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**Participatory Assessment of Bamboo Resources in Kampong Kboeung, Koh Ent Chey, Kampong Damrey and O Krasang Villages, Boeung Char Commune, Sambo District, Kratie Province**



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## Acronyms

The following list of acronyms aim to guide to the bamboo resource assessment being carried out in the four villages of Kampong Kboeung, Koh Ent Chey, Kampong Damrey and O Krasang, Boeng Char commune, Sambo district, Kratie province.

BF	Bamboo Forest
CF	Community Forestry
CFi	Community Fisheries
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
RV	Riparian Vegetation
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 conducted in four villages of Kampong Kboeung, Koh Ent Chey, Kampong Damrey and O Krasang, Boeung Char commune, Sambo district, Kratie province on 24-31 December, 2014. 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 the project “Cambodia Supporting Forests and Biodiversity, in Prey Land Landscape (PLL) and Eastern Plain Landscape (EPL).

The resource assessment was first started with 2 day class 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 33 community participants (23 men and 10 women) were engaged in the field data collection. Two forms of datasheet were developed – one for recording bamboo density and another for bamboo size. Seven bamboo species were reported by villagers, of which four species were indigenous, and other three species were domestic. In terms of morphological character and culm size, the two local name species – Russey Roleak and Russey Prey were combined to only one species called Russey Roleak (*Bambusa bambos*). *Bambusa Bambos* was regarded as a potential species in terms of its abundance, utilization and market values. The bamboo resource assessment was conducted at 11 areas located in the four villages of Kampong Kboeung, Koh Ent Chey, Kampong Damrey and O Krasang. Sample plots were 50 m by 20 m (1000 m<sup>2</sup> or 0.1 m ha), laid out along the streams.

The four villages were account for 138.7 hectares, of which 38.2 ha located in Kampong Kboeung, 26.5 ha located in Koh Ent Chey, 27 ha located in Kampong Damrey and 47 ha located in O Krasang village. A total of 78 sample plots in equivalent to 7.8 hectares were conducted in the four villages, of which 19 plots laid out in Kampong Kboeung village, 14 plots laid out in Koh Ent Chey village, 15 plots laid out in Kampong Damrey village and 30 plots laid out in O Krasang village. Russey Roleak are potential for a variety of products ranging from household utensils to valuable products like paper, pulp and ply wood. However, there was no bamboo processing in the village, except cut for sale in raw poles. The following table shows population of Russey Roleak in the four villages.

Villages	Name of Bamboo areas	Size of Bamboo area (ha)	Total		Density (h <sup>-1</sup> )	
			Clump	Culm	Clump	Culm
Kampong Kboeung	O Svay	34	6,277	109,342	185	3,216
	O Don Orn	4.2	630	22,260	150	5,300
	<b>Total</b>	<b>38.2</b>	<b>6,907</b>	<b>131,602</b>	<b>167</b>	<b>4,258</b>
Koh Ent Chey	O Samroang	12	2,260	51,580	188	4,298
	O Russey	7	2,260	19,093	323	2,728
	O Tunlea Toch	7.5	1,350	29,888	180	3,985
	<b>Total</b>	<b>26.5</b>	<b>5,870</b>	<b>100,560</b>	<b>230</b>	<b>3,670</b>
Kampong Damrey	O Khlem	18	4,488	45,240	249	2,513
	O Tasok	9	2,475	24,488	275	2,721
	<b>Total</b>	<b>27</b>	<b>6,963</b>	<b>69,728</b>	<b>262</b>	<b>2,617</b>
O Krasang	O Chheuteal	18	5,256	96,714	292	5,373

	O Romaing	9	2,520	54,072	280	6,008
	O Taros	15	3,818	61,623	255	4,108
	O Krasang	5	1,440	26,075	288	5,215
	<b>Total</b>	<b>47</b>	<b>13,034</b>	<b>59,621</b>	<b>279</b>	<b>5,176</b>
<b>Total/Average density</b>		<b>138.7</b>	<b>32,774</b>	<b>361,511</b>	<b>235</b>	<b>3,930</b>

The data analysis also include cut culms as they are within the culms with ages 2 to 5 years old. Hence, the study showed that there were 4,258 culms/ha in Kampong Kboeurng village, 3,670 culms/ha in Koh Ent Chey village, 2,617 culms/ha Kampong Damrey village and 5,176 culms/ha in O Krasang village. Of the four villages, the current average harvest is carried out only 21% of the harvestable culms. Bamboo culms in O Krasang village were harvested to 28.8%, followed by Koh Ent Chey village with 22.9%, Kampong Kboeung village to 13%, and Kampong Damrey village to 5.7%. The limited harvest of culm for sale is because of two main factors including selective cut of larger diameter culms (7 cm dia. upwards) and lack of market access of bamboo poles to the villages.

Since that bamboo is the clumpy species, which new regeneration is made from rhizome every year, so 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 177,780 culms in the four villages, and the following years can be implemented on a basis of its annual growth as presented in the above table.

In average, based on analysis of culms by ages of a clump within 6 years, each bamboo clump is able to produce 1 to 6 culms annually, and in general 3 culms. So, the annual culm regeneration of the entire study area is 90,062 culms. Hence, the annual allowable harvest of this second stage of following year can be projected using this annual regeneration rate. If care of bamboo is sufficiently undertaken, the level of harvest can be higher than the current projection.

Culms should be cut at ground level to allow health growth of bamboo shoots and culms. The best time to harvest the culms is in November through April to avoid destroying the bamboo shoots and young culms. However, it would not workable in this area because it is related to transport by a raft along Mekong River. Therefore, culms may can be harvested in August through April.

Due to that most of bamboo areas are located outside the CF but within social concession land, it will be subject to land clearance or conversion to other land uses in future. In order to secure these bamboo areas, all concern stakeholders, and especially local authority and community should demarcate these areas for sustainable uses of bamboo resources, prevention of stream bank erosion, and stabilizing ecosyculm. At the same time, bamboo market should be established and diversified so as to add value to bamboo and for the sake of local economic development.

## 1. Introduction

The Prey Lang Landscape (PLL) consists of bamboo population inhabiting along the Mekong River and its main and small estuaries running through deciduous forest. The medium culm thickness species of *Bambusa bambos* (Russey Roleak) is more abundant and commonly harvested for household utilization and sale. In terms of its density, culm quality and market demand, it is considered potential product in the landscape, but currently of limited commercial value to the local communities, aside from making fishing equipment, building houses and fences. Because of lack of market access to the community, some portions of bamboo forest located along stream banks are being cleared and replaced by agricultural crops such as rice, corn, vegetables and others. Clearance of bamboo forest area has resulted in soil erosion and ecosystem degradation. If well managed bamboo forest area, it will provide two aspects of benefits – prevention of soil erosion along stream banks and sloping areas, and contribution to local livelihood development.

The Supporting Forests and Biodiversity Project's (SFB's) goal of a joint initiative of 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 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 through value addition to bamboo products and access to markets and if managed properly, it will not only enhance livelihood 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. 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 four villages – Kampong Kboeung, Koh Ent Chey, Kampong Damrey and O Krasang;
- 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 process as follows:

- Bamboo resource assessment training: two day training was held in Kampong Damrey, Boeung Char commune, the centre of other villages. Due to that the initial plan was to conduct bamboo resource assessment in Koh Ent Chey, Kampong Damrey and Angkor Ent, 5 CF members from each of these villages were invited, and 2 CF members each from O Krasang and Kampong Kboeung villages were also invited to the training. Local authority including chief of Boeung Char commune, commune police chief and chiefs of the five villages were also invited. 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 of 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 clumps growing along the stream bank. On a basis of group discussion on bamboo areas, the team decided to drop out Ankor Ent village due to death of bamboo, and replaced by other two villages including Kampong Kboeung and O Krasang villages. So, the bamboo resource assessment was planned to conduct in four villages – Kampong Kboeung, Koh Ent Chey, Kampong Damrey and O Krasang.
- Five percent of sample size of the entire bamboo areas was delimited, and sample plots of 50 m x 20 m (1,000m<sup>2</sup> or 0.1 ha) were applied to ensure the full coverage of bamboo clumps. Since bamboo clumps were 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.
- Small plots of 1 m<sup>2</sup> were set at the bamboo seedlings area in order to count seedlings per square meter.
- The plot interval was calculated by two means – 1) divide length of the stream by number of plots if plots are laid out just a long one side of the stream, and 2) divide length of the stream by total plots, and multiply by two if two plots are laid out in opposite sides of the stream banks. So, the length of plot interval is variable dependence on size of bamboo forest on both sides of the stream.
- 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 (2-5 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

There were 25 people, composed of

- Chief of Boeung Char commune council;
- Chief of commune police;
- Five chiefs/deputy chiefs of the five villages;
- Six representative of Koh Ent Chey CF;
- Six representative of Kampong Damrey CF;
- CF chief of Angkor Ent;
- CF chief of O Krasaing, and
- CF deputy chief of Kampong Kboeung.

#### 3.2 Inventory team composition

The bamboo resource assessment was conducted simultaneously in the four villages, and three groups were split into three villages. Kampong Damrey, the last bamboo resource assessment village, was conducted by two groups and led by Phearom and Piseth. A total of 33 community participants took part in the bamboo resource assessment, of whom 10 women making up to 30% participated the data collection.

Village	Inventory team				Total
	Community participant		Police	Leader	
	Male	Female			
Kampong Kboeung	2	7	1	1	11
Koh Ent Chey	4	3	0	1	8
Kampong Damrey	4	6	1	2	13
O Krasang	1	6	1	1	9

The followings highlight resource assessment teams by village.

- Kampong Kboeung: The team was composed of 11 people, including 9 CF members, one police and led by Mr. Ken Piseth. The 9 community participants were composed of 7 men and 2 women representing 22%.
- Koh Ent Chey: The team consisted of 7 CF members and led by Mr. Neak Phearom. Three out of the 7 CF members were women, which made up of 43% of the community participants.
- Kampong Damrey: There were 10 community participants, one police and two trainers. In order for effectiveness in data collection in the field, two teams were split - one team consisted of 6 community participants (4 men, 2 women) and led by Mr. Ken Piseth, and another team was composed of 5 community members (3 men, 2 women) and led by Mr. Neak Phearom.
- O Krasang: The team was composed of 7 community participants (6 men, 1 woman), one police and led by Khou Eang Hourt. There were some changes of the members during the resource assessment.

### 4. Study areas

This year, 645.3 hectares or 78.5 percent of bamboo population in the five villages died because of flowering/fruited. Ecologically, bamboo dies following flowering and fruited, and then a mass of seedlings start to regenerate reproductively. So, only 6.7 percent of the total bamboo areas of the 691.3 hectares are not dead. Moreover, most of bamboo areas reported by community participants are less than four hectares which is not much worth for

the management. So, the inventory was implemented only at areas of about 5 hectares upwards. The following is a table showing bamboo areas, their size and number of inventory plots.

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

Village	Name of area	Bamboo areas (ha)	Plot number
Kampong Damrey	O Khlem	18	10
	O Tasok	9	5
Kampong Kboeung	O Svay	34	13
	O Don Orn	4.2	6
Koh Ent Chey	O Samroang	12	6
	O Russey	7	4
	O Tunlea Toch	7.5	4
O Krasang	O Chheuteal	18	10
	O Romaing	9	5
	O Taros	15	11
	O Krasang	5	4

## 5. Results

### 5.1 Bamboo species diversity

In accordance to information shared by local community through group discussion, there are totally seven bamboo species in the five villages, of which four species are indigenous and three are domestic. However, Russey Prey in here is included into Russey Roleak because the morphological character of these two local names cannot be differentiated in terms of clump size, culm size, internodes and culm sheath. So, it is reduced to six species as presented in the following table.

**Table 2: Bamboo species diversity in the five villages**

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

Local name	Origin	Culm wall thickness	Botanical name	Abundance				
				Angkor Ent	O Krasang	Kampong Kboeung	Koh Ent Chey	Kampong Damrey
Ping Pong	Domestic	Thick	<i>Thyrsostachys siamensis</i>	1	0	0	0	0
Tronong Moin	Wild	Thick	<i>Thyrsostachis oliveri</i>	0	1	1	0	1
Russey Srok	Domestic	Medium thick	<i>Bambusa blumeana</i>	2	2	2	2	2
Russey Roleak	Wild	Medium thick	<i>Bambusa bambos</i>	3 (died)	3	3	3	3
Russey Khley	Wild	Thick	<i>Gigantochloa albociliata</i>	2	2	2	2	2
Russey Pok	Domestic	Thin	<i>Neohouzeaua mekongensis</i>	1	0	0	1	0

Russey Srok (*B. plumeana*) was not included in the resource assessment due to that this species is cultivated at homestead or farmlands by households, and so does not need collective management effort. Regarding utilization, this species is used for the same purpose as Russey Roleak. However, culms of Russey Srok seems to have better quality in terms of longer internodes, less spiny branches and larger culm size. Many participants including commune council and community members expressed their interest in planting Russey Srok, and requested to the team to share bamboo propagation technique, and provide future support in planting Russey Srok on their communal land. It is worth noted that a culm of Russey Srok is 8,000 riel or about US\$ 2. There is also community resource person who has experiences in propagating and planting Russey Srok on his private land. Russey Srok is identical to Russey Roleak, but has bigger culm, longer internode and less spiny branches on the ground.

Population of Russey Khley was reported to be as common as Russey Roleak, but it was seldom come across at the sample plots. This small culm species has short zigzag internodes, and so not much preferred to use for any product development beside used for supporter of the black pepper plantation or fen bar. The price of its culm at a depot in Kratie is 600 riel per pole. So, if a market of its poles exists in the province, it will still not be possible for community to collect for sale.

## **5.2 Bamboo Taxonomy and Ecology**

Community participants reported four wild bamboo species including Russey Khley (*Gigantochloa albociliata*), Russey Tronung Moin (*Thyrsostachys oliveri*), Russey Roleak (*Bambusa bambos*) and Russey Prey (*Bambusa* sp.). However, Russey Roleak and Russey Prey cannot be well distinguished and are included in one species by taxonomists. These 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 the two species of Russey Roleak and Russey Tronung Moin represented a very low number (less than 0.1 percent of Russey Roleak) in the study areas of the four villages, so these two species are not included in this report.

Russey Roleak mainly confines only along the stream bank, and occurs in small patches along the Mekong Rivers. Streams which are estuaries of the Mekong River are seasonal and usually shorter than 2 km. Bamboo population are more abundant and larger poles at the low lying area, interface between two streams and at a distance of some 250 meters to the Mekong River with a rich and moist soil. The stream bank with deep slope, bamboo culm is smaller and less abundant and usually grow in rows along the bank. Another observation noted that bamboo along the streams that is far from the Mekong River have small clumps and poles (pole diameter less than 6 cm), and so do 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 of bamboo becomes old and die after 6 years, and the whole clumps may produce flowers and fruits in 60 years and die afterwards. Citing, blooming of flowering and fruiting of Russey Roleak at the study area. As a result, bamboo creates a large biomass which easily causes to massive forest fire during the dry season. 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 along O Chheuteal, Rongeaav Island, O Krasang 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 cm to over 5 m diameter dependence on soil and moisture. The clump forms thickest at the ground to around 3 meters due to densely spin-like 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 internodes, 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. It is also used as scaffolding for high building construction.

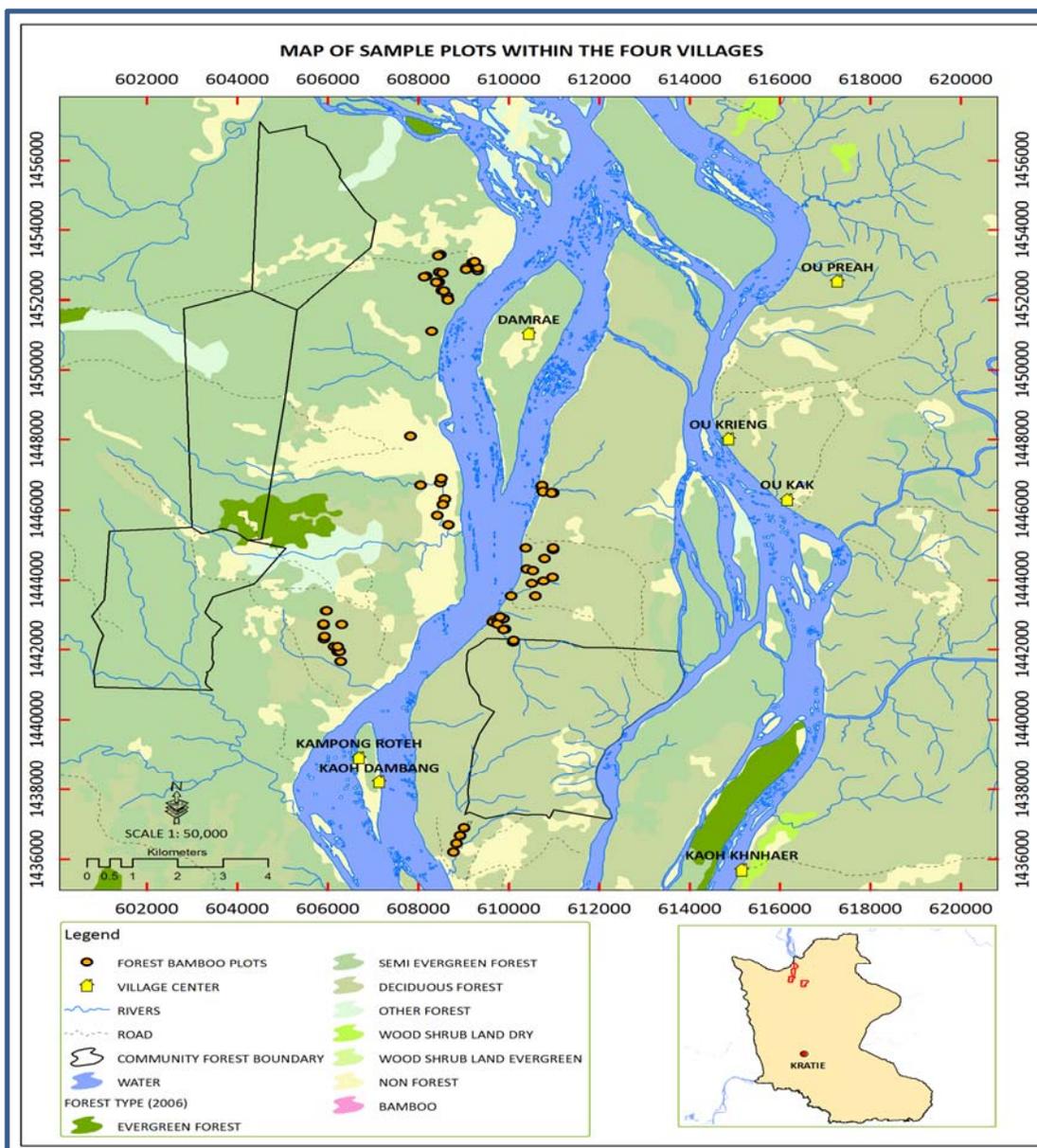


### 5.3 Location of bamboo resources

The population of Russey Roleak grows along the streams or called “O” in Khmer language, and low lying areas on mainland in Khmer called “Dei Treuy” and islands in Khmer called “Dei Koh”. Certain smaller streams are branches of the main streams, and so 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. However, bamboo growing in patches along the edge of island was directly given by estimating the size in hectare. Bamboo abundance was also qualitatively assessed to provide an overall view of the population. There were 56 bamboo areas covering total areas of 691.3 hectares across the five villages, of which 55 areas (645.3 hectares or 93.3 percent) fall outside the CF, and 46.1 hectares in equivalent to 6.7 percent are within O Krasang CF. Angkor Ent was not included in the inventory plan because bamboo areas cover only 17.1 hectares and 82 percent of the bamboo population died. 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: Locations of bamboo resources within the four villages**



The following are bamboo locations of the four villages:

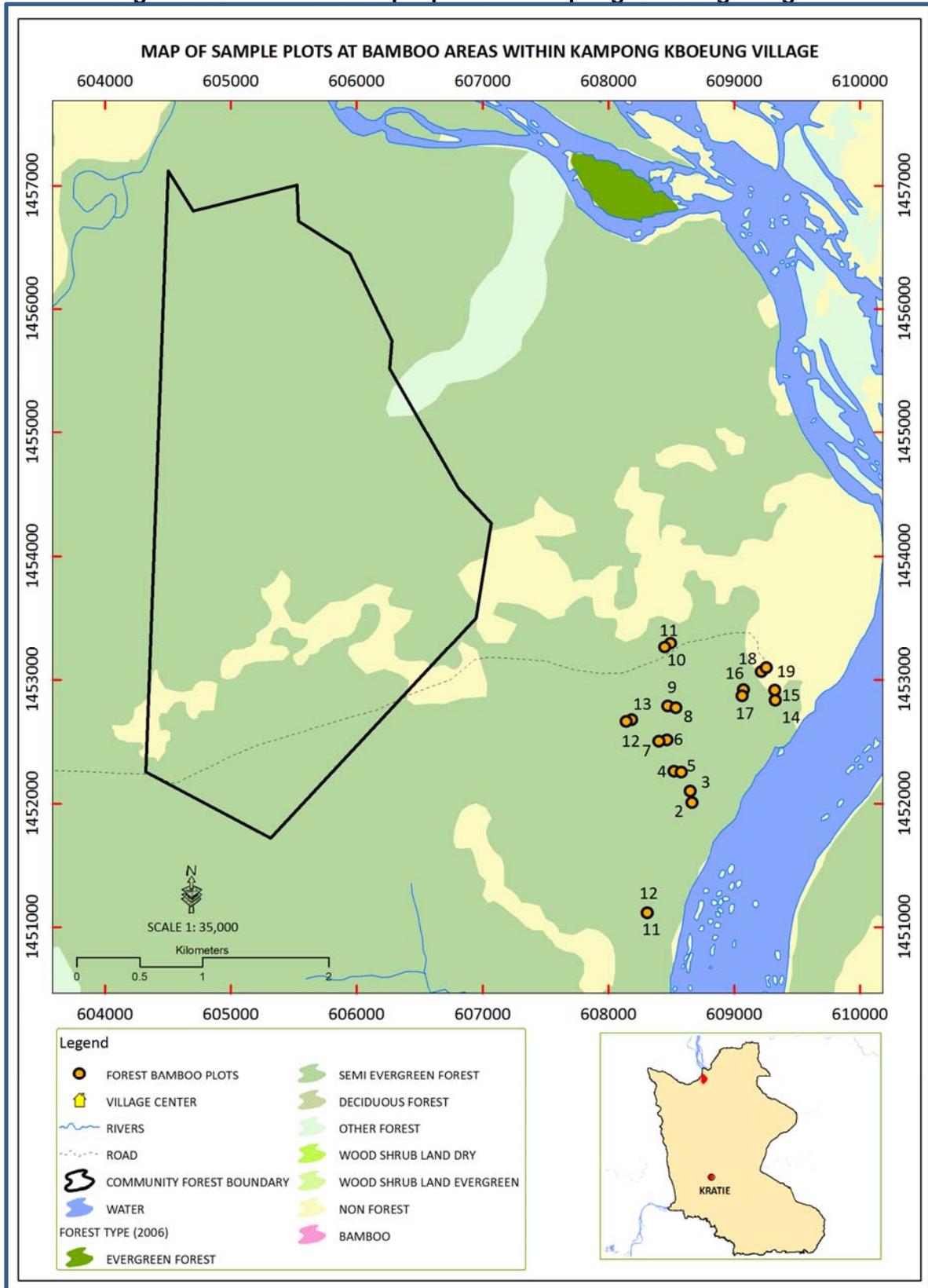
- **Kampong Kboeung village**

Based on group discussion, bamboo areas were reported to be present in 12 areas, of which 4 areas are located along the mainland's streams outside the Community Forestry (CF), but within the social economic land, and other 8 areas are located on the 8 islands of the Mekong River. These island are parts of the management zone of Kampong Kboeung Community Fisheries (CFi). The following table shows the bamboo areas and other associated information.

**Table 3: Forest type and bamboo abundance in Kampong Kboeung village**

Name of area	Size of area in hectare			Forest type	Inside CF	Outside CF	Abundance	Distance from village (m)	Potential area for harvest	Not die (%)	Fruit-died (%)
	Length of stream (m)	Distance of bamboo clump from stream bank (m)	Size of bamboo area (ha)								
O Svay	2000	170	34	RV	0	34.00	2	60	3	80	20
O Don Orn	70	60	0.42	RV	0	0.42	2	30	1	100	0
O Yeay Thuch	200	30	0.6	RV	0	0.60	2	20	1	100	0
O Cheung Khael	2000	60	12	RV	0	12.00	3	10	1	100	0
Koh Kampeung			0.2	BF	0	0.20	3	1000	1	100	0
Koh Tung Daeng			3	BF	0	3.00	3	1.5-7 km	3	100	0
Koh Preah Trabaek			1	BF	0	1.00	3	7km	3	100	0
Koh Sampong Thom			1	BF	0	1.00	3	8km	1	100	0
Koh Sampong Toch			0.5	BF	0	0.50	3	7km	1	100	0
Koh Khleay			2	BF	0	2.00	3	3km	3	100	0
Koh Narong			1.5	BF	0	1.50	3	3km	1	100	0
Total area (ha)		56.2		0	56.2						

Figure 4: Location of sample plots in Kampong Kboeung village



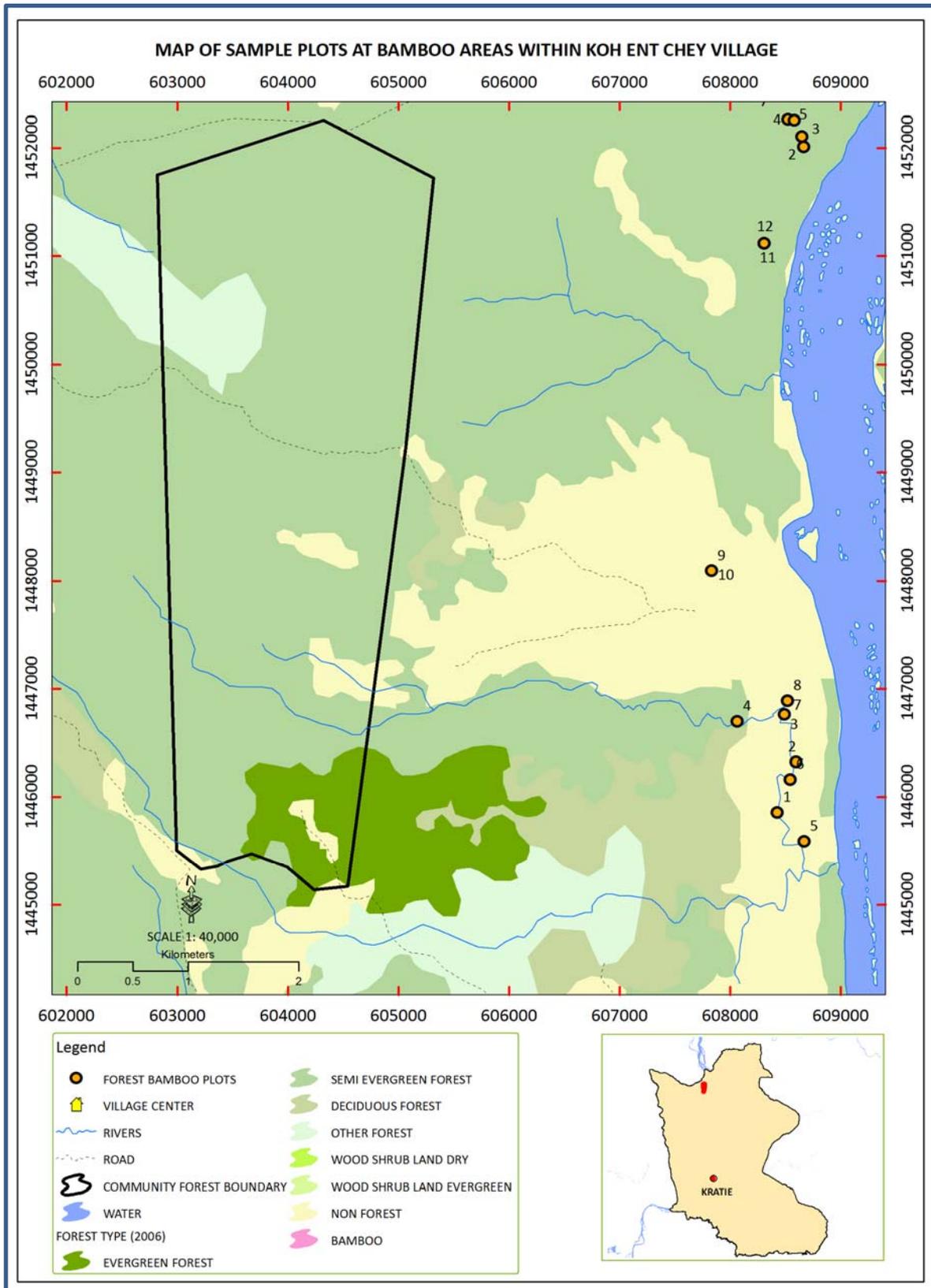
- **Koh Ent Chey village**

Bamboo inhabits along 11 streams and two islands of the Mekong River, where are situated outside the CF. 10 bamboo areas are variable in sizes from less than one to four hectares. The three larger bamboo areas are within social concession land which are allocated for future development in the village. These three areas are at the distance of 500 m to 2000m away of the village and be able to access by boat in the rainy season and motorbike/tiller in the dry season. These three areas were selected for resource assessment as proposed by local authority and community to demarcate them for future management and harvest.

**Table 4: Forest type and bamboo abundance in Koh Ent Chey village**

Name of area	Size of area in hectare			Forest type	Inside CF	Outside CF	Abundance	Distance from village (m)	Potential area for harvest	Not die (%)	Fruit-died (%)
	Length of stream (m)	Distance of bamboo clump from stream bank (m)	Size of bamboo area (ha)								
O Samroang	3000	40	12	RV	0	12.00	2	1000	3	80	20
O Samoang Toch	2500	30	7.5	RV	0	7.50	2	1500	3	80	20
O Russey	3500	20	7	RV	0	7.00	2	500	3	80	20
O Tatak	200	40	0.8	RV	0	0.80	2	100	3	80	20
O Tachem	150	20	0.3	RV	0	0.30	2	50	3	80	20
O Spean	200	20	0.4	RV	0	0.40	2	20	3	80	20
O Ankgkrong	300	80	2.4	RV	0	2.40	2	200	3	80	20
O Kamboa	300	20	0.6	RV	0	0.60	2	2500	3	80	20
O Prahout	2000	20	4	RV	0	4.00	2	3000	3	80	20
O Tonlea Thom	300	20	0.6	RV	0	0.60	2	3500	3	80	20
O Tonlean Toch	500	50	2.5	RV	0	2.50	2	4000	3	80	20
Koh Ent Chey	300	30	0.9	RV	0	0.90	1	1800	3	10	90
Koh Chrem	500	50	2.5	RV	0	2.50	1	5000	3	10	90
<b>Total</b>			<b>41.5</b>		<b>0</b>	<b>41.5</b>					

Figure 5: Location of sample plots in Koh Ent Chey village



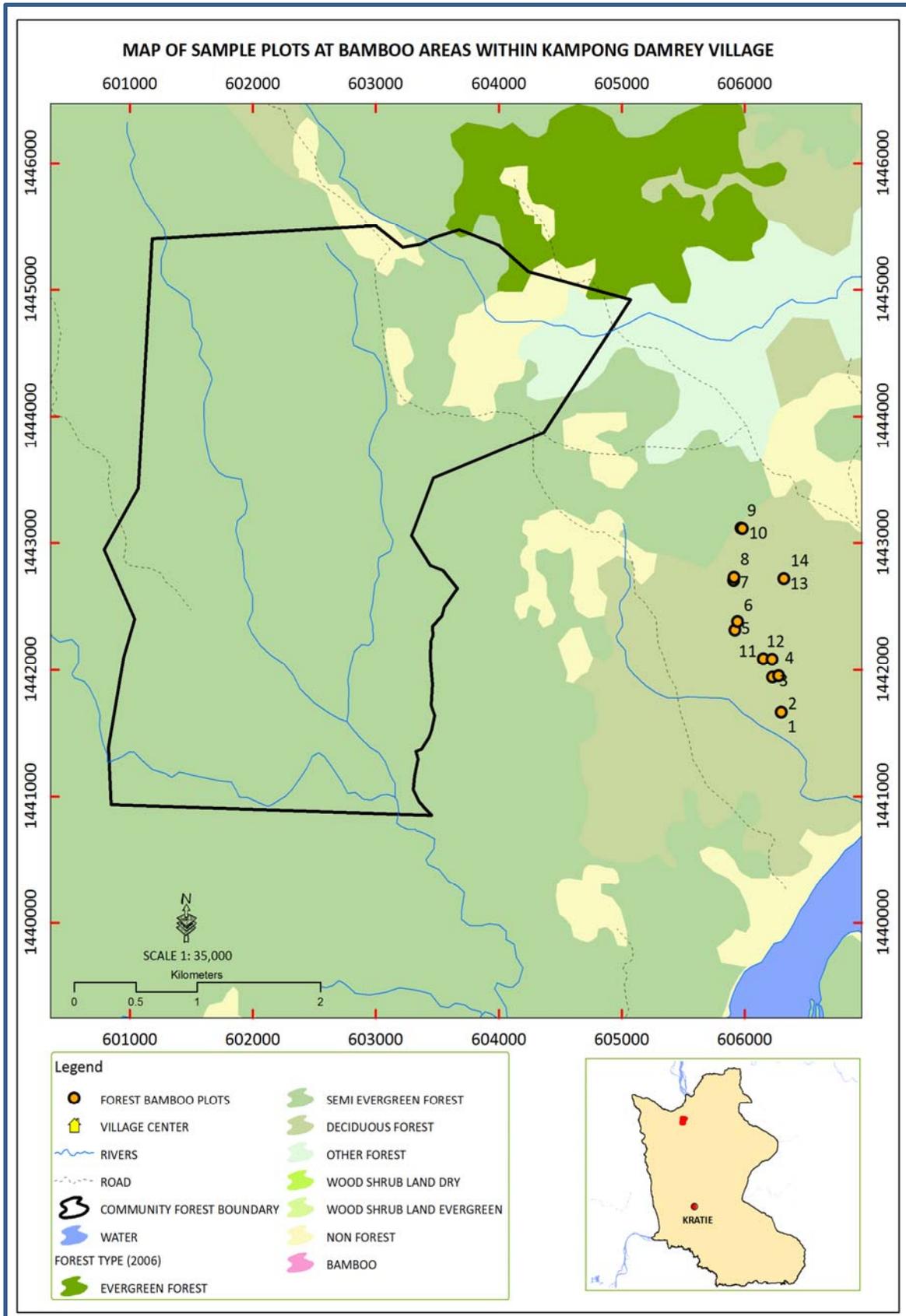
- **Kampong Damrey village**

12 bamboo areas were identified by local authority and community of Kampong Damrey village during the group discussion. Three out of them composing of O Khlem, O Khlem Leu and O Tasok cover areas of 12 ha, 10 ha and 7.5 ha respectively. The other 9 areas are smaller than 3 ha. O Khlem Leu will be subject to bamboo clearance and conversion to farmland in future, so only two areas – O Khlem and O Tasok are planned for bamboo management areas for utilization, and so resource assessment were carried out within these two areas.

**Table 5: Forest type and bamboo abundance in Kampong Damrey village**

Name of area	Size of area in hectare			Forest type	Inside CF	Outside CF	Abundance	Distance from village (m)	Potential area for harvest	Not die (%)	Fruit-died (%)
	Length of stream (m)	Distance of bamboo clump from stream bank (m)	Size of bamboo area (ha)								
O Khlem	3000	40	12	RV	0	12.00	3	1000	2	10	90
O Khlem Leu Estuary	1000	100	10	RV	0	10.00	3	700	2	10	90
O Khlem Kroam Estuary	500	40	2	RV	0	2.00	3	1500	1	10	90
O Kmoach	200	20	0.4	RV	0	0.40	3	30	3	10	90
O Meun Keo	450	20	0.9	RV	0	0.90	2	200	3	100	0
O Domrei	200	20	0.4	RV	0	0.40	2	500	1	100	0
O Yeaymao	300	40	1.2	RV	0	1.20	2	700	2	100	0
Mekong River bank	400	20	0.8	RV	0	0.80	2	800	2	100	0
O Tasok	1500	50	7.5	RV	0	7.50	2	1800	2	100	0
Total area (ha)			35.2	0	0	35.20					

Figure 6: Location of sample plots in Kampong Damrey village



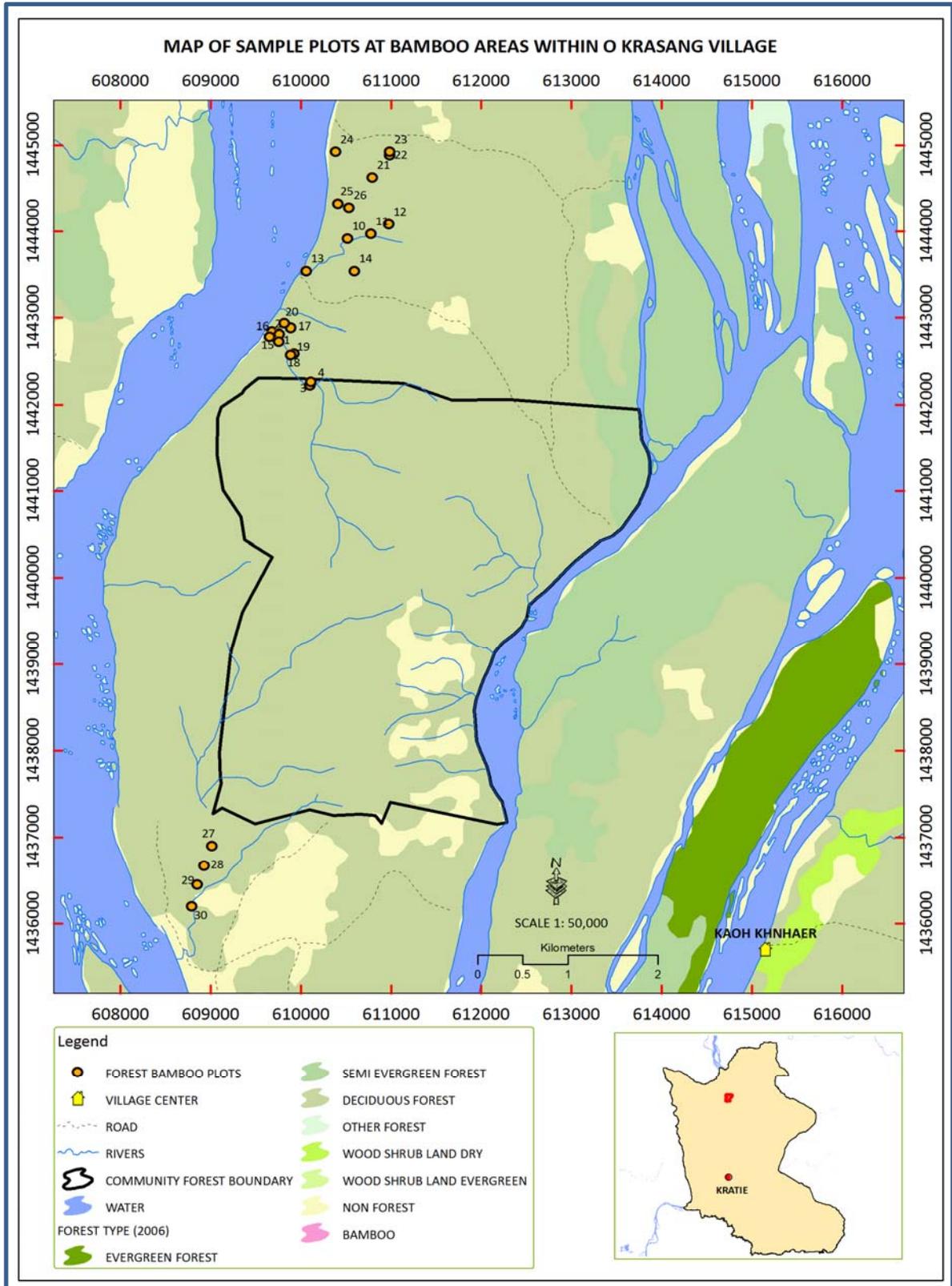
- **O Krasang village**

There are 15 bamboo areas being identified by vice chief of O Krasang village and chief of O Krasang CF. O Preang covers an area of 450 hectares which is contributed to 65.1 percent of total bamboo areas of the five villages. However, bamboo on this island has died after flowering and fruiting. Other nine bamboo areas on this island were also died. Of these total areas, 46.11 ha or 8.5% are located within O Krasang CF, whereas another 81.5% are located outside the CF. As a result, the bamboo resource assessment was carried out at four bamboo areas including O Chheuteal, O Romaing, O Taros and O Krasang.

**Table 6: Forest type and bamboo abundance in O Krasang village**

Name of area	Size of area in hectare			Forest type	Inside CF	Outside CF	Abundance	Distance from village (m)	Potential area for harvest	Not die (%)	Fruit-died (%)
	Length of stream (m)	Distance of bamboo clump from stream bank (m)	Size of bamboo area (ha)								
O Proley	3000	50	15	RV	0	15.00	2	100		0	100
O Proley Estuary	1500	20	3	RV	0	3.00	1	200		0	100
O Krasang	7000	30	21	RV	10.5	10.50	2	50		80	20
O Krasang Estuary		30	0	RV		0.00	2	2000		0	100
Thmor Totoeng	250	50	1.25	RV	0	1.25	2	7000		100	0
O Chheuteal	3000	60	18	RV	12.6	5.40	2	9000		70	30
O Taros Lech	3100	24	7.44	RV	5.21	2.23	2	12000		70	30
O Romaing	1500	60	9	RV	6.3	2.70	2	14000		100	0
Koh Preang	3000	1500	450	RV	0	450.00	3	2000		0	100
O Taros Keut	1500	20	3	RV	0	3.00	2	1500		0	100
O Chumtavan	700	30	2.1	RV	0	2.10	2	1500		0	100
O Vealval	1000	30	3	RV	3	0.00	2	3000		0	100
O Koki	500	30	1.5	RV	1.5	0.00	2	4000		0	100
O Kolruntas	1500	30	4.5	RV	4.5	0.00	2	9000		0	100
O Prek Phneang	500	50	2.5	RV	2.5	0.00	2	14000		0	100
<b>Total</b>			<b>541.29</b>		<b>46.1</b>	<b>495.18</b>					

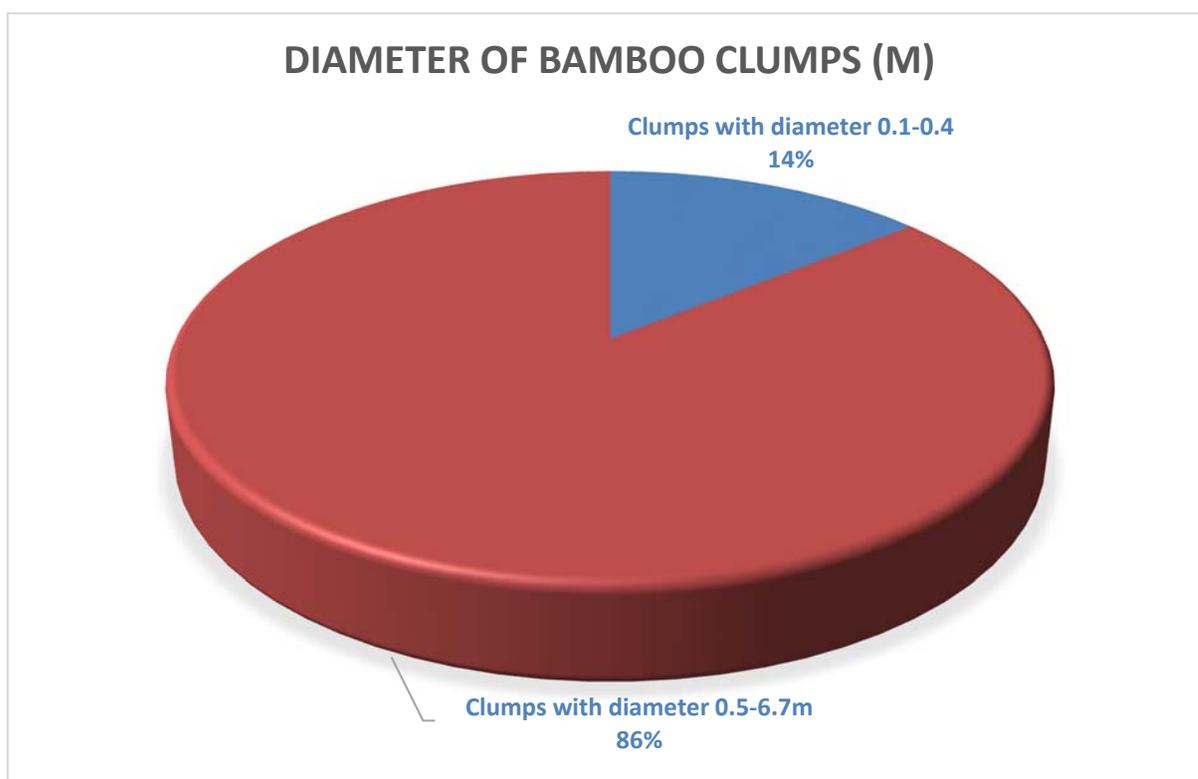
Figure 7: Location of sample plots in O Krasang village



## 5.4 Bamboo density

The size of bamboo clumps are variable from 0.1 m to 6.7 m diameter. All bamboo clumps with diameter smaller than 0.5 m (or 50cm) usually have slender culms because of unsuitable conditions such as receiving less sunlight for those growing under large clumps, unfertile soil or close to 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 5,287 clumps with diameters of 0.1-0.4 m, and 32,172 clumps with diameter ranging from 0.5 to 5.6 m.

**Figure 8: Graph of bamboo clumps with diameters 0.1 - < 0.5 m vs. 0.5 - >6 m**



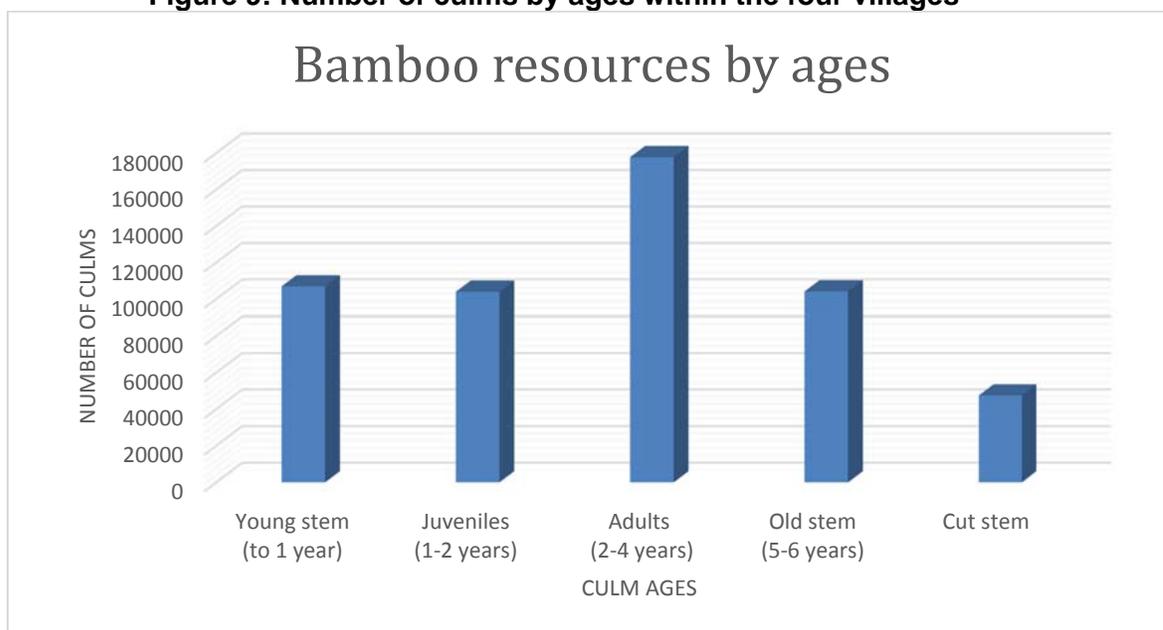
In order to avoid or reduce bias in estimating commercial bamboo poles, all clumps with diameter less than 0.5 m are excluded from the data analysis.

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.

Of the 11 bamboo areas, O Svay was account for 109,342 culms, which represented the highest bamboo resources of the four villages, and followed by O Chheuteal having 96,714 culms. The third largest bamboo population area was O Taros which accounted for 61,623

culms. The fourth abundant bamboo areas were O Romaing and O Samroang with bamboo resources in the amount of 54.072 culms and 51.580 culms respectively. O Tasok consisted of 45,240 culms. The remaining six areas contained bamboo resources ranging from some 20,000 culms to 29,888 culms. The following is a graph presenting bamboo resources by area of the four villages.

**Figure 9: Number of culms by ages within the four villages**



The followings are bamboo density by village and area.

#### 5.4.1 Kampong Kboeung village

The bamboo resource assessment in Kampong Kbeurung covered two areas of 38.2 hectares, which made up of 63.7% of the total area of 60 hectares. O Say covers an area of 34 hectares which is the largest bamboo area in Kampong Kboeung village, whereas O Don Orn is 4.2 hectares – the third largest bamboo area in the village. 19 sample plots or 1.9 hectares representing 5 % of the two areas were carried out along the two streams. The result showed that O Svay consisted of 6,907 clumps or 109,342 culms, and O Don Orn accounted for 630 clumps or 22,260 culms. The average cut poles within the two areas were composed of only 7% of all bamboo resources. The adult poles (2-5 year old poles) of the two areas are 59,003 poles or 46.4% of all bamboo ages. Young culms which have just been freshly developed from bamboo shoots early 2014 consisted of 45,191 poles. The juvenile culms consisted of only 3,099 poles, which are placed in the third range.

**Table 7: Summary of bamboo resources in Kampong Kboeung village**

Areas		O Svay	O Don Orn
Size of bamboo area (ha)		34	4
Plot number		13	6
Total clumps		6,277	630
Total culms		109,342	22,260
Bamboo shoots	Total	0	0

Young culm (to 1 year)	Density (h <sup>-1</sup> )	1,205	1,008
	Total	40,957	4,234
	Percent	37	19
Juveniles (1-2 years)	Density (h <sup>-1</sup> )	51	1,380
	Total	1,719	5,796
	Percent	2	26
Adults (2-4 years)	Density (h <sup>-1</sup> )	1,518	1,756
	Total	51,628	7,375
	Percent	47	33
Old culm (5-6 years)	Density (h <sup>-1</sup> )	244	756
	Total	8,291	3,175
	Percent	8	14
Cut culm	Density (h <sup>-1</sup> )	198	400
	Total	6,748	1,680
	Percent	6	8

#### 5.4.2 Koh Ent Chey village

The three bamboo areas covered by the assessment were composed of 63.8% (26.5 ha) of the total area of 41.5 hectares. O Samroang, which covers an area of 12 hectares, is the largest bamboo area, and followed by O Russey and O Tunlea Toch covering areas of 7 ha and 7.5 ha respectively. 14 sample plots were conducted, representing 5.3% of the three areas. The results showed that three areas were composed of 100,560 bamboo poles including all bamboo ages and cut poles. Young poles to one year old were in the amount of 17,751 culms, representing 18% of all bamboo ages and cut poles of the three areas. Juvenile culms consisted of 27,881 poles, or made up of 28%. The adult poles with age ranges of 2-5 years old are account for 30,163 poles or 30% of bamboo resources of the three areas. The cut poles within the last six year period was account for 8,978 poles, representing 9% of all bamboo resources.

**Table 8: Summary of bamboo population by species in Koh Ent Chey village**

Areas		O Samroang	O Russey	O Tunlea Toch
Size of bamboo area (ha)		12	7	8
Plot number		6	4	4
Total clumps		2,260	2,260	1,350
Total culms		51,580	19,093	29,888
Bamboo shoots		0	0	0
Young culm (to 1 year)	Density (h <sup>-1</sup> )	915	483	453
	Total	10,980	3,378	3,394
	Percent	21	18	11
Juveniles (1-2 years)	Density (h <sup>-1</sup> )	1,465	585	828
	Total	17,580	4,095	6,206
	Percent	34	21	21

<b>Adults (2-4 years)</b>	<b>Density (h<sup>-1</sup>)</b>	997	1,170	1,335
	<b>Total</b>	11,960	8,190	10,013
	<b>Percent</b>	23	43	34
<b>Old culm (5-6 years)</b>	<b>Density (h<sup>-1</sup>)</b>	613	245	895
	<b>Total</b>	7,360	1,715	6,713
	<b>Percent</b>	14	9	22
<b>Cut culm</b>	<b>Density (h<sup>-1</sup>)</b>	308	245	475
	<b>Total</b>	3,700	1,715	3,563
	<b>Percent</b>	7	9	12

### 5.4.3 Kampong Damrey village

The two bamboo areas of O Khlem and O Tasok are made up of 61.9% of 41.4 ha within the total 9 areas. O Khlem covers an area of 18 hectares, representing the largest bamboo area, whereas O Tasok with 7.5 hectares is the third largest bamboo area of the Kampong Damrey village. 15 sample plots representing 5.6% of the two areas were carried out the assessment. The result demonstrates that the two areas contain 68,923 bamboo poles including all bamboo ages and cut poles. Young poles to one year old were in the amount of 8,098 culms, representing 12% of all bamboo ages and cut poles of the three areas. Juvenile culms consist of 18,890 poles, or make up of 27%. The adult poles are account for 19,700 poles or 29% of bamboo resources of the three areas. The old poles consists of up to 21,044 poles or 31% of all bamboo resources. The cut poles are account for only 1,193 poles, representing just 2% of all bamboo resources.

**Table 9: Summary of bamboo population in Kampong Damrey village**

<b>Areas</b>		<b>O Khlem</b>	<b>O Tasok</b>
<b>Size of bamboo area (ha)</b>		18	9
<b>Plot number</b>		10	5
<b>Total clumps</b>		4,488	2,475
<b>Total culms</b>		45,240	24,488
<b>Bamboo shoots</b>		0	0
<b>Young culm (to 1 year)</b>	<b>Density (h<sup>-1</sup>)</b>	316	277
	<b>Total</b>	5,688	2,494
	<b>Percent</b>	13	10
<b>Juveniles (1-2 years)</b>	<b>Density (h<sup>-1</sup>)</b>	619	904
	<b>Total</b>	11,148	8,138
	<b>Percent</b>	25	33
<b>Adults (2-5 years)</b>	<b>Density (h<sup>-1</sup>)</b>	739	721
	<b>Total</b>	13,296	6,488
	<b>Percent</b>	29	26
<b>Old culm (5-6 years)</b>	<b>Density (h<sup>-1</sup>)</b>	805	754
	<b>Total</b>	14,496	6,788

	<b>Percent</b>	32	28
<b>Cut culm</b>	<b>Density (h<sup>-1</sup>)</b>	34	65
	<b>Total</b>	612	581
	<b>Percent</b>	1	2

#### 5.4.4 O Krasang village

The four bamboo resource assessment areas reported by all participants are 55.44 hectare, but O Taros was increased its size from 7.44 ha to 15 ha because the actual size observed during the field assessment is larger than information provided by community during group discussion. O Krasang was decreased from 21 ha to 5 ha because of the effect of flowering and fruiting. As a result, only 47 ha are conducted the assessment. 30 plots in equivalent to 6.4 percent of the bamboo areas were conducted the assessment. The result showed that young poles of 1 one years old were account for 35,812 poles or 15% of all bamboo ages and cut poles. The juvenile poles were account for 49,315 poles or 21 percent of all culm ages. The adult culms were in the amount of 68.832 poles or 29 percent. Old culms were account for 55,603 poles representing 12 percent. The cut poles within this 6 year period were totally 28,922 poles.

**Table 10: Summary of bamboo population in O Krasang village**

<b>Sites</b>		<b>O Chheuteal</b>	<b>O Romaing</b>	<b>O Taros</b>	<b>O Krasang</b>
<b>Size of bamboo area (ha)</b>		18	9	15	5
<b>Plot number</b>		10	5	11	4
<b>Total clumps</b>		5,256	2,520	3,818	1,440
<b>Total culms</b>		96,714	54,072	61,936	26,075
<b>Bamboo shoots</b>		0	0	0	0
<b>Young culm (to 1 year)</b>	<b>Density (h<sup>-1</sup>)</b>	731	1,266	508	728
	<b>Total</b>	13,158	11,394	7,623	3,638
	<b>Percent</b>	14	21	12	14
<b>Juveniles (1-2 years)</b>	<b>Density (h<sup>-1</sup>)</b>	1,124	1,728	775	383
	<b>Total</b>	20,232	15,552	11,618	1,913
	<b>Percent</b>	21	29	19	7
<b>Adults (2-4 years)</b>	<b>Density (h<sup>-1</sup>)</b>	1,360	1,408	1,334	2,335
	<b>Total</b>	24,480	12,672	20,005	11,675
	<b>Percent</b>	25	23	32	45
<b>Old culm (5-6 years)</b>	<b>Density (h<sup>-1</sup>)</b>	1,178	1,120	1,145	1,428
	<b>Total</b>	21,204	10,080	17,182	7,138
	<b>Percent</b>	22	19	28	27
<b>Cut culm</b>	<b>Density (h<sup>-1</sup>)</b>	980	486	346	343
	<b>Total</b>	17,640	4,374	5,195	1,713
	<b>Percent</b>	18	8	8	7

### 5.5 Bamboo seedlings

Bamboo seedlings were counted to see its density. Five 1 m<sup>2</sup> plots were conducted at the dead bamboo areas in O Krasang and O Dorn. The seedlings per square meter are highly variable from about 200 to more than 1,000 individuals. In average, there are 668 seedlings per m<sup>2</sup>. These seedlings may be adversely effected by two major factors including forest fire in the dry season and grazing.

**Table 11: Number of seedlings per square meter**

No	Seedlings/m <sup>2</sup>	Area
1	1326	O Krasang
2	178	O Krasang
3	620	O Dorn
4	640	O Dorn
5	575	O Dorn
Total	3,339	
Average seedlings per m <sup>2</sup>	668	

### 5.6 Current harvest practice

According to field observation, culms of Russey Roleak were collected at 1.5-4 meters above the ground. This collection practice is because of a number factors as follows:

- Russey Roleak has densely spiny-branches on the ground, so hard to be accessed 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 from the clumps to a pile. Culm wall of the lower section is very thick, and so heavy which is hard to move from a clump to a pile. In addition, the standard length of culms at the markets is required only 7 m long. If the culms are longer than the delimited length, it is still paid the same price.

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. Moreover, 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.

### 5.7 Current market status

Bamboo culms have not been processed into any product, except fishing gear like fish traps for own use and utilized for small house and/or hut construction. Currently, there has been regular market access of bamboo poles in O Krasang village, but rarely access to other three villages of Kampong Kboeung, Koh Ent Chey and Kampong Damrey. An old couple of traders, Yeay Phou and Ta Leng, from Sambo district come to buy bamboo poles in O Krasang village. The farm gate price of bamboo poles is 1500 riel per culm if money is advanced to collectors, and 1700 riel per culm if paid when bamboo pole is sold. A price of bamboo pole paid at a Thmor Kre depot owned by Ly Cheu, Kratie province is 2700 riel per pole with size of 7 m long x 7 cm dia.

Based on statistic provided by deputy chief of O Krasang village, 28,400 poles have been collected annually by 15 out of 44 households, of which 3000 poles each collected by 6 households, 1400 poles each collected by 7 households and 300 poles each collected by 2 households. A collector team with two people is able to harvest 35 to 50 poles per day depending on how hard they work, convenience of the access site for pole harvest and distance of clumps to a pile area near stream bank. Some collectors sometimes do not collect bamboo pole when they get an advance from the trader, but this is rare. Bamboo poles are harvested in May through November, except cultivation months of July and August. The highest peak month of bamboo collection is in September. However, bamboo poles can be collected the entire year if market is available in their village. At the last day of this course, participants of the other three villages expressed their interest in harvest of bamboo poles for sale if there is market access to their village. They also requested legal support in bamboo pole collection, and help provide vocational training on bamboo processing and marketing of the products.

Transporting bamboo poles from the four upstream villages to Thmor Kre takes about one day and associates with many cost items such as diesel, engine oil, labor cost, food for trader and workers, and informal fee to police at three places along the stream. Based on calculation made by participants, total transport cost of 5,000 poles from the four villages to Sambo or Thmor Kre is 2.465,000 riel. The transport cost of 5,000 poles and 10,000 poles by a raft is different only at fee to carry bamboo culms from stream bank to the river to making a raft (1 pole is 300 riel).

**Table 12: Transport cost of 5,000 poles from the four villages to the Thmor Kre depot**

Expense item	Unit	Total	Unit cost (Riel)	Total cost (Riel)
Fee to carry, fasten culms into bundles and make a raft	pole	5000	300	1,500,000
Diesel	Litre	120	3,850	462,000
Engine oil	cane	1	18,000	18,000
Food for trader	Meal	2	40,000	80,000
Food for workors (5 per x 5 days)	per	25	15,000	375,000
Pay to police along the river	post	3	10,000	30,000
Total				2,465,000

If the farm gate price at the village is 1,700 riel per pole, and the price at the Thmor Kre depot is 2,700 riel per pole, the net profit in selling 5,000 poles at the depot is 2,535,000 riel.

## 6. Discussion

### 6.1. Size and use of Russey Roleak

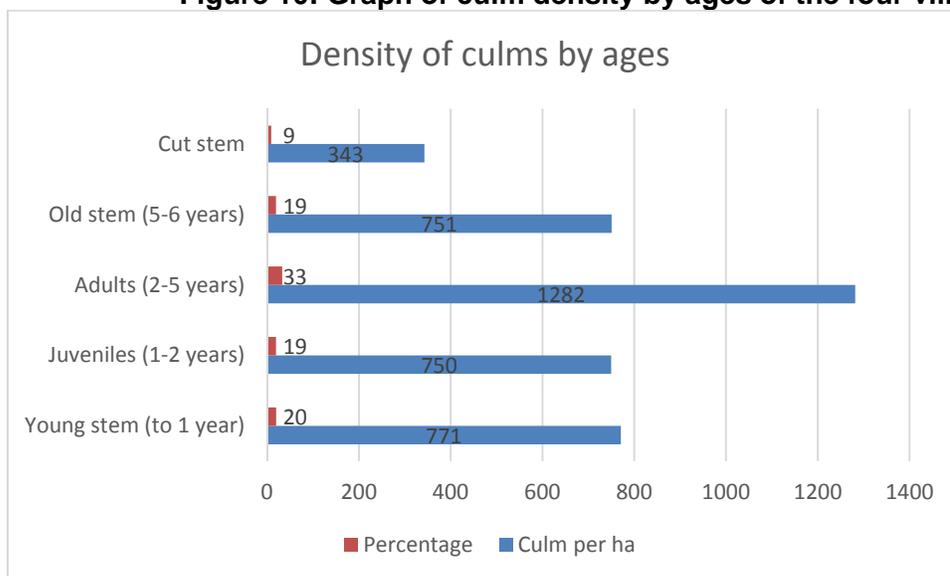
Russey Roleak can be classified as a medium thick culm wall species. Based on measurement, the sizes of this species are variable from the base section close to the ground to the top – The base section from the ground to 2-3 meters has smaller diameters, thicker culm wall and shorter internodes; the 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 depend on sections of the culm. Usually, this species has high potential for housing materials, kitchen utensils, fishing traps and nets, and core of incense sticks.

## 6.2 Culm density

In average, a one hectare bamboo area consists of 236 clumps, or 6,629 culms. Of the total account of culms, dead culms are composed of 2,733 individuals (41%), and the 1-6 year old and cut culms are in the amount of 3,896 individuals. Of the 3,896 culms, there are 771 young culms (20%), 750 juvenile culms (19%), 1,282 adult culms (33%), 751 old culms (19%), and 343 cut culms (9%). It is notable that, most of the cut culms are at the adult age. So, if the cut culms are included in the adult ages, it will be accumulated to 1,624 individuals or 42 percent. The 9 percent of cut culms in this data analysis represents poles being collected last 2 to 5 years. Based on the result of this analysis, the bamboo poles should be able to be annually collected up to 649 individuals per hectare, but the current collection has been made to only 343 individuals or 52 percent of harvestable poles. This reason may be because the culm sizes are greatly variable from small to large culms, whereas harvest is selected only the larger culm sizes (from 7cm dia. upward), and so the smaller diameter culms are left in the clump.

**Figure 10: Graph of culm density by ages of the four village**



The 41% of dead culms remaining in a clump usually result in forest fire in the dry season, which provide immediate impact to bamboo clumps by burning young culms, and also affect nearby ecosculms. It is believed that if culms are harvested properly, it will help minimize hazard of forest fire in the dry season. In addition, good practice of bamboo management will allow bamboo shoots to grow well and developed into high culm quality.

**Table 13: Live and cut culms vs. dead culms**

Areas	Bamboo area (ha)	Plot number	Total clump	# clumps per ha	Total culms of each assessment area			Density of bamboo resources (# culm/ha)		
					Total culms	1-6 year old culms	Dead culm	Total culms	1-6 year old culms	Dead culms
O Svay	34	13	6,277	185	192,930	109,342	83,588	5,674	3,216	2,458
O Don Orn	4.2	6	630	150	27,997	22,260	5,737	6,666	5,300	1,366
O Samroang	12	6	2,260	188	85,480	51,580	33,900	7,123	4,298	2,825
O Russey	7	4	2,260	323	38,710	19,093	19,618	5,530	2,728	2,803
O Tunlea Toch	7.5	4	1,350	180	48,919	29,888	19,031	6,523	3,985	2,538
O Khlem	18	10	4,488	249	96,756	45,240	51,516	5,375	2,513	2,862
O Tasok	9	5	2,475	275	48,619	24,488	24,131	5,402	2,721	2,681
O Chheuteal	18	10	5,256	292	150,156	96,714	53,442	8,342	5,373	2,969
O Romaing	9	5	2,520	280	85,842	54,072	31,770	9,538	6,008	3,530
O Taros	15	11	3,818	255	102,259	61,623	40,636	6,817	4,108	2,709
O Krasang	5	4	1,440	288	41,813	26,075	15,738	8,363	5,215	3,148

### 6.3 Annual bamboo growth

With regard to bamboo ecology, individual culms of a clump die after six years, so the analysis of annual bamboo growth is made within 6 years only. Hence the dead culms are excluded from the analysis. Cut culms are included in the analysis because it is still within 6 years. The first year growth is defined as the accumulation of bamboo shoots and young culms which are developed from bamboo shoots last rainy season. The total account of culms per clump 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 average annual growth of culms per clump is greatly variable by areas from 1 individual per clump at O Russey area to 6 individuals per clump at O Don Orn area. In general, a clump is able to produce three new culms annually. The number of annual culm production is still low if compared with number of rhizomes being capable to produce new shoots, but perhaps 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. If properly taken care of the clumps, more culms may be regenerated annually. Shanmughavel *et al.*, (1997) reported that on an average 5 new culms were produced per year per clump (*Bambusa bambos*) and there were about 275 to 300 productive clumps per hectare. 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.

**Table 14: volume of annual growth of Russey Roleak in the four villages**

Villages	Areas	Bamboo area (ha)	Total clumps	Total culms	Annual culm growth per area	Average range of annual culm growth per clump
Kampong Kboeung	O Svay	34	6,277	109,342	18,224	3
	O Don Orn	4.2	630	22,260	3,710	6
Koh Ent Chey	O Samroang	12	2,260	51,580	8,597	4
	O Russey	7	2,260	19,093	3,182	1
	O Tunlea Toch	7.5	1,350	29,888	4,981	4
Kampong Damrey	O Khlem	18	4,488	45,240	7,540	2
	O Tasok	9	2,475	24,488	4,081	2
O Krasang	O Chheuteal	18	5,256	96,714	16,119	3
	O Romaing	9	2,520	54,072	9,012	4
	O Taros	15	3,818	61,623	10,270	3
	O Krasang	5	1,440	26,075	4,346	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 result, the first year collection of 2-5 year old culms can be made up to its maximum level of 177,780 individuals, and culm collection of the following years is based on the annual growth, (See table 14).

**Table 15: Harvest volume of culms in the third and following years**

Villages	Areas	Bamboo area (ha)	Total Clump	Annual harvest volume		
				Adults (2-5 years)	Juveniles (1-2 years)	bamboo shoot to 1 year old culm year
Kampong Kboeung	O Svay	34	6,277	51,628	1,719	40,957
	O Don Orn	4	630	7,375	5,796	4,234
	Total	38	6,907	59,003	7,515	45,191
Koh Ent Chey	O Samroang	12	2,260	11,960	17,580	10,980
	O Russey	7	2,260	8,190	4,095	3,378

	O Tunlea Toch	8	1,350	10,013	6,206	3,394
	Total	27	5,870	30,163	27,881	17,751
Kampong Damrey	O Khlem	18	4,488	13,296	11,148	5,688
	O Tasok	9	2,475	6,488	8,138	2,494
	Total	27	6,963	19,784	19,286	8,182
O Krasang	O Chheuteal	18	5,256	24,480	20,232	13,158
	O Romaing	9	2,520	12,672	15,552	11,394
	O Taros	15	3,818	20,005	11,618	7,623
	O Krasang	5	1,440	11,675	1,913	3,638
	Total	47	13,034	68,832	49,315	35,812
Total		139	32,774	177,780	103,997	106,936

### 6.5 Culm utilization

The size of culm diameter and length of internodes are mainly considered in bamboo trade for both in raw material and semi-product. The sizes of culms are greatly variable from smaller than 5 cm diameter to bigger than 10 cm diameter. Whereas the current bamboo pole trade is required only 7 cm diameter of culms upwards. So all culms with diameters smaller than 7 cm are usually not harvested. Based on observation, culms with diameters from 7 cm upwards are composed of 40 percent, and another 60 percent are culms with diameter smaller than 7 cm (See table 15). According to data record, both adult culms and cut culms (included in the same age) were account for 225,301 culms, of which 47,520 (21%) culms were cut culms, and 177,780 (79%) culms have not been cut. Majority of the 79% uncut culms have diameter smaller than 7 cm. So, 60% or more bamboo culms will be left in the forest if bamboo pole market demands only sizes of 7 cm diameter upwards, and no other product processing initiative is invented. In average, the lower section at 1.6 m above the ground has a variable internodes between 16.8 cm and 25.1 cm long, and the internodes of the middle section of 9.2 m long are variable from 32 to 40 cm long. With regard to two products - incense sticks are required 32 cm and 34 cm long (or rarely up to 38 cm long), and meat skewers are required 20 cm long. So, beside trade of bamboo poles, all culms with diameter less than 7 cm can be processed into bamboo slat, incense stick and/or meat skewer products which are available on the current markets.

**Table 16: Culms with diameters larger than 7 cm vs. smaller than 7 cm**

Culm size	Percentage	Adult	Juvenile	Bamboo shoot
Diameter > 7 cm	40%	71,112	41,599	42,774
Diameter < 7 cm	60%	106,668	62,398	64,161

Hence, if market opportunity of these bamboo culms are available in the four villages, it may provide bamboo-based livelihood opportunity to at least 30-40 percent of households of the four villages, and including Angkor Ent village as well.

## 7. Recommendations

- If bamboo resource becomes potential for local livelihood, bamboo clumps should be properly managed. Silviculture practice like thinning bamboo clumps, and removal of unhealthy clumps of 0.1 to 0.3 m diameters with slender culms that are under shade of larger clumps should be carried out by community, especially primary beneficiaries. Old and dead culms should be removed in order to provide adequate space to promote bamboo shoot growth.
- In order to get good culm quality, should collect adult culms with ages 2-5 years old, except culms for craft weaving. The young culms with ages younger than one year still have weak lignin and tend to shrink and are prone to insect attack after collection. Based on this finding, all adult culms could be harvested, whereas juvenile culms should better be harvested based on annual generation rates.
- Cutting culms should be carried out at 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. Bambusa company and WWF's SFB programme in the Eastern Plain Landscape conducted a pilot bamboo management practice in Chi Khlop CPF. Only 10 culms were kept in the clump, and branches at the base section were removed. If success, this result can be applied in these CFs. Alternatively, community resource person, chief of O Krasang CF, can be a resource person to train community on how to prevent bamboo forest from forest fire.
- 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.
- All large bamboo areas of the four villages are located outside the CF, which are susceptible to land conversion to other purposes, especially household farmland. If bamboo enterprise is not promoted, bamboo resources will become useless, and thus bamboo areas will be cleared. Hence, the use of bamboo should be diversified so as to enhance its value. Bamboo slat, incense stick and meat skewer should be potential products for these villages.
- Both local authority (commune council and village chiefs) and community should prevent bamboo forest areas from clearance by defining their areas for utilization in future.
- Of the four village, O Krasang village should be the first village to be considered in bamboo enterprise promotion due to the fact that 39% of the 44 households partly rely on bamboo collection for sale. The second village to be considered should be Kampong Damrey, followed by Koh Ent Chey, and finally Kampong Kboeung.
- Community members of the four villages, in particular forest/bamboo reliant households, should be made aware of protecting bamboo seedlings from fire in order for them to mature.

- Based on bamboo species and transport condition, small product items like incense sticks, skewers, etc. can be the promising products for these villages. However, they lack this processing skill, which need to be provided together with processing hand tools. They should also be built capacity in bamboo horticulture and enterprise development so that they are able to link their products to market and have confidence in costing their products, negotiating the price and managing their enterprises effectively.

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## Appendices

### 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 (2-4 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)	Culms with thick branches, thick white cuticle and dark green color, almost absence of culm sheath.
Adults (2-4 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 culm, half death at the above section, and remain green at the lower section.
Cut culm	Culms cut for uses.
Dead culm	Grey culm,
Additional note	Provide special information to this bamboo clump if any.



### D. Bamboo areas, size in hectare and abundance

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

Village	Name of area	Size of bamboo area (ha)	Habitat	Name of bamboo	Abundance	Distance from village (m)	Potential area for harvest	Location		Accessibility		Percentage		Area (ha)	
								Inside CF	Outside CF	Dry season	Rainy season	Not die	Fruit-died	Not die	Died
Kampong Kbeurng	O Svay	34	Bamboo forest	RP, RTM	2	60 m	3	0	100%	Tiller	Boat	80	20	27.2	6.8
	O Don Orn	0.42	Bamboo forest	RP, RTM	2	30 m	1	0	100%	Tiller	Tiller	100	0	0.42	0
	O Yeay Thuch	0.6	Bamboo forest	RP, RK	2	20 m	1	0	100%	Tiller	Tiller	100	0	0.6	0
	O Cheung Khael	12	Bamboo forest	RP, RTM	3	10 m	1	0	Inside CFi	Tiller	Tiller	100	0	12	0
	Koh Kampeung	0.2	Bamboo forest	RP	3	1000 m	1	0	Inside CFi	Boat	Boat	100	0	0.2	0
	Koh Tung Daeng	3	Bamboo forest	RP	3	1.5-7 km	3	0	Inside CFi	Boat	Boat	100	0	3	0
	Koh Preah Trabaek	1	Bamboo forest	RP	3	7 km	3	0	Inside CFi	Boat	Boat	100	0	1	0
	Koh Sampong Thom	1	Bamboo forest	RP	3	8 km	1	0	Inside CFi	Boat	Boat	100	0	1	0
	Koh Sampong Toch	0.5	Bamboo forest	RP	3	7 km	1	0	Inside CFi	Boat	Boat	100	0	0.5	0

	Koh Khleay	2	Bamboo forest	RP	3	3 km	3	0	Inside CFI	Boat	Boat	100	0	2	0
	Koh Narong	1.5	Bamboo forest	RP	3	3 km	1	0	Inside CFI	Boat	Boat	100	0	1.5	0
Koh Ent Chey	O Samroang	12	Bamboo forest	RR	2	1 km	3	0	100%	Tiller	Boat and raft	80	20	9.6	2.4
	O Samoang Toch	7.5	Bamboo forest	RR	2	1.5 km	3	0	100%	Tiller	Boat and raft	80	20	6	1.5
	O Russey	7	Bamboo forest	RR	2	500 m	3	0	100%	Tiller	Boat and raft	80	20	5.6	1.4
	O Tatak	0.8	Bamboo forest	RR	2	100 m	3	0	100%	Tiller	Boat and raft	80	20	0.64	0.16
	O Tachem	0.3	Bamboo forest	RR	2	50 m	3	0	100%	Tiller	Boat and raft	80	20	0.24	0.06
	O Spean	0.4	Bamboo forest	RR	2	20 m	3	0	100%	Tiller	Boat and raft	80	20	0.32	0.08
	O Ankgkrong	2.4	Bamboo forest	RR	2	200 m	3	0	100%	Tiller	Boat and raft	80	20	1.92	0.48
	O Kamboa	0.6	Bamboo forest	RR	2	2.5 km	3	0	100%	Tiller	Boat and raft	80	20	0.48	0.12
	O Prahout	4	Bamboo forest	RR	2	3 km	3	0	100%	Tiller	Boat and raft	80	20	3.2	0.8
	O Tonlea Thom	0.6	Bamboo forest	RR	2	3.5 km	3	0	100%	Tiller	Boat and raft	80	20	0.48	0.12

	O Tonlean Toch	2.5	Bamboo forest	RR	2	4 km	3	0	100%	Tiller	Boat and raft	80	20	2	0.5
	Koh Ent Chey	0.9	Bamboo forest	RP	1	1.8 km	3	0	100%	Tiller	Boat and raft	10	90	0.09	0.81
	Koh Chrem	2.5	Bamboo forest	RR	1	5 km	3	0	100%	Tiller	Boat and raft	10	90	0.25	2.25
KampongDamrey	O Khlem	12	Bamboo forest	RR, RP	3	1 km	2	0	100%	cart, tiller, walk	Boat, cart	10	90	1.2	10.8
	O Khlem Leu Esturi	10	Bamboo forest	RR, RP	3	700 m	2	0	100%	Ox cart, tiller, walk	cart, walk	10	90	1	9
	O Khlem Kroam Esturi	2	Bamboo forest	RR, RP	3	1.5 km	1	0	100%	Walk, cart, tiller	Boat	10	90	0.2	1.8
	O Kmoach	0.4	Bamboo forest	RP	3	30 m	3	0	100%	Walk, tiller	Walk	10	90	0.04	0.36
	O Meun Keo	0.9	Bamboo forest	RP	2	200 m	3	0	100%	Walk, tiller, moto	Tiller, walk, moto	100	0	0.9	0
	O Domrei	0.4	Bamboo forest	RR, RP	2	500 m	1	0	100%	Walk, tiller, moto	Boat	100	0	0.4	0

	O Yeaymao	1.2	Bamboo forest	RR, RP	2	700 m	2	0	100%	boat, tiller, moto	tiller, boat	100	0	1.2	0
	River bank	0.8	Bamboo forest	RR, RP	2	800 m	2	0	100%	boat, tiller, moto	tiller, boat	100	0	0.8	0
	O Tasok	7.5	Bamboo forest	RR, RP	2	1.8 km	2	0	100%	tiller	tiller	100	0	7.5	0
O Krasang	O Proley	15	Bamboo forest	RR	2	100 m		0	100%	walk	walk, boat	0	100	0	15
	O Prolei Estuari	3	Bamboo forest	RR	1	200 m		0	100%	walk	walk, boat	0	100	0	3
	O Krasang	21	Bamboo forest	RR	2	50 m		50%	50%	walk	walk, boat	80	20	16.8	4.2
	Thmor Totoeng	1.25	Bamboo forest	RR	2	7 km		0	100%	cart	cart	100	0	1.25	0
	O Chheuteal	18	Bamboo forest	RR	2	9 km		70%	30%	cart, walk	cart, walk	70	30	12.6	5.4
	O Taros Lech	7.44	Bamboo forest	RR	2	12 km		70%	30%			70	30	5.208	2.232
	O Romaing	9	Bamboo forest	RR	2	14 km		70%	30%			100	0	9	0
	Koh Preang	450	Bamboo forest	RR	3	2 km		0	100%	boat	boat	0	100	0	450
	O Taros Keut	3	Bamboo forest	RR, RK	2	1.5 km		0	100%	cart, walk	cart, walk		100	0	3

	O Chumtavan	2.1	Bamboo forest	RR	2	1.5 km		0	100%	cart, walk	cart, walk		100	0	2.1
	O Vealval	3	Bamboo forest	RR	2	3 km		100%	0	cart, walk	cart, walk		100	0	3
	O Koki	1.5	Bamboo forest	RR, RK	2	4 km		100%	0	cart, walk	cart, walk		100	0	1.5
	O Kolruntas	4.5	Bamboo forest	RR, RK	2	9 km		100%	0	cart, walk	cart, walk		100	0	4.5
	O Prek Phneang	2.5	Bamboo forest	RR, RK	2	14 km		100%	0	cart, walk	cart, walk		100	0	2.5
Angkor Ent	O Toch	0.3	Bamboo forest	RR, RP, RK	3	300 m	2	0	100%	Tiller	Boat	0	100	0	0.3
	O Boeng Cha	9	Bamboo forest	RR, RP	2	200 m	1	0	100%	Tiller	Boat	0	100	0	9
	Sre Boeng Cha	2	MDF and Forest	RR, RP	2	1 km	3, not sold	0	100%	Tiller	Tiller	100	0	2	0
	O Dambang	0.125	Bamboo forest	RR, RP	1	300 m	3	0	100%	Tiller	Tiller	100	0	0.125	0
	O Raing	1.2	Bamboo forest	RR, RP	3	150 m	3	0	100%	Tiller	Boat or Tiller	0	100	0	1.2
	Along Mekong River	2.5	Bamboo forest	RP	3	Inside village	3	0	100%	Boat	Boat	0	100	0	2.5
	Koh Phlong	2	MDF	RR, RP	3	Island, 100 m	3	0	100%	Boat	Boat	50	50	1	1

### E. Size of Russey Roleak

No	Length of section 1 (Length of internodes shorter than 30 cm)								Length of section 2 (Length of node interval longer than 30 cm)												
	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)	Total node intervals	Total length of culm
	Base	End	Base	End	Base	End			Base	Middle	End	Base	Middle	End	Base	Middle	End				
1	17.0	16.0	20.0	29.0	No hole	20.0	6.0	1.2	16.0	18.0	12.0	30.0	44.0	39.0	20.0	15.0	10.0	21.0	8.4	25.0	11.0
2	18.0	18.0	15.0	29.0	No hole	20.0	11.0	2.7	18.0	20.0	13.0	33.0	41.0	39.0	20.0	10.0	3.0	23.0	8.3	38.0	11.5
3	17.0	17.0	13.5	26.0	No hole	15.0	13.0	2.6	17.0	15.0	10.0	32.0	32.0	38.0	19.0	15.0	10.0	13.0	4.8	29.0	8.5
4	19.0	18.0	17.0	30.0	No hole	25.0	9.0	2.0	18.0	19.0	14.0	32.0	42.0	40.0	19.5	15.0	15.0	23.0	9.2	30.0	12.6
5	10.0	11.0	16.0	30.0	No hole	10.0	4.0	2.0	11.0	12.0	11.0	31.0	41.0	38.0	10.0	10.0	8.0	24.0	9.1	24.0	12.5
6	24.0	38.0	16.5	30.0	30.0	15.0	15.0	3.3	37.0	32.0	21.0	33.0	45.5	33.5	15.0	12.5	1.0	19.0	8.3	41.0	13.1
7	24.0	22.0	19.0	30.0	35.0	20.0	10.0	2.5	22.0	22.0	17.0	31.0	43.5	47.0	20.0	15.0	10.0	23.0	9.3	37.0	13.5
8	24.0	31.0	18.0	29.0	35.0	15.0	14.0	3.5	31.0	28.0	18.0	34.0	41.0	30.0	35.0	15.0	10.0	30.0	11.3	49.0	16.4
9	26.0	28.0	17.0	30.0	40.0	2.0	10.0	2.4	28.0	30.0	20.0	32.0	40.0	28.5	2.0	15.0	10.0	34.0	12.0	52.0	16.9
10	21.0	21.0	14.5	30.5	25.0	1.5	12.0	2.9	21.0	20.0	15.0	32.0	38.5	33.0	15.0	10.0	10.0	19.0	6.0	36.0	10.9
11	22.5	22.0	23.0	26.0	20.0	2.0	6.0	1.4	22.0	23.0	17.0	32.0	47.0	48.0	30.0	15.0	10.0	26.0	10.0	36.0	13.1
12	19.0	17.0	17.0	12.0	20.0	1.8	2.0	0.3	17.0	21.0	12.0	19.0	43.0	31.0	2.0	4.0	3.0	33.0	12.0	35.0	12.3
13	21.0	21.0	14.0	17.0	30.0	3.0	2.0	0.3	21.0	20.9	13.0	18.0	38.0	32.0	3.0	10.0	9.0	34.0	11.5	36.0	11.8
14	17.0	17.0	8.0	18.0	20.0	20.0	20.0	0.3	17.0	23.0	14.0	22.0	40.0	38.0	2.0	18.0	11.0	32.0	12.5	34.0	12.8
15	20.0	21.0	14.0	11.5	20.0	3.0	2.0	0.3	20.0	24.0	30.0	20.0	44.0	35.0	3.0	1.0	1.0	38.0	12.0	40.0	12.3
16	18.0	17.0	13.0	1.0	28.0	1.0	2.0	0.3	17.0	20.0	12.0	19.0	37.0	36.0	2.0	0.9	0.6	33.0	10.7	35.0	11.0
17	22.0	23.0	21.0	22.2	22.0	1.8	2.0	0.3	21.0	21.0	22.0	22.6	40.0	44.0	22.0	1.0	0.6	31.0	11.5	33.0	10.8
18	14.0	13.0	17.0	20.0	16.0	1.2	2.0	0.3	13.0	15.0	11.0	19.0	35.0	37.0	1.2	0.6	0.4	27.0	8.7	29.0	9.0
19	17.0	17.0	15.0	18.0	20.0	2.0	2.0	0.3	13.0	20.0	10.0	29.0	30.0	29.0	1.0	1.0	0.3	38.0	9.4	40.0	9.7

### F. Participant list

No	Name of participant	Sex		Position	Institution	Ethnic	Address			
		M	F				Village	Commune	District	Province
1	Ny Kimhueurn	1		Kg Kboeung CFMC	<b>Position</b>	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
2	Nguon Hon	1		Deputy village chief	Kg. Kboeung CFMC	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
3	Song Chann Khorn	1		Deputy of Kg Kboeung CF	Kg Kboeung village	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
4	Sem Ven	1		Deputy chief of CFMC	Kboeung CF	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
5	Heang Vila	1		CF member	Kg Kboeung	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
6	Mai On	1		CF member	Kg Kboeung	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
7	Nguon Virak	1		CF member	Kg Kboeung	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
8	Ee Sochea	1		Officer	Boeung Char	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
9	Nguon Sophat		1	CFMC member	Kg Kboeung	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
10	Sron Sam Ul		1	CFMC member	Kg Kboeung	Khmer	Kg Kboeung	Boeung Char	Sambo	Kratie
11	Hul Vet	1		Deputy village chief	Koh Ent Chey CF	Khmer	Koh Ent Chey	Boeung Char	Sambo	Kratie
12	Nguon Soa	1		CFMC member	Koh Ent Chey CF	Khmer	Koh Ent Chey	Boeung Char	Sambo	Kratie
13	San VanSen		1	CFMC member	Koh Ent Chey CF	Khmer	Koh Ent Chey	Boeung Char	Sambo	Kratie
14	Sou Laim		1	CFMC member	Koh Ent Chey CF	Khmer	Koh Ent Chey	Boeung Char	Sambo	Kratie
15	Mao Hin	1		CFMC member	Koh Ent Chey CF	Khmer	Koh Ent Chey	Boeung Char	Sambo	Kratie
16	Sor Sim	1	1	CFMC member	Koh Ent Chey CF	Khmer	Koh Ent Chey	Boeung Char	Sambo	Kratie
17	Nguon Sina	1		CFMC member	Koh Ent Chey CF	Khmer	Koh Ent Chey	Boeung Char	Sambo	Kratie
18	Khuon Deurn		1	CF chief	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
19	Meas Rithy		1	CFMC member	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
20	Seb Narin		1	CFMC member	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
21	Sruerng Han	1		CFMC member	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
22	Prum Tith	1		CFMC member	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
23	So Vanney	1		CFMC member	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
24	Sao Nen	1		Second deputy village chief	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie

25	Sem Beurn	1		First deputy village chief	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
26	Uk Kim Hong		1	CFMC member	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
27	Song Yean	1		CFMC member	Kg. Damrey CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
28	Keo Chhat	1		Deputy village chief	O Krasang CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
29	Ek Than	1		CFMC chief	O Krasang CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
30	Pring Sameurn		1	CFMC member	O Krasang CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
31	Keo Vannak	1		CFMC member	O Krasang CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
32	En Kheurn	1		CFMC member	O Krasang CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
33	Bat Lean	1		CFMC member	O Krasang CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
34	Keo Tola	1		CFMC member	O Krasang CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
35	Uch Dong	1		Officer	Police	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
36	Seur Sang	1		CFMC member	O Krasang CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
37	Ek Voir	1		CFMC member	O Krasang CF	Khmer	Kg. Damrey	Boeung Char	Sambo	Kratie
38	Preap Prathna	1		Livelihood specialist	WI	Khmer				Kg Thom
39	Khou Eang Hourt	1		Team leader	Consultant					Phnom Penh
40	Neak Phearom	1		Member	Consultant					Phnom Penh
41	Ken Pisith	1		Member	Consultant					Phnom Penh