.47 USD) and the highest maximum price (34.84 USD), cf. table 7. Spong has the lowest minimum price for one container (13.65 USD) and also the lowest maximum price (24.04 USD).

Table 7: The average minimum and maximum selling price for a 30 litres container in each of the four target villages.

Villages	*Minimum selling price (USD)*	*Maximum selling price (USD)*
Thmea	15.47 (Apr)	34.84 (Sep)
Spong	13.65 (Mar-May)	24.04 (Oct)
Srae Veal	14.17 (Feb-May)	27.75 (Oct)
Phneak Roulek	14.17 (Mar/Apr)	29.58 (Sep)

Figure 13 shows the average monthly income from liquid resin per family across all four villages in 2014. March is the month with the lowest income (167 USD) and September is the month with the highest income (378 USD). That makes an average monthly income of 252 USD for an average family living in Thmea, Srae Veal, Phneak Roulek and Spong, which equals to 13.1 sold resin containers. The monthly income in the rainy season is 74 % higher than in the dry season. The annual income is 3083 USD per family per year.

Figure 13: Monthly income from liquid resin per family across all four villages. The orange columns represent the dry season and the blue columns represent the rainy season. The red column is average monthly income in 2014 across all 12 months.

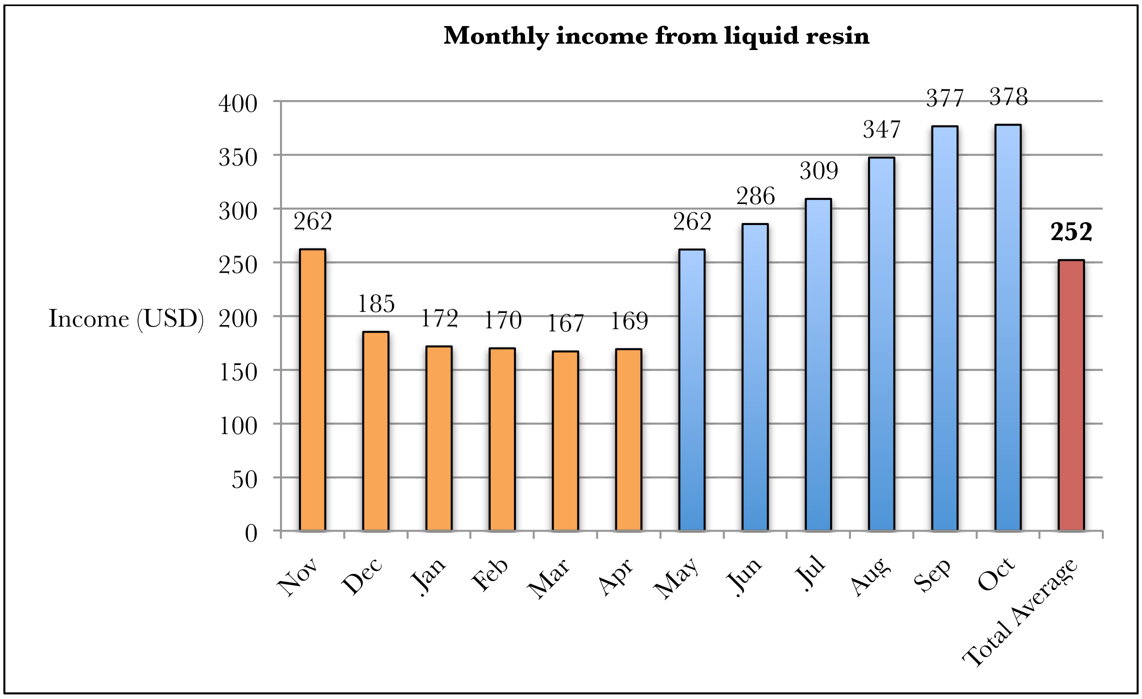


Figure 13 shows the income fluctuations during 2014. Thmea has the lowest monthly income on liquid resin with an average income of 83 USD and Spong has the highest monthly income of 380 USD. The fluctuations during the year 2014 are approximately the same in all four villages, with the rainy season (May-Oct) being the months with the highest monthly income.

Figure 14: Monthly income from liquid resin per family in each of the four target villages throughout the year 2014. The black curve is the average of all four curves.

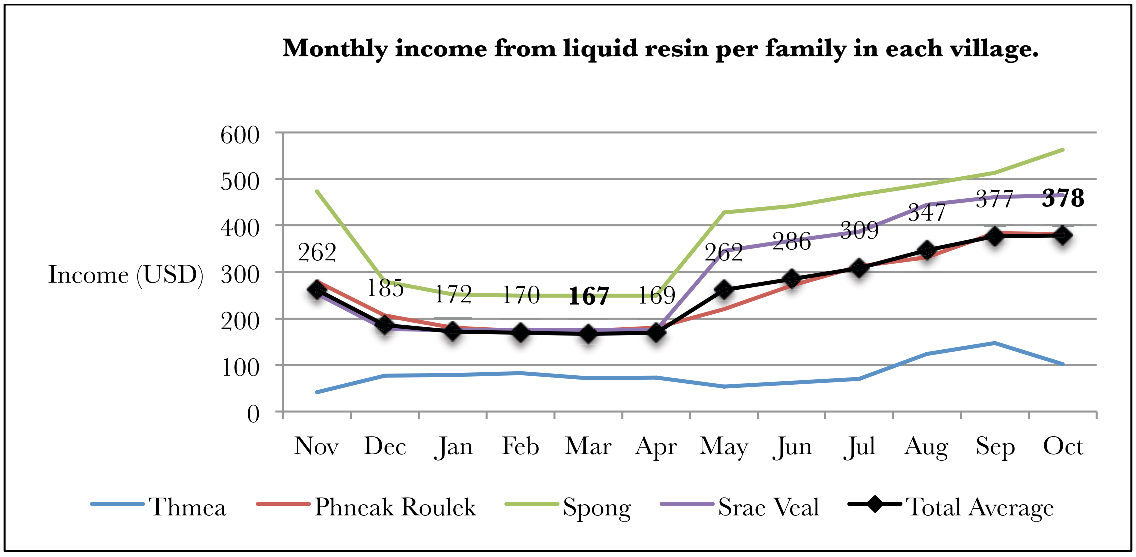
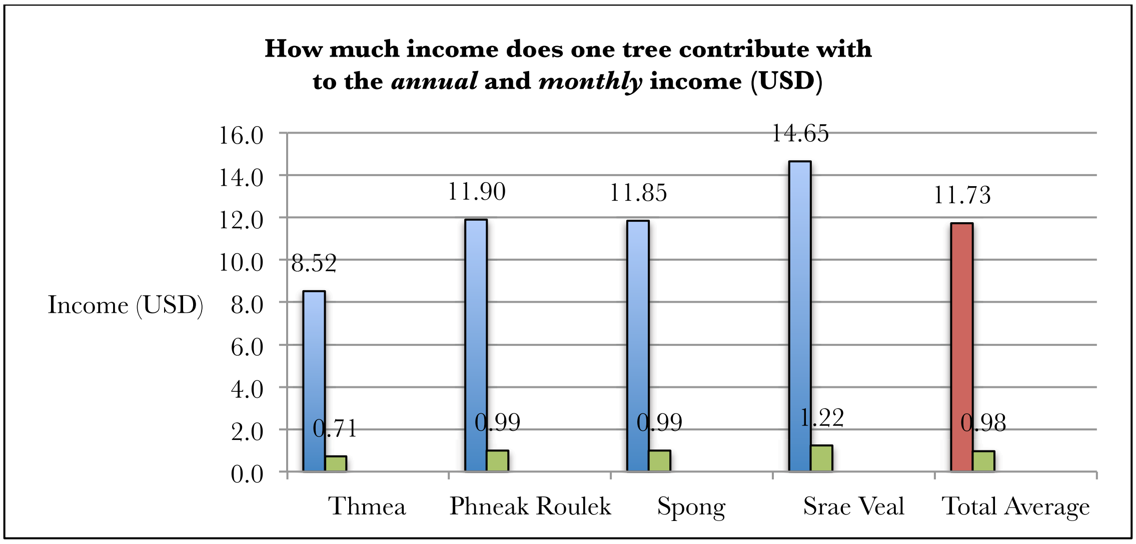


Figure 15 shows how much income one single resin tree contributes to the monthly and annual income in a family in each of the four target villages. In average one resin tree contributes with 0.98 USD per month and 11.73 USD per year. With the highest contribution in Srae Veal being 14.65 USD/year/tree.

Figure 15: Columns show how much one resin tree contributes to the monthly and annual income in an average family in each of the four villages.



3.3.7 Costs related to resin tapping

Two main costs were recorded. Petrol to go to the forest and containers the resin is stored in. The food that a collector brings on the collecting trips was not taken into account. One respondent (no. 24) rents a local tractor (goh yun) on a monthly basis for 37.5 USD. But we do not know if it is a general thing or only a single incident. Figure 16 shows the distribution of cost intervals (2 USD intervals) across all four villages.

Figure 16: Distribution of cost intervals across all four villages. Only petrol expenses are included in this histogram (Costs in US Dollars per collecting trip).

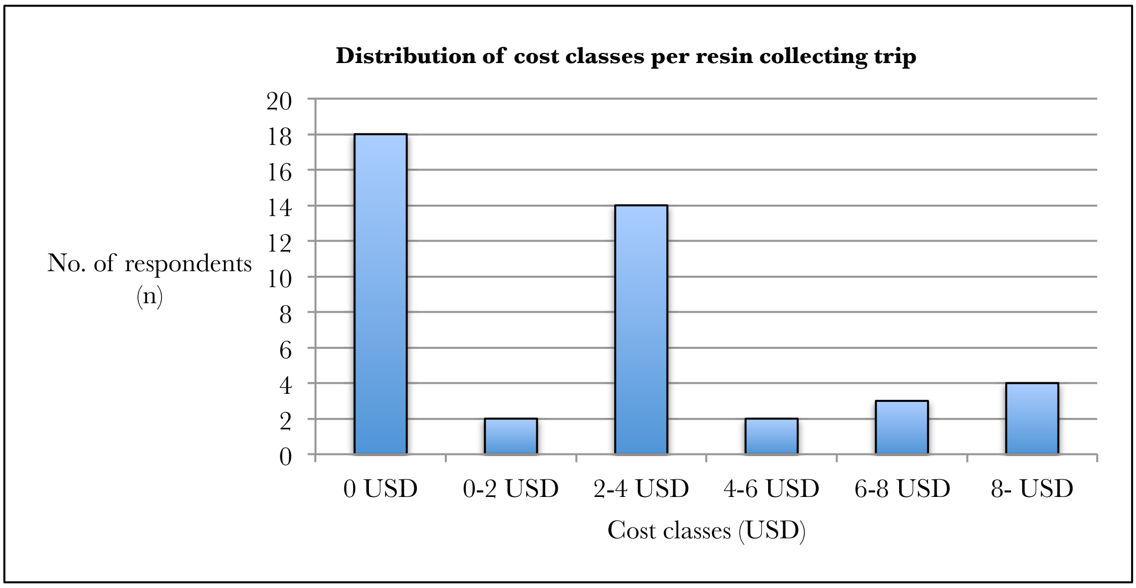
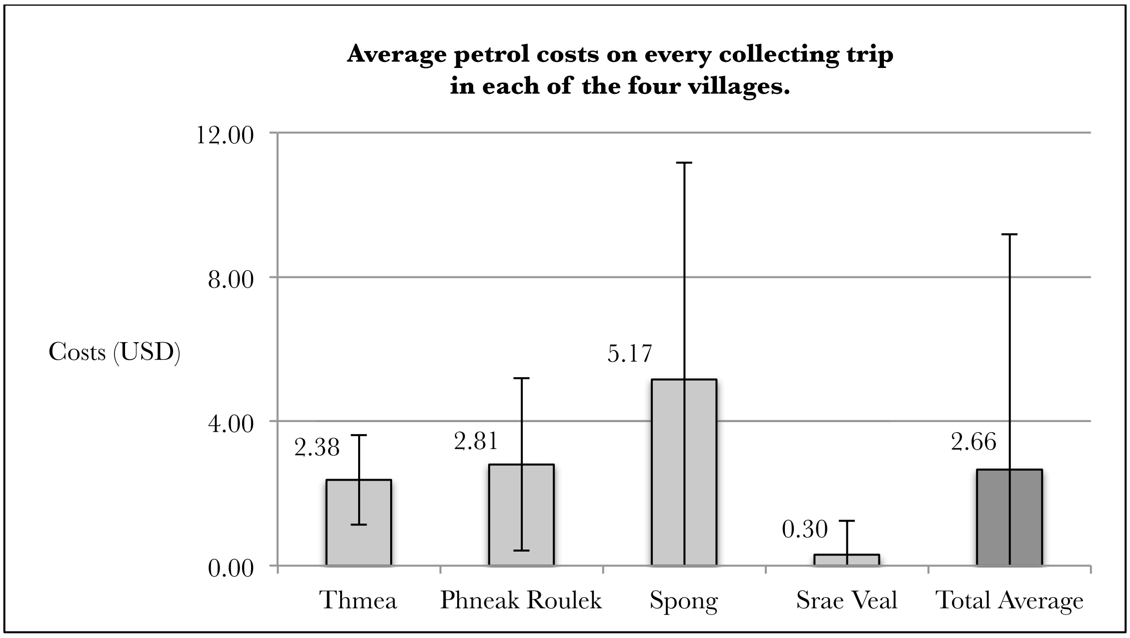


Figure 16 show that 18 (42 %) of the 43 respondents do not have any petrol costs. These respondents walk when collecting the resin. 14 of them live in Spong and Srae Veal. The average petrol costs per trip is 2.66 USD. Families in Spong have the highest petrol costs per collecting trip (5.17 USD/trip). Srae Veal has the lowest with 0.3 USD/trip in average, cf. figure 17.

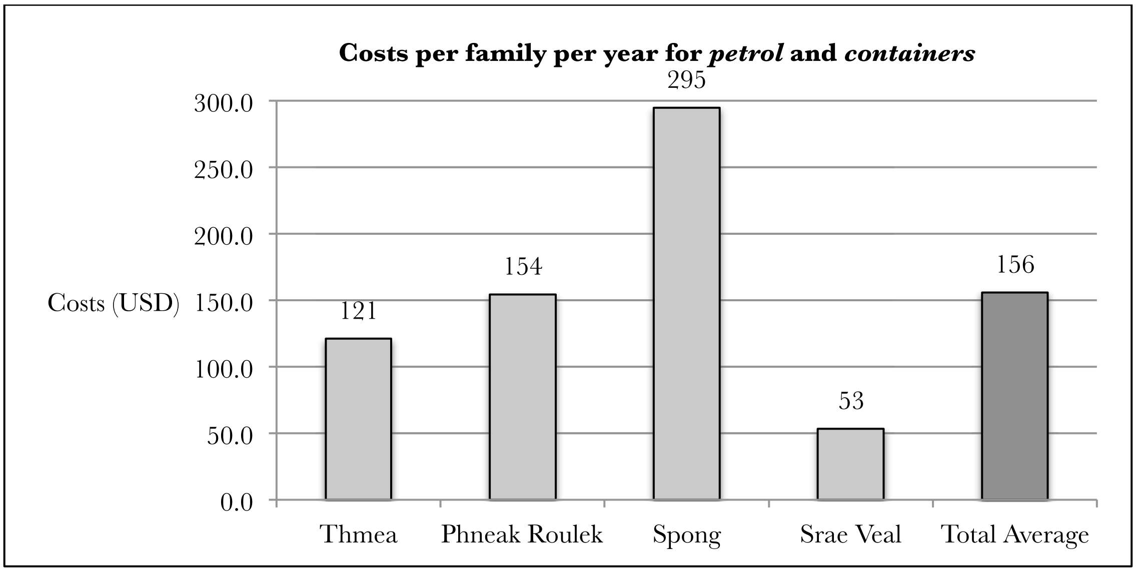
Figure 17: Average petrol costs on every collecting trip in each of the four villages in US Dollars.



Besides costs for petrol, resin tappers have expenses for 30 litre containers to store the resin in. One container cost from 2.0-2.5 USD, wether it is a resin tapper from Thmea (2 USD) or from Spong (2.5 USD). Spong villagers pay more per container because of larger distance to the nearest market where the containers are purchased. Traders brings the containers. The average costs for resin containers are 23.6 USD per year. The yearly expenses for containers are different from each village. In Thmea where there is less tapping activity and resin dependency a family uses 1.8 USD per year and in Phneak Roulek it is 13.3 USD per year. An average family in Spong and Srae Veal uses accordingly 35.4 USD and 38.3 USD per year.

Figure 18 shows the total costs for petrol and containers on an annual basis. The average costs for petrol and containers are 156 USD per year per family. Whereas Spong has the highest costs of 295 USD per family per year and Srae Veal the lowest (53 USD/family/year). The main reason for this is that all respondents from Srae Veal do not have any petrol costs, they collect resin by foot and furthermore the resin containers are cheaper in Srae Veal than in Spong. As estimated in section 3.3.6, an average family in the target villages earn 3083 USD per year on resin collection. Around 5 % of the cash-income is used for petrol and container expenses.

Figure 18: Average costs on an annual basis in each of the four villages in US Dollars. The costs cover petrol and 30 litres containers.



3.3.8 Data on solid resin

The solid resin is found as natural exudations on living trees, on the ground beneath the trees or found buried in the ground (Appanah & Turnbull, 1998). Solid resin is called *Chor Chong* in Khmer, which both refer to the solid resin in general and also the species listed in table 1. Solid resins are not collected in the same quantity as liquid resin and it appears to be relatively insignificant to the local economies in Prey Lang, according to (Evans, Piseth, Phaktra, & Mary, 2003). The interview data shows the same tendency, though families in Spong generate significant cash income from solid resin.

In May 2015 we came to visit Spong in continuation of another project. We got the chance to interview Mr. Prom Lum, who is a 61-year-old resin tapper who also collects solid resin. He told that trees, which produce solid resins, are not owned by anybody unlike trees that produces liquid resin. Everyone who collects solid resin, share the trees in between each other.

Only six respondents out of 45 collected solid resin, two from Phneak Roulek and four from Spong. Solid resin is usually collected from the Shorea genera (*Dipterocarpaceae)*, mostly the species *Shorea guisu* also called Chor chong in Khmer. Five respondents collect from *Shorea guisu* and one collect from *Shorea obtusa* (Pchuek Odorm in Khmer*)*. According to Mr. Prom Lum, there are four solid resin producing tree species that generate cash-income in the forest area of Spong, cf. table 8. Chor chong is the most abundant one.

Table 8: Trees that produces solid resin of economic value.

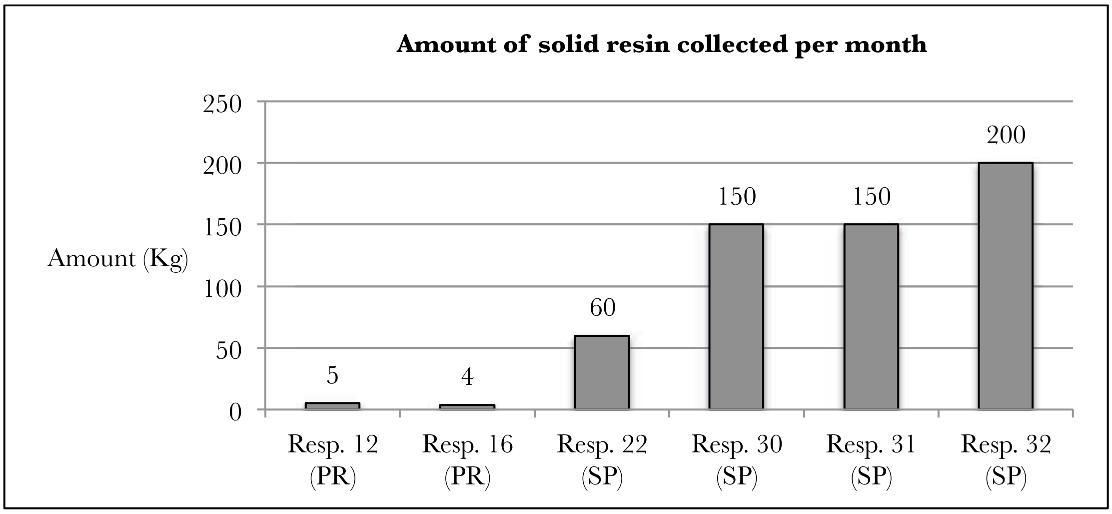
Local tree name	*Tapping method*	*Production amount (1=most, 4=least)*	*Selling prices (Riel/kg)*	*Flowering period*
Chor chong	No holes cut in the trunk. The resin exudates from the bark and loosens and fall of in chunks. Often of a size of a fist or larger.	1	2500	March
Chor Steang	No holes cut in the trunk. The resin exudates from the bark and loosens and fall of in chunks. Often of a size between a thumb and a fist.	2	4000	March
Chor Seong/Cham Bok	Flies called "Seong" produce this resin (Like a bee). The resin is produced in holes of the trunk, mostly in the tree Cham Bok (local tree name). Resin is collected from dead trees or when a tree is cut.	3	500	Not flowering
Chor Srorl	1) Make a hole in the trunk (20 cm wide) and hang a plastic bag under the hole, which catches the resin. Firstly, the resin comes out in a liquid form then it hardens in the plastic bag. 2) Make a hole in the trunk (same as above) and dig a hole in front of the tree that catches the resin. NB: Nobody collect resin from the Chor Srorl anymore, because there are only a few trees left. The tree cannot grow there properly. See pictures in appendix 6.	4	3000	February

According to Mrs. Phork Hong and Mr. Prom Lum the solid resin are often collected by women, because it is less physically demanding than collecting liquid resin. Though there was only one respondent (No. 31) in the interview survey whose wife collects solid resin separately. The rest of the respondents collected solid resin while collecting liquid resin.

Figure 19 shows how much solid resin is collected each month from every respondent. The respondents from Phneak Roulek do not collect resin throughout the year, but only from Dec/Jan to April (dry season). Which in average are 4-5 kg of solid resin each month and 60-200 kg in Spong. Unfortunately we do not know how many trees that are tapped from to reach this amount of solid resin. According to Prom Lum, the collection of solid resin is less systemized as the liquid resin collection. According to (Appanah &

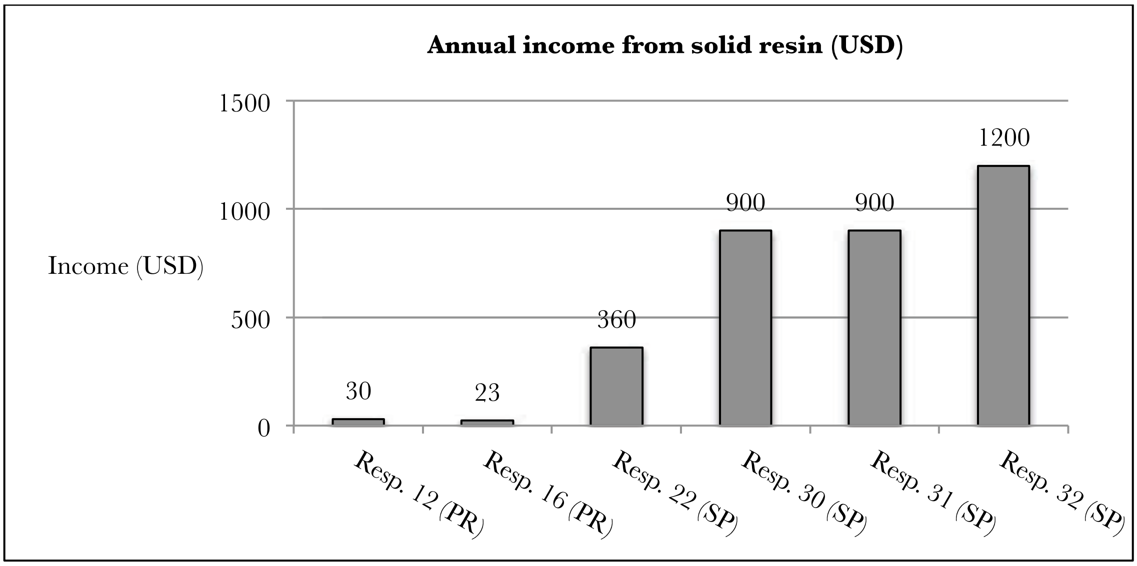
Turnbull, 1998; Community Peace-Building Network, 2014; Community Peace-Building Network, 2014) a fully productive tree may produce 50 kg of solid resin per year.

Figure 19: Amount of solid resin collected per month from each respondent. PR=Phneak Roulek, SP=Spong.



The selling price for solid resin stays at the same level all year round across all six respondents, unlike liquid resin. The price is approximately 0.5 USD per kg of solid resin (see also table 8), where as liquid resin goes from 0.48 USD/litre to 0.98 USD/litre, cf. section 1.6. Figure 20 shows the annual income derived from solid resin in 2014 for each of the six respondents. The income from solid resin for the Spong villagers seems to be quite significant for their economies, ranging from 365-1200 USD per year.

Figure 20: Annual income for the six respondents derived from solid resin. PR=Phneak Roulek, SP=Spong.



4. Field study

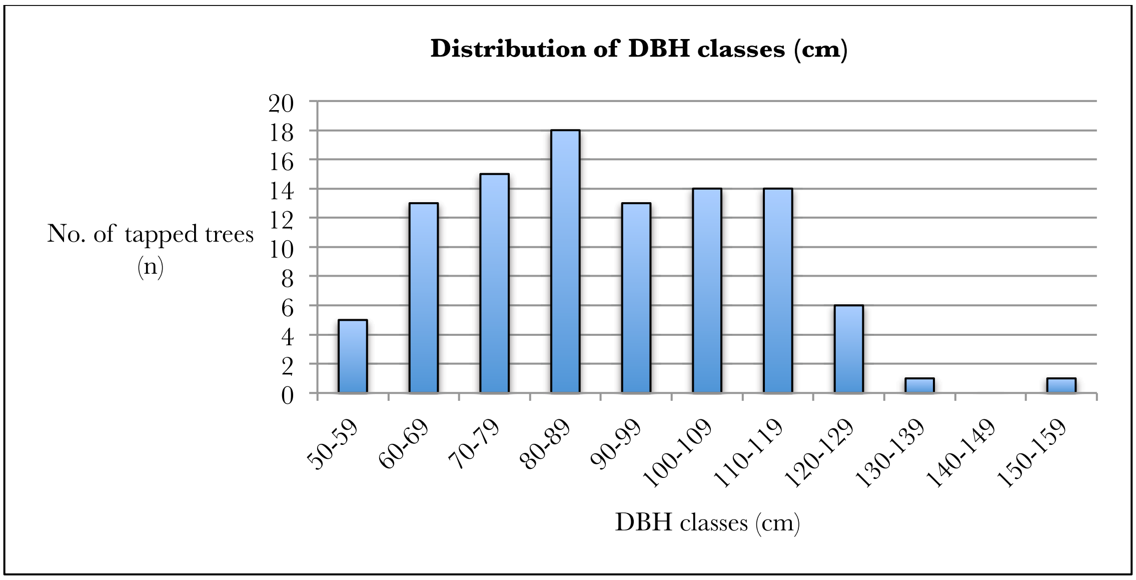
Data collection on resin trees was carried out over three days. A group consisting of two resin tappers, the local woman Mrs. Phork Hong, the interpreter Mr. Long Hay and the author went to the tall evergreen part of Prey Lang, also called *Prey Thom* in Khmer, which means the big forest. We collected information on 100 trees, whereas 97 of them being Cheuteal (*Dipeterocarpus alatus*) and three of them Trach (*Dipterocarpus intricatus*). The measured variables are outlined in appendix 3.

4.1 Results

4.1.1 Background information

We made measurements on resin trees belonging to Mr. Don Chann (respondent no. 20). Two tappers were present and they approximately tapped 50 trees each. The 46-year-old man from Phneak Roulek village, Mr. Don Chann, tapped the first half and the 27-year-old man, Mr. Toern, tapped the second half. Both tappers used the same tapping materials and tapping method, but the younger walked slightly faster going from one tree to the next. Therefore measurement M2 *(Transportation time from last tree)* can be slightly biased. The 97 Cheuteal trees were located in the tall evergreen forest, whereas the 3 Trach trees were located in an open, dry area once cleared for rice cultivation. The tapped trees had a dbh>50 cm, with an average dbh of 93 cm. According to the two tappers resin trees are not tapped from before the tree exceeds a dbh>50 cm. According to the resin tappers a tree with a smaller dbh will provide insignificant yield and the tree might die. The distribution of dbh classes (cm) for the resin trees is shown below, cf. figure 21. The most abundant dbh-class was with a dbh=80-89 (n=18 trees).

Figure 21: Distribution of DBH classes for tapped resin trees belonging to Mr. Don Chann (Respondents no. 20, cf. appendix 1)



4.1.2 Categorization of resin trees

The resin trees are divided in three equally seized groups according to the diameter by breast height (dbh) of the resin trees, cf. figure 22. The three groups are as follows:

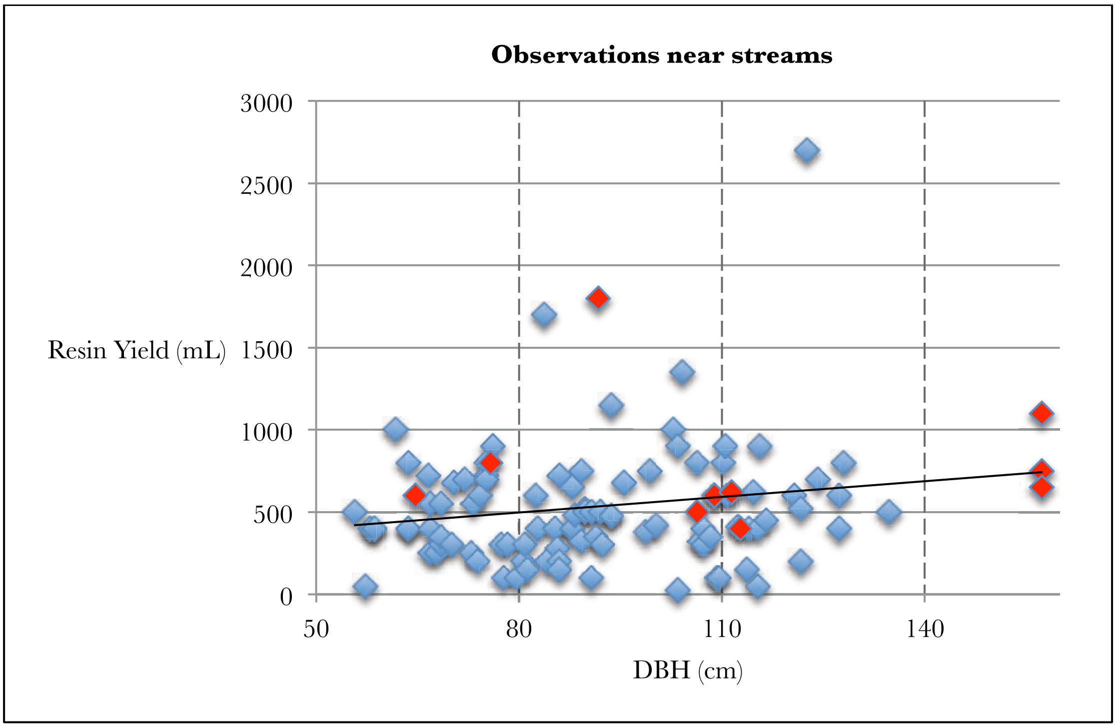
Small trees	*(DBH=50-80 cm)*
Medium trees	*(DBH=80-110 cm)*
Large trees	*(DBH= 110- cm)*

The first data we take a look at is an x/y-plot for dbh and resin yield, cf. figure 22. Every data point represents one tapping-hole (Observation) and not one tree. Many of the trees had more than one tapping-hole sometimes all of them were active, cf. appendix 2. There is a slight linear relationship between the dbh and the amount of resin the tapping-hole produce, see simple moving average in graph. The larger dbh the more resin every tapping hole can produce per tapping event. If we take a look at the three groups there is a tendency that resin trees with a large dbh produce more resin, cf. figure 22. The small trees averagely produce 480 mL per tapping-hole per tapping event, the medium seized trees produce 521 mL and the large trees produce 604 mL of resin per tapping hole per tapping event.

4.1.3 Observations near stream

When collecting the data we registered trees, which were located within 25 meters of a stream. 10 % of the observations (8 trees) were located within 25 meters of a stream. These data-points are marked with a red colour in figure 22. The average yield for resin trees located near streams is 828 mL, where as the average yield for the other trees is 513 mL per tapping event. The yield from trees near streams is 38 % higher. These data-points are quite disperse, but does to some extent show that resin trees near streams produce more resin. Besides from that a few respondents in the interview survey, mentioned that their trees located near streams or wet areas, produced more resin and therefor they tap these particular trees more often than trees not located near streams.

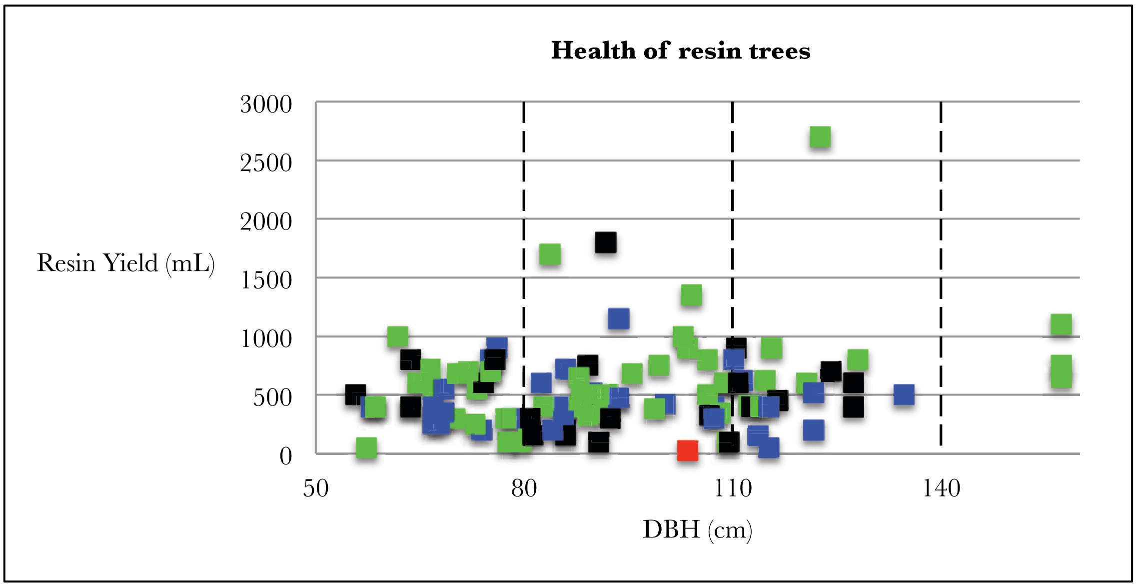
Figure 22: Every data point represents one tapping hole. The data set is divided in three groups according to DBH. The first group is small DBH (50-80 cm), second group is medium DBH (80-110) and the third group is large DBH (110-). The horizontal axe shows diameter by breast height (DBH) and the three groups. The vertical axe shows the resin yield in litres that every tapping hole produces. The red coloured data points represent



4.1.4 Health of tree

We recorded health of the tree when collecting data. The trees were distributed in three health categories. Accordingly, good condition, medium condition, bad condition and there were also trees were we could not assess the health, because of very dense vegetation, cf. figure 23. The health categorization is defined in appendix 3. Trees that were recorded as being in a good condition, averagely yielded 604 mL of resin and trees that were in a medium condition averagely yielded 461 mL of resin. There was only one tree registered as being in a bad condition. This particular tree only yielded 25 mL and was close to become abandoned according to the collector. 22 % of the trees we could not assess the health.

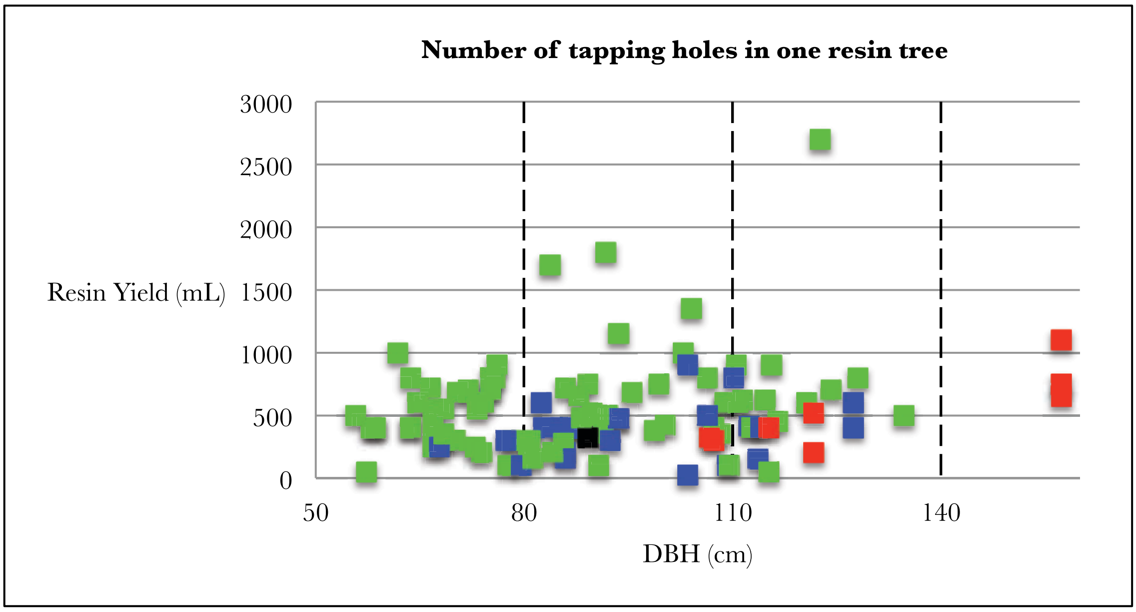
Figure 23: All data points are coloured according to the health condition of the resin trees. Green coloured data points = healthy trees, blue coloured data points = trees with medium health, red coloured data points = trees with bad health and black coloured data points = Not possible to assess health on trees.



4.1.5 Number of tapping holes in the resin trees

On the field trip the number of tapping holes in the resin tree was recorded, both active and non-active. Five of the 100 recorded resin trees had more than one active tapping hole. In this study trees with one tapping hole produced 608 mL of resin in average on one tapping event. Trees with two tapping holes produced 433 mL and trees with 3 holes or more produced 626 mL of resin, cf. figure 24.

Figure 24: Shows all observations according to their resin yield and diameter by breast height. Green observations = 1 tapping hole, blue observations = 2 tapping holes, red observations = 3 tapping holes, black observations = 4 tapping holes.

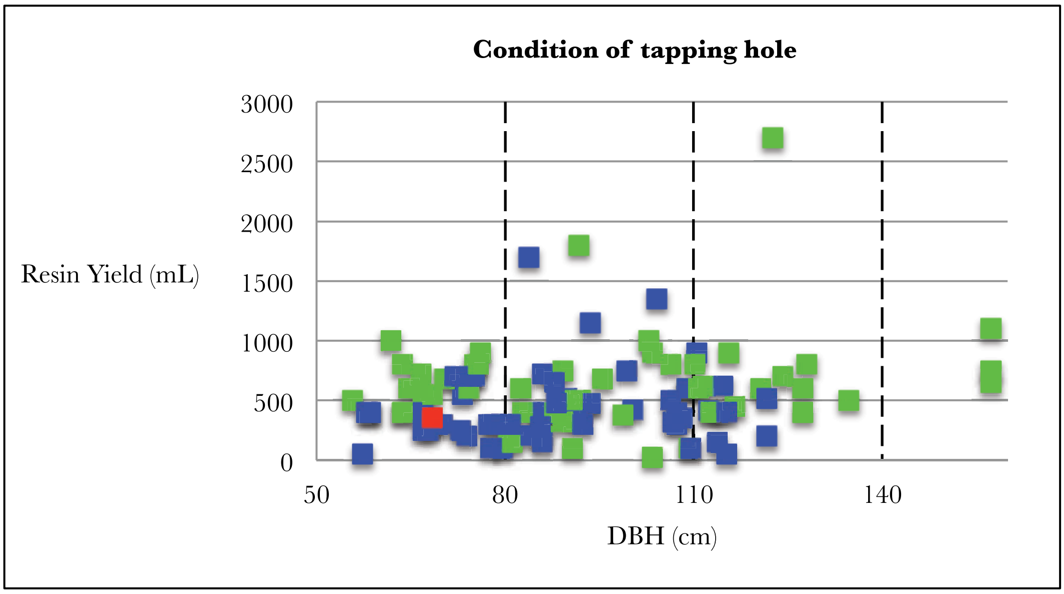


4.1.6 Condition of tapping holes

Figure 25 shows all observations (tapping holes) according to the dbh of the tree and how much yield the tapping hole produces. On the field trip the health of the active tapping holes was recorded in three categories, cf. appendix 2 and 3. Observations in a green colour are tapping holes in a good condition and blue colour is medium condition and red represent bad condition. The condition of the tapping hole is based on the resin tappers opinion. The argumentation was based on i) the resin yield from the particular hole and, ii) how much the bark was burned above the tapping hole, cf. appendix 3. There was no other specific reason to register the hole as being good, medium or bad. Therefore these field data are insignificant. Photos of tapping holes in a good and bad condition is shown below, cf. photo 2. Only one observation was recorded as a tapping hole in a bad condition. Tapping holes in a good condition was able to yield 636 mL on one tapping event in average. Tapping holes in a medium and bad condition was able to yield 437 mL in average.

Photo 2: Examples of a tapping hole in a good condition (left) and a tapping hole in a bad condition (right). Pictures are taken on the field trip and are both of the species *Dipterocarpus alatus.*

Figure 25: Shows all observations according to their resin yield and diameter by breast height. Green observations = tapping hole in a good condition, blue observations = tapping hole in a medium condition, red observations = tapping hole in a bad condition.



4.1.7 Hourly income for resin tappers

During the field study we included measurements on time-use on resin tapping, to roughly estimate an hourly pay for a resin tapper. We measured how long time it took for the resin tapper to finish one tapping event (cf. appendix 2, M3) and the time used on getting from one tree to the next (cf. appendix 2, M2). This we did for all 100 resin trees.

The time from preparing burning of the tapping hole until the resin was put in the container, were 4 minutes and 10 seconds in average. The actual burning lasted usually 1-2 minutes. The total sum for all 100 tapping events was 7 hours. The transportation time between the trees was 2 minutes and 52 seconds in average on foot, except from observation 97 to 98, which took 30 minutes with a goh yun. Moreover, it took 2-3 hours to go from Phneak Roulek to the resin block. The resin tapper we followed on this trip, Mr. Don Chann, also took part in the interview survey (respondent no. 20). The total time used on getting from tree to tree (transportation time) was 4 hours and 44 minutes. In total almost 12 hours were used on transport between trees and tapping the resin (excluding getting to the resin block and back to the village). On this collecting trip 57 Litres of liquid resin was collected (app. 2 containers). This gives a collecting activity of almost 5 litres of resin per hour. So it takes approximately12 minutes to collect 1 litre of resin. The field trip was conducted in December 2014, where Mr. Don Chann are able to sell one 30 Litre resin container for 17.5 USD, cf. appendix 2 (respondent no. 20, Q7_Dec (L)). This gives an hourly pay of almost 3 USD for this particular tapping trip. Mr. Don Chann owns 300 resin trees. He is able to collect from 100 trees on one collecting day with help from 2 extra tappers. So Mr. Don Chann uses three days to collect resin from all his resin trees. How they distribute the work between each other is unknown.

5. Discussion

In this section includes four points. Firstly, what impact different ecological factors have on the quantity of resin yield. Secondly, the selling prices of resin between the target villages. Thirdly, the used methodology in the present study is discussed. Finally, I compare the cash-income derived from resin based on the results from the present study with the poverty line set by the World Bank to frame the importance of this traditional occupation form.

5.1 Resin yielding

There can be several factors affecting resin yielding. For example, 1) environmental factors, 2) size (height and dbh), 3) tapping duration, 4) skills of the tapper (exploitation), 5) health of the tree, 6) genetic factors or 7) seasonal climate effects, 8) hydrology (Evans, Piseth, Phaktra, & Mary, 2003). As human interaction is involved, it is complicated to make clear conclusions on what factors have a significant impact on the yielding. The data in the present field study shows that the resin yield from observations near streams in general produced more resin, cf. section 4.1.2. This is in line with the statements of few respondents in the interview survey who mentioned that trees near streams produced more resin and these particular trees were also exposed to more tapping events. However, due to the low number of counts near the stream (8 trees) it was not possible to apply a correlation test to draw a significant conclusion.

Management of the tree is a central factor. Trees may be heavily burnt because of poor management (over-exploitation) of the tree, which may decrease the resin yield. With over-exploitation is meant over-burning of the tree, high tapping frequency (the tree gets very little rest in between tapping events), lack of maintenance of the tapping hole (accumulation of carbon in the hole) and too many tapping holes cut in one trunk. Results in figure 11 may indicate that resin tappers in Thmea over-exploit their resin trees. Thmea is the village that gets the lowest amount of resin yield per tree (11.9 Litres/tree/year). This may be correlated to the dependency of resin in the villages. Thmea is the village that is least dependent on resin for cash-income (lowest tapping activity and income from resin). This fact might illustrate that villagers in Thmea are less motivated and has less incentives to manage their resin trees well, because this occupation form is secondary and not primary like in Spong. Thmea supposedly has more occupation options because of proximity to bigger towns and markets like Chey Sen, Rovieng and Kampong Thom district town. Most if not all villagers of Spong depend primarily on the harvest and sale of oleoresins (Evans et al. 2003). Villagers in Spong tap 19.7 Litres/tree/year and villagers from Srae Veal tap 22.3 Litres/tree/year, cf. figure 11. No significant conclusions can be made on this matter, but higher resin dependency seems to increase management/-skills.

Resin trees can have more tapping holes than one, both active and non-active. This may on the one hand damage the tree and on the other hand take up more of the total resin production of the tree. The data from the present field study shows the production of resin per observation (tapping hole). According to figure 24, trees with 3-4 tapping holes produces more resin than trees with one and two holes. It is hard to make a final conclusion on this matter. On the one hand a higher number of active tapping holes potentially takes up more of the trees total production of resin. On the other hand more holes can cause damage to the tree, in terms of over-exploitation by collectors or more holes may influence the trees ability to absorb nutrients. There were three trees of the two-hole observations with two active tapping holes. The rest had one active and one non-active/abandoned tapping hole.

The effect of the condition of the tapping hole is not significant. As outlined in section 4.1.6 condition of the tapping hole is based on the resin tappers opinion. The reason was based on i) the resin yield from the particular hole and, ii) how much the bark was burned above the tapping hole. Suggestion for further research on this matter can be, 1) to record the carbon accumulation in and around the tapping hole and, 2) measure the size of the tapping hole (Width, depth and height) vs. the diameter of the tree. These two factors possibly have a significant influence on the trees ability to yield resin. First of all, holes that are cut too large and deep might affect the resin trees ability to absorb nutrients. Second of all, trees that are over-burnt or has accumulated a large amount of carbon might have a decreased resin yielding.

As shown in appendix 2, height of the tree (M8), diameter of the treetop (M9) and treetop depth (M10), are estimated. These parameters are estimated by the method outlined in appendix 3. The part of the forest where the field study was carried out was very dense and resin trees were one of the highest tree species in that area. This made it complicated to estimate M8, M9 and M10, because we could not see large parts of the tree because of other vegetation. 8% of the measured resin trees we could not estimate the height, 29% of the trees we could not measure the treetop diameter, 34% we could not measure the treetop depth. For that reason these measurements are excluded in the present report.

5.2 Selling price

According to section 3.3.6 selling prices for resin is generally higher in Thmea throughout the year. Both regarding the lowest selling price and highest selling price in each village. The average maximum price for a 30 Litre resin container in Thmea is 34.84 USD, which is more that 30 % higher than the average maximum price in Spong, which is 24.04 USD. The same goes for the average lowest price, here is the difference 12 %. The explanation for this price difference can be proximity to larger towns and markets. The same argument is outlined in the resin yielding section above. Thmea is less isolated than Spong according to proximity to markets and does also have better roads. Traders who are buying the resin from the villagers set the price. Villagers are not aware the reasons for the price fluctuations. The traders are not willing to pay as much for a 30 litre containers in Spong compared with Thmea. The reason is that traders have to spend an extra ½ day of transportation and additional petrol expenses.

5.3 Methodology

Interviews were central to the present study. Numerical data and qualitative data were recorded according to the resin collectors resin practice. Unless used carefully, interviews surveys can generate data that appear detailed and accurate, but can be quite biased. Firstly, the questions can be formulated in a way that the translator misunderstand and thereby get incorrect information from the interviewees. The way the author approached this potential problem was to i) conduct pilot interviews to capture unclear formulations and inaccuracies in the questionnaire, ii) the first interviews was carried out carefully after every answered question, iii) the interviewer is professionally engaged with resin tapper communities and has thereby extensive knowledge on the topic. Secondly, the interviewees might not answer precisely on numerical questions because they either cannot remember the numbers or the topic is less important to them and thereby not important for them to answer correctly to the question. In the present questionnaire there are several numerical questions regarding selling price, tapping frequency, tapping amount, specific information from each month of the year etc. When the dependency on the topic is high, the accuracy of the answers most likely increases. The four target villages was chosen by Mrs. Phork Hong and my translator Mr. Long Hay, because of the high resin tapping activity and dependency. Furthermore, most part of the interviewees answered quickly and confident on the numerical questions. The numerical data from all 43 respondents are compatible with each other. Interview data on the yearly collection amount is also compatible with another similar study carried out in Laos. In the interview survey the annual production is around 18 liter's per tree, cf. figure 11. In the Laos survey, the annual production reached 22.5-31.0 Liter's (Ankarfjärd & Kegl, 1998). For the reasons outlined above I assess the numerical data derived from the interviews as being rather reliable.

The field study can be used to crosscheck information in the interview scheme. However the field study only shows data from one resin tapper in one month (December). The average resin yield per tapping event on the field trip was almost 540 ml. In the interview survey the average yield per tapping event across all respondents is 375 ml. Moreover, Mr. Don Chann´s resin trees are collected from 73 times per year. So every tree is exposed to 73 tapping events per year. In the interview survey the average number is 51 tapping events per year. The yield fluctuations during the year cannot be taken into account in the field study results, because it is a single survey in December. The data on Mr. Don Channs` trees is slightly different from the means in the interview survey. However, the numbers are assessed as being compatible with each other.

According to Mr. Don Chann the resin trees has a dbh>50 cm before they start tapping from the trees, cf. section 4.1.1. With a smaller dbh there is a risk that the tree do not provide enough yield and the tree might die. This correlates with the received information from the oleoresin study in Laos (Ankarfjärd & Kegl, 1998).

There are made measurements on 100 resin trees in the field study. This is a low number of observations to show significant effects of the selected measured variables. In section 4.1.4, 4.1.5 and 4.1.6 the groups are too small to conclude on the impact of these three variables on the resin yielding. However, these numbers can be used for future studies on this matter.

5.4 The economic impact of resin and the poverty line

In 2013 the fertility rate was 2.9 children per family in Cambodia, which makes a household with parents and children existing of 5 members (Unicef, 2013). Some households also have their grand parents staying at their house and are therefore also a part of the household economy. The fertility-rate is often higher in the rural areas of Cambodia. I have not asked the respondents the number of people in their households, so I have no exact numbers on this matter in the area. If for example an average household exist of two parents, one grandparent and three children, an average household will consist of 6 members. The average yearly income from resin in the target villages is 3083 USD, which is a daily income of 8.4 USD. This income shall support the living of all household members. With 6 household members, every person is living on 1.4 USD per day. The poverty line set by the World Bank is 1.25 USD per day per capita. People who are living on less than 1.25 USD a day are defined as being poor. Some families in the area have additional cash-income derived from rice farming, if the family end up having more rice than they can consume. But mostly the rice is used for self-consumption in the target villages according to (Lægaard, 2010). How other income sources contribute to the economies in the target villages is not examined in the present study. However, this report shows that harvest of liquid resin is a significant source of income for the Prey Lang communities and a traditional occupation that requires enforced legislative protection in order to continue supporting local economies and prevent rural poverty.

With strong political commitment from the Royal Government of Cambodia, ministries, local authorities and a strong legal framework, it is my hope that this report can contribute to the future protection of Prey Lang and furthermore contribute to future forest-based poverty-alleviation programs. Protection that will benefit the climate, biological diversity, the broader Cambodian public and livelihoods of the Prey Lang communities.

6. Conclusion

The main findings show (1) that an average family use 9.2 days per month on liquid resin tapping, which is 108 days annually. The species *Diptereocarpus alatus* is most abundant (tapped from) in in this study. There are usually around two tappers on the trips. Averagely 1044 tapping events are carried out every month in the target villages. On the trips tappers are able to collect from 121 resin trees per day (121 tapping events), which gives a number of 12530 tapping events per year, whereas one tapping event usually provides 375 mL of resin. One person is able to tap from 55 trees per tapping day. This gives a monthly collection of 392 litres of liquid resin. One tree is tapped from 3.9 times per month, which is 50.9 times per year. One single tree provides 1.5 Litres of resin per month, which is around 18 Litres per year. (2) The average monthly income derived from liquid resin is 252 USD, which is 3083 USD in a year. The income in the rainy season is 74 % higher compared with the dry season. One resin tree contributes with 0.98 USD per month, which is 11.73 USD per year. (3) The yearly costs regarding resin tapping is 156 USD, which corresponds to 5 % of the yearly income derived from liquid resin. (4) Cash-income from solid resin shows to be significant only in the village Spong, where the yearly income range from 395-1200 USD. The key solid resin producing species is Chor chong (*Shorea guisu).* The tree species that produces solid resin are not owned by anyone, but shared between tappers. (5) Trees located near streams tend to produce a higher resin yield than trees not located near streams. In this survey the resin yielding is 38 % higher. (6) The field study shows that it takes 12 hours to collect from 100 resin trees (including transportation between trees and the actual collection). The tapping amount was 57 litres, which is worth around 34 USD and corresponds to a pay of 3 USD per working hour.

7. Annexes

Annex 1 – Results from interview survey (Excel sheet)

Click on the following hyperlink in order to see the original excel sheet with results from the interview survey. A part of the excel sheet is shown below.

Interview data.xlsx

No.	Date	Province	District	Commune	Village	Gender	Name	Age	Occupation	Roof type
1	7/12/14	Preah Vihear	Chey Sen	Thmea	Thmea	M	Mr. Yen Ren	44	Farmer	Steel
2	7/12/14	Preah Vihear	Chey Sen	Thmea	Thmea	M	Mr. Huon Yoeut	57	Farmer	Steel
3	7/12/14	Preah Vihear	Chey Sen	Thmea	Thmea	M	Mr. Soeung Thy	45	Farmer	Steel
4	7/12/14	Preah Vihear	Chey Sen	Thmea	Thmea	F	Ms. Hing Vorn	53	Farmer	Leaf
5	7/12/14	Preah Vihear	Chey Sen	Thmea	Thmea	M	Mr. Min Choeun	61	Farmer	Leaf
6	7/12/14	Preah Vihear	Chey Sen	Thmea	Thmea	F	Ms. Srey Raen	54	Farmer	Steel
7	7/12/14	Preah Vihear	Chey Sen	Thmea	Thmea	F	Ms. Chun Ran	35	Farmer	Leaf
8	7/12/14	Preah Vihear	Chey Sen	Thmea	Thmea	M	Mr. Am Thet	41	Farmer	Steel
9	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	F	Ms. Chan Sam	61	Farmer	Steel
10	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	M	Mr. Kong Tin	52	Farmer	Steel
11	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	M	Mr. Kong Phai	42	Farmer	Leaf
12	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	M	Mr. Kuy Nang	44	Farmer	Steel
13	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	F	Ms. Seap Mali	17	Farmer	Tile
14	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	F	Ms. Sok Khea	25	Farmer	Steel
15	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	F	Ms. Loeung Sim	37	Farmer	Tile
16	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	M	Mr. Vong Sophy	46	Farmer	Leaf
17	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	F	Ms. Yan ry	48	Farmer	Tile
18	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	M	Mr. Puth Ken	40	Farmer	Leaf
19	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	M	Mr. Yun Thoeun	25	Farmer	Steel
20	8/12/14	Preah Vihear	Chey Sen	Thmea	Phneak Rolek	M	Mr. Don Chann	43	Farmer	Steel
21	9/12/14	Stung Treng	Thala Borovat	Anlong Phe	Spong	M	Mr. Loeung Pouk	34	Farmer	Steel
22	9/12/14	Stung Treng	Thala Borovat	Anlong Phe	Spong	M	Mr. Lin Thong	48	Farmer	Leaf
23	9/12/14	Stung Treng	Thala Borovat	Anlong Phe	Spong	M	Mr. Prum Voeun	34	Farmer	Leaf
24	9/12/14	Stung Treng	Thala Borovat	Anlong Phe	Spong	M	Mr. Lin They	53	Farmer	Steel
25	9/12/14	Stung Treng	Thala Borovat	Anlong Phe	Spong	M	Mr. Hun Bo	68	Farmer	Steel
26	9/12/14	Stung Treng	Thala Borovat	Anlong Phe	Spong	M	Mr. Hun Thoeun	57	Farmer	Steel
27	9/12/14	Stung Treng	Thala Borovat	Anlong Phe	Spong	M	Mr. Eam Orn	54	Farmer	Leaf
28	9/12/14	Stung Treng	Thala Borovat	Anlong Phe	Spong	M	Mr. Loeung San	30	Farmer	Steel
29	9/12/14	Stung Treng	Thala Borovat	Anlong Phe	Spong	M	Mr. Choun Lon	30	Farmer	Steel

Annex 2 – Results from field study (Excel sheet)

M1 - No.	M2 - Transport time	M3 - Tapping time	M4 - Years	M5 - Days	M6 - Species	M7 - DBH	M7 - omkreds	M8 - Height	M9 - TT diam	M10 - TT depth	M11 - Density	M12 - GPS	M13 - Health	M14 - Forest type	M15 - Yield (mL)	M16 - no. holes	M17 - Tap hole
1	-	05:20	10	5	Cheuteal	109	342	30	10	6	D	N 13° 29.993,	1	TE+R	600	1	1
2	10:00	07:22	10	5	Cheuteal	85	268	25	10	6	D	N 13° 29.885,	2	TE	400	2	2
3	00:46	06:03	10	5	Cheuteal	91	287	30	12	8	D	N 13° 29.899,	1	TE	350	1	2
4	01:36	04:22	10	5	Cheuteal	96	300	32	10	8	D	N 13° 29.885,	1	TE	680	1	1
5	01:32	04:32	10	5	Cheuteal	115	360	35	-	-	D	N 13° 29.886,	1	TE	620	1	2
6	01:07	02:58	10	5	Cheuteal	109	342	35	-	-	D	N 13° 29.889,	1	TE	600	1	2
7	01:13	03:58	10	5	Cheuteal	107	337	35	12	10	D	N 13° 29.868,	2	TE	400	1	2
8	07:30	05:15	10	5	Cheuteal	111	350	25	10	8	D	N 13° 29.843,	2	TE+R	620	1	1
9	01:32	04:09	10	5	Cheuteal	73	230	30	10	-	D	N 13° 29.865,	1	TE	550	1	2
10	01:44	06:19	10	5	Cheuteal	75	236	30	8	8	D	N 13° 29.905,	2	TE	720	2	1
11	00:38	05:53	10	5	Cheuteal	112	353	30	15	12	D	N 13° 29.904,	1	TE	410	2	2
12	01:45	03:44	10	5	Cheuteal	109	343	35	16	10	D	N 13° 29.939,	1	TE	100	2	1
13	00:33	05:16	5	5	Cheuteal	104	327	40	20	16	D	N 13° 29.946,	1	TE	1350	1	2
14	00:15	03:35	10	5	Cheuteal	104	325	25	10	6	D	N 13° 29.948,	3	TE	25	2	1
15	00:57	06:10	10	5	Cheuteal	90	282	30	16	8	D	N 13° 29.968,	2	TE	520	1	2
16	02:35	04:38	10	5	Cheuteal	116	363	40	20	14	D	N 13° 29.931,	1	TE	900	1	1
17	01:28	03:29	10	5	Cheuteal	113	354	35	10	-	D	N 13° 29.940,	-	TE+R	400	1	1
18	01:52	05:04	10	5	Cheuteal	135	423	40	16	12	D	N 13° 29.962,	2	TE	500	1	1
19	00:28	05:22	10	5	Cheuteal	68	215	30	10	10	D	N 13° 29.961,	1	TE	300	1	2
20	01:52	04:00	10	5	Cheuteal	62	194	30	10	8	D	N 13° 29.920,	1	TE	1000	1	1
21	00:50	04:29	10	5	Cheuteal	74	232	25	8	8	D	N 13° 29.924,	2	TE	200	1	2
22a	00:27	08:37	10	5	Cheuteal	88	276	35	16	12	D	N 13° 29.922,	1	TE	390	2	2
22b	-	-	10	5	Cheuteal	88	276	35	16	12	D	N 13° 29.922,	1	TE	400	2	1
23	04:58	03:17	10	5	Cheuteal	108	340	35	10	8	D	N 13° 29.835,	1	TE	350	1	2
24	01:01	04:28	10	5	Cheuteal	64	200	-	-	-	D	N 13° 29.814,	-	TE	800	1	1
25	04:00	05:00	10	5	Cheuteal	86	270	-	-	-	D	N 13° 29.821,	-	TE	200	2	1
26	00:40	03:55	10	5	Cheuteal	89	280	25	12	8	D	N 13° 29.809,	1	TE	320	4	1
27	00:40	07:18	10	5	Cheuteal	83	260	35	16	12	D	N 13° 29.802,	1	TE	400	2	1
28	00:37	04:00	10	5	Cheuteal	111	347	25	-	-	D	N 13° 29.787,	-	TE	900	1	2
29	02:46	04:37	1	5	Cheuteal	114	358	30	12	12	D	N 13° 29.745,	1	TE	400	2	1
30	02:41	05:00	1	5	Cheuteal	81	253	25	12	10	D	N 13° 29.701,	1	TE	200	1	1
31	01:00	03:43	1	5	Cheuteal	91	285	35	-	-	D	N 13° 29.691,	-	TE	100	1	1
32a	00:40	05:43	1	5	Cheuteal	127	400	40	-	-	D	N 13° 29.699,	-	TE	600	2	1
32b	-	-	1	5	Cheuteal	127	400	40	-	-	D	N 13° 29.699,	-	TE	400	2	1
33	00:47	01:58	1	5	Cheuteal	110	344	-	-	-	D	N 13° 29.682,	-	TE	100	1	2
34	00:34	04:16	1	5	Cheuteal	92	289	35	-	-	D	N 13° 29.669,	1	TE	500	1	1
35	07:00	06:35	1	5	Cheuteal	64	200	25	10	10	D	N 13° 29.781,	1	TE	400	1	1
36	01:30	05:35	1	5	Cheuteal	92	288	35	12	10	D	N 13° 29.279,	-	TE+R	1800	1	1
37	06:56	03:46	10	5	Cheuteal	90	282	25	10	10	D	N 13° 29.946,	1	TE	500	1	1
38	05:28	04:56	10	5	Cheuteal	84	263	22	10	8	D	N 13° 29.914,	1	TE	1700	1	2
39	00:57	03:51	10	5	Cheuteal	74	233	30	-	-	D	N 13° 29.915,	-	TE	600	1	1
40	03:13	05:14	10	5	Cheuteal	82	259	30	12	10	D	N 13° 29.862,	2	TE	600	2	1
41	02:47	04:09	10	5	Cheuteal	121	379	30	16	8	D	N 13° 29.862,	1	TE	600	1	1
42	06:10	02:03	10	5	Cheuteal	78	244	25	12	8	D	N 13° 29.787,	1	TE	100	1	2
43	00:29	03:22	10	5	Cheuteal	86	269	20	6	5	D	N 13° 29.775,	2	TE	280	1	2
44	03:40	04:27	10	5	Cheuteal	106	334	30	-	-	D	N 13° 29.749,	1	TE	800	1	1
45a	01:12	04:57	1	5	Cheuteal	94	294	30	-	-	D	N 13° 29.778,	2	TE	475	2	1
45b	-	-	10	5	Cheuteal	94	294	30	-	-	D	N 13° 29.778,	2	TE	475	2	2
46	00:39	03:49	10	5	Cheuteal	111	348	30	-	-	D	N 13° 29.785,	-	TE	600	1	1
47	03:23	03:23	10	5	Cheuteal	100	315	30	15	12	D	N 13° 29.766,	2	TE	420	1	2
48	04:51	04:03	10	5	Cheuteal	67	210	30	12	8	D	N 13° 29.802,	1	TE	550	1	1
49	01:04	04:00	10	5	Cheuteal	110	346	20	15	6	D	N 13° 29.776,	2	TE	800	2	1
50	00:24	03:30	10	5	Cheuteal	67	210	18	8	5	D	N 13° 29.775,	2	TE	400	1	2
51	01:25	03:40	10	5	Cheuteal	124	390	-	-	-	D	N 13° 29.799,	-	TE	700	1	1
52	08:17	03:06	10	5	Cheuteal	86	270	25	-	-	D	N 13° 29.744,	-	TE	150	2	2
53	00:40	03:00	10	5	Cheuteal	86	270	25	6	5	D	N 13° 29.736,	2	TE	720	1	2
54	00:18	05:10	10	5	Cheuteal	99	312	18	10	10	D	N 13° 29.731,	1	TE	750	1	2
55	01:41	04:14	1	5	Cheuteal	65	203	15	-	-	D	N 13° 29.716,	1	TE+R	600	1	1
56	02:30	03:54	1	5	Cheuteal	103	323	22	12	8	D	N 13° 29.699,	1	TE	1000	1	1
57	01:03	04:35	1	5	Cheuteal	128	402	25	12	8	D	N 13° 29.687,	1	TE	800	1	1
58	03:50	02:15	1	5	Cheuteal	68	215	30	8	6	D	N 13° 29.627,	2	TE	550	1	1
59	01:00	03:36	1	5	Cheuteal	64	200	20	-	-	D	N 13° 29.609,	-	TE	400	1	1
60	07:02	02:59	1	5	Cheuteal	117	366	25	-	-	D	N 13° 29.623,	-	TE	450	1	1
61	02:09	03:10	1	5	Cheuteal	56	175	16	8	6	D	N 13° 29.662,	-	TE	500	1	1
62	04:33	03:46	1	5	Cheuteal	99	310	20	10	6	D	N 13° 29.724,	1	TE	380	1	1
63	01:03	02:00	1	5	Cheuteal	80	250	25	10	8	D	N 13° 29.741,	1	TE	100	2	2
64	01:00	02:59	1	5	Cheuteal	91	285	30	12	8	D	N 13° 29.720,	1	TE	500	1	1
65	00:15	03:18	1	5	Cheuteal	81	255	-	-	-	D	N 13° 29.734,	-	TE	150	1	1
66	07:09	03:48	10	5	Cheuteal	70	220	25	10	8	D	N 13° 29.798,	1	TE	300	1	2
67	16:00	03:15	10	5	Cheuteal	88	277	25	12	8	D	N 13° 30.018,	1	TE	480	1	2
68	00:56	02:55	10	5	Cheuteal	89	280	22	-	-	D	N 13° 30.069,	-	TE	750	1	1
69	02:00	03:13	10	5	Cheuteal	94	294	22	10	6	D	N 13° 30.098,	2	TE	1150	1	2
70	01:20	02:09	1	5	Cheuteal	114	357	22	12	8	D	N 13° 30.066,	2	TE	150	2	2
71	03:43	03:42	1	5	Cheuteal	76	239	25	12	8	D	N 13° 30.086,	2	TE	900	1	1
72	00:48	03:52	10	5	Cheuteal	75	236	20	10	6	D	N 13° 30.105,	2	TE	800	1	1
73	02:26	03:00	10	5	Cheuteal	75	236	20	12	6	D	N 13° 30.113,	1	TE	700	1	2
74	00:32	02:28	10	5	Cheuteal	67	210	-	-	-	D	N 13° 30.117,	2	TE	250	1	2
75	01:38	04:49	10	5	Cheuteal	76	238	-	-	-	D	N 13° 30.117,	-	TE+R	800	1	1
76	00:40	03:00	10	5	Cheuteal	78	246	22	-	-	D	N 13° 30.131,	2	TE	300	1	2
77	00:07	03:58	10	5	Cheuteal	70	221	22	8	8	D	N 13° 30.135,	1	TE	680	1	1
78	00:20	03:45	10	5	Cheuteal	72	226	25	-	-	D	N 13° 30.146,	1	TE	700	1	2
79	01:00	02:38	10	5	Cheuteal	73	229	25	-	-	D	N 13° 30.166,	1	TE	250	1	2
80	04:30	03:30	10	5	Cheuteal	67	209	18	8	6	D	N 13° 30.219,	1	TE	720	1	1
81	03:46	04:47	1	5	Cheuteal	123	385	32	16	10	D	N 13° 30.257,	1	TE	2700	1	1
82	07:40	03:33	10	5	Cheuteal	104	325	30	14	8	D	N 13° 30.176,	1	TE	900	2	1
83	01:48	03:27	10	5	Cheuteal	115	362	30	12	8	D	N 13° 30.149,	2	TE	400	3	2
84	04:30	03:18	10	5	Cheuteal	107	335	-	-	-	D	N 13° 30.109,	-	TE	320	3	2
85	03:22	03:20	10	5	Cheuteal	106	334	25	8	8	D	N 13° 30.110,	1	TE+R	500	2	2
86	06:28	04:52	10	10	Cheuteal	57	180	22	8	6	D	N 13° 30.468,	1	TE	50	1	2
87	00:08	05:20	10	10	Cheuteal	81	254	25	-	6	D	N 13° 30.475,	-	TE	300	1	2
88a	01:30	13:22	10	10	Cheuteal	157	494	30	12	10	D	N 13° 30.470,	1	TE+R	1100	3	1
88b	-	-	10	10	Cheuteal	157	494	30	12	10	D	N 13° 30.470,	1	TE+R	750	3	1
88c	-	-	10	10	Cheuteal	157	494	30	12	10	D	N 13° 30.470,	1	TE+R	650	3	1
89	06:26	03:36	10	10	Cheuteal	58	182	22	8	-	D	N 13° 30.498,	2	TE	400	1	2
90	00:40	04:13	10	10	Cheuteal	92	290	25	-	-	D	N 13° 30.487,	-	TE	300	2	2
91	02:26	03:20	5	10	Cheuteal	77	243	20	8	-	D	N 13° 30.462,	1	TE	300	2	2
92	03:04	04:26	5	10	Cheuteal	84	264	22	10	-	D	N 13° 30.410,	2	TE	200	1	2
93	01:40	03:19	10	10	Cheuteal	59	184	25	-	-	D	N 13° 30.405,	1	TE	400	1	2
94a	03:06	06:28	10	10	Cheuteal	122	382	20	8	-	D	N 13° 30.366,	2	TE	520	3	2
94b	-	-	10	10	Cheuteal	122	382	20	8	-	D	N 13° 30.366,	2	TE	200	3	2
95	00:40	03:00	10	10	Cheuteal	59	184	15	5	3	D	N 13° 30.351,	1	TE	400	1	2
96	00:31	03:14	10	10	Cheuteal	88	276	22	8	10	D	N 13° 30.337,	1	TE	650	1	2
97	06:02	03:11	12	10	Cheuteal	68	213	20	8	6	D	N 13° 30.420,	2	TE	250	2	2
98	30:00	03:00	10	5	Trach	107	337	18	10	12	O	N 13° 30.414,	2	DISTURBED	300	3	2
99	07:44	02:05	10	5	Trach	115	362	16	10	8	O	N 13° 30.495,	2	DISTURBED	50	1	2
100	01:29	02:02	10	5	Trach	68	215	16	5	5	O	N 13° 30.532,	2	DISTURBED	350	1	3

Annex 3 – Questionnaire

Date of survey: ______________________
Serial Number (1-40): ______________________

Province: ______________________
District: ______________________
Commune: ______________________
Village: ______________________

Basic questions about IP (Interview Person)
Gender (M/F): ______________________
Name of respondent: ______________________
Age: ______________________
Occupation: ______________________
Social status (Roof type): ______________________
(Leaf, steel or Tile roof)

Question 1
How many days do you usually use per resin collecting trip?
** Respondent can answer in whole and ½ days.*
** Fx 3½ days*

Question 2
How many resin trees do you usually tap <u>per day</u> on the collecting trips?

Number of trees: ____________

Question 3
How many resin collecting trips do you conduct per month?
** This question relates to the past 12 Month of the respondents resin collection.*
** Please specify on <u>each month.</u>*

A. *Dry Season*
November _______
December _______
January _______
February _______
Marts _______
April _______

B. *Rainy Season*

May ________
June ________
July ________
August ________
September ________
October ________

Additional comments:

Question 4

Which costs do you have per resin collecting trip?

** Fx for materials, gasoline, manufacture, trading or other costs.*

** Please fill out table with items and costs for the items.*

Items	Costs (Riel/USD)

Question 5

Do you tap both liquid resin and solid resin?

** Put an X*

Both liquid and solid:___
Only liquid:___
Only solid:___

Question 6

How much resin do you tap per collecting trip?

** Write down the yield the respondent tap per collecting trip in the certain months of the year.*

** Only the last 12 months are taken into account.*

A. *Dry Season:*

November ____________**(Liquid)** ____________**(Solid)**
December ____________**(Liquid)** ____________**(Solid)**
January ____________**(Liquid)** ____________**(Solid)**
February ____________**(Liquid)** ____________**(Solid)**
Marts ____________**(Liquid)** ____________**(Solid)**
April ____________**(Liquid)** ____________**(Solid)**

B. *Rainy Season:*

May ____________**(Liquid)** ____________**(Solid)**
June ____________**(Liquid)** ____________**(Solid)**
July ____________**(Liquid)** ____________**(Solid)**
August ____________**(Liquid)** ____________**(Solid)**
September ____________**(Liquid)** ____________**(Solid)**
October ____________**(Liquid)** ____________**(Solid)**

Additional comments:

Question 7

What has the selling price for resin been the past 12 months?

** Write the price in riel or USD per weight.*

** Fx 30 USD for a 30 litres container.*

November	______________	**(Liquid)**	______________	**(Solid)**
December	______________	**(Liquid)**	______________	**(Solid)**
January	______________	**(Liquid)**	______________	**(Solid)**
February	______________	**(Liquid)**	______________	**(Solid)**
Marts	______________	**(Liquid)**	______________	**(Solid)**
April	______________	**(Liquid)**	______________	**(Solid)**
May	______________	**(Liquid)**	______________	**(Solid)**
June	______________	**(Liquid)**	______________	**(Solid)**
July	______________	**(Liquid)**	______________	**(Solid)**
August	______________	**(Liquid)**	______________	**(Solid)**
September	______________	**(Liquid)**	______________	**(Solid)**
October	______________	**(Liquid)**	______________	**(Solid)**

Additional comments:

Question 8

Has the selling price gone up or down the past 12 months?

Yes ______ **No**_____

Question 9

Can you explain why?

Question 10

How many resin trees does your family own or share?

**Put an X by the right answer*

Number_____________

Additional comments:

Question 11

How many resin trees have your family tapped resin from the past 12 months?

Number_____________

Additional comments:

Question 12

Why are you not tapping resin from all your resin trees?

** Only ask this question if the number in Q10 and Q11 are different.*

Question 13

What different tree species do you tap resin from?

***** *Write down the local names of the* *<u>species</u>* *and* *<u>sub-species</u>*.

Species 1 (liquid): ______________________Species 1(solid): ________________________
Species 2 (liquid): ______________________Species 2(solid): ________________________
Species 3 (liquid): ______________________Species 3(solid): ________________________
Species 4 (liquid): ______________________Species 4(solid): ________________________
Species 1 (liquid): ______________________Species 4(solid): ________________________
Species 1 (liquid): ______________________Species 4(solid): ________________________

Additional comments:

Question 14 – Additional comments

Do you have any additional comments on what we have discussed during this interview?

** Fx Relevant information related to the respondents tapping procedures or resin business in general.*

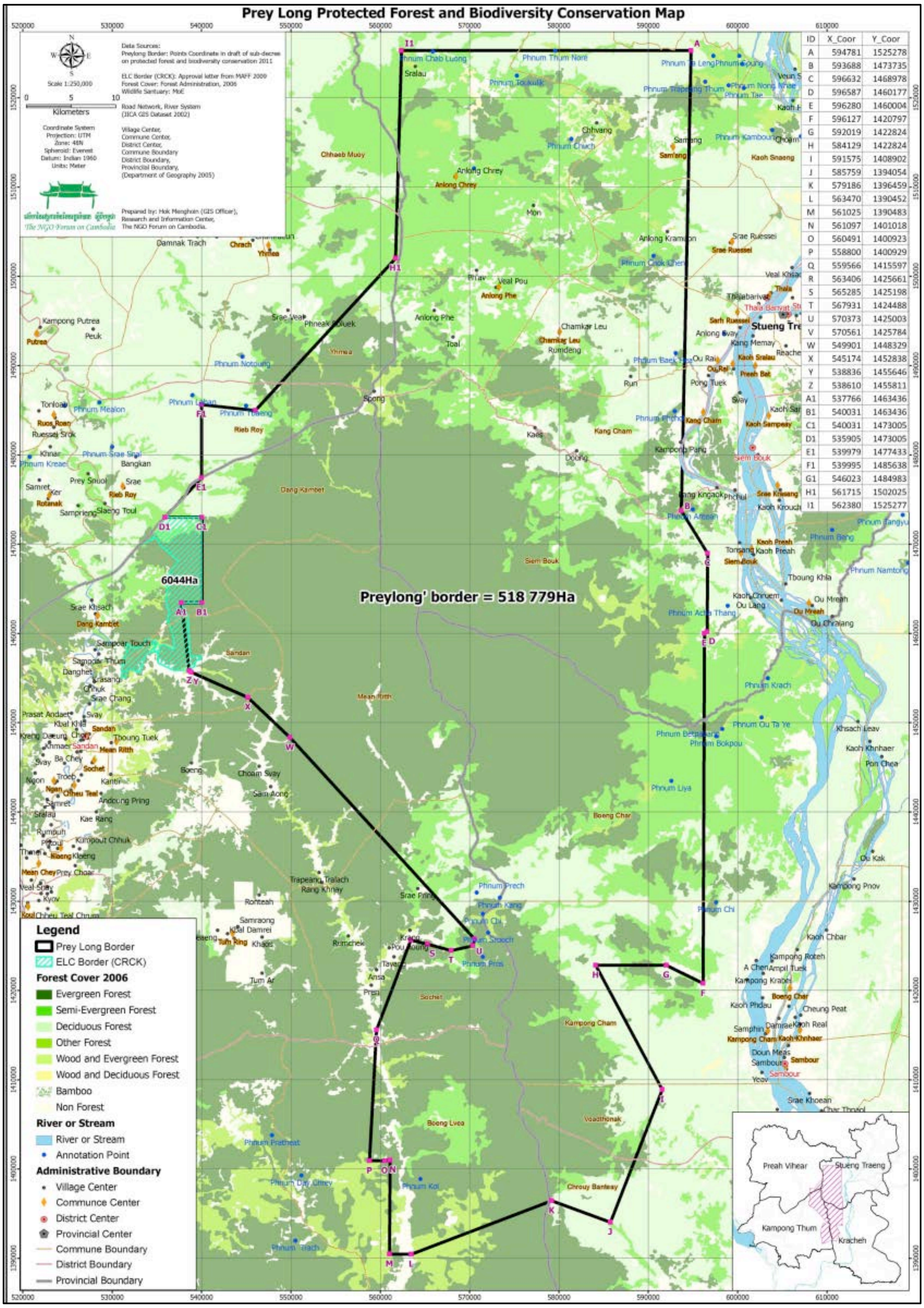
Annex 4 – Information on measured variables (Field study)

M1 - Number on observations.	We made measurements on 100 trees in total. Every tree was given a number from 1-100. The resin trees that have more active tapping holes than one was numbered a, b and c. For example 88a, 88b and 88c.
M2 - Transportation time from last tree.	Measurement on how much time it takes to travel from one resin tree to the next resin tree. All data are collected by foot, except from the last three Trach trees, which were reached by "goh yun" and by foot on the way back to the village Phneak Roulek.
M3 - Tapping time.	Measurement on how much time that is used on tapping resin from every tree. We measure the time when the resin tapper starts the fire in the tapping hole till the resin is tapped from the tree and put into the container. Normally the resin tapper put the resin directly from the tapping hole into the container he collects the resin in. In this study the resin tapper puts the resin directly into the measuring jug instead of his own container. So we measure that time instead and pour the resin into his own container afterwards.
M4 - Years of tapping	The number of years the resin tree have been tapped from in total. There is also information on how many years the particular tapping hole is: No. 10, 12, 25, 26, 27, 40, 49, 52, 63, 70 (1 year) No. 94a (5 years)
M5 - Last tapping	Information on how many days ago the particular tree was tapped the last time. The most trees were tapped 5 days before, with 15 trees being tapped 10 days before.
M6 – Tree species	Name on the tree species. There are 97 observations on Cheuteal (*Dipterocarpus alatus*) and three observations on Trach *(Dipterocarpus intricatus)*.
M7 – Diameter by Breast Height	Measurements on the resin trees diameter by breast height (approximately 130 cm). We use a tape measure to measure the circumference. The actual diameter is calculated afterwards.
M8 - Height of tree	We estimated a point 2 meters up the resin tree (somewhat more than a tall person). Then we estimated how many times two meters matches the height of the tree. Same method was used to measure M9 (Treetop diameter) and M10 (Treetop depth). These data can be biased because of the density of the forest, which made it hard to see the treetop properly because *Dipterocarpus alatus* is one of the higher tree species in Prey Lang.
M9 - Tree top diameter	Estimated with the same method as in M8.
M10 – Tree top depth	Estimated with the same method as in M8. I estimated a point on the tree were the main part of the tree top/crown began and found the tree top depth.
M11 - Density of forest	The density at the forest floor was assessed by the following definitions: *Dense (D):* You are able to see 10 metres. *Medium (M):* You are able to see 25 metres. Open (O): You are able to see 50 metres or more. All observations (*Dipterocarpus alatus*) were located in very dense forest, except from the last 3 resin trees of the species Trach, which were located in open and dry areas.
M12 – GPS coordinates	GPS coordinates are registered for every resin tree.

M13 - Health of tree	Used to assess the condition of the resin trees by a simple classification. Accordingly, Good, Medium and bad: *(1) Good:* No sign of diseases. No broken branches. *(2) Medium:* Larger branches broken of. Branches without leaves or withered leaves. Rotting wholes in stem. Bark stripped off. Main part of crown healthy. *(3) Bad:* Larger parts of crown dead.
M14 - Forest type	The main part of the observations (all *Dipterocarpus alatus*) was located in the tall evergreen part of Prey Lang forest. Trees that were located within 25 meters from a stream or river were defined as (TE+R) instead of RF. The Trach (*Dipterocarpus intricatus*) species were located in disturbed and cleared forest areas. *Tall evergreen forest (TE):* The tall evergreen forest is mostly in the core area of Prey Lang. The trees are 30 meters high or more. *Short evergreen forest (SE):* The short evergreen is between 15-30 metres high. *Riverine forest (RF):* Hard to differ from tall evergreen forest. Resin tree is 25 meters or less from a stream or river. *Other:* Other types of forest that do not match TE, SE or RF.
M15 – Tapping yield	The resin yield is measured from every tree. Some trees had more active tapping holes than one, so there are made measurements on 100 trees but tapped resin from 106 tapping holes (106 observations).
M16 – No. Of tapping holes	Many of the trees had more tapping holes than one, both active and non-active. There were between 1-4 tapping holes in one tree.
M17 – Condition of tapping holes	I asked the tapper if the tapping hole was in a good, medium or in a bad condition. The argument for the condition was if the bark was heavily burned over the tapping hole or not and if the tapping hole provided a large or small amount of yield.

Annex 5 – Map of demarcated area of Prey Lang

(Open Development, n.y.)



Annex 6 – Picture of Chor Srorl (Solid resin)

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