Participatory Assessment of Bamboo Resources in Kroam and Krala Peas Villages, Preah Rumkel Commune, Thalaborivat District, Stung Treng Province

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Acronyms

The following list of acronyms aim to guide to the bamboo resource assessment being carried out in the two Community Forestry/villages of Kroam and Krala Peas, Preah Rumkel commune, Thalaborevat district, Stung Treng province.

BF	Bamboo Forest
CF	Community Forestry
CFMC	Community Forestry Management Committee
DDF	Deciduous Dipterocarp Forest
EWMI	East-West Management Institute
GMS	Greater Mekong Sub-region
MDF	Mixed Deciduous Forest
PLL	Prey Lang Landscape
RECOFTC	Centre for People and Forest
SFB	The Supporting Forests and Biodiversity Project
WCS	Wildlife Conservation Society
WI	Winrock International
WWF	World Wide Fund for Nature

Glossary

Culm	main stem, sometimes referred as cane. After cut, it is usually called pole.
Culm wall	the culm thickness Rhizome an underground stem which is distinguished from a root by the presence of nodes, buds and leaves or scales.
Internode	segment of culm, branch, or rhizome between nodes.
Node	the joint between hollow segments of a culm, branch, or rhizome; the point at which a rigid membrane of vascular bundles lends strength to an axis of bamboo by crossing it from wall to wall.
Sheath	a vegetative part embracing and protecting culm and rhizome. Sheath attaching the culm node called culm sheath. It usually falls off when plant gets older.
Shoot	the stage in the development of the bud before it becomes a culm with branches and leaves.

Summary

A bamboo resource assessment was carried out in two Community Forestry (CF)/villages of Kroam and Krala Peas, Preah Rumkel commune, Thalaborivat district, Stung Treng province on 3-12 January, 2015. This resource assessment aims to identify potential commercial species, abundance of the population, annual culm growth and annual allowable harvest. This study was to support sustainable harvest of bamboo for livelihood enhancement of local community, under the project "Cambodia Supporting Forests and Biodiversity (SFB), in Prey Land Landscape (PL) and Eastern Plain Landscape (EPL).

The bamboo resource assessment was first started with 2 day training on general knowledge of bamboo botany and ecology, bamboo species diversity, inventory methodology and participatory discussion on the bamboo areas and size, and then followed by inventory data collection, and finally data analysis and inventory result demonstration. A total of 16 community participants (12 men and 4 women) were trained and engaged in the field data collection. Two forms of datasheet were developed which are attached to this report as annexes – one for recording bamboo density and another for bamboo size. Three wild species and four domestic ones were reported by community participants, but only Russey Roleak is potential in terms of abundance and utilization. The bamboo resource assessment was conducted at 09 areas located both within and outside the two CFs of Kroam and Krala Peas. The size of sample plots was 50 m x 20 m (1000 m^2 or 0.1 m ha). No subplot is laid because of that bamboo has no seedlings except when it fruits.

Kroam village consists of 9 bamboo areas with a total area of 98.3 hectares, of which 6 areas are located within the Kroam CF, and other three areas are located outside the CF. The bamboo resource assessment was decided and conducted within five areas only with a total size of 77.5 ha. Krala Peas village consists of 9 bamboo forest areas covering 98 ha, of which 7 areas are located within the Krala Peas CF and other 3 areas are located outside the CF. O Dong covers an area of 20 ha, of which 10 ha is located within the CF called O Dong Kroam, and another 10 ha are located outside the CF called O Dong Leu. The bamboo resource assessment was conducted at 6 areas with a total size of 65 ha, 5 of which are located within the CF, and another one area (O Dong Leu) is located outside the CF. A total of 64 sample plots of 0.1 ha each were laid out in systematic way across the total area of 142.5 ha of the two villages. The total size of sample plots is 6.5 ha equaling to about 4.6 percent of the total area.

The data was recorded in different ages of bamboo culms from bamboo shoots to 6 year old culms, and dead culms and cut culms. However, dead culms were recorded just to know the scope of bamboo utilization, but not included in the data analysis for future projection on bamboo harvest. So, the analysis was made then from bamboo shoots to 6 year old culms and cut culms as they are within the culms with ages 2 to 5 years old. The study showed that the 5 bamboo areas of Kroam village consisted of 12,593 clumps and 235,745 culms, and the six study areas of Krala Peas village consisted of 14,330 clumps and 182,931 culms. The average density of bamboo resource of these two villages is 189 clumps or 2,938 culms per hectare. With regard to annual regeneration, in general, one clump is able to produce 2-3 culms or rarely up to 4-5 culms annually. The average annual growth of culms per clump is 2.7 culms. The annual culm regeneration of the entire study area is 72,950 culms. Hence, the annual allowable harvest of this second stage of following years can be projected using this annual regeneration rate. If care of bamboo is sufficiently undertaken, the regeneration rate will be higher, and so does the harvest. In relation to the current harvest, 3 percent was harvested in Kroam village and 2 percent was harvested in Krala Peas village for household consumption. Limited harvest of culms is because of lack of bamboo market in these two villages.

Since that bamboo is the clumpy species, which new shoots is regenerated from rhizome annually, annual cut of culms at ages 2-5 years old can be carried out to its full extent of resources. If planned for harvest, the first stage of bamboo harvest can be up to its full amount

of 179,498 culms in the two villages, and the following year harvest plan can be projected on a basis of its annual growth as presented in the following table.

Village	Name of bamboo areas (ha)	Location	Bamboo areas (ha)	Total		Density (h^{-1})	
				Clumps	1-6 year old and cut culms	Clumps	1-6 year old and cut culms
Krala Peas	O Dong Leu	Outside CF	10	2,440	38,100	244	3,810
	O Dong Kroam	Within CF	10	1,560	31,140	156	3,114
	O Kokoh	Within CF	10	2,280	22,060	228	2,206
	O Sleng	Within CF	15	4,294	40,331	286	2,689
	O Kub Phnov	Within CF	5	1,150	11,400	230	2,280
	O Taprei	Within CF	15	2,606	39,900	174	2,660
	Total		65	14,330	182,931	220	2,814
Kroam	O Dong Leu	Outside CF	17.0	2,890	66,844	3,932	3,932
	O Khan Leurng	Outside CF	29.5	4,512	63,384	2,149	2,149
	O Dong Kroam	Within CF	12.5	1,594	45,844	3,668	3,668
	O Rundas	Within CF	12.5	2,472	41,328	3,306	3,306
	Prolay Anlung Thmor	Within CF	6.0	1,125	18,345	3,058	3,058
	Total		77.5	12,593	235,745	162	3,042
Total/average density			**142.5**	**26,923**	**418,676**	**189**	**2,938**

In order to enhance forest reliance livelihood of the community by means of bamboo resources, its products should be invented and market of these products should be identified. A variety of products including bamboo slats, meat skewer, incense stick, furniture, handicraft and bio char can be produced from this species resource.

Culms should be cut at ground level (20 cm above ground) to allow health growth of bamboo shoots and culms. The best time to harvest the culms is between November through April to avoid the destruction of the bamboo shoots and young culms.

56.5 ha out of the total area of 142.5 ha are located outside the two CFs. The bamboo resources located outside these 2 CFs were accounted for 168,328 (40.2%) culms of the entire population. The areas located outside the CF are likely hard to be secured in future due to the rapid land conversion trends to agricultural land. In order to secure these bamboo areas, all concern stakeholders, and especially local authority and community should reserve these areas for sustainable use of bamboo resources, prevention of stream bank erosion, and stabilizing ecosystem.

1. Introduction

The two sites of Kroam and Krapaleas Community Forestry (CF), which are situated in Preah Rumkel commune, Thalaborevat district, Stung Treng province, are included in the Prey Lang Landscape (PLL). These two CF sites have the potential of bamboo resources, confining along the streams, which are branches of the Mekong River. These streams are surrounded by deciduous forest. The medium culm thickness species of *Bambusa bambos* (Russey Roleak) is the most common species but little harvested for utilization. This species is highly potential for market demand in other areas but has not been commercialized in these villages so far because of lack of market access. Hence, many dead culms are encountered in the clumps, and some patches of bamboo rich forest located outside the two CFs have been cleared and converted to farmland. Therefore, in order to enhance value of the bamboo resources, its market in the forms of either raw materials or final/semi-products needs to be promoted. It is believed that if its market is promoted, it will provide many benefit dimensions like local ecosystem-based livelihood improvement, soil erosion prevention and biodiversity conservation enhancement for these areas.

The Supporting Forests and Biodiversity Project's (SFB's) goal of a joint initiative between the Winrock International, WWF Cambodia, East-West Management Institute (EWMI), Wildlife Conservation Society (WCS) and the Center for People and Forests (RECOFTC) is to improve conservation and governance of the Eastern Plains and Prey Lang Landscapes to mitigate climate change and conserve biodiversity. Three interlinked objectives of this project include 1) build capacities of national and sub-national government officers, 2) improve dialog between forest communities and other stakeholders to solve problems that ensure conservation, and 3) ensure equitable and improved livelihoods for persons, primarily forest communities, who are living in the landscapes and committed to conserving forest resources and biodiversity.

Objective 3 is critically important to the effectiveness of forest and biodiversity conservation and the success of the SFB Project. This Objective considers ways to improve income from diversified value chains. Bamboo enterprise will help address deforestation and enhance rural livelihoods of forest community through value addition to bamboo products and access to markets and if managed properly, it will not only enhance livelihoods but also help mitigate climate change through carbon sequestration and contribute to habitat and wildlife protection in the PLL.

Winrock International recommended that an innovative pro-poor bamboo approach would help address biodiversity conservation and poverty alleviation in Vietnam, Cambodia, Laos and the Greater Mekong Sub-region (GMS). In order for sustainable bamboo management, bamboo resource inventory is needed to assess its current population and estimate annual harvest volume in subsequent years. Hence, this inventory aims to:

- Determine commercial species of bamboo for trade (as a raw product and post production potential);
- Estimate density of species specific bamboo and their potential use within the identified areas of the two villages – Kroam and Krala Peas;
- Estimate the volume of annual growth of different bamboo species per pilot area, and
- Estimate the approximate volume of culms for annual extraction under the scenarios as indicated in the objectives

2. Methodology and Materials

The bamboo resource assessment went through a number of processes as follows:

- Bamboo resource assessment training: two day training was held in Kroam village, Preah Rumkel commune. 9 members (7 men, 2 women) from Kroam and 7 members Krala Peas Community Forestry Management Committee (CFMC), and

commune council of Preah Rumkel were invited and participated in the training. This training was to provide them knowledge of the bamboo structure and ecology, to identify bamboo areas and associated information, organize resource inventory team, and develop inventory plan. Based on the input/information provided by community members, the bamboo areas were identified, and size of bamboo areas was determined by multiplication of the length of stream with bamboo resources and average width of bamboo growing along the stream bank. As a result of group discussion by CFs, 4 bamboo areas in Kroam and 5 bamboo areas in Krala Peas were selected for resource assessment.

- The team basically decided to take five percent of sample size of the entire bamboo areas for the study, and sample plots of 50 m x 20 m (1,000m^2 or 0.1 ha) were applied to ensure the full coverage of bamboo clumps. Since bamboo was mainly confined along the streams with variable extension from the stream bank to the rear side, the length of the plot (50 m) is laid in parallel to the stream, whereas the width of the plot (20m) is laid perpendicular to the stream.

- The plot interval was calculated by division of length of the stream by number of plots. Each plot is located at different sides of the stream bank.

- The datasheet for recording bamboo resources was divided into two main sections: one on general information of the plot and the other on bamboo data. The table of bamboo data was designed to record thorough information of clump number, bamboo species, clump circumference, bamboo shoot, young culm (to 1 year old), juveniles (1-2 year old), adults (2-4 year old), old culms (5-6 year old), dead culm, cut culm and additional note if any. The knowledge of culm ages is a fundamental basis to record accurate information of bamboo for annual regeneration analysis and annual collection projection.

- Materials and equipment used for the resource assessment include machete, GPS, measuring tapes (50 meters, 10 meters, 5 meters), datasheet and folder and pen/pencil.

- Information on bamboo property such as size of the culm, culm thickness, internodes and length of bamboo pole were also recorded as these information were useful in identifying the uses of bamboo at different sections – at the lower section, middle section and top section.

3. Participants

3.1 Training participants

Participants of the two villages consisted of 16 people as follows:

- Kroam CF consisted of 9 people including one CF chief (also village chief and 8 CFMC members. There were two women participating in this resource assessment, which represented 22% of the team.

- Krala Peas CF consisted of one CF chief and 6 CFMC members. Two women representing 29% of the team participated in this resource assessment.

3.2 Inventory team composition

The bamboo resource assessment was conducted simultaneously in the two CFs, and two groups were split into each of the two CFs respectively. The followings highlight resource assessment team by CF.

- Kroam CF: The team was composed of 10 members including 9 community members, and led by Mr. Ken Piseth, and
- Krala Peas CF: The team consisted of 8 members and led by Mr. Neak Phearom;

4. Study Area

Total bamboo areas of the two CFs where the resource assessment was conducted, are account for 142 hectares. Kroam village consists of 77 hectares within 4 bamboo areas, of which 30.5 hectares are located within CF, and another 46.5 hectares are located outside the CF. Krala Peas village are composed of 65 hectares of five bamboo areas, 55 hectares of which are located within the Krala Peas CF, and another 10 hectares are situated outside the CF.

Table 2: Bamboo locations and sizes of the study areas covered

Village/CF	Areas	Total area	Size of bamboo area (ha)	
			Within CF	Outside CF
Kroam	O Dong	12.5	12.5	17
	O Khan Leurng	29.5	0	29.5
	O Rundas	12	12	0
	Pralay Anlung Thmor	6	6	0
Krala Peas	O Dong	20	10	10
	O Taprei	15	15	0
	O Kub Pnov	5	5	0
	O Sleng	15	15	0
	O Kokoh	10	10	0

5. Results

5.1 Bamboo species diversity

In accordance to information shared by local community through group discussion, there are three indigenous bamboo species in the two CFs, including Russey Roleak (*Bambusa bambos*), Russey Tronung Moan (*Thyrsostachys olivery*) and Russey Khley (*Gigantochloa albociliata*). The community of Kroam and Krala Peas villages also grow domestic bamboo species in few quantity, consisting of *Bambusa blumeana*, *B. vulgaris*, *Dendrocalamus asper* and *Thyrsostachys siamensis* either in their homestead or farmland. These species are summarized in the following table.

Table 2: Bamboo species diversity in the two villages

Abundance: 3 = Abundant; 2 = Moderate; 1 = Rare

Local name	Culm wall thickness	Botanical name	Abundance	
			Kroam	Krala Peas
Tronong Moin	Thick	*Thyrsostachis olivery*	1	1
Russey Roleak	Medium thick	*Bambusa bambos*	3	3
Russey Khley	Thick	*Gigantochloa albociliata*	1	1
Russey Srok	Medium thick	*Bambusa blumeana*	0	1
Russey Keo	Medium thick	*Bambusa vulgaris*	0	1
Russey Srokchen	Medium thick	*Dendrocalamus asper*	1	1
Ping Pong	Thick	*Thyrsostachys siamensis*	0	1

5.2 Bamboo Taxonomy and Ecology

Community participants reported three wild bamboo species including, Russey Roleak (*Bambusa bambos*), Russey Khley (*Gigantochloa albociliata*) and Russey Tronung Moin (*Thyrsostachys oliveri*). The three species are sympodial with short neck rhizome and deciduous, which means leaves are shed regularly in the dry season (November to April), and so fire usually occurs in the bamboo forest with dominance of these species. Ecologically, these species grow together in the same habitat but population of the two species of Russey Roleak and Russey Tronung Moin were come across in the sample plots.

Russey Roleak mainly confines only along the seasonal streams, which are estuaries of the Mekong River. There are more abundant resources and larger poles at the low lying area with rich and moist soil. Clumps located along the streams with deep slop have smaller poles and less abundant, and usually grow in row along the bank. Another observation noted that bamboo along the smaller streams usually have small clumps and poles (pole diameter less than 6 cm), and so not meet the market demand of bamboo poles (required 7 cm diameter upwards). Bamboo can grow in poor soil, but prefer more fertile loamy soil with periodic water in the rainy season. Bamboo that grows in shorter distance between clumps (2-3 meter apart) are usually not so healthy, and smaller clumps that receive less sun light cannot develop into larger clumps and sometimes the entire clumps die. In nature, bamboo clumps with distance between 6 meters apart from each other grow well and have good poles. Individual culm become old and die after 6 years, and the whole clumps may produce flowers and fruits in 60 years and die afterwards. As a result, dead bamboo creates a large biomass which easily cause to massive forest fire during the dry season. None of bamboo in the two villages produces flowers and fruits. According to field observation, dead bamboo may decay in 5 to 6 years and provide good fertilizer to the soil. Since bamboo is a clumpy species where young shoots grow annually from the rhizomes, it is considered a quick renewable resources and good potential for sustainable enterprise.

Figure 1: Bamboo forest in Kroam CF, Kroam village

Russey Roleak

Vernacular name: Russey Roleak
Scientific name: *Bambusa bambos* (l.) Voss
Synonym: *Bambusa spinosa* Roxb., *Bambusa arundianacea* (Retzius) Willd, *Arundo bambos* L.

Description: It is densely tufted bamboo, with a variable clump sizes from 0.20 m to over 5 m diameter or rarely up to 10 m diameter depending on soil and moisture. The clump forms thickest at the ground to around 3 meters due to densely spiny branch development at nodes of the bamboo poles. Clumps exposing to more sun light have more branchy culms than ones in the shade area. The nodes are slightly swollen, and the lower parts usually have aerial roots. The pole is variable in sizes from 9 m to 12 m long and 3 cm to 12 cm diameter at base; internodes are variable from about 2 cm long at the base to 47 cm long in the middle section. The average ranges of internodes at the middle section are 40 cm long. Culm wall is almost solid at the base and gradually thin to around 10 mm at the middle section and 3 mm at the top. In general, culm wall thickness is moderate. Culm sheath has moderate brown hair when young and becomes glabrous when old. This species is dominant in the bamboo forest of the study areas. It also occurs almost every places along the lowland streams running through deciduous forest across the country. Based on local knowledge, Russey Prey can be distinguished from this species by a number of characters such as densely black short hair on the back side of the culm sheath, more robust clumps and spiny, larger pole, shorter internode, and weaker culm wall. However, most of local community referred Russey Roleak to Russey Prey.

Uses: The culms of this species are split into strips for different purposes like house wall and floor, furniture, foundation of light concrete and other products like meat skewers, incense handles and chop stick. Currently, its culms are mainly used as scaffolding for high building construction, and foundation.

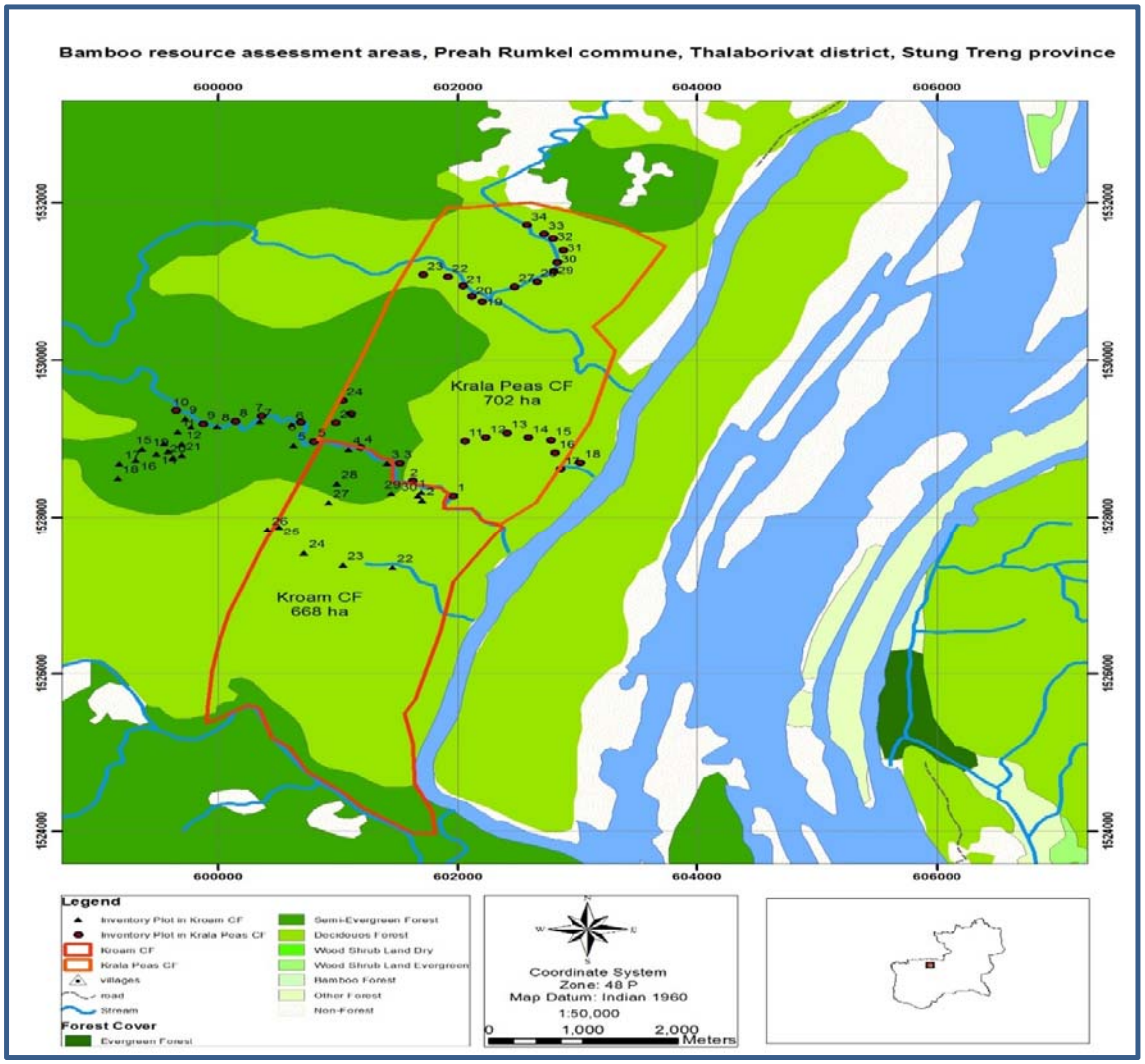
Figure 2: a) Branchy clump of Russey Roleak; b) Young culm with sheath attached.

5.3 Location of bamboo resources

The population of Russey Roleak grows along the larger streams called “O” or smaller stream called “Pralay” in Khmer language, and low lying areas. Certain smaller streams, which are branches of the main streams, are not be visible on a map. The size of bamboo areas in hectare were measured based on the length of stream and the average cross section of bamboo clumps on the stream banks. The calculation of the area was also validated in the field by the two team leaders in consultation with community members. Bamboo abundance was also qualitatively assessed to provide an overall view of the population. There are 18 bamboo areas covering total areas of 196.3 hectares, of which 6 areas (100 hectares or 51 percent) fall outside the CF, and 96.3 hectares in equivalent to 49 percent are within the two CFs. It is notable that O Dong is located on the border of Kroam and Krala Peas CF, and extended from outside to within the CF. Unlike bamboo of the five villages in Kratie province, none of bamboo in the two CF/villages produces flowers and fruits in this 2014/2015. Distances from villages to the areas and means of transportation were highlighted as they are also important factors in harvest planning throughout the year. The following abbreviations were used in describing the bamboo habitats.

- BF Bamboo Forest;
- DDF Deciduous Dipterocarp Forest
- MDF Mixed Deciduous Forest.

Figure 3: Location map of bamboo resources within and outside the two CFs



The followings are bamboo locations of the two villages:

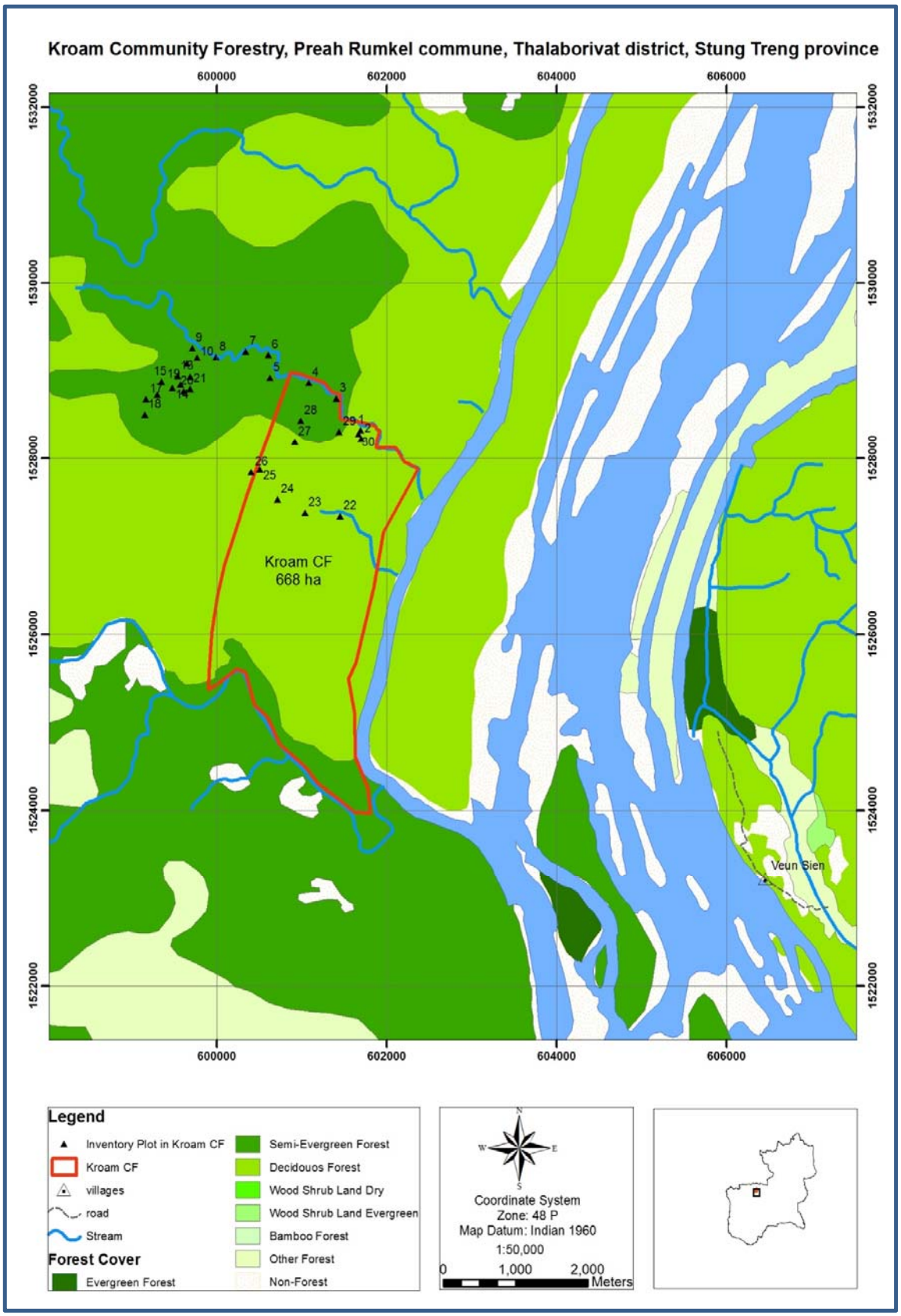
- **Kroam village**

Based on group discussion, bamboo areas were reported to be present in 9 areas, of which 6 areas are located along the streams running through Kroam CF, and other 3 areas are located along the streams located outside the CF. The following table shows the bamboo areas and other associated information.

Table 3: Forest type and bamboo abundance in Kroam village

Name of area	Size of area in hectare			Forest type	Inside CF	Outside CF	Abundance	Distance from village (m)	Potential area for harvest
	Length of stream (km)	Distance of bamboo clump from stream bank (m)	Size of bamboo area (ha)						
O Dong Kroam	2500	50	12.5	BF	12.5	0.0	3	5 km	3
Anlong Thmor	1500	40	6	BF + DDF	6.0	0.0	2	5 km	1
O Rundas	3000	40	12	BF	12.0	0.0	2	7 km	3
O Khan Leurng (branch of O Dong)	1500	200	30.0	BF	0.0	30.0	2	10 km	3
Dai Pralay	400	20	0.8	BF + DDF	0.8	0.0	2	5 km	2
O Dong Leu	3400	50	17	BF	0.0	17.0	3	5 km	3
O Tadeurn	2000	20	4	BF	4.0	0.0	1	9 km	1
O Russey Kroam	1000	40	4	BF	4.0	0.0	2	10 km	3
O Russey Leu	3000	40	12	BF	0.0	12.0	2	10 km	3
Total area (ha)			98.3		39.3	59.0			

Figure 4: Location of sample plots in Kroam CF



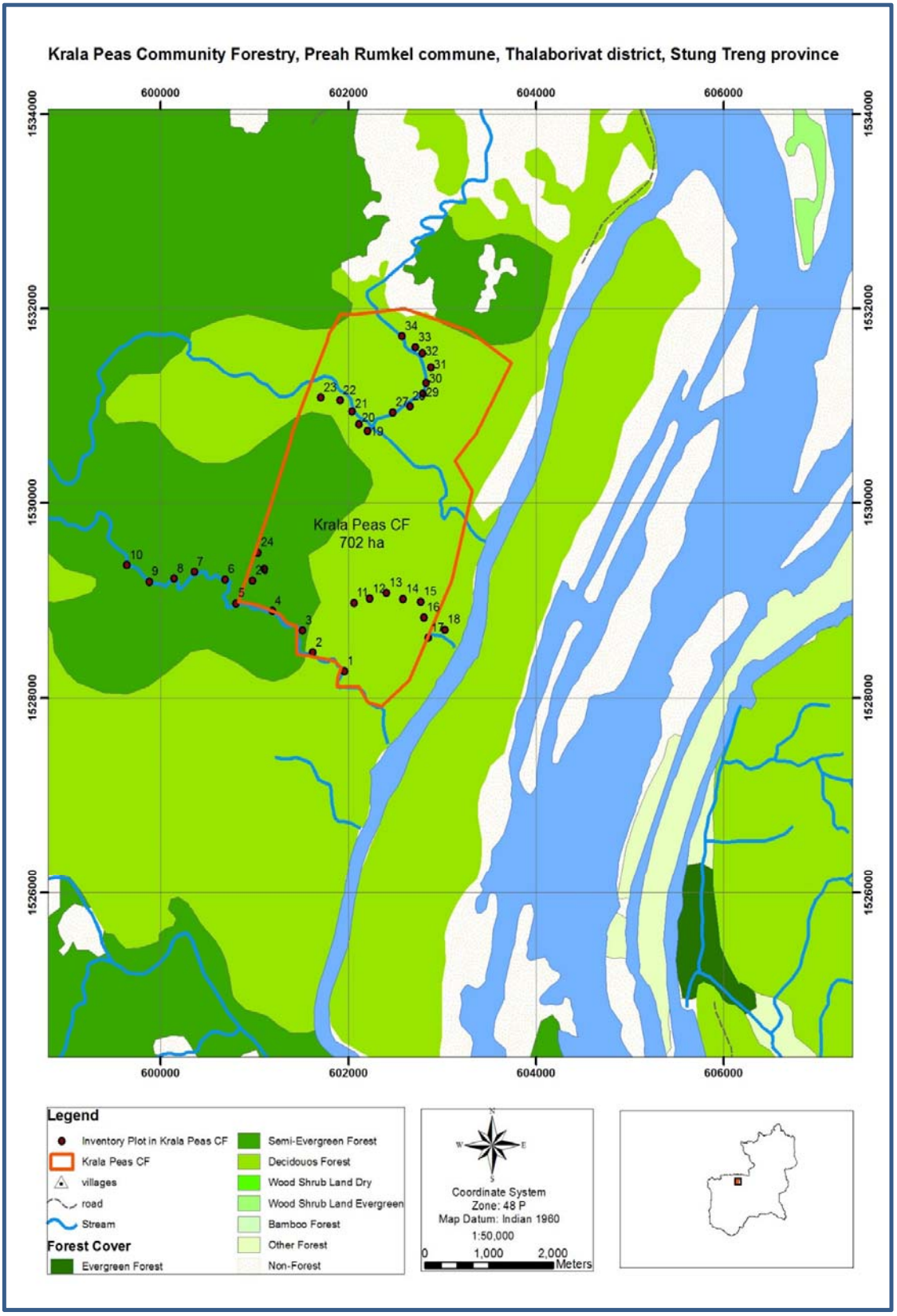
- **Krala Peas village**

Bamboo inhabit along 9 streams, of which 7 areas are located within the CF, and 2 areas are situated outside the CF. All bamboo areas can be accessed by either boat or on foot in the rainy season and by motor bike, tiller or on foot in the dry season. These areas are at the distance of 2.5 km to 6 km away from the village. The following table is summarized of the bamboo areas.

Table 4: Forest type and bamboo abundance in Krala Peas village

Name of areas	Size of areas in hectare			Forest type	Inside CF	Outside CF	Abundance	Distance from village (m)	Potential area for harvest
	Length of stream (km)	Distance of bamboo clump from stream bank (m)	Size of bamboo area (ha)						
O Dong	4000	50	20	MDF	10	10	3	6	3
O Taprei	1500	100	15	MDF	15	0	3	3	2
O Kub Pnov	500	100	5	MDF	5	0	2	5	3
O Sleng	1500	100	15	MDF	15	0	3	4	3
O Kokoh	1000	100	10	MDF	10	0	2	3.5	2
Pean Lok	300	50	1.5	MDF	1.5	0	2	3	2
Pralay Rumsae			0.5	MDF	0.5	0	1	3.5	1
Kbal O Taprey	2000	30	6	BF	0	6	1	2.5	1
Kbal O Dong	50	5000	25	BF	0	25	2	6??	3
Total area (ha)			98		57	41			

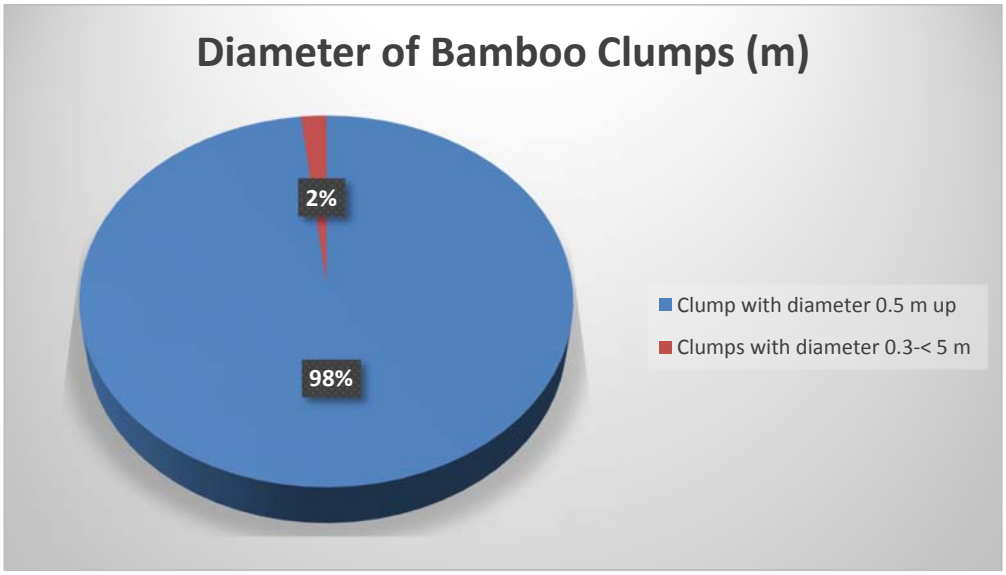
Figure 5: Location map of sample plots in Krala Peas CF



5.4 Bamboo density

The size of bamboo clumps are variable from 0.3 m to 10 m diameter. The clumps with 10 m diameter usually grow on termite hills. All bamboo clumps with diameter smaller than 0.5 m (or 50 cm) usually have slender culms because of unsuitable conditions such as receiving less sunlight for those growing under large clumps, unfertile soil or close to Deciduous Dipterocarp Forest (DDF) which is affected by annual forest fire and too close intervals between clumps. The smaller diameter clumps seem not be able to develop into larger clumps, and sometimes result in dying the entire clumps, and culms of these clumps are usually as small as 0.1 cm - 0.3 cm diameters or rarely close to 0.5 cm diameter. Based on the analysis, the entire area was composed of 472 clumps with diameters of 0.3-0.4 m, and 24,202 clumps with diameter ranging from 0.5 to 10 m.

Figure 6: Graph of bamboo clumps with diameters 0.1 - < 0.5 m vs. 0.5 - 10 m

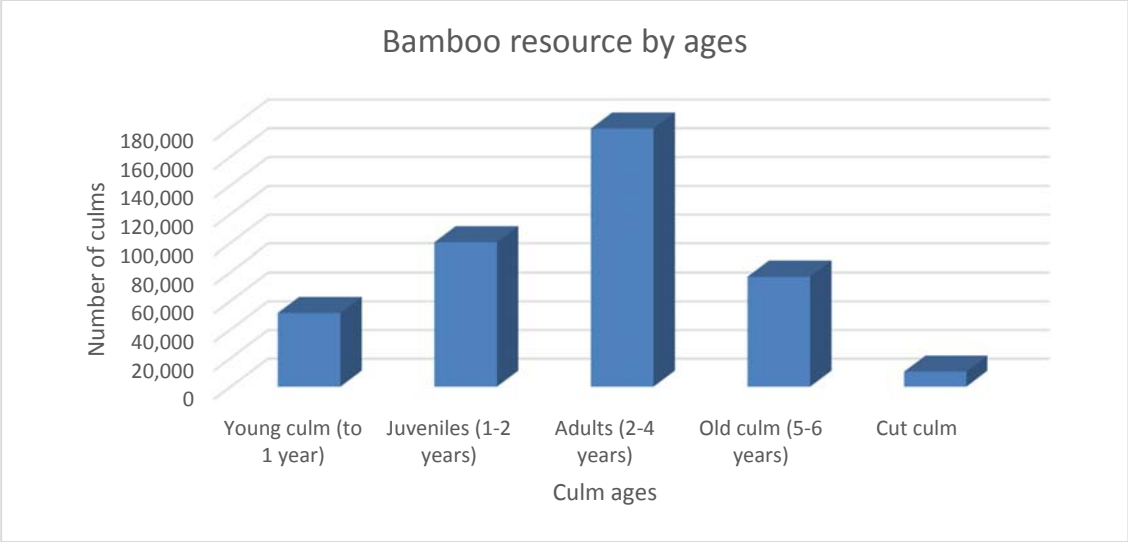


In order to ovoid or reduce bias in estimating commercial bamboo poles, all clumps with diameter less than 0.5 m are excluded from the data analysis. In addition, dead culms were not included in this analysis.

The bamboo resource assessment includes all culm ages from bamboo shoots to 6 year old culms and cut culms. The reason to include cut culms in the analysis is because it is within 6 years old. Bamboo shoots were not present during the assessment because it is produced only after first rain in April to July the latest. However, young culms with less than one year old have recently developed from the bamboo shoots, and so considered annual regeneration of the first year.

The 11 bamboo resource assessment areas contained 418,676 culms. The highest population bamboo areas were O Dong Leu of Kroam village, accounting for 66,844 culms, and followed by Khan Leurng having 63,384 culms. The third highest population area was O Dong Kroam of Kroam CF composing of 45,844 culms. Bamboo resources of O Rundas and O Sleng were accounted for 41,328 culms and 40,331 culms respectively. The moderate abundant bamboo areas were O Taprei and O Dong Leu of Krala Peas CF with respective account for 39,900 culms and 38,100 culms. The areas representing less bamboo resources were O Kokoh, Pralay Anlung Thmor and O Kub Phnov containing 22,060 culms, 18,345 culms, and 11,400 culms respectively. The following is a graph presenting bamboo resources by area of the two CF/villages.

Figure 7: Graph of culm density by ages of the two CF/villages



The followings are bamboo density by CF and/or village.

5.4.1 Kroam CF/village

The bamboo resource assessment within and outside Kroam CF was carried out in five areas covering 77.50 hectares, which made up of 78.8% of the total area of 98.3 hectares. The other areas not included in the inventory were small, and far which considered not potential for either harvest or management. Of the five resource assessment areas of 77.5 ha, 30.5 ha (39.4%) of O Dong Kroam, Anlong Thmor, and O Rundas were located within the CF, and 47 ha (60.6%) of O Dong Leu and O Khan Leurng were located within social land concession which have been allocated for future development in the village. The total of 30 sample plots or 3 hectares representing about 3.9% of the four areas were implemented. The result showed that bamboo resources were account for 4,512 clumps or 63,384 culms along O Khan Leurng, 2,890 clumps or 66,844 culms along O Dong Leu; 1,594 clumps or 45,844 culms along O Dong Kroam; 2,472 clumps or 41,328 culms along O Rundas, and 1,125 clumps or 18,345 culms along Pralay Anlung Thmor. The cut poles within the four areas were in the amount of 5,317 culms, which make up of 3% of all bamboo resources. With regard to quantity of culms by ages, there were 47,294 adult culms, 25,295 juvenile culms, 11,776 young culms which have just been developed from bamboo shoots early 2014, 4,948 cut culms and 16,150 old culms.

Table 5: Summary of bamboo resources in Kroam CF/village

Description		Outside CF		Within CF		
		O Dong Leu	O Khan Leurng	O Dong Kroam	O Rundas	Prolay Anlung Thmor
Bamboo areas (ha)		17	29.5	12.5	12	6
Plot number		5	12	4	5	4
Total clumps		2,890	4,512	1,594	2,472	1,125
Total culms		66,844	63,384	45,844	41,328	18,345
Bamboo shoots		0	0	0	0	0
Young culm (to 1 year)	Density (h^{-1})	726	357	500	258	405
	Total	12,342	10,536	6,250	3,096	2,430
	Percent	18	17	14	7	13

Juveniles (1-2 years)	**Density (h^{-1})**	1,404	491	778	1,048	500
	Total	23,868	14,472	9,719	12,576	3,000
	Percent	36	23	21	30	16
Adults (2-5 years)	**Density (h^{-1})**	1,254	1,057	1,360	1,674	1,710
	Total	21,318	31,176	17,000	20,088	10,260
	Percent	32	49	37	49	56
Old culms (5-6 years)	**Density (h^{-1})**	474	219	663	442	428
	Total	8,058	6,456	8,281	5,304	2,565
	Percent	12	10	18	13	14
Cut culms	**Density (h^{-1})**	74	25	368	22	15
	Total	1,258	744	4,594	264	90
	Percent	2	1	10	1	0

5.4.2 Krala Peas CF/village

The six bamboo areas where the assessment was conducted were composed of 65 ha (66.33 %) of the total area of 98 hectares. O Sleng and O Taprei cover an area of 15 ha each; followed by O Dong Leu, O Dong Kroam and O Kohoh, extending to area of 10 ha each, and finally O Kub Phnov covering an area of 5 ha. The total amount of 34 sample plots were laid out within the six areas, representing 5.2% of the five areas. The other areas not included in the resource assessment were small or located outside the CF. The result showed that the six areas had 11,890 clumps and 144,831 culms, of which included all bamboo ages and cut culms. Of total culms, 63,896 culms representing 44 % were adult; 36,685 culms or 21% were juvenile; 14,138 culms or 10% were young, 3,417 culms or 2% were cut, and 33,615 culms or 25% were old.

Table 6: Summary of bamboo resources in Krala Peas CF/village

Description		Outside CF	Within CF				
		O Dong Leu	O Dong Kroam	O Kokoh	O Sleng	O Kub Phnov	O Taprei
Bamboo areas (ha)		10	10	10	15	5	15
Plot number		5	5	5	8	3	8
Total clump		2,440	1,560	2,280	4,294	1,150	2,606
Total culm		38,100	31,140	22,060	40,331	11,400	39,900
Bamboo shoots		0	0	0	0	0	0
Young culm (to 1 year)	**Density (h^{-1})**	276	276	368	133	343	266
	Total	2,760	2,760	3,680	1,988	1,717	3,994
	Percent	7	9	17	5	15	10
Juveniles (1-2 years)	**Density (h^{-1})**	692	530	430	518	467	671
	Total	6,920	5,300	4,300	7,763	2,333	10,069
	Percent	18	17	19	19	20	25
Adults (2-4 years)	**Density (h^{-1})**	1,576	1,228	1,066	1,529	710	965
	Total	15,760	12,280	10,660	22,931	3,550	14,475
	Percent	41	39	48	57	31	36
Old culm (5-6 years)	**Density (h^{-1})**	1,252	1,046	336	503	757	565
	Total	12,520	10,460	3,360	7,538	3,783	8,475

	Percent	33	34	15	19	33	21
Cut culm	**Density (h^{-1})**	14	34	6	8	3	193
	Total	140	340	60	113	17	2,888
	Percent	0.4	1.1	0.3	0.3	0.1	7.2

5.5 Current harvest practice

As harvest practice being operated by collectors in Kratie, 1.5-4 meters above the ground were cut, leaving below section in clumps. When asked their existing harvest technique, their answers were not different from community in Kratie province as highlighted in the followings:

- Densely spiny-branch clumps on the ground, which is hard to access to its clump.
- It is easy to use a sickle equipped with long handle to cut bamboo poles from some distance of the clump.
- The cut culm is easy to be taken out because the upper section has less branches than the ground section.
- The upper part of the culm has thinner culm wall, and so light in weight. So, it is easy to carry.

The lower sections of the culms which are left in a clump form a denser clump, which may adversely affect the young growth of bamboo shoots. In addition, the young culms with weak wall is able to move just from 3-4 meters above the ground upwards which sometimes result in broken culms at the upper part.

5.6 Current market status

There has been lack of market of neither bamboo pole nor processed products in Kroam and Krala Peas villages. Bamboo has not been processed into any product, except fishing gear like fish traps for own use and utilized for small house and/or hut construction. Last two years, few members of Kroam CFMC were trained to process incent stick for sale, but they abandoned this occupation because of that income from incent stick processing (5000-6000 riel/day) was much less than their usual daily income of 15,000-20,000 riel that they could earn from doing other type of work. At present, bamboo slats have been utilized in Stung Treng city, and its main supply source is from Kratie province. Currently, there is no any bamboo shop in Stung Treng city. So, there can be an opportunity for community of these two villages to process bamboo slats for sale to Stung Treng city, but market of this product needs to be studied properly.

6. Discussion

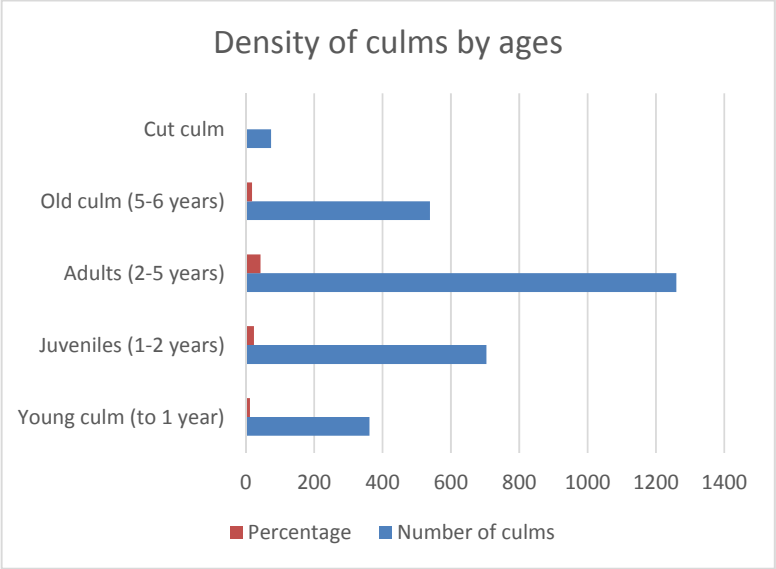
6.1 Size and use of Russey Roleak

Many botanists regard Russey Roleak as thick culm species due to very thick culm wall at the base. However, its culm wall is thinner than *Thysostachys* spp., but thicker than *Neohouzeaua* spp. (group of Russey Pok). Therefore, in this study it is classified as a medium thick culm wall species. Based on measurement, the sizes and thickness of culm wall of this species are highly variable from the base section close at the ground to the top – The base section from the ground to 2-3 meters has smaller diameter, thicker culm wall and shorter internodes; the middle section has larger diameter, medium thick culm wall and longer internodes, and the top section has smaller diameter than others, shorter internodes and thinner culm wall. Hence, the product processing made of culms can be dependent on sections of the culm. Usually, this species are highly potential for housing materials, kitchen utensils, fishing traps and nets, and core of incense sticks. If use of this species is intensified, products can be designed in line with three sections – base section with length of longer than 10 cm to below 30 cm can be produced meat skewers or bio char, middle sections with length longer than 30 cm long to around 40 cm long can be processed into incense stick or bamboo slat, and top section can be processed into handicraft product, other smaller products or souvenir.

6.2 Culm density

In average, a one hectare of bamboo area consists of 189 clumps, or 5,644 culms. Of the total account of culms, dead culms are composed of 2,706 individuals (48%), and the 1-6 year old and cut culms are in the amount of 2,938 individuals (52%). Of the 2,938 culms, there are 362 young culms (12.3%), 704 juvenile culms (24%), 1,260 adult culms (42.9%), 539 old culms (18.3%), and 74 cut culms (2.5%). The 2.5 percent of cut culms in this data analysis represents poles being collected in the last 2 to 5 years. So, if the cut culms are included in the adult ages, it will be accumulated to 1,333 individuals or 45.4 percent. Based on the result of this analysis, the bamboo poles should be able to be annually collected up to 490 individuals per hectare, but the current annual collection has been made to only 74 individuals or 2.5 percent. All bamboo culms that people collected were for household utilization purpose only. At present, there has been neither bamboo market access nor product processing in these two villages.

Figure 8: Comparison graph of culm density by ages



The 45% of dead culms remaining in a clump usually result in forest fire in the dry season, which provides immediate impact to bamboo clumps by burning young culms, and also affect nearby ecosystems. It is believed that if all harvestable culms are collected properly, it will help minimize hazard of forest fire in the dry season. In addition, good bamboo management practice will allow bamboo shoots to grow well and develop into high culm quality.

Table 7: Live and cut culms vs. dead culms

Village	Name of bamboo areas (ha)	Bamboo areas (ha)	Plot number	Total clumps	Total culms of each assessment area			Density of bamboo resources (# culm/ha)		
					Total culms	1-6 year old and cut culms	Dead culms	Total culms	1-6 year old culms	Dead stem
Krala Peas	O Dong Leu	10	5	2,440	60,860	38,100	22,760	6,086	3,810	2,276
	O Dong Kroam	10	5	1,560	43,320	31,140	12,180	4,332	3,114	1,218
	O Kokoh	10	5	2,280	40,240	22,060	18,180	4,024	2,206	1,818
	O Sleng	15	8	4,294	88,613	40,331	48,281	5,908	2,689	3,219
	O Kub Phnov	5	3	1,150	19,083	11,400	7,683	3,817	2,280	1,537

	O Taprei	15	8	2,606	64,181	39,900	24,281	4,279	2,660	1,619
Kroam	O Dong Leu	17.0	5	2,890	140,896	66,844	74,052	8,288	3,932	4,356
	O Khan Leurng	29.5	12	4,512	149,640	63,384	86,256	5,073	2,149	2,924
	O Dong Kroam	12.5	4	1,594	75,625	45,844	29,781	6,050	3,668	2,383
	O Rundas	12.5	5	2,472	85,920	41,328	44,592	6,874	3,306	3,567
	Prolay Anlung Thmor	6.0	4	1,125	35,850	18,345	17,505	5,975	3,058	2,918

6.3 Annual bamboo growth

Ecologically, individual culms die after six years if no collection is made, so the analysis of annual bamboo growth is made for culms with ages 1-6, and also included cut culms because it is still within 6 years. Whereas dead culms are excluded from the analysis because their ages are not known. The first year growth is defined as the accumulation of bamboo shoots and young culms which are developed from bamboo shoots in the last rainy season. The total account of culms per clump of an area is the sum of first year growth (bamboo shoots and young culms), juvenile culms, adult culms, old culms and cut culms. The average annual growth being produced per area is a division of the total culms of one area with six, and the average annual growth of culms per clump is a division of annual culm production with total clumps of an area. The annual growth of culms per clump is usually 2-3 culms per clump, except O Dong Leu and O Dong Kroam areas at Kroam CF with annual generation to 4-5 culms per clump. The average annual regeneration of culms per clump is 2.7 culms. The figure of annual growth rate of culms per clump is low, perhaps because of lack of maintenance. In addition, new shoots may grow from the rhizome of one year old culm. The low regeneration rate also may be because of the effect of many factors like too dense clump, bamboo shoots eaten by animals or collected by people, death of bamboo shoots due to unsuitable condition. It might be that young rhizome will be healthy if more bamboo shoots are taken care, and so more new culms will be regenerated. Since that bamboo is a clumpy species with new culms every year, annual culm harvest of a clump would not be negatively affected to the regeneration if well managed. So far, there has not been studied on either the regeneration of new shoots from the rhizome of harvested bamboo shoots or second year or older culms. In accordance to this study, it is likely that the new shoots could be regenerated from the rhizome of one year old culm only. Based on another observation, the annual growth of new culms are in two forms – in continuous line from year one to the following year, and in circle. This growth form may be mainly because of the soil factor.

Table 8: Volume of annual growth of Russey Roleak in the two CF/villages

Village	Bamboo areas (ha)	Bamboo areas (ha)	Total clump	Total culms	Annual growth per area	Average rate of annual growth per clump
Krala Peas	O Dong Leu	10	2,440	38,100	6,350	3
	O Dong Kroam	10	1,560	31,140	5,190	3
	O Kokoh	10	2,280	22,060	3,677	2
	O Sleng	15	4,294	40,331	6,722	2
	O Kub Phnov	5	1,150	11,400	1,900	2
	O Taprei	15	2,606	39,900	6,650	3
Kroam	O Dong Leu	17	2,890	66,844	11,141	4
	O Khan Leurng	29.50	4,512	63,384	10,564	2
	O Dong Kroam	12.50	1,594	45,844	7,641	5
	O Rundas	12	2,472	41,328	6,888	3

	Prolay Anlung Thmor	6	1,125	18,345	3,058	3

6.4 Volume of annual harvest

The bamboo extraction is carried out in accordance to the type of uses. Old culms are difficult to be used for product development, especially for bending because of old and crisp lignin, except used as supportive materials and fence bar. For flooring, furniture and incense stick, 2-5 year culms are most suitable, whereas handicraft products, 1-2 year old culms can be used as lignin is still flexible. Based on the data analysis, the first year collection of 2-5 year old culms can be made up to its maximum level of 179,842 individuals, and culm collection of the following years is based on the annual growth rate. The current average annual growth rate is 2.7 culms per clump (See table 14). So, the average culm regeneration of 26,923 clumps across the two CF/villages is 72,950 culms. However, the current average annual cut culms within the two CFs are only 8,364 (2%) culms of the 418,676 culms of all ages.

Table 9: Harvest volume of culms in the third and following years

Village	Name of areas (ha)	Size of areas (ha)	Clumps	Annual harvest volume		
				Young culms (to 1 year)	Juveniles (1-2 years)	Adults (2-5 years)
Krala Peas	O Dong Leu	10	2,440	2,760	6,920	15,760
	O Dong Kroam	10	1,560	2,760	5,300	12,280
	O Kokoh	10	2,280	3,680	4,300	10,660
	O Sleng	15	4,294	1,988	7,763	22,931
	O Kub Phnov	5	1,150	1,717	2,333	3,550
	O Taprei	15	2,606	3,994	10,069	14,475
	Total	65	14,330	16,898	36,685	79,656
Kroam	O Dong Leu	17.0	2,890	12,342	23,868	21,318
	O Khan Leurng	29.5	4,512	10,536	14,472	31,176
	O Dong Kroam	12.5	1,594	6,250	9,719	17,000
	O Rundas	12.5	2,472	3,096	12,576	20,088
	Prolay Anlung Thmor	6.0	1,125	2,430	3,000	10,260
	Total	78	12,593	34,654	63,635	99,842
Total		**142.50**	**26,923**	**51,552**	**100,319**	**179,498**

6.5 Culm utilization

The sizes of culms are greatly variable from smaller than 5 cm diameter to bigger than 9 cm diameter. The team observed culm sizes and noted that culms with diameter 7 cm upwards were only 35 percent, whereas culm sizes with diameter smaller than 7 cm were 65 percent. Currently, there is lack of market of bamboo poles in the two villages. Just assumed that if market of bamboo poles is available, and only 7 cm diameter is required as in Kratie province, so a huge number of culms would be left in the clumps. Therefore, bamboo-made products need to be established and diversified in order to maximize the use of bamboo resources in the areas. In average, the lower section at 2.6 m above the ground has a variable internodes between 17 cm and 29 cm long, and the internodes of the middle section of 8.9 m long are variable from 31 to 44 cm long. So, products can be designed in according to different sizes of bamboo culms.

7. Recommendations

- Based on resource assessment, only Russey Roleak (*B. bambos*) can be commercialized in large scale, whereas other species are rare which cannot be considered potential for market. So, bamboo in here is referred to Russey Roleak only.

- The bamboo-derived products and their markets should be promoted in order to enhance either forest ecosystem-based livelihood or sustainable CF management. The promise products made of this species should be bamboo slat, meat skewer, incense stick and chop stick. In order to accomplish this goal, vocational training to community is needed.

- Bamboo-made furniture products like sofa, chair, bed, etc. in the two villages should be studied if there is demand for this product. Additional technique like bamboo treatment should be considered so as for enhancing product quality.

- Bamboo-made bio char product using bamboo residual waste and dead culms should be invented. However, cost of a kiln construction is high (US$ 1500-2000). In addition, market of bio char should be developed even though it takes time.

- Unlike Kratie town, Stung Treng town has no depot to sell poles, bamboo slat and/or other wood materials. So, it would be worth to initiate this type of market in the town in order to sell this type of product.

- If there is bamboo market demand in the forms of raw pole or products, there will be more pressure on bamboo harvest, and so will result in negative impact on bamboo resources. In coping with this possible problem, bamboo dependent households should be trained to harvest bamboo culms and manage bamboo forest in sustainable manner. For instance, silviculture practice like thinning bamboo clumps, removal of unhealthy clumps, old and dead culms in order to improve the regeneration. Bambusa company and WWF's SFB programme in the Eastern Plain Landscape have trialed bamboo silviculture technique in Sre Huy CPF, Mondulkiri province. This trial, if success, can also be applied within these community areas using resource person from Sre Huy CPF. Alternatively, community resource person, chief of O Krasang CF, can be a resource person to train on the prevention of bamboo forest from forest fire.

- Bamboo culms with ages between 2 and 5 years old are good for all types of products. Hence, the culm collection should be targeted to these ages.

- Cutting culms should be operated at the base in order to make space in a clump for healthy bamboo shoots and culms. If branches on the ground are cleaned in year one, it would not take much labor to clean in subsequent years. Currently, culms are cut at 3 meters above the ground because people want to avoid the thick spiny branches on the ground. This will keep the bamboo clumps becoming denser at the base and prevent bamboo from generating new shoots, and bamboo shoots will not develop into good quality culms.

- Collecting culms operated at the onset of rainy season, especially between May and July may impact bamboo shoots. So, it would be better to harvest culms from August to May to minimize the impact.

- Potential bamboo forests that fall outside the CF should be preserved for public use under the commune or village land use planning. Commune council and villages chiefs are the key actors in this planning.

Acknowledgement

We are very grateful thanks and extend our deep appreciation for valuable financial support by USAID through the project “Cambodia Supporting Forests and Biodiversity (SFB)”.

Special thanks are due to chiefs of Kroam and Krala Peas Community Forestry (CF), and members of the two CF for their contribution in information gathering. Additional thanks are giving to deputy chief of commune council for his collaboration during the data collection process. This bamboo resource assessment report would not be completed well without contribution, supervision and good feedback from Winrock International, especially Ms. Elisabeth Gish, Mr. Preap Prathna, Mr. Oeurn Sophath, Mr. Ouk Sisovann and Mr. Curtis Hundley, and , Amalia R. Maling of WWF- Cambodia..

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Annexes

A: Datasheet for Field Record of Bamboo Density

Date:……., Group members:……..…… Recorder:……..
Village:…….. Commune:……...…… District:……..……
Province:……..……...
Area name/feature:…….…… Block no:…… Plot no:……., sheet no:……..
Forest type:…….. UTM:……..…..….. Elevation:……
Distance from village: Disturbance:…….. Plot size:……

Clump no	Bamboo species	Clump cir (m)	bamboo shoots	Young culm (to 1 year)	Juveniles (1-2 years)	Adults (2-5 years)	Old culm (5-6 years)	Dead culm	Cut culm	Additional note
1										
2										
3										
4										
5										

B: Identification of culm ages

Field data	Explanation
bamboo shoots	New shoot grown from bud of the rhizome.
Young culm (to 1 year)	Culms with absence or less branches, thick white cuticle on both culm and branches, present of culm sheath at base, green culm sheet and light green culm.
Juveniles (1-2 years)	Stems with thick branches, thick white cuticle and dark green color, almost absence of culm sheath.
Adults (2-5 years)	Less dark grey cuticle culm, light green with patches of lichen culm, decay or falling out of some culm sheaths at lower sections.
Old culm (5-6 years)	Absence of cuticle culm; brownish green culm; absence of culm sheath almost the whole stem, half death at the above section, and remain green at the lower section.
Cut culm	Culms cut for uses.
Dead culm	Grey stem,
Additional note	Provide special information to this bamboo clump if any.

C: Datasheet to record culm size

Bamboo species: ……..

Recorder..... Area: ……..…… Date……

No	Length of section 1(Length of internodes shorter than 30 cm)								Length of section 2(Length of internodes longer than 30 cm)											Total node intervals	Total length of culm
	Cir (cm)		Length of node interval (cm)		Culm thickness (mm)		Number of node intervals	Length of section1(m)	Cir (cm)			Length of node interval (cm)			Culm thickness (mm)			Number of node intervals	Length of section1(m)		
	Base	End	Base	End	Base	End			Base	Middle	End	Base	Middle	End	Base	Middle	End				

D. Bamboo areas, size in hectare and abundance

RR: Russey Roleak, RTM: Russey Tronung Moan; RK: Russey Khley

Villages	Name of areas	Size of bamboo area (ha)	Habitat	Name of bamboo species	Abundance	Distance from village (km)	Potential area for harvest	Location		Accessibility	
								Inside CF	Outside CF	Rainy season	Dry season
Kroam	O Dong Kroam	12.5	BF	RR	3	5 km	3	12.5	0.0	Tiller	Boat
	Anlong Thmor	6	BF + DF	RR	2	5 km	1	6.0	0.0	Tiller	Boat
	O Rundas	12	BF	RR	2	7 km	3	12.0	0.0	Motorbike	Boat
	O Khan Leurng (branch od O Dong)	30.0	BF	RR	2	10 km	3	0.0	30.0	Motorbike	Boat
	Dai Pralay	0.8	BF + DF	RR	2	5 km	2	0.8	0.0	Tiller	Boat
	O Dong Leu	17	BF	RR	3	5 km	3	0.0	17.0	Motorbike	Boat
	O Tadeurn	4	BF	RR	1	9 km	1	4.0	0.0	Motorbike	Boat
	O Russey Kroam	4	BF	RR	2	10 km	3	4.0	0.0	Motorbike	Boat
	O Russey Leu	12	BF	RR	2	10 km	3	0.0	12.0	Motorbike	Boat
Krala Peas	O Dong	20	DF	RR, RTM	3	6 km	3	10	10	Walk, Tiller, Oxcart	Boat, walk
	O Taprei	15	DF	RR	3	3 km	2	15	0	Tiller, walk, cart	walk, motorbike
	O Kub Pnov	5	DF	RR	2	5 km	3	5	0	Tiller, motorbike	Boat, walk
	O Sleng	15	DF	RR	3	4 km	3	15	0	Tiller, cart	Boat, walk
	O Kokoh	10	DF	RR, RK	2	3.5 km	2	10	0	Tiller, walk, cart	walk
	Pean Lok	1.5	DF	RR	2	3 km	2	1.5	0	Tiller	Walk
	Pralay Rumsae	0.5	DF	RR	1	3.5 km	1	0.5	0	Walk, boat	Boat
	Kbal O Taprey	6	BF	RR	1	2.5 km	1	0	6	Tiller, walk	Walk
	Kbal O Dong	25	BF	RR	2	6 km??	3	0	25	Walk, Tiller	Boat, walk

E. Size of Russey Roleak

No	Length of section 1(Length of internodes shorter than 30 cm)								Length of section 2(Length of internodes longer than 30 cm)											Total node intervals	Total length of bamboo culm
	Cir (cm)		Length of node interval (cm)		Culm thickness (mm)		Number of node intervals	Length of section1(m)	Cir (cm)			Length of node interval (cm)			Culm thickness (mm)			Number of node intervals	Length of section1(m)		
	Base	End	Base	End	Base	End			Base	Middle	End	Base	Middle	End	Base	Middle	End				
1	26.0	23.0	12.0	12.0	3.4	3.0	2.0	1.2	23.0	21.0	11.0	12.0	32.0	33.0	3.0	6.0	4.0	37.0	8.4	39.0	11.1
2	20.0	20.0	10.0	12.0	3.0	2.6	3.0	2.7	20.0	24.0	14.0	12.0	39.0	31.0	2.6	1.0	3.0	40.0	8.3	43.0	13.8
3	24.0	23.0	13.0	14.0	3.0	2.8	2.0	2.5	23.0	27.0	12.0	14.0	37.0	32.0	2.8	1.5	1.0	40.0	4.8	42.0	13.7
4	20.0	22	26	29	10	10	4	1.2	23	23.5	14.5	32	44	31	10	7	5	31	12.5	35.0	13.7
5	21.5	21.5	18.0	28.0	20.8	17.0	10.0	2.2	21.5	24.5	13.5	31.0	36.5	31.0	10.5	8.0	4.0	31.0	19.6	41.0	21.8
6	15.0	19.0	18.0	28.0	20.8	17.0	10.0	2.5	19.0	19.0	10.0	29.0	7.5	31.0	9.0	9.0	4.0	21.0	5.4	31.0	7.9
7	27.0	33.0	19.0	29.0	20.8	12.0	18.0	4.7	33.0	29.0	15.0	31.0	38.0	32.0	11.0	8.0	6.0	29.0	9.8	47.0	14.5
8	15.0	18.0	17.0	29.0	20.0	11.0	10.0	2.4	19.0	19.5	13.0	30.0	33.0	31.0	11.0	6.0	6.0	20.0	6.5	30.0	8.9

F. List of participants

No	Name of participant	Sex					Address			
		M	F	Position	Institution	Ethnic	Village	Commune	District	Province
1	Choam Nhep	1		CFMC member	Krala Peas	Khmer	Krala Peas	Preah Rumke	Thalaborevat	Stung Treng
2	Suy Yuong	1		CFMC member	Kroam	Khmer	Kroam	Preah Rumke	Thalaborevat	Stung Treng
3	Chorn Makara	1		CFMC member	Kroam	Khmer	Kroam	Preah Rumke	Thalaborevat	Stung Treng
4	Hait Hong	1		CFMC member	Krala Peas	Khmer	Krala Peas	Preah Rumke	Thalaborevat	Stung Treng
5	Som Sang	1		CFMC member	Kroam	Khmer	Kroam	Preah Rumke	Thalaborevat	Stung Treng
6	Kham Phan	1		Deputy village chief	Krala Peas	Khmer	Krala Peas	Preah Rumke	Thalaborevat	Stung Treng
7	Huon Morn	1		Deputy village chief	Kroam	Khmer	Kroam	Preah Rumke	Thalaborevat	Stung Treng
8	Khon/Sok	1		CFMC member	Kroam	Khmer	Kroam	Preah Rumke	Thalaborevat	Stung Treng
9	Sek Sophal	1		CFMC chief	Kroam	Khmer	Kroam	Preah Rumke	Thalaborevat	Stung Treng
10	Vain Samphay		1	CFMC member	Kroam	Khmer	Kroam	Preah Rumke	Thalaborevat	Stung Treng
11	Phem Leur		1	CFMC member	Krala Peas	Khmer	Krala Peas	Preah Rumke	Thalaborevat	Stung Treng
12	Sen Kaing	1		CFMC member	Krala Peas	Khmer	Krala Peas	Preah Rumke	Thalaborevat	Stung Treng
13	Nhem Pov	1		CFMC chief	Krala Peas	Khmer	Krala Peas	Preah Rumke	Thalaborevat	Stung Treng
14	Da Samith		1	CFMC member	Krala Peas	Khmer	Krala Peas	Preah Rumke	Thalaborevat	Stung Treng
15	Thorn Mom		1	CFMC member	Kroam	Khmer	Kroam	Preah Rumke	Thalaborevat	Stung Treng
16	Saiy Ratha	1		CFMC member	Kroam	Khmer	Kroam	Preah Rumke	Thalaborevat	Stung Treng
17	Ken Piseth	1		Trainer member	Phnom Penh	Khmer				Phnom Penh
18	Neak Phearom	1		Trainer member	Phnom Penh	Khmer				Phnom Penh