



**Enhancing Capacity of Local Communities and Forestry Administration
to Effectively Implement Community Forestry Program
in Kratie and Monduliri Provinces**

Forest Cover Assessment in Kratie and Monduliri provinces

Pak Chealy

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Forestry Administration
Hort Sothea, National Project Coordinator

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project of 36 months**

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The collective efforts of the Cambodia Project Team and officials of the Department of Forest Management and Community Forestry were responsible for conducting the field verification of land cover in Kratie and Monduliri provinces.

Summary

To monitor the loss of forestland and forest degradation, the Forestry Administration has conducted a series of forest cover assessments in 1992/93, 1996/97, 2000 (partial), 2002, 2006, and 2010. In complying with REDD+ reporting and forest management requirements, the Forestry Administration has updated the methodology and the national forest cover assessments of 2006 and 2010 and conducted new forest cover assessments in 2014 and every 2 years succeeding the 2014 assessment through 2020. In 2021, the Forestry Administration conducted the assessment of forest cover in Kratie and Mondulkiri provinces.

Monitoring and evaluation of the forest cover in Kratie and Mondulkiri provinces was generated by semi-auto classification with spatial segmentation and classification based on the national forest cover 2020. To improve the final results for forest cover 2021, the manual edition on Sentinel-2 satellite imagery with 10 m resolution was applied. According to the assessment of forest cover 2021, the forest cover in Kratie province is approximately 497,086 ha (41.52%) and the forest cover in Mondulkiri province is approximately 1,141,578 ha (83.52%) with an overall accuracy of 76%.

The assessments also indicated that the rate of forest cover change in Kratie province from 2013 to 2021 was 18.35%, with an average annual change of 2.29% of the provincial land area. The changes increased during the period 2016-2018, with forest cover in Kratie province declining more than 4%, with forest decreasing by 6.83% from 2018-2021.

The rate of forest cover change in Mondulkiri province from 2013 to 2021 was 4.47%, with an average annual change of 0.55% of the provincial total land area. The changes increased during the period 2014-2016, with forest cover in Mondulkiri province declining by 1.69%, while from 2018-2021, the rate of change became relatively stable with an annual change of 0.43%.

There is considerable demand for updated forest cover data to monitor and control various situations associated with forest cover resources that have changed at the sub-national level. To support the development of a strategic plan to manage and develop forest resources in accordance with the National Forest Programme and a draft forestry strategy, the assessment of forest cover and forest cover change at the subnational level should be conducted annually.

The results of the field verification provide an additional indicator for monitoring variations in forest cover in the region and support the classification of forest cover of the country.

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1. Introduction

The management of forests in Cambodia is confronted by many challenges. The Royal Government of Cambodia (RGC) is determined to continue its forestry reforms in order to strengthen the protection and sustainable management of the country's forest resources. In 1965, forests covered an estimated 73% of the country's territory. To monitor the loss of forestland and forest degradation, the Forestry Administration has conducted a series of forest cover assessments in 1992/93, 1996/97, 2000 (partial), 2002, 2006, and 2010. In complying with REDD+ reporting and forest management requirements, the Forestry Administration has updated the methodology and national forest cover assessments of 2006 and 2010 and conducted new forest cover assessments in 2014 and every 2 years succeeding the 2014 assessment through 2020. The Forestry Administration has also implemented a national forest cover assessment through 2020 for the entire country with technical and financial support from the UNDP, FAO-UNREDD, and ITTO. Currently, we are working on forest cover assessments for 2021 in Monduliri and Kratie provinces by using SENTINEL-2 imagery with support from the ITTO. In this project, we are introducing a semi-auto categorization methodology to classify forest cover in the project area.

2. Objective

The primary objective of this project is to produce updated forest cover maps of Permanent Forest in Kratie and Monduliri provinces of Cambodia in 2021.

3. Data Processing and Classification Procedure

3.1. SENTINEL-2 Imageries

SENTINEL-2, launched as part of the European Commission's Copernicus program on June 23, 2015, was designed specifically to deliver a wealth of data and imagery. The satellite is equipped with an opto-electronic multispectral sensor (MSI) for surveying with a sentinel-2 resolution of 10 to 60 m in the visible, near infrared (VNIR), and short-wave infrared (SWIR) spectral zones. This includes 13 spectral channels, which ensures the capture of differences in vegetation state, including temporal changes, and also minimizes impacts on the quality of atmospheric photography. Within the 13 bands, the 10 meter spatial resolution allows for continued collaboration with the SPOT-5 and Landsat-8 missions, with a core focus on land classification. There is a free and open data acquisition policy.

The satellite orbits at an average height of 785 km and the presence of two satellites in the mission allows repeated surveys every 5 days at the equator and every 2-3 days at middle latitudes. The Sentinel-2 data provides the GMES (Global Monitoring for Environment and Security) program, which is jointly implemented by the EC (European Commission) and ESA (European Space Agency) with services related to land management, agricultural production, and forestry, as well as the monitoring of natural disasters and humanitarian operations.

The study area is dominated by dry deciduous forests whose trees drop their leaves in the dry season according to the characteristics of the classification of forest cover and forest cover change. The most appropriate time for obtaining the most useful satellite images is, therefore, from November to early February of every year.

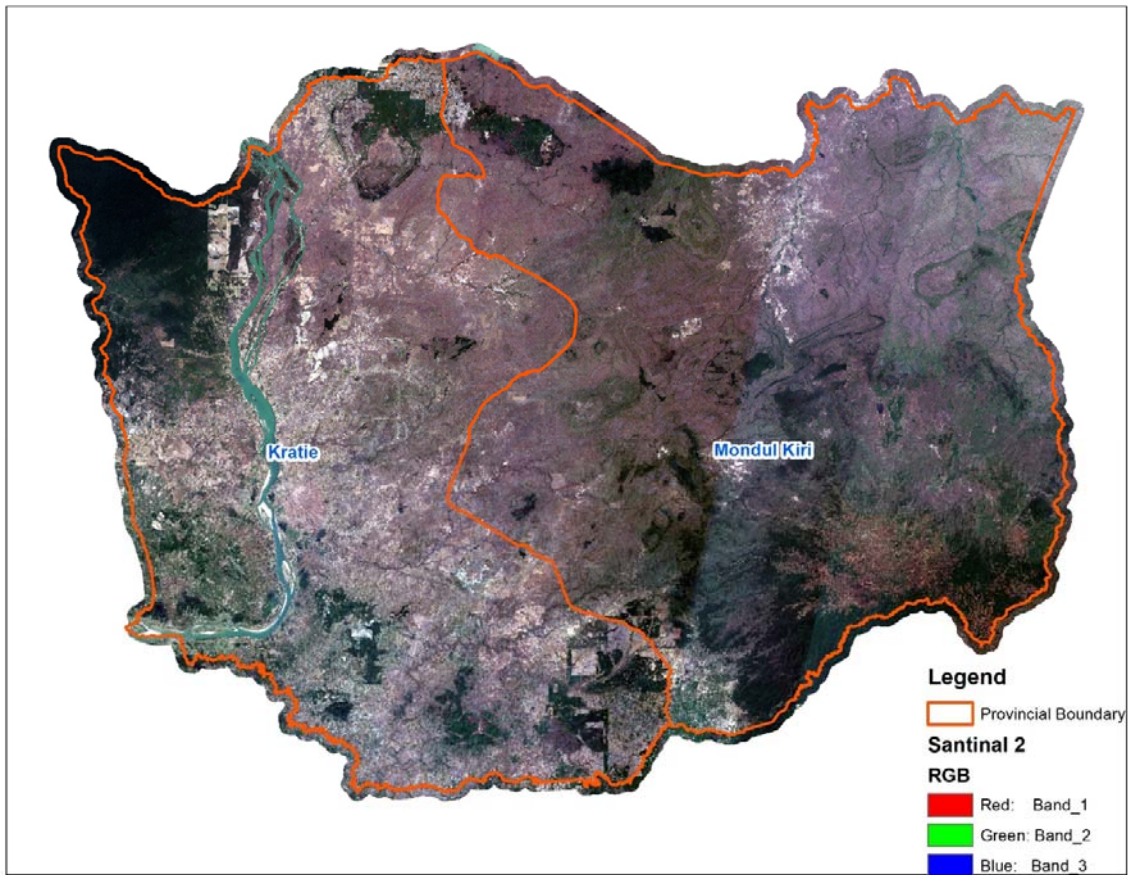


Figure 1. SENTINEL-2 cover in the project area.

3.2. Classification Procedure

- **Definition of forest cover classification**

One of the critical aspects of the process of forest land use/cover resource assessments is that the decision on defining forest is an important technical consideration. To maintain consistency, the Forestry Administration uses the definition of forests stated in the National Forest Program (NFP) for the assessment of land use/cover map 2014. The NFP 2010-2029, which aims to achieve sustainable forest management to contribute to the development of the national economy and the reduction of poverty has defined “forest” for the national forest assessment in the following manner: **“Forest is the unit of the natural ecosystem or plantation in the forms of wetland, low land and dry land which cover by natural stands or plantation trees with a height from 5 meters on an area at least 0.5 hectares with a canopy of more than 10 percent. The plantation such as rubber, oil palm, teak, acacia and eucalyptus and other kinds of trees which fall under the above criteria will also be classified as forests.”** The classification of forests in the forest cover assessment 2021 in Kratie and Mondul Kiri provinces is consistent with the definition of forest provided in the NFP.

- **Classification Method**

After processing, the downloaded SENTINEL-2 satellite image is quality enhanced and interpreted for the mapping of different forest and land statuses. Image interpretation methods applied to SENTINEL-2 represent classification by a manual using ArcGIS based on the base map of forest cover 2020 produced by the Forestry Administration. Subsequent to image interpretation, the forest cover in the project was classified into 15 different types.

Table 2. Criteria for classified forest cover assessment in the project area.

No	Land cover class	Description
1	Evergreen forest (E)	Areas covered by trees maintaining their leaves during the whole year.
2	Semi-evergreen forest (Se)	Contain variable percentages of evergreen and deciduous trees.
3	Deciduous forest (D)	Comprised of dry mixed deciduous forest and dry Dipterocarp forests.
4	Bamboo (B)	Areas dominated by bamboo.
5	Wood shrub (Ws)	Areas dominated by evergreen and deciduous woodland with a height less than 5 meters.
6	Rubber plantation (Rp)	Areas currently supporting, and areas reserved for, rubber plantations.
7	Forest Regrowth (Fr)	<p>Areas of naturally regenerated forest where there are clearly visible indications of human activities such as selective logging, areas regenerating following agricultural land use, or areas recovering from human induced fire.</p> <ul style="list-style-type: none"> • Includes forest where it is not possible to distinguish whether the forest has been planted or naturally regenerated. • Includes forests with a mix of naturally regenerated trees and planted/seeded trees and where the naturally regenerated trees are expected to constitute more than 50 percent of the growing stock at stand maturity. • Includes abandoned forestland and bare land which will regrow into forest within ten years.
8	Paddy Field (Hr)	A paddy field is a flooded parcel of <u>arable land</u> used for growing <u>semiaquatic rice</u> .
9	Crop Land (Hc)	This category includes arable and tillage land and agroforestry systems where vegetation falls below the thresholds used for forestland categories.
10	Grassland (G)	Grasslands are characterized as lands dominated by grasses rather than by large shrubs or trees. It is crucial that the rainfall is concentrated in six or eight months of the year, followed by a long period of drought when fires can occur.
11	Built-up area (Bu)	A patch of land with buildings and construction.
12	Village (Bt)	A patch of land with houses and gardens surrounding the houses.
13	Rock (R)	Land of naturally exposed rocks or strip mines, quarries and gravel pits.
14	Sand (S)	In general, land of sand having thin soil or sand, including deserts, dry salt flats, beaches, and sand dunes.
15	Water (W)	Area of fresh or sea water.

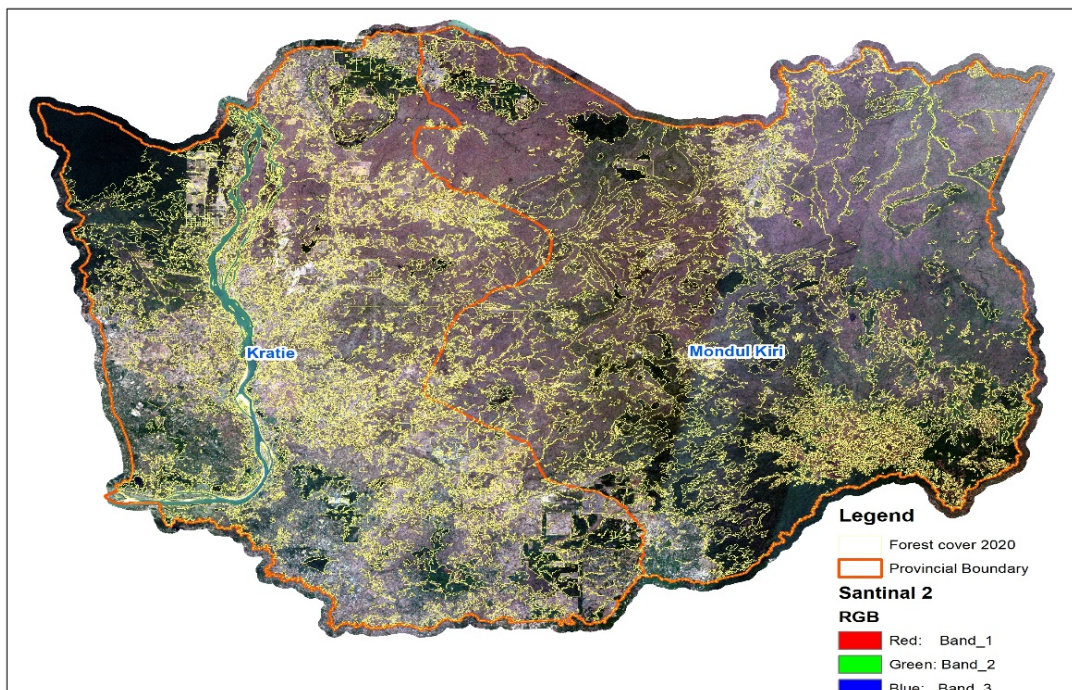


Figure 2. Segmentation based on the base map forest cover 2020.


3.3. Accuracy assessment

The assessment of accuracy was determined empirically by selecting pixels from the thematic map and checking their labels against classes determined from reference data available in existing land cover maps and aerial photographs. Without the accuracy assessment, the output would be of limited value.

The accuracy assessment of the 2021 LULC was conducted using the FAO SEPAL system. Reference samples for accuracy assessment were generated by using SEPAL's stratified area estimation tool.

Reference samples were collected in ground surveys, as well as by interpretation of satellite imagery such as Google Earth.

Outline of the steps of the accuracy assessment.

<p style="text-align: center;">Map data</p> <p style="text-align: center;">Obtain map data</p> <p style="text-align: center;">Clearly define all the map classes</p> <p style="text-align: center;">Check and correct for obvious errors</p> <p style="text-align: center;">Define the strata</p>	<p style="text-align: center;">Legend labeling</p> <p>The legend classes need to be specified and submitted. Please wait for the map values to appear. Then type the names of the classes and submit the legend. After submitting the legend the table with the map classes and area will appear. The legend names can be modified at any time in this tab.</p> <p style="text-align: center;">Submit legend</p> <p>Edi class name for map value: 0 0</p> <p>Edi class name for map value: 0t 0t</p> <p>Edi class name for map value: 0u 0u</p> <p>Edi class name for map value: 0 0</p>	<p style="text-align: center;">Display map</p> 
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Sampling Design

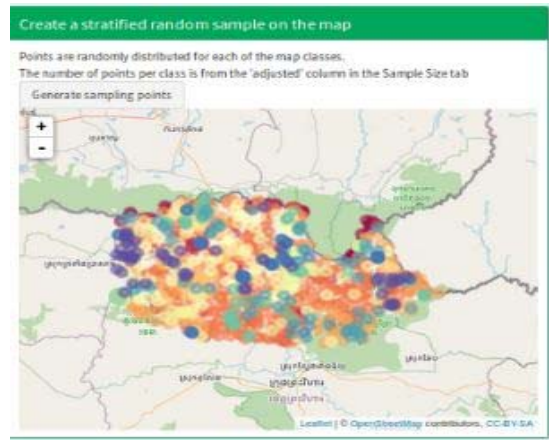
Determine the sampling approach

Calculate the overall sample size

Determine the distribution of the overall sample by strata

Determine the spatial unit of assessment for the reference data

Distribute the amount of sample within the map data



Response Design

Translate the map class definition into

Definition for the reference classes

Collect the reference data

Analysis

Estimate the accuracy and area estimates with associated confidence intervals

3.3.1 Field survey

• Field preparation

The points selected for field checking were transferred to Garmin GPS 60 csx devices. Optimal routes for the validation teams were prepared based on road maps and other relevant information. The following materials and information were prepared prior to departing for the field:

- 1) A map for field checking the points to visit, with the field check points overlaid and labelled with an overlay of the road layer to assist in accessing the point and administrative data.
- 2) The definition of land cover and forest cover classification based on the forest cover definition.

The following equipment was used in the field:

- Map of satellite image and check list
- GPS Garmin 60 csx
- Compass for navigation
- Digital camera
- Notebook
- Transportation

3.3.2 How to obtain field verification data?

The land use and cover classes were categorized with reference to the definition and characteristics of each land use. The field team leader had to have sufficient experience reading the information in the field and had to recognize the tree species in identifying the forest type.

Field photos for field verification data require representative samples and photos that describe the field or the landscape.



Figure 3. The four directions of plot photos taken using a digital camera.

To take photos useful for assessing accuracy and mapping and analysing land use and land cover change, the following protocols were used.

- It is useful to take field photos and record locations at a regular temporal interval that can illustrate the phenology of the landscape or the change in land use and land cover
- To provide a general pattern of the landscape, the size of the field, and neighborhood features, the pictures should be taken from the center of the selected field and directed in each of the four directions (N, E, W, S)
- One vertical picture at breast height will indicate the percentage cover of vegetation, soil, and other matter similar to the way that satellites view objects on the earth's surface.

4. Results

4.1 Forest cover 2021 in Kratie province

The forest cover 2021 in Kratie and Monduliri provinces was generated manually based on the forest cover 2020. According to the assessment of forest cover 2021, the forest cover in Kratie province is approximately 497,086 ha (41.52%). The area is dominated by deciduous forest amounting to almost 322,290 ha (26.92%), with 67,299 ha (5.62%) classified as evergreen forest, 60,042 ha (5.01%) classified as semi-evergreen forest, and approximately 700,178 ha (58.48%) classified as Non-Forest of the total land in the province.

The summary of land use/land cover types in different classes in Kratie province is provided in Table 3 and displayed in Figure 4.

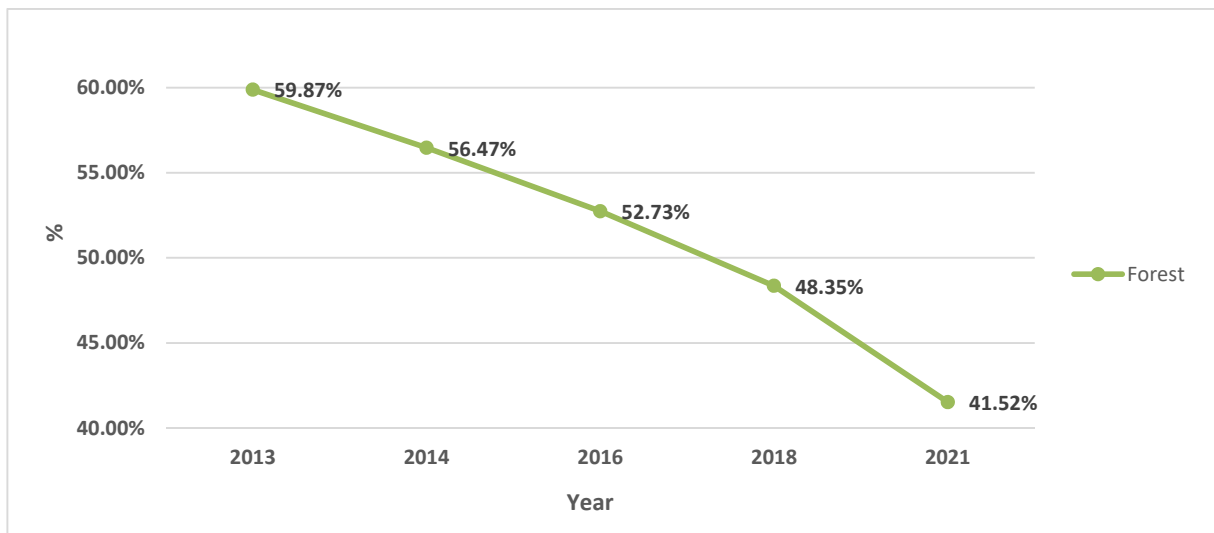
Table 3. Forest cover 2021 in Kratie province.

ID	Forest cover	2021	
		Area (ha)	%
1	Evergreen	67,299	5.62
2	Semi-evergreen	60,042	5.01
3	Deciduous	322,290	26.92
4	Bamboo	13,818	1.15
5	Forest regrowth	12,089	1.01
6	Flooded forest	9,123	0.76

7	Tree plantations	12,426	1.04
	Forest cover	497,086	41.52
8	Rubber plantations	84,635	7.07
9	Crop land	353,781	29.55
10	Paddy fields	85,385	7.13
11	Villages	7,451	0.62
12	Built up areas	597	0.05
13	Grass	124,921	10.43
14	Rock	583	0.05
15	Sand	2,748	0.23
16	Water	33,810	2.82
17	Wood Shrubs	6,267	0.52
	Non Forest	700,178	58.48
	Total Area (ha)	1,197,264	100

4.2 Forest Cover trend in Kratie province

According to the depiction provided in the following graphic, the rate of forest cover change from 2013 to 2021 was 18.35%, with an average annual change of 2.29% of the provincial land area. The changes increased during the period 2016-2018, with forest cover in Kratie province declining more than 4%, with forest decreasing by 6.83% from 2018-2021.



Graphic 1. Land cover trend in Kratie province from 2013-2021.

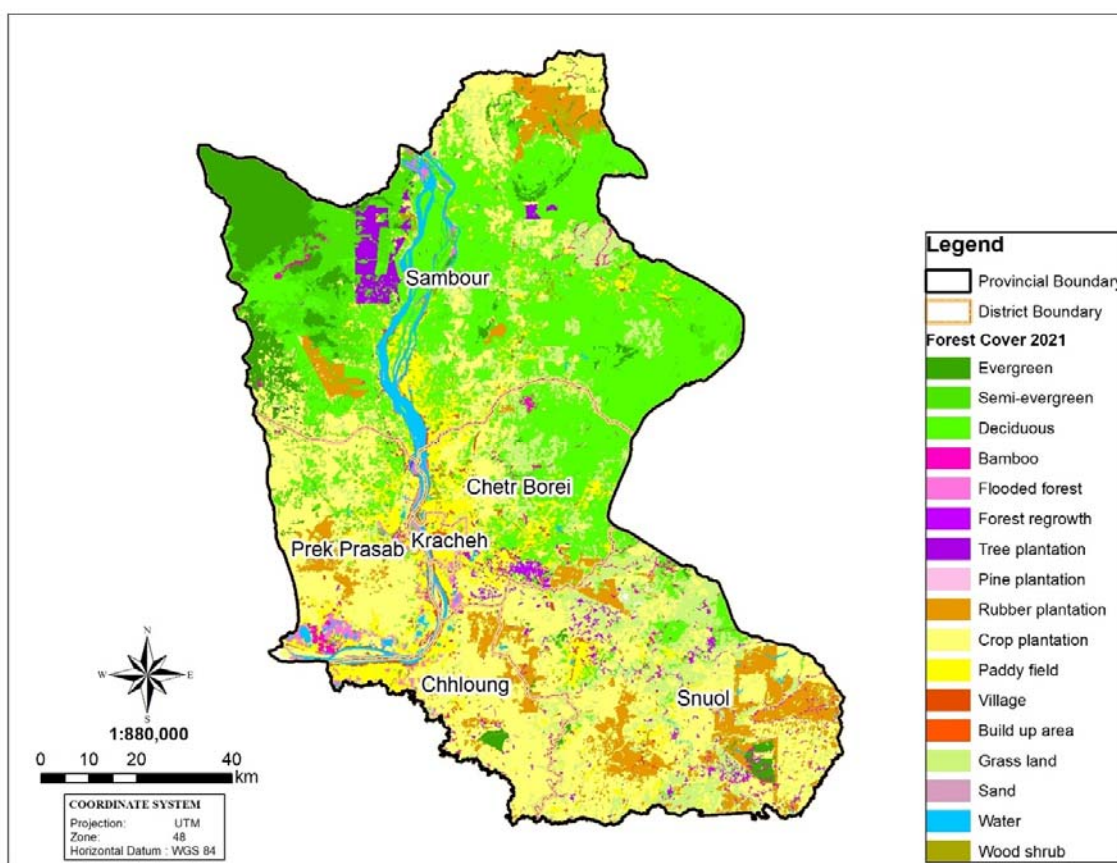


Figure 4. Forest cover map 2021, Kratie province.

4.3 Forest cover 2021 in Mondulkiri province

The forest cover 2021 in Kratie and Mondulkiri provinces was generated manually based on the forest cover 2020. According to the assessment of forest cover 2021, the forest cover in Mondulkiri province is approximately 1,141,578 ha (83.52%). The area is dominated by deciduous forest amounting to almost 825,965 ha (60.43%), with 166,476 ha (12.18%) classified as semi-evergreen forest, 119,966 ha (8.78%) classified as evergreen forest, and approximately 225,330 ha (16.48%) classified as Non-Forest of the total land in the province.

The summary of land use/land cover types in different classes is provided in Table 4 and displayed in Figure 5.

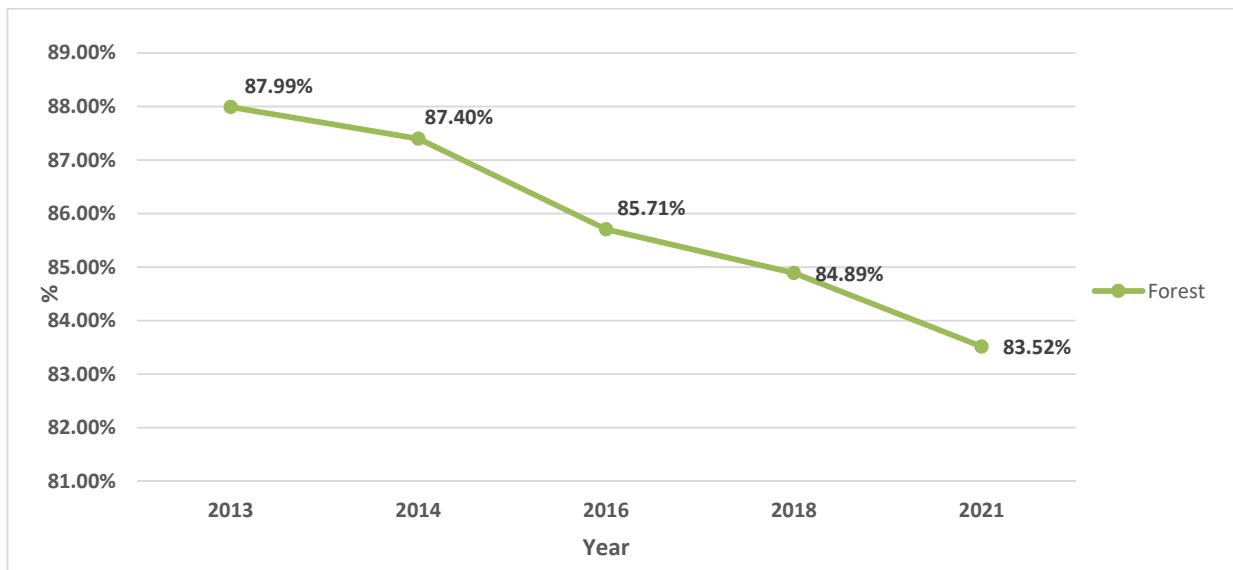
Table 4. Forest cover 2021 in Mondulkiri province.

ID	Forest cover	2021	
		Area (ha)	%
1	Evergreen	119,966	8.78
2	Semi-evergreen	166,476	12.18
3	Deciduous	825,965	60.43
4	Bambo	9,777	0.72
5	Forest regrowth	16,641	1.22
6	Flooded forest	76	0.01
7	Pine plantations	2,669	0.20
8	Tree plantations	8	0.00
	Forest cover	1,141,578	83.52

9	Rubber plantations	43,399	3.17
10	Cropland	68,568	5.02
11	Paddy fields	20,034	1.47
12	Villages	2,440	0.18
13	Built up areas	472	0.03
14	Grass	84,710	6.20
15	Sand	1,180	0.09
16	Water	2,551	0.19
17	Woods/Shrubs	1,976	0.14
	Non Forest	225,330	16.48
	Total Area (ha)	1,366,908	100.00

4.4 Forest Cover trend in Mondulkiri province

According to the depiction provided in the following graphic, the rate of forest cover change from 2013 to 2021 was 4.47%, with an average annual change of 0.55% of the provincial total land area. The changes increased during the period 2014-2016, with forest cover in Mondulkiri province declining by 1.69%, while from 2018-2021, the rate of change became relatively stable with an annual change of 0.43%.



Graphic 2. Land cover trend in Mondulkiri province from 2013-2021.

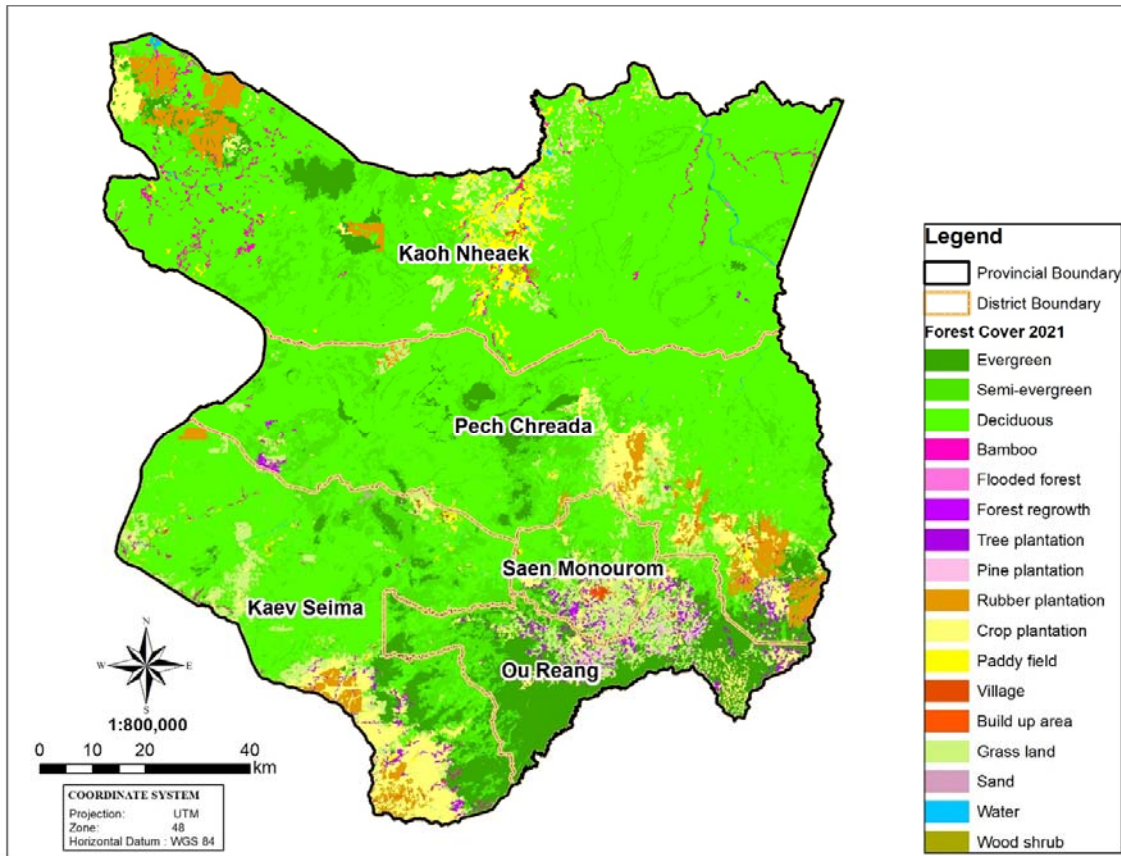


Figure 5. Forest cover map 2021, Mondulkiri province.

4.5 Accuracy Assessment

The accuracy assessment is the most important step in the classification procedure because it determines the accuracy of the classification received and the probability of the reliability of the image classification.

The accuracy assessment reflects the difference between our classification and the reference data. Consequently, if the reference data is highly inaccurate, the assessment might indicate that the classification is poor, while, in reality, it really is a relatively good classification. It is better to obtain fewer, but more accurate, reference data points. You also have to be aware of temporal changes. If the satellite image was taken at a different time than when the reference data were collected, apparent errors might be due to the fact that the landscape had changed.

The random sample points were generated by SEPAL with 50 the minimum random points in each class.

Table 6. The random points for checking the accuracy assessment.

Forest Type	Random Point
Evergreen	59
Semi-evergreen	60
Deciduous	330
Bamboo	32
Forest regrowth	15
Flooded forest	32
Pine plantations	13
Tree plantations	34

Rubber plantations	35
Crop land	139
Paddy fields	34
Villages	33
Built up areas	24
Grass	69
Sand	29
Water	22
Rock	29
Wood/Shrubs	26
Grand Total	1015

4.6 Random field sample

To increase accuracy, 7% (75) of the 1,015 random sample points were generated for field checking. The distribution of random sample points was based on road accessibility.

Table 5. Summary of random points in Kratie and Mondulkiri provinces.

Forest Type	Random points for field verification	
	Kratie	Mondulkiri
Evergreen		3
Semi-evergreen		
Deciduous	5	7
Bamboo		
Forest regrowth	1	1
Flooded forest		
Pine plantations		6
Tree plantations		
Rubber plantations		1
Crop land	9	5
Paddy fields	6	2
Villages	8	2
Built up areas	2	6
Grass	2	5
Sand		1
Water		
Rock		
Wood Shrubs		3
Grand Total	33	42



Figure 6. Field verification activities in Kratie and Mondulkiri provinces.

Table 6. Confusion matrix of the field verification.

Forest cover	Bt	Bu	D	E	Fr	G	Hc	Hr	Pp	Rp	S	Ws	Grand Total
Bt	10							2					12
Bu		8											8
D			8			3	1						12
E				2									2
Fr				1	2								3
G						4	1						5
Hc							11						11
Hr								6					6
Pp									6	1			7
Rp							1						1
S											1		1
Se			1										1
Ws			3									3	6
Grand Total	10	8	12	3	2	7	14	8	6	1	1	3	75

Note: E: Evergreen forest, Se: Semi-evergreen forest, D: Deciduous forest, Fr: Forest Regrowth, G: grass, W: water, WS: Wood shrubs B: Bamboo, S: sand, Hc: Crop, Hr: Rice field, Bu: Build up area, Bt: village

The confusion matrix (Table 6) indicates that the overall accuracy associated with the field check is **77 %**.

The accuracy assessment of the LULC 2021 was improved by conducting interpretation of the Collect Earth base on the high-resolution image on Google Earth with 18 forest classes. The final accuracy combined the results collected from the field with the interpretation of the reference data by Collect Earth.

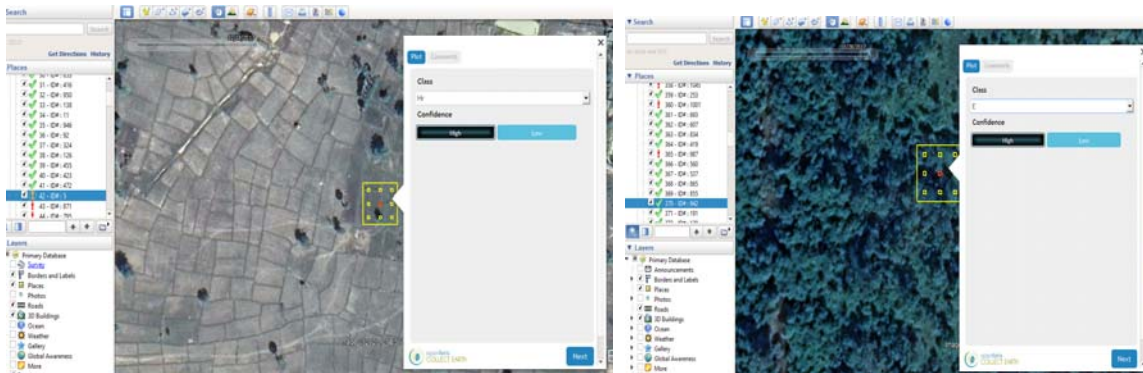


Figure 7. Random points were interpreted by Collect Earth.

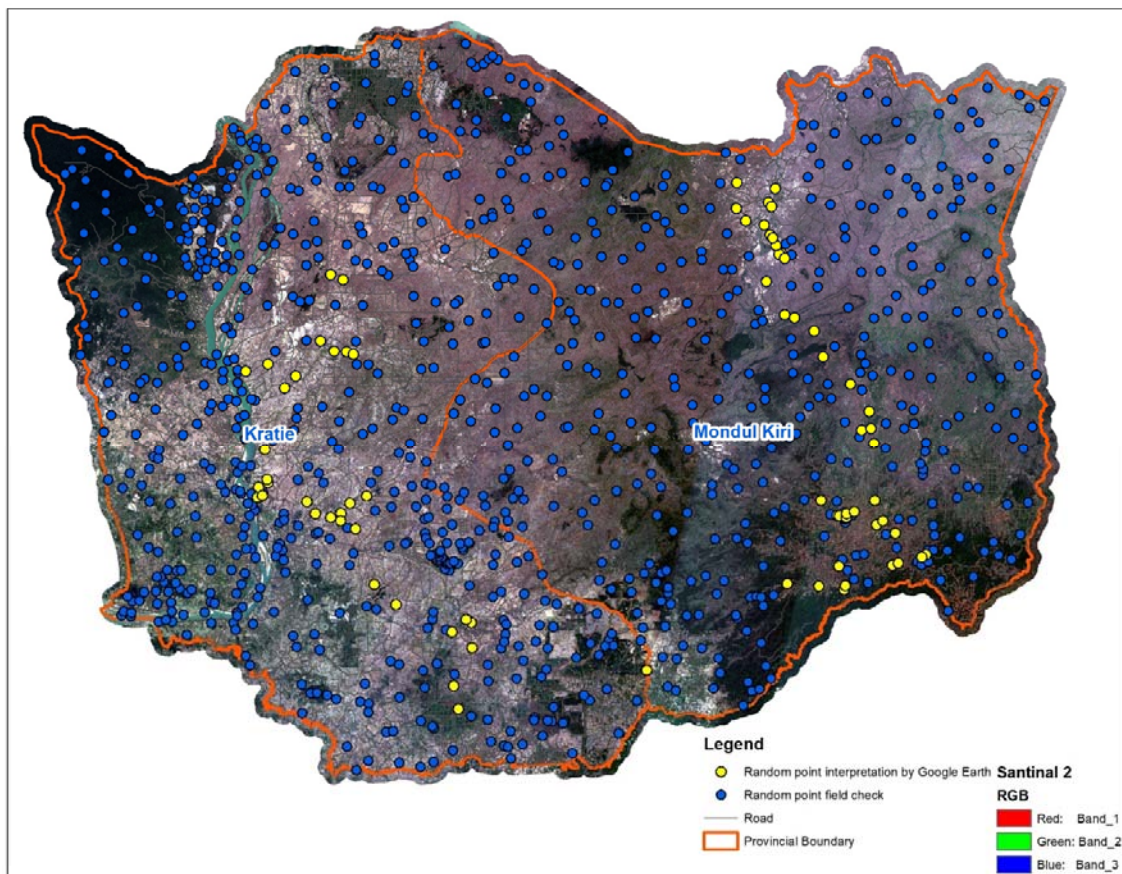


Figure 8. The distribution of random points was interpreted by Collect earth and field data.

Table 7. The data quality assessment of the classified land use/cover image for 2021.

Forest Types	B	Bt	Bu	D	E	Ff	Fr	G	H _c	H _r	Pp	R	Rp	S	Se	Tp	W	W _s	Total	User accuracy (%)
B	24			6				1		1									32	75
Bt		26							1	4							2		33	79
Bu		2	20	2															24	83
D	1			31 0				16	1	2									330	94
E	1				51		2								5				59	86
Ff						22	4	2		2							2		32	69
Fr					2		6	5	1	1									15	40
G	2			7	1		2	55	2										69	80
H _c	1	1		9	8			25	82	6					7				139	59

Hr				4					3	26						1		34	76	
Pp							1	1			11							13	85	
R			2					5										29	76	
Rp				3	2		2	5	3					18		1	1		35	51
S	2			2	1	1		2					1	16	2		2		29	55
Se	1			11		1									47				60	78
Tp				8				6	1						10	9			34	26
W				1				1									20		22	91
Ws				5				2	1	2				1			2	13	26	50
Total	32	29	22	36 8	65	24	17	12 6	95	44	11	22	19	17	72	9	30	13	1015	
Producers accuracy (%)	75	90	91	84	78	92	35	44	86	59	100	100	95	94	65	100	67	100		

Note: E : Evergreen forest , Se: Semi-evergreen forest, D : Deciduous forest, Fr: Forest Regrowth, G: grass, W: water, Ws: Wood shrub B : Bamboo, S: sand, Hc: Crop, Hr: Rice field, Bu: Build up area, Bt: village, R: rock, Rp : Rubber plantation, Pp: Pine Plantation, Tp: Tree plantation, Ff: Flooded Forest

According to the results of the confusion matrix, the overall accuracy is 76% with low values associated with tree plantations (26%) and Forest Regrowth (40%).

4.7 Forest Cover in Community Forestry

The final results of forest cover 2021 in Kratie and Monduliri provinces were used to monitor and assess community forestry areas in Kratie and Monduliri provinces. To support the project, statistics and maps of forest cover 2021 were generated. These are presented in tables 8 and 9 and depicted in figures 8 and 9.

Table 8. Forest cover 2021 statistics in community forests, Kratie province.

ID	Communities	Area (Ha)	E	Se	D	Fr	B	Ff	Rp	G	TP	Hc	Hr	Ws	R	W	S	Bt
1	Phnom Meas	1824		44	1613					115		18	34					
2	Sre Roneam	2021			1761		58			199		3						
3	Ro Lous	1163		55	1032					20		37				2	17	
4	Pa Kle	1940			1729					30		3	175				6	
5	Stoung Thom	638				4			4			628	4					
6	KanTout	716			669	8						14	13			12		
7	Our Ta Neang	613			586					20		7						
8	Cham Bok	122					120					2						
9	Our Kreang	2713	8	40	2595					8		41	6				15	
10	Cham Reoun	825			762					28			35					
11	Ta VA	982			945							11	13	13				
12	Ksach Leav	1886			1849					12		7				18		
13	Koh Xhjar	1659		6	1280					43		202	123			4		1
14	Poun Da	692		39	640							13						
15	Boung Char	5584		324	5089	9	21	8				10	23	7		93		
16	Sre Cheas	2730		97	2623								9					
17	Our Kok	1200			1168					25		7						
18	Chromol	692			455					156		32	49					
19	Anglong Vean	692			500	99						64	29					
20	Romeas Poun Machoul	543			82	364						95	2					
21	Treab	1588		21	1265					50		120	132					
22	Tmar Tonle	2228	19	132	1708				38	8		286	3		34			
23	Kpoul	798		24	714					60								

24	Prasat Srot Sronge	733			657					20	31	25				
25	Phnom Torteng	463		9	354					13	80	7				
26	Phnom Bak	7205	1518	563	4868					4	10	240			2	
27	Veal Kanseng	1624	1549						1	7		34				33
28	Agnjagn	123	104	8	8	1						2				
29	Sre Thom	260	125	58	21		28			11		16			1	
30	Sre Touk	111					108					3				
31	Phnom Khrong	833			650					50		49	84			
32	Paear	468			438					30						
33	Prasat Teuk Khmoa	5630	1831	2839	890							38	4	5		23
34	Our Da	1349			874		17			215		240	3			
35	Phnom Ses	3081	249	345	1293			4	86			1104				
36	Phnom Lok	1334			26			42				1141	86	39		
37	Steung Tro	2392						77				2298	17			
38	Chrava	1216			164					78		842	64	50		18

Note: E : Evergreen forest , Se: Semi-evergreen forest, D : Deciduous forest, Fr: Forest Regrowth, G: grass, W: water, Ws: Wood shrub B : Bamboo, S: sand, Hc: Crop, Hr: Rice field, Bu: Build up area, Bt: village, R: rock, Rp : Rubber plantation, Pp: Pine Plantation, Tp: Tree plantation, Ff: Flooded Forest.

Table 9. Forest cover 2021 statistics in community forests, Mondulkiri province.

ID	Communities	Area (Ha)	E	Se	D	Rp	G	Tp	Hc	Hr	W
1	Pou Kroch	1231	98		881	1	201		50		
2	Or Chongnach	944		229	675		40				
3	Poum Pou Krang	678		154	402	79	16		8		19
4	Pou Radet	1323		18	982		274		36	13	
5	Ping Prang Klangpesso	1104	1050	46			8				

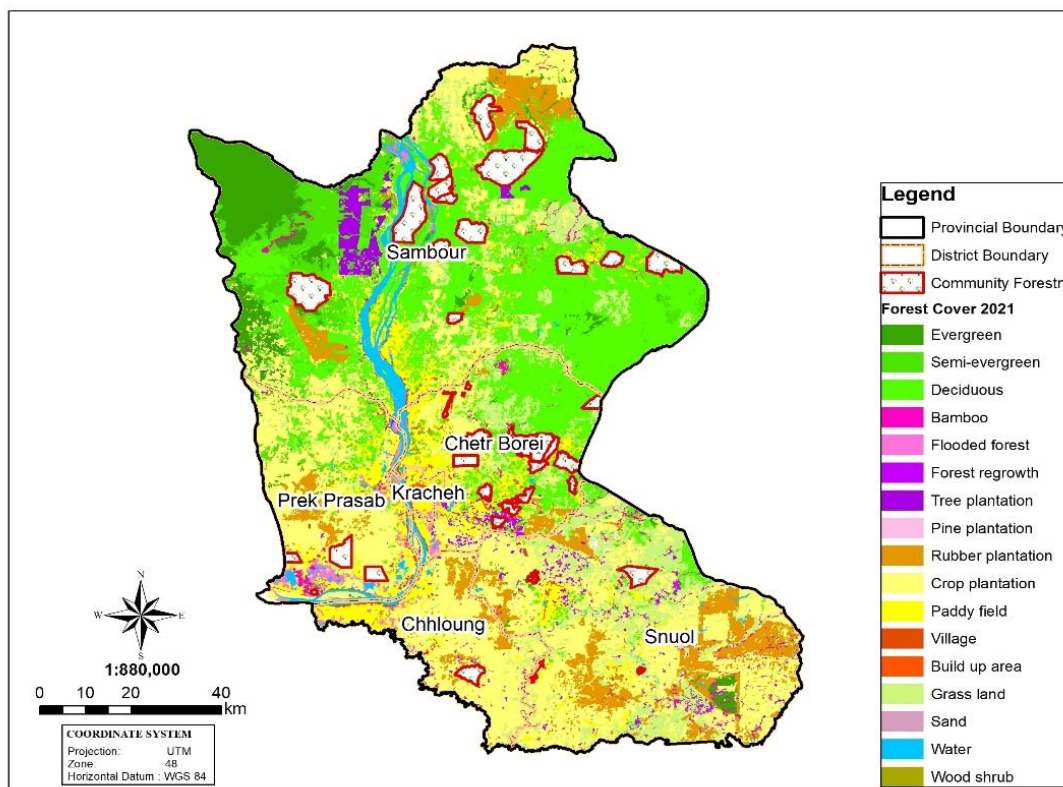


Figure 8. Community Forestry in Kratie province.

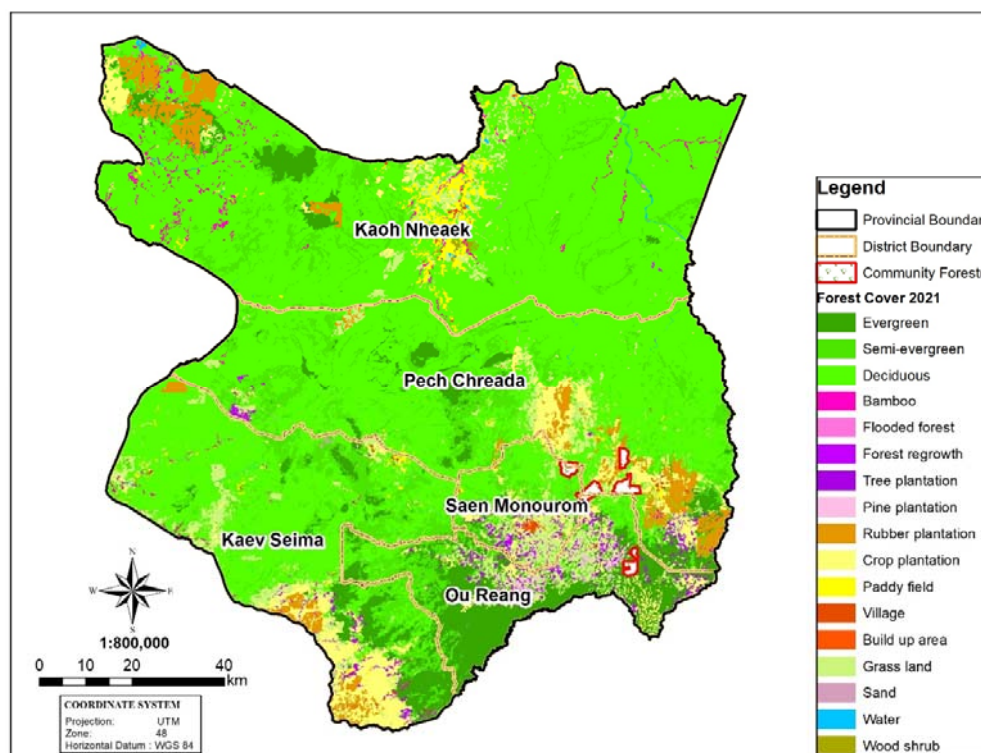


Figure 9. Community Forestry in Mondulkiri province.

5. Conclusions

Monitoring and evaluation of the forest cover in Kratie and Mondulkiri provinces was generated by semi-auto classification with spatial segmentation and classification based on the national forest cover 2020. To improve the final results for forest cover 2021, the manual edition of Sentinel-2 satellite imagery with 10 m resolution was applied. According to the assessment of forest cover 2021, the forest cover in Kratie province is approximately 497,086 ha (41.52%) and the forest cover in Mondulkiri province is approximately 1,141,578 ha (83.52%) with an overall accuracy of 76%.

There is considerable demand for updated forest cover data to monitor and control various situations associated with forest cover resources that have changed at the sub-national level. To support the development of a strategic plan to manage and develop forest resources in accordance with the National Forest Programme and a draft forestry strategy, the assessment of forest cover and forest cover changes at the subnational level should be conducted annually.

The results of the field verification provide an additional indicator for monitoring variations in forest cover in the region and support the classification of forest cover of the country.

Appendix 1: Field data sheet

Feature ID លេខរៀង		Date/Time ថ្ងៃទី/ខែ/ឆ្នាំ	
GPS Serial No. លេខ ធីតាអេស			
Waypoint No. ចំណុចលេខ		Surveyor Name ឈ្មោះអ្នកស្រាវជ្រាវ	
GPS Northing (WGS84) ខាងជើង (Y)		Weather (circle) អាកាសធាតុ	Sunny / Cloudy / Rainy មានថ្ងៃ / ពពក / ភ្លៀងធ្លាក់
GPS Easting (WGS84) ខាងកើត (X)		Slope ជម្រាល	Flat / Gentle Slope / Steep រាបស្មើ / ជម្រាលធម្មតា / ទាប
Camera ID (Make/Model) លេខម៉ាក/ម៉ូដែល			
Photo No លេខរូបថត		Compass Direction of Photo ទិសដៅនៃរូបថត	
Class (1 ha) ចំណាត់ថ្នាក់	EF / SE / DF / OF RP / NF / WE	Alt. class (20 ha unit)	
Certainty ច្បាស់លាស់	High / Low ខ្ពស់/ទាប	Stability (changes) ស្ថិរភាព	High / Low ខ្ពស់/ទាប
Average Height of Upper Storyកំពស់គិតជាមធ្យមភាគ			
	Crown density		
Upper Story ទិដ្ឋភាពខាងលើ	0-25% - 25-50% 50 - 75 % - 75 - 100	All the Stories ទិដ្ឋភាពរួម	0-25% - 25-50% 50 - 75 % - 75 - 100 %
Sketch គំនូសប្រាង			

Dominant species
ប្រភេទដើមឈើ

Guide to filling out the form

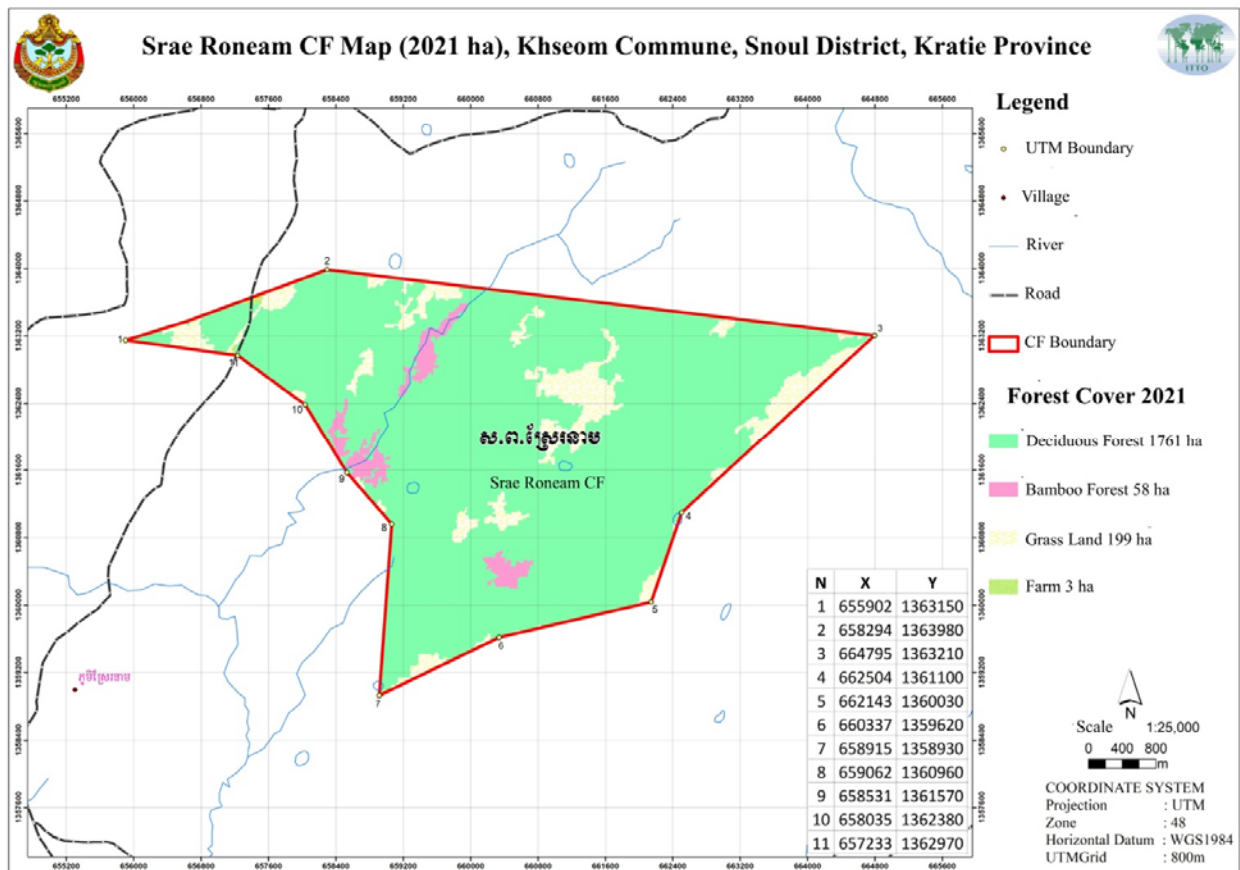
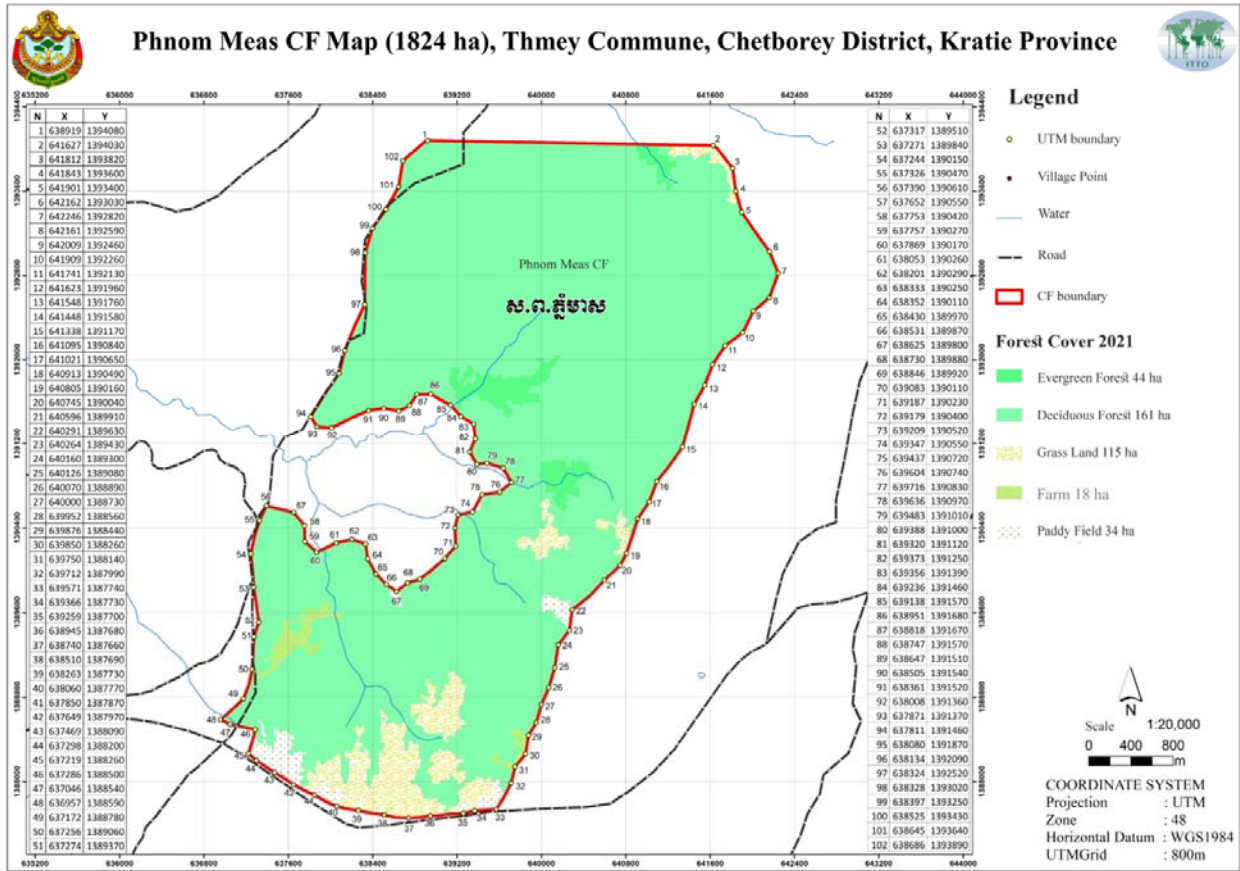
- 1) Class (1 ha): the class that best describes a 100 x 100 m area around the point.
- 2) Certainty of the field classification. For mixed classes or transitional classes, it can be a problem assigning a correct label in the field and, therefore, the certainty can be LOW. For uniform areas with little variation, the certainty is HIGH.
- 3) Class (20 ha): the class that best describes the 20-ha polygon around the point.
- 4) Stability: likelihood of recent changes. e.g., if an area appears to have been recently deforested or reforested, put LOW. If it appears to be unchanged, put HIGH.

Appendix 2: List of field data

N	Province	Code	X	Y	X1	Y1	1Ha	2Ha	5Ha	20Ha	Height of Upper story
1	Kratei	001	655033	1335889	655033	1335888	Bt	Bt	Bt	Bt	
2	Kratei	002	654023	1340931	654023	1340931	Bt	Bt	Bt	Bt	
3	Kratei	003	657675	1354692	657675	1354691	Bt	Bt	Hc	Hr	
4	Kratei	004	641560	1358488	641560	1358488	Bt	Bt	Bt	Bt	
5	Kratei	005	632864	1374910	632864	1374910	Bt	Bt	Bt	Bt	
6	Kratei	006	627507	1377410	627527	1377435	Bt	Bt	Bt	Bt	
7	Kratei	007	629653	1378356	629652	1378356	Bt	Bt	Bt	Bt	
8	Kratei	008	635156	1382096	635156	1382094	Hr	Hr	Hr	Bt	
9	Kratei	009	611997	1383964	611997	1383962	Hr	Hr	Bt	Hr	
10	Kratei	010	614040	1384921	614040	1384920	Bt	Bt	Hr	Bt	
11	Kratei	012	611812	1381744	611811	1381741	Bu	Bu	Bu	Bu	
12	Kratei	013	612880	1382098	612880	1382096	Bu	Bu	Bu	Bu	
13	Kratei	014	629636	1376665	629636	1376665	D	D	D	D	6m
14	Kratei	015	613986	1410921	613982	1410918	D	D	D	D	10m
15	Kratei	016	630715	1413693	630715	1413693	G	G	G	G	
16	Kratei	017	632152	1413186	632150	1413180	D	D	D	D	8m
17	Kratei	018	629930	1429299	629928	1429299	D	D	D	D	10m
18	Kratei	019	657906	1349189	657906	1349187	Fr	Fr	Fr	Fr	
19	Kratei	021	656625	1355342	656625	1355341	G	G	G	G	
20	Kratei	022	627265	1430436	627265	1430436	Hc	Hc	G	G	
21	Kratei	024	653588	1352592	653588	1352592	Hc	Hc	Hc	Hc	
22	Kratei	025	636912	1362864	636912	1362864	Hc	Hc	Hc	Hc	
23	Kratei	026	622332	1380889	622331	1380889	Hc	Hc	Hc	Hc	
24	Kratei	027	617555	1405794	617552	1405791	Hc	Hc	Hc	Hc	
25	Kratei	028	619870	1408330	619870	1408330	Hc	Hc	Hc	Hc	
26	Kratei	029	628060	1413802	628071	1413814	Hc	Hc	Hc	Hc	
27	Kratei	030	625169	1415989	625165	1415988	Hc	Hc	Hc	Hc	
28	Kratei	032	624203	1378209	624203	1378207	Hr	Hr	Hr	Hr	
29	Kratei	033	631569	1380551	631569	1380550	Hr	Hr	Hr	Hr	
30	Kratei	034	613889	1385612	613889	1385611	Hr	Hr	Hr	Hr	
31	Kratei	035	609241	1409363	609241	1409361	Hr	Hr	Hr	Hr	
32	Kratei	036	695393	1344642	695393	1344642	Hc	Hc	Hc	Hc	
33	Kratei	037	613407	1392184	613402	1392181	D	Hr	Hr	Hr	7m
34	Modulkiri	001	740982	1397353	740981	1397351	Bt	Bt	Bt	Bt	
35	Modulkiri	002	720672	1446772	720672	1446772	Bt	Bt	Bt	Bt	
36	Modulkiri	003	744356	1376645	744355	1376644	Bu	Bu	Bu	Bu	
37	Modulkiri	004	735931	1378582	735931	1378582	Bu	Bu	Bu	Bu	
38	Modulkiri	005	736313	1378530	736313	1378531	Bu	Bu	Bu	Bu	
39	Modulkiri	006	737800	1378120	737800	1378118	Bu	Bu	Bu	Bu	
40	Modulkiri	007	737911	1379012	737911	1379012	Bu	Bu	Bu	Bu	
41	Modulkiri	008	739504	1379462	739504	1379462	Bu	Bu	Bu	Bu	
42	Modulkiri	009	732429	1381790	732429	1381790	G	G	G	G	
43	Modulkiri	010	738502	1407346	738501	1407345	Hc	Hc	Hc	Hc	
44	Modulkiri	011	732573	1413218	732571	1413217	G	G	G	G	
45	Modulkiri	012	724339	1422312	724339	1422311	D	D	D	D	11m
46	Modulkiri	013	730651	1418828	730651	1418825	D	D	D	D	12m

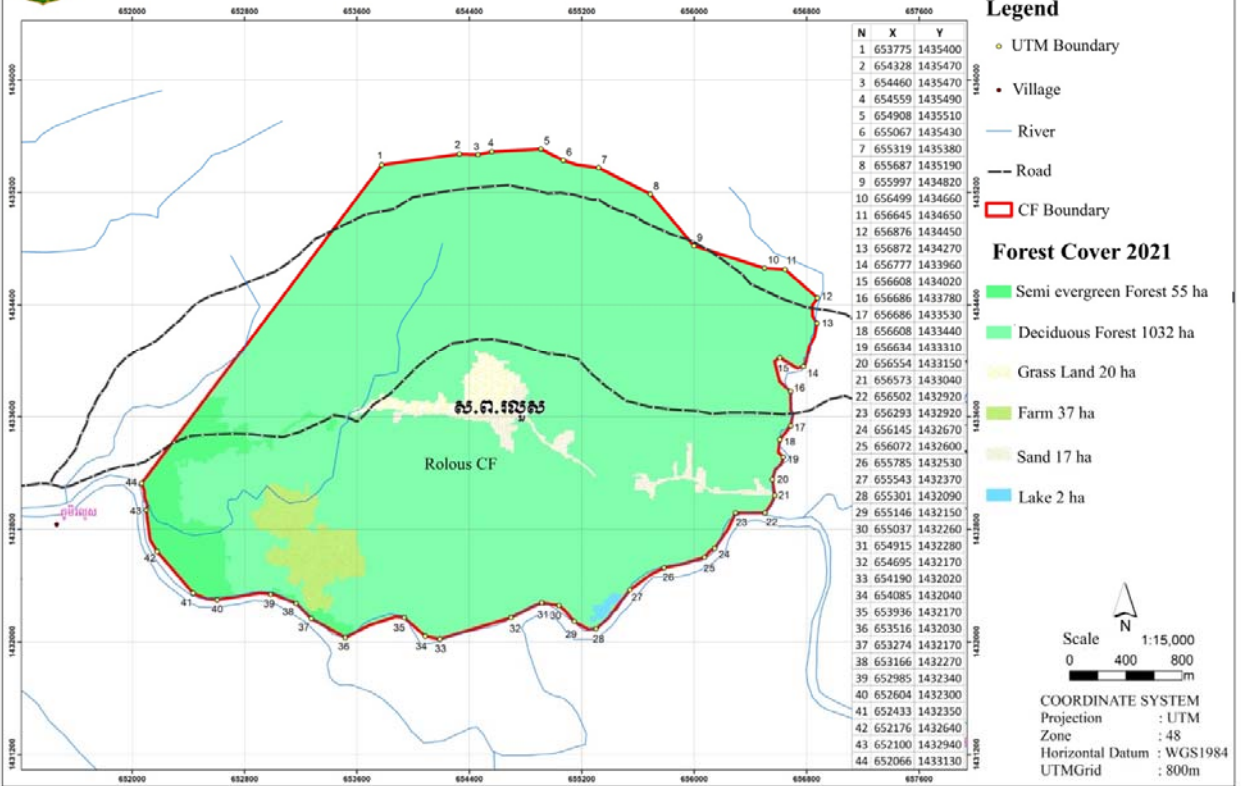
47	Modulkiri	014	720358	1429550	720355	1429549	D	D	D	D	10m
48	Modulkiri	015	723471	1435676	723470	1435675	D	G	G	G	6m
49	Modulkiri	017	725333	1363569	725331	1363567	E	E	E	E	20m
50	Modulkiri	018	737506	1362415	737464	1362413	E	E	E	E	20m
51	Modulkiri	020	732118	1363105	732111	1363102	Fr	Fr	Fr	Fr	8m
52	Modulkiri	021	755014	1370177	755014	1370176	E	E	E	E	17m
53	Modulkiri	025	722990	1435522	722991	1435520	G	G	G	G	
54	Modulkiri	026	721254	1445820	721254	1454817	G	G	Bt	Bt	
55	Modulkiri	027	713881	1450988	713881	1450986	G	G	G	G	
56	Modulkiri	028	745729	1377458	745725	1377457	Hc	Hc	Hc	Hc	
57	Modulkiri	029	743886	1381901	743885	1381900	Hc	Hc	Hc	Hc	
58	Modulkiri	030	743604	1394442	743604	1394441	Hc	Hc	Hc	Hc	
59	Modulkiri	031	742559	1401416	742557	1401415	Hc	Hc	Hc	Hc	
60	Modulkiri	033	713825	1445420	713825	1445417	Hr	Hr	Hr	Hr	
61	Modulkiri	034	715851	1442689	715850	1442684	Hr	Hr	Hr	Hr	
62	Modulkiri	035	737746	1363222	737746	1363221	Pp	Pp	Pp	Pp	12m
63	Modulkiri	036	736395	1367471	736392	1367468	Pp	Pp	Pp	Pp	15m
64	Modulkiri	037	747778	1367836	747778	1367835	Pp	Pp	Pp	Pp	12m
65	Modulkiri	038	749035	1368310	749034	1368310	Pp	Pp	Pp	Pp	11m
66	Modulkiri	039	754100	1369624	754100	1369624	Pp	Pp	Pp	Pp	13m
67	Modulkiri	042	748334	1374806	748333	1374805	Pp	Pp	Pp	Pp	10m
68	Modulkiri	043	742918	1397747	742917	1397745	Rp	Rp	Rp	Rp	10m
69	Modulkiri	044	724250	1434560	724248	1434560	S	G	G	G	
70	Modulkiri	046	726401	1421681	726400	1421679	D	D	D	D	9m
71	Modulkiri	048	722319	1437367	722317	1437364	Ws	Ws	Hr	Hr	5m
72	Modulkiri	049	721089	1439676	721087	1439675	D	D	D	D	10m
73	Modulkiri	050	721620	1438987	721618	1438985	D	D	D	D	9m
74	Modulkiri	051	719787	1441829	719784	1441825	Ws	Ws	Hc	Hc	3m
75	Modulkiri	052	722101	1449764	722101	1449761	Ws	Ws	Ws	Ws	5m

Appendix 3: Community forest cover map 2021 Kratie province

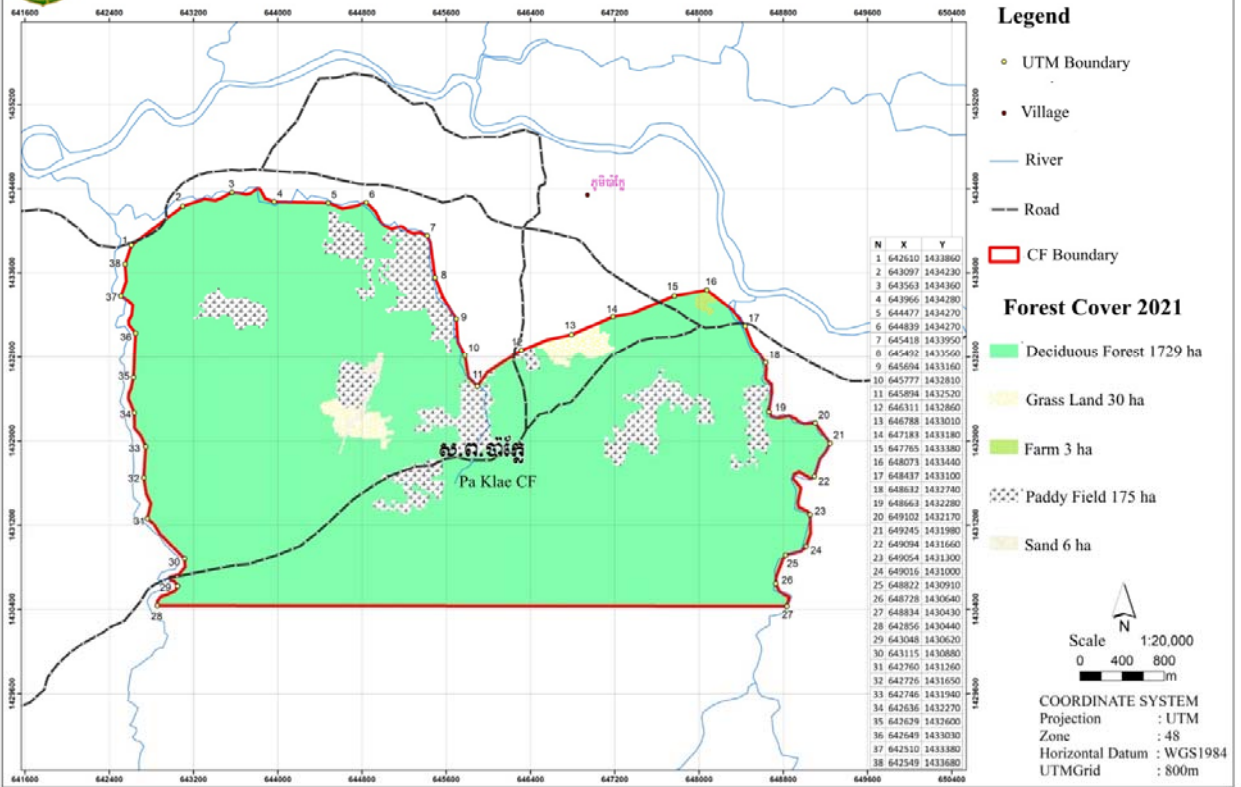


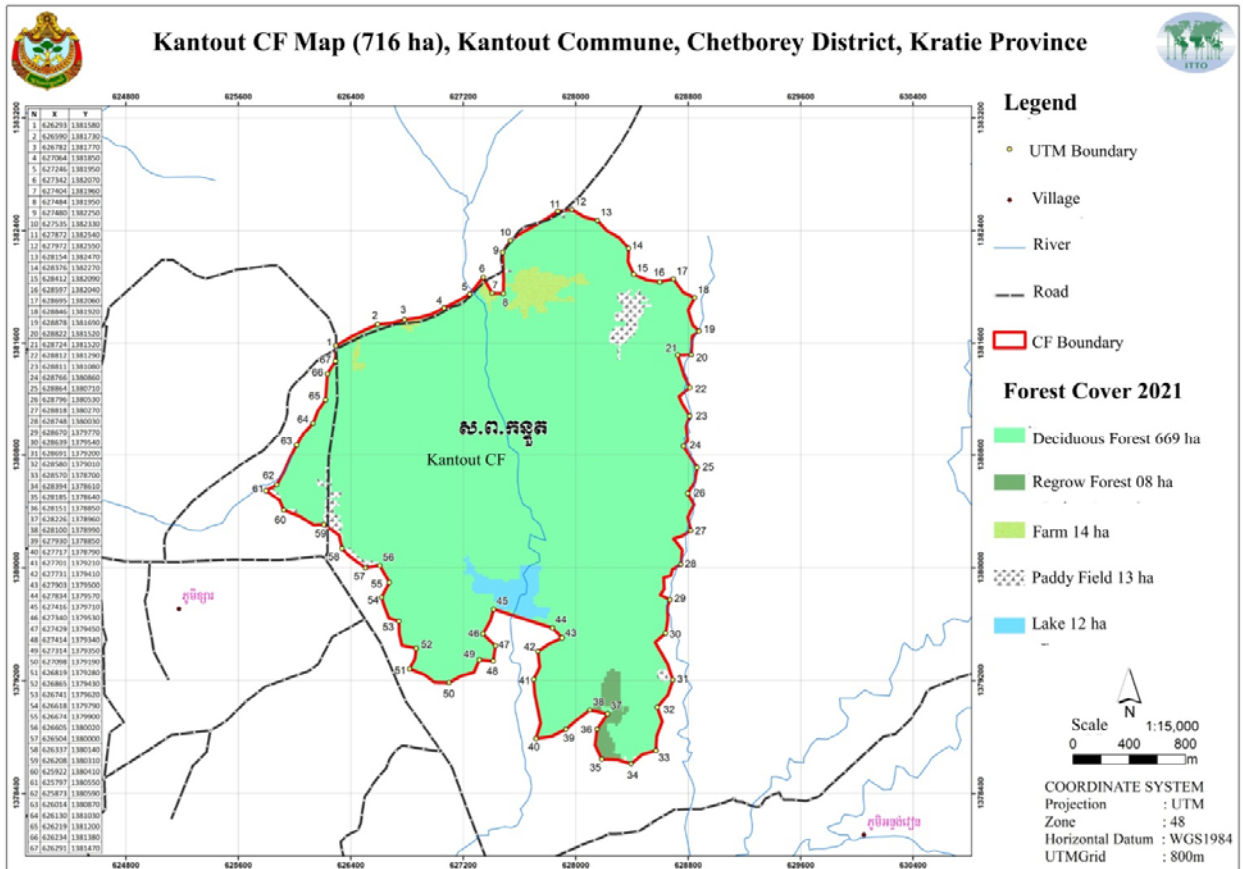
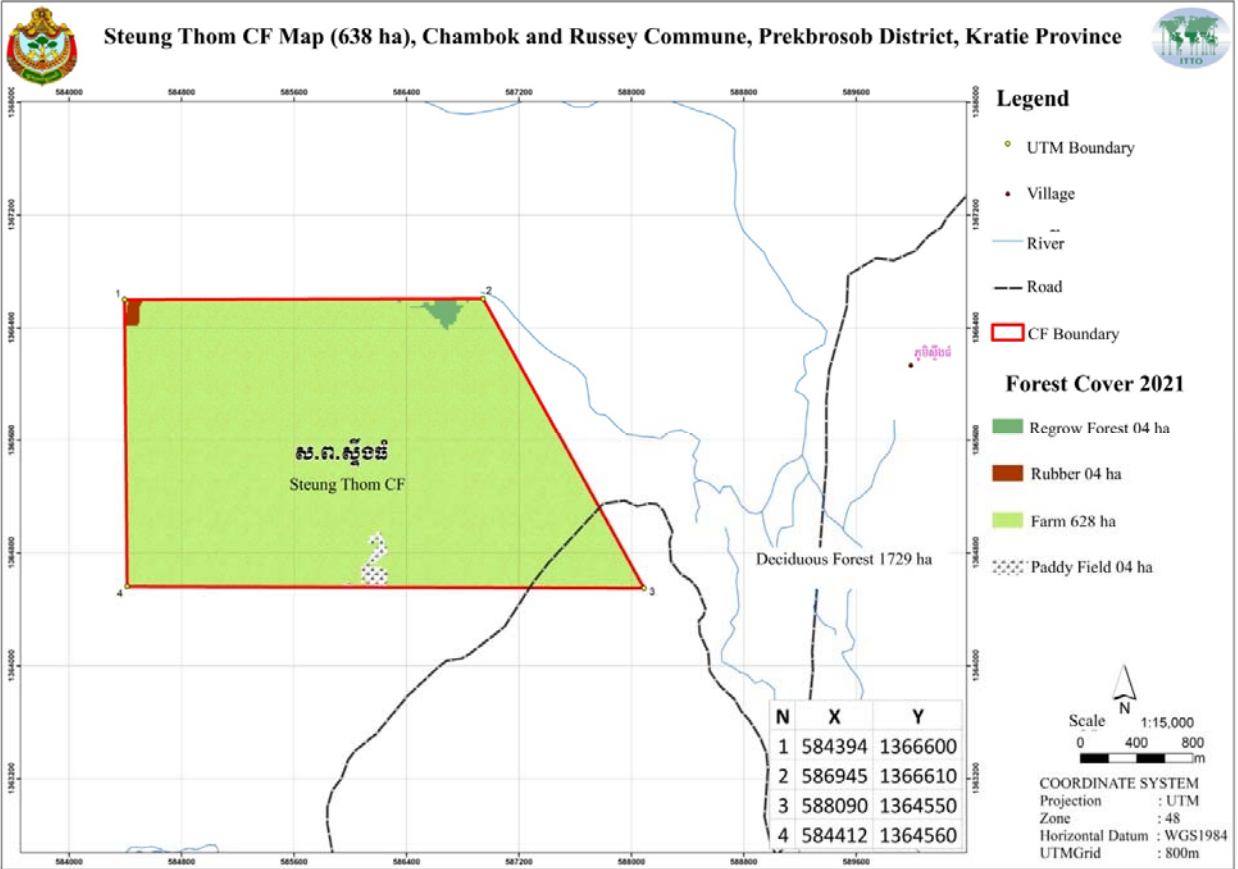


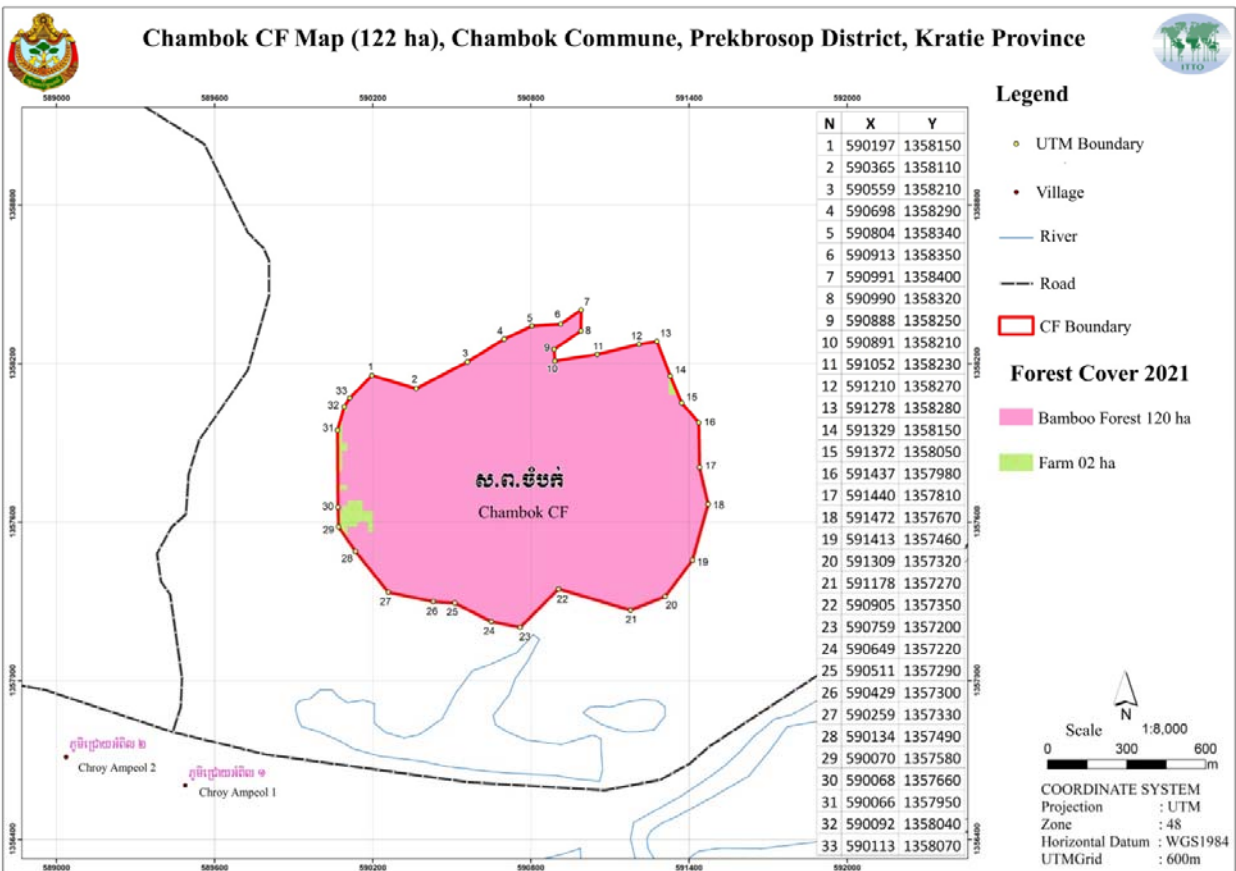
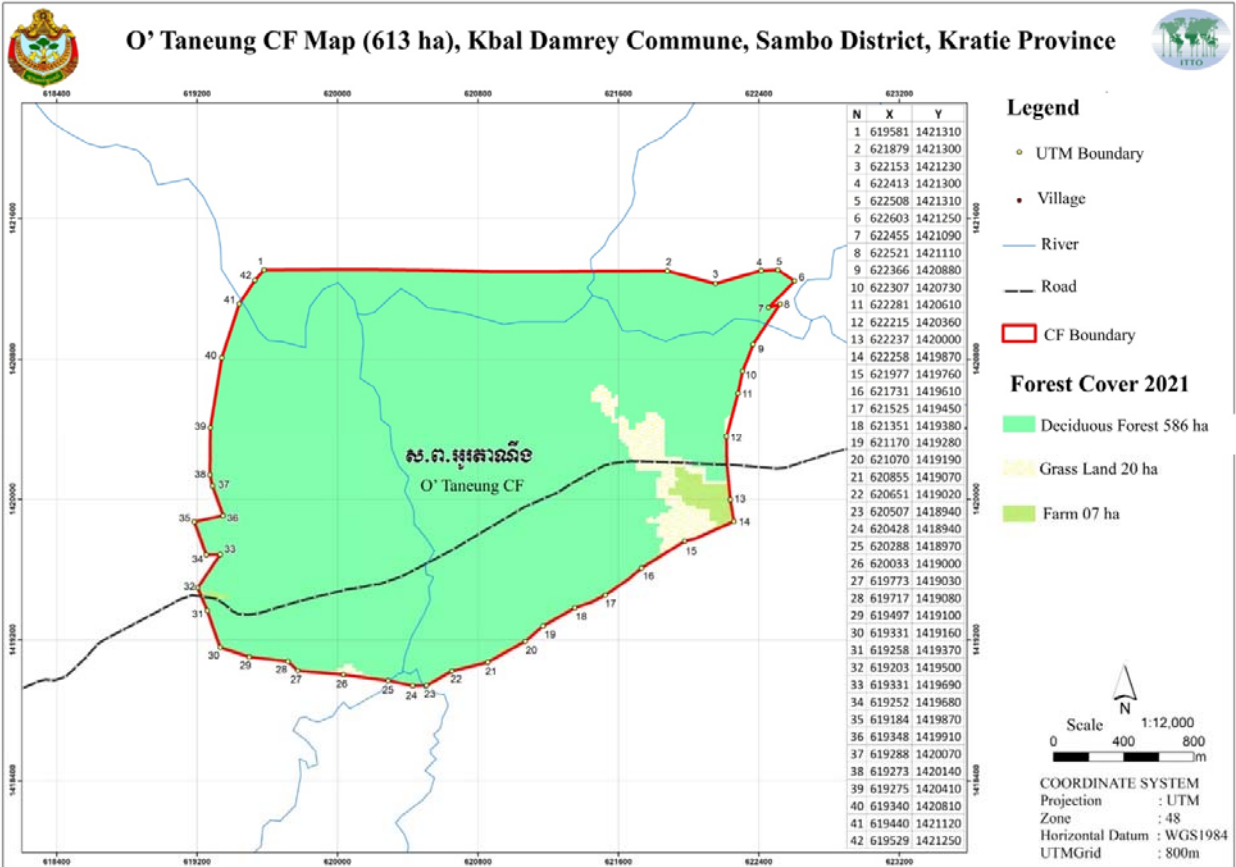
Rolous CF Map (1163 ha), Rolous Meanchey Commune, Sambo District, Kratie Province



Pa Klae CF Map (1940 ha), Rolous Meanchey Commune, Sambo District, Kratie Province

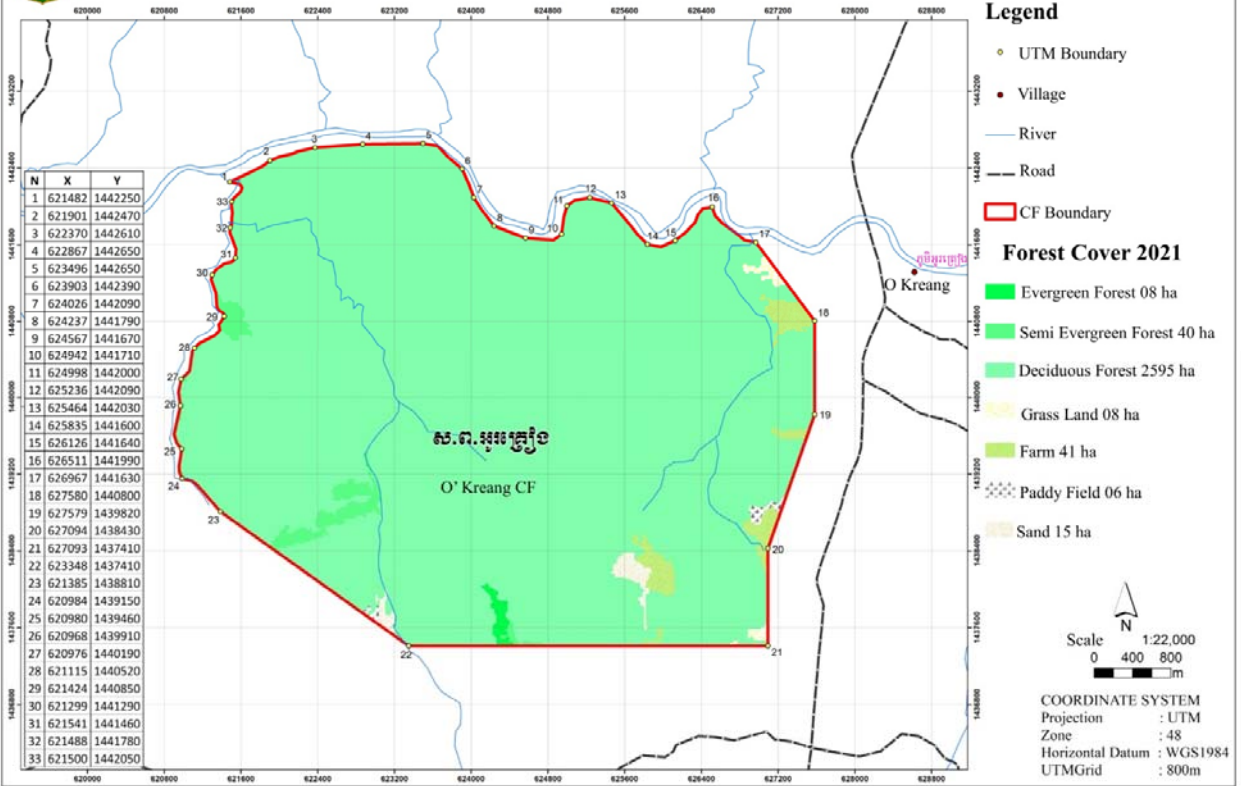




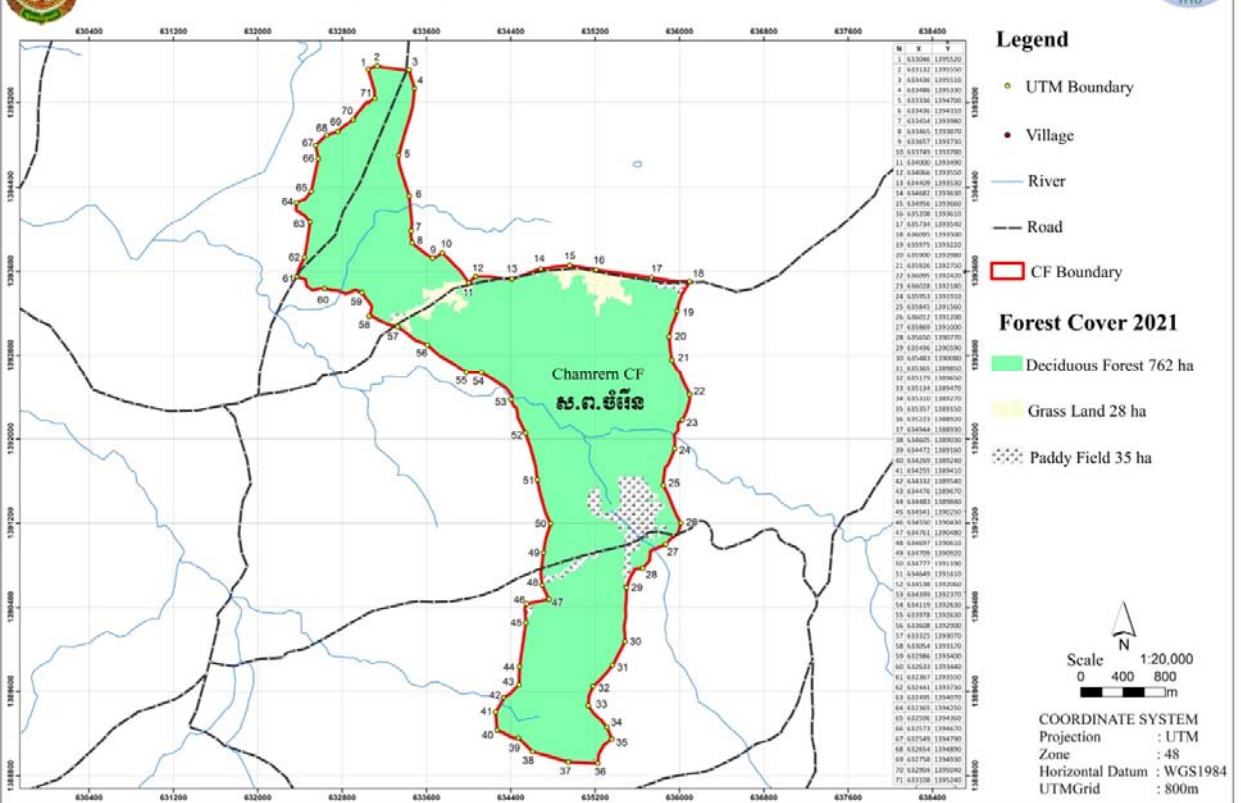


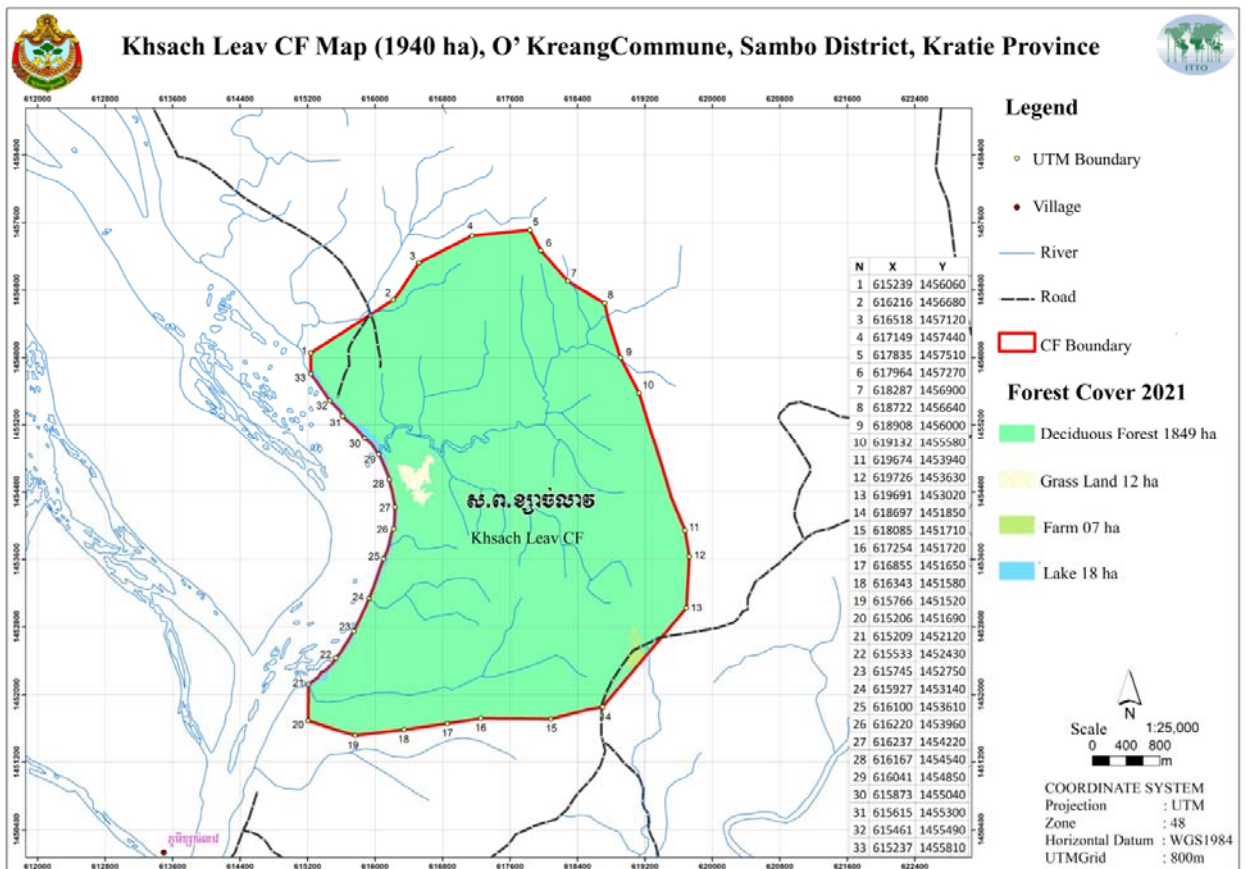
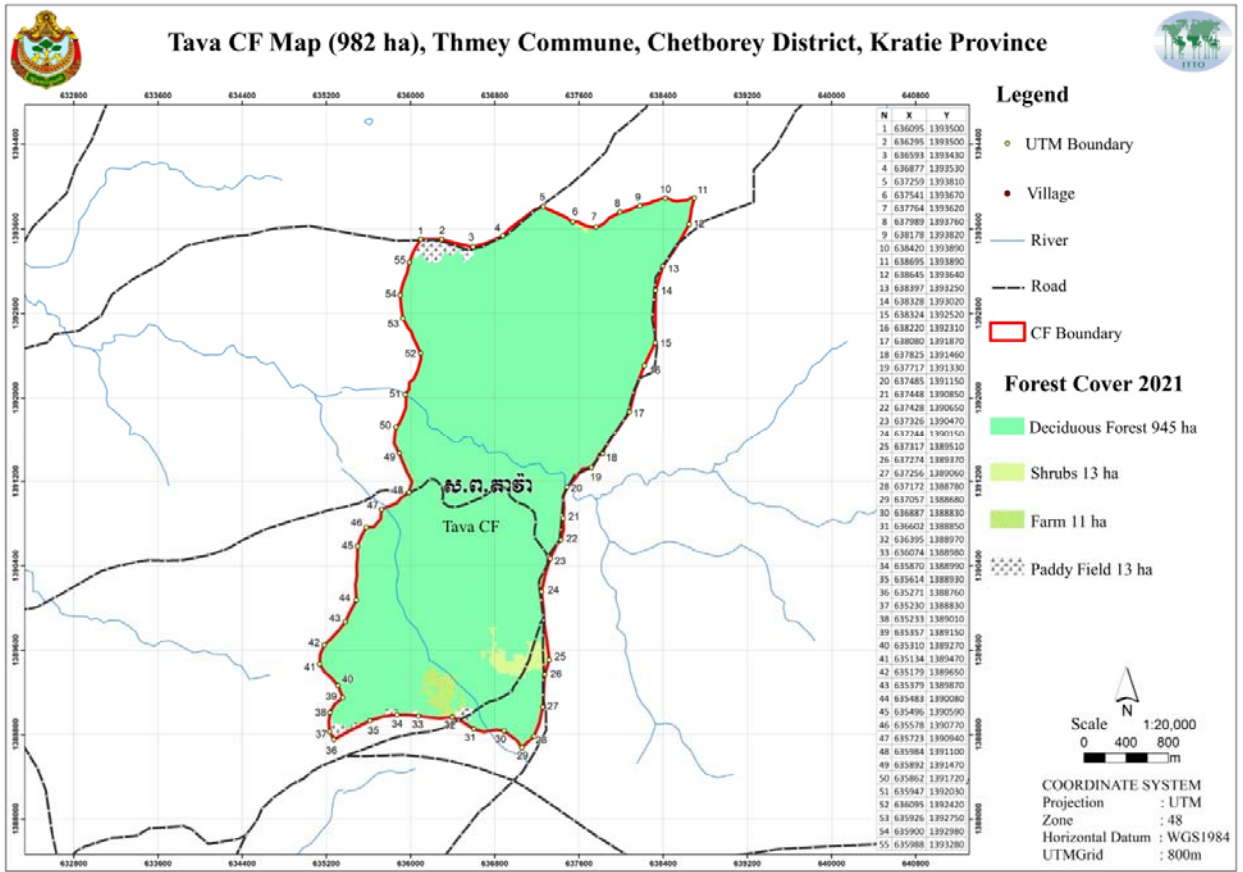


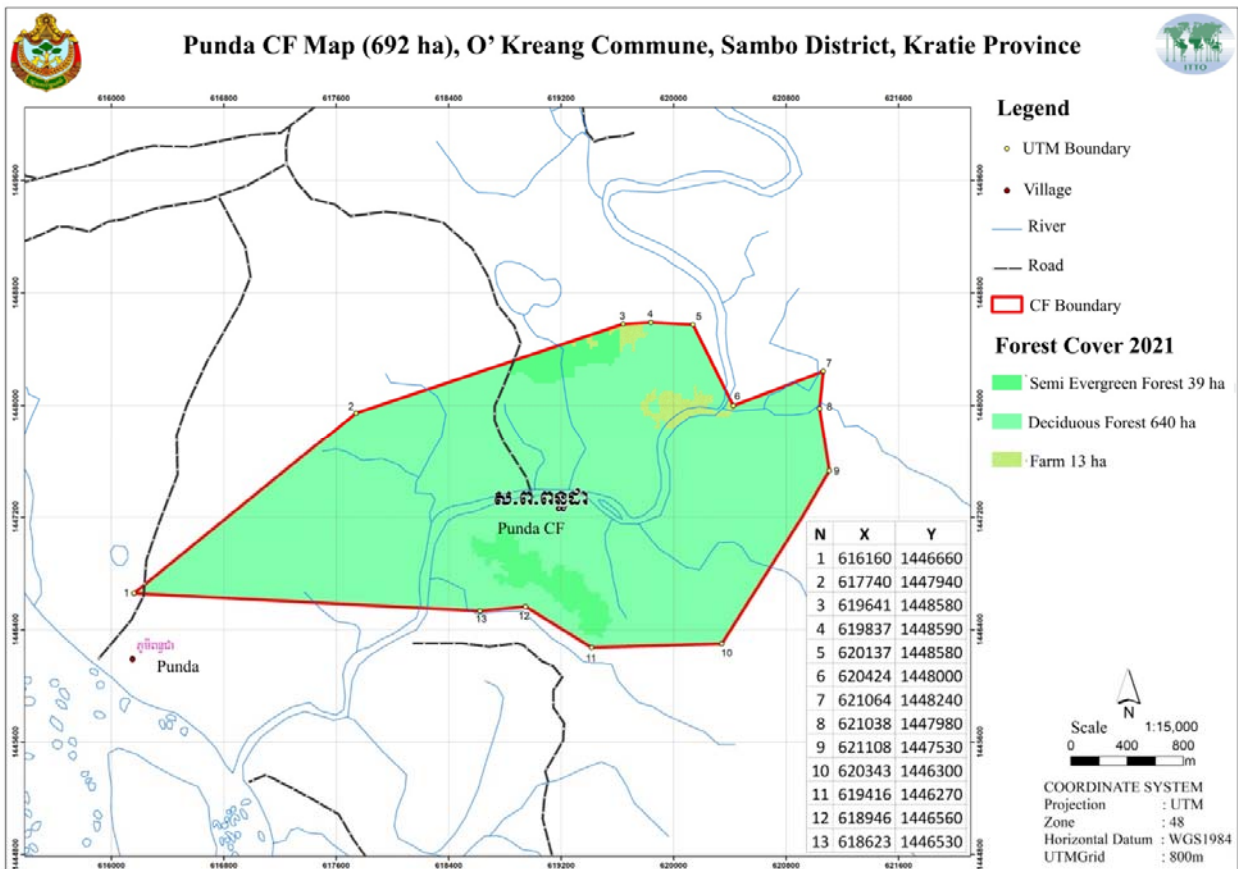
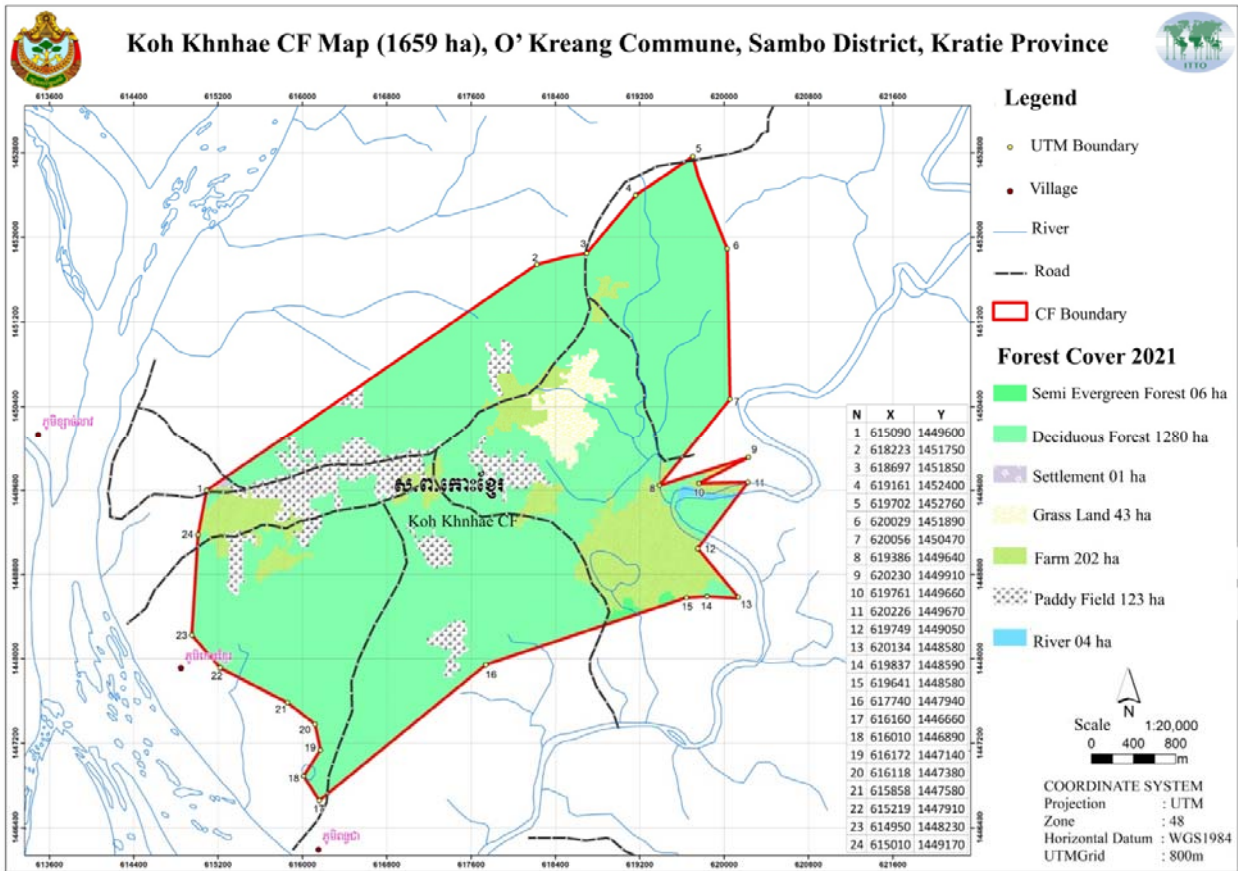
O' Kreang CF Map (2713 ha), O' Kreang Commune, Sambo District, Kratie Province

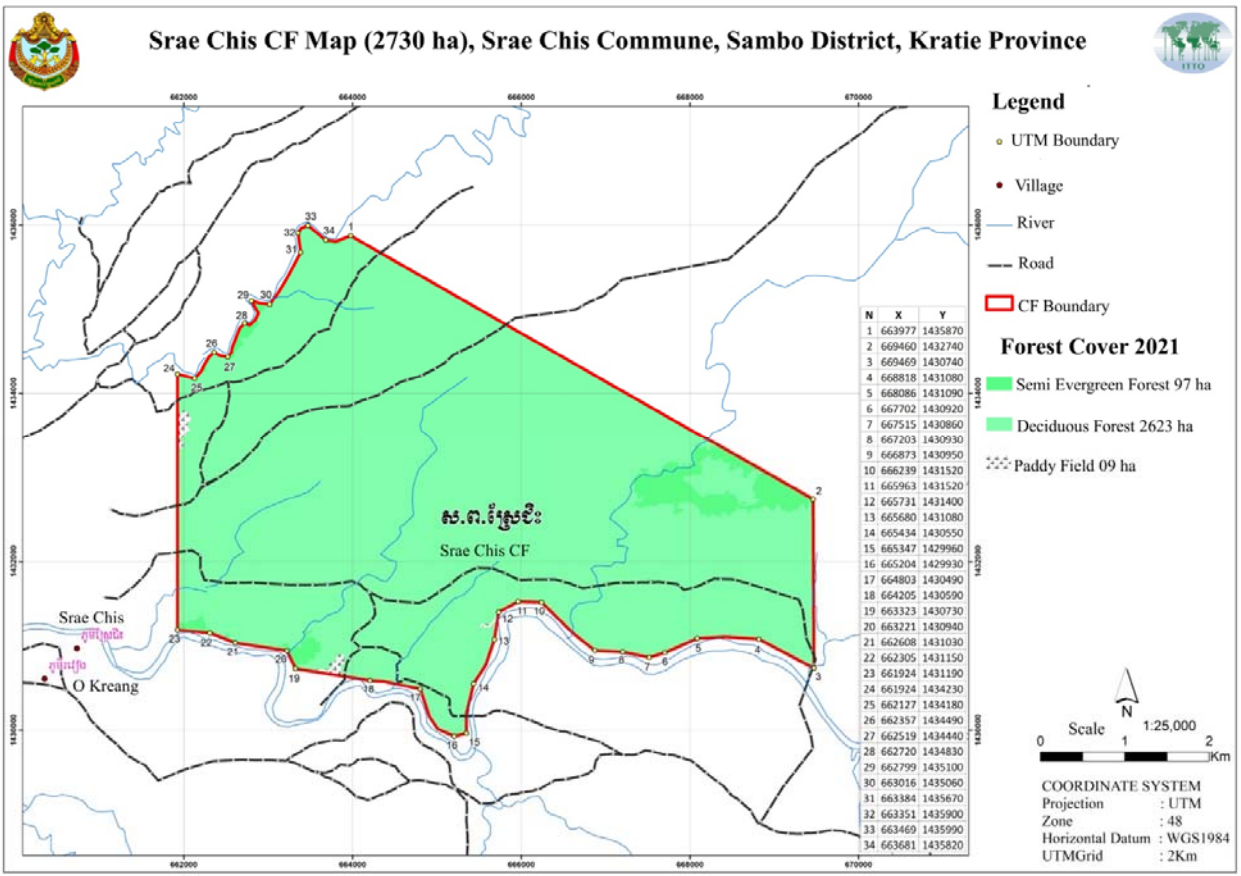
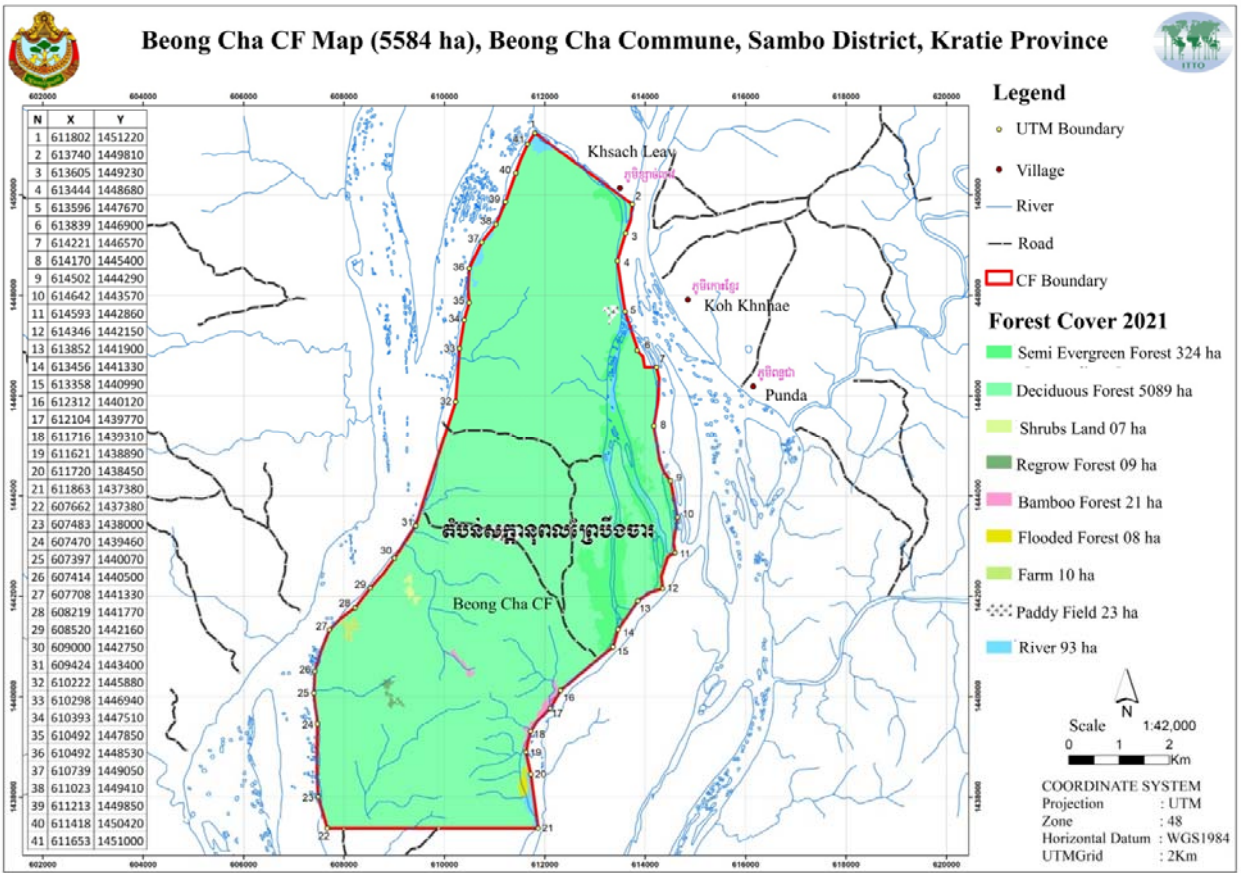


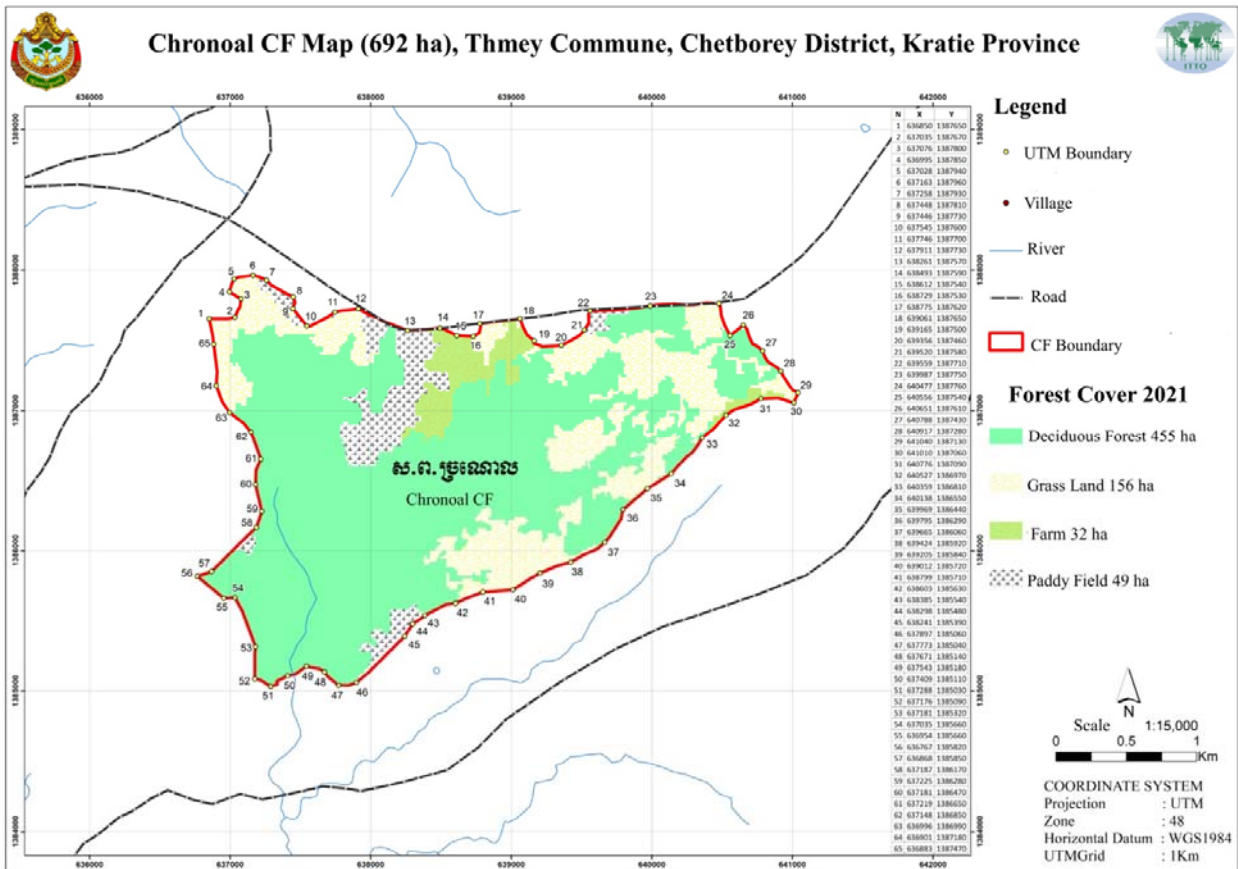
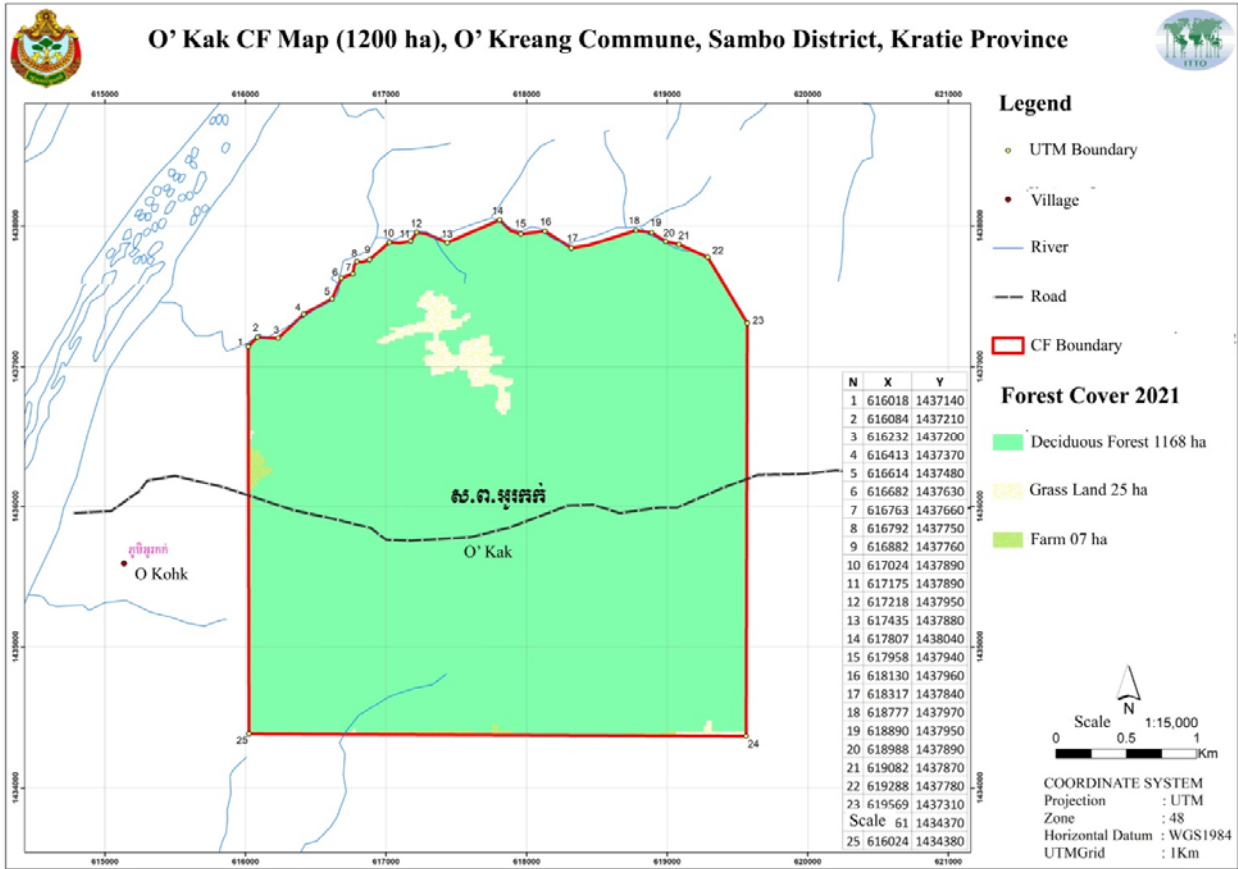
Chamrenn CF Map (825 ha), Thmey Commune, Chetborey District, Kratie Province





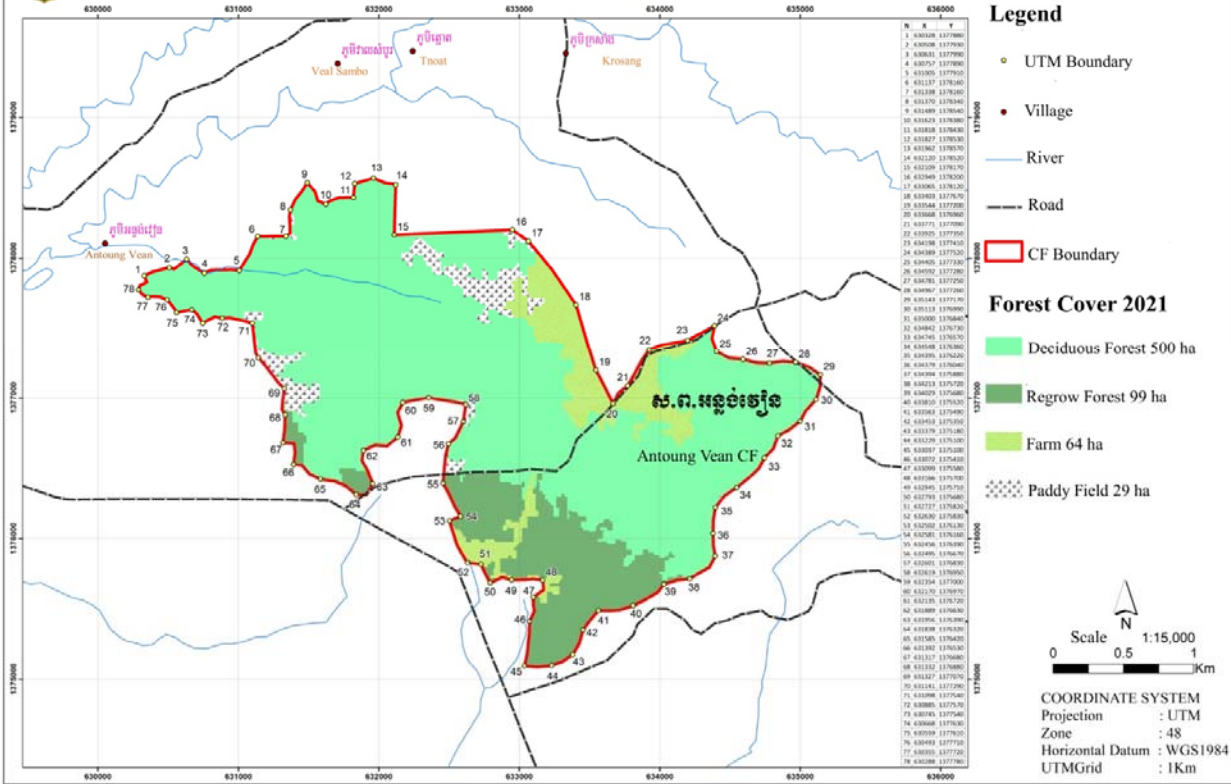




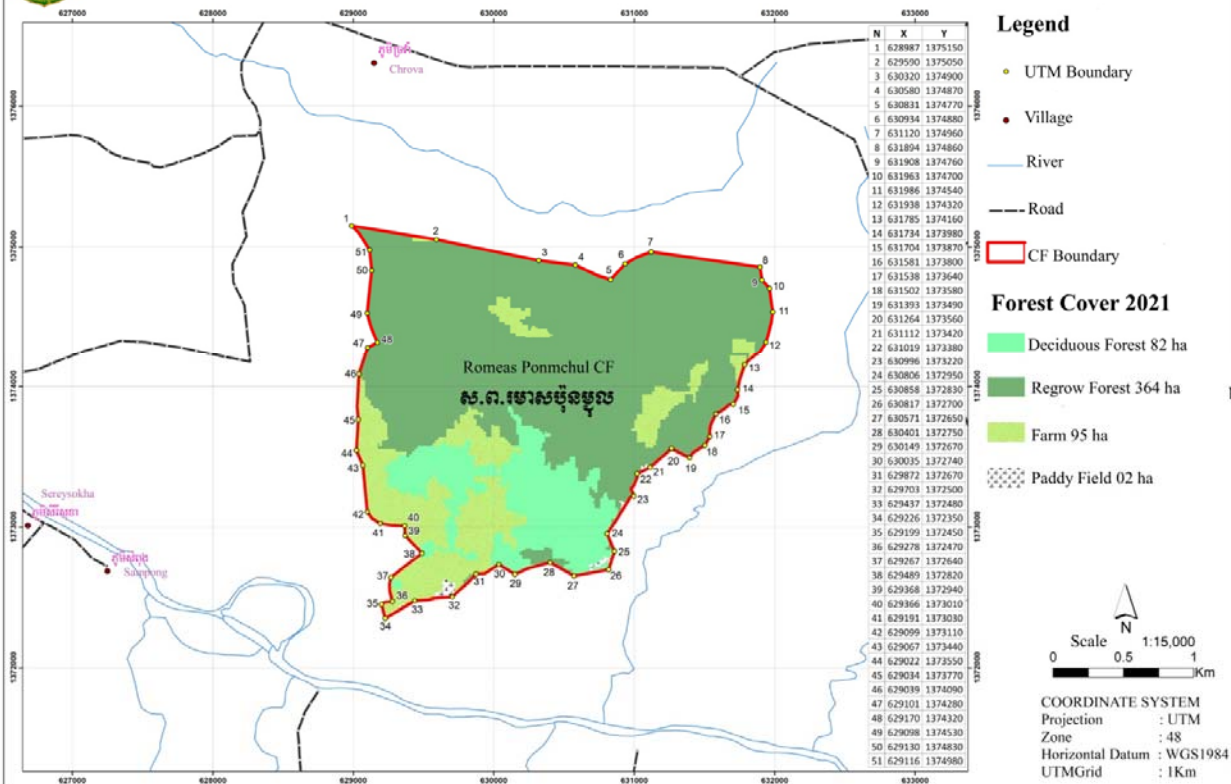


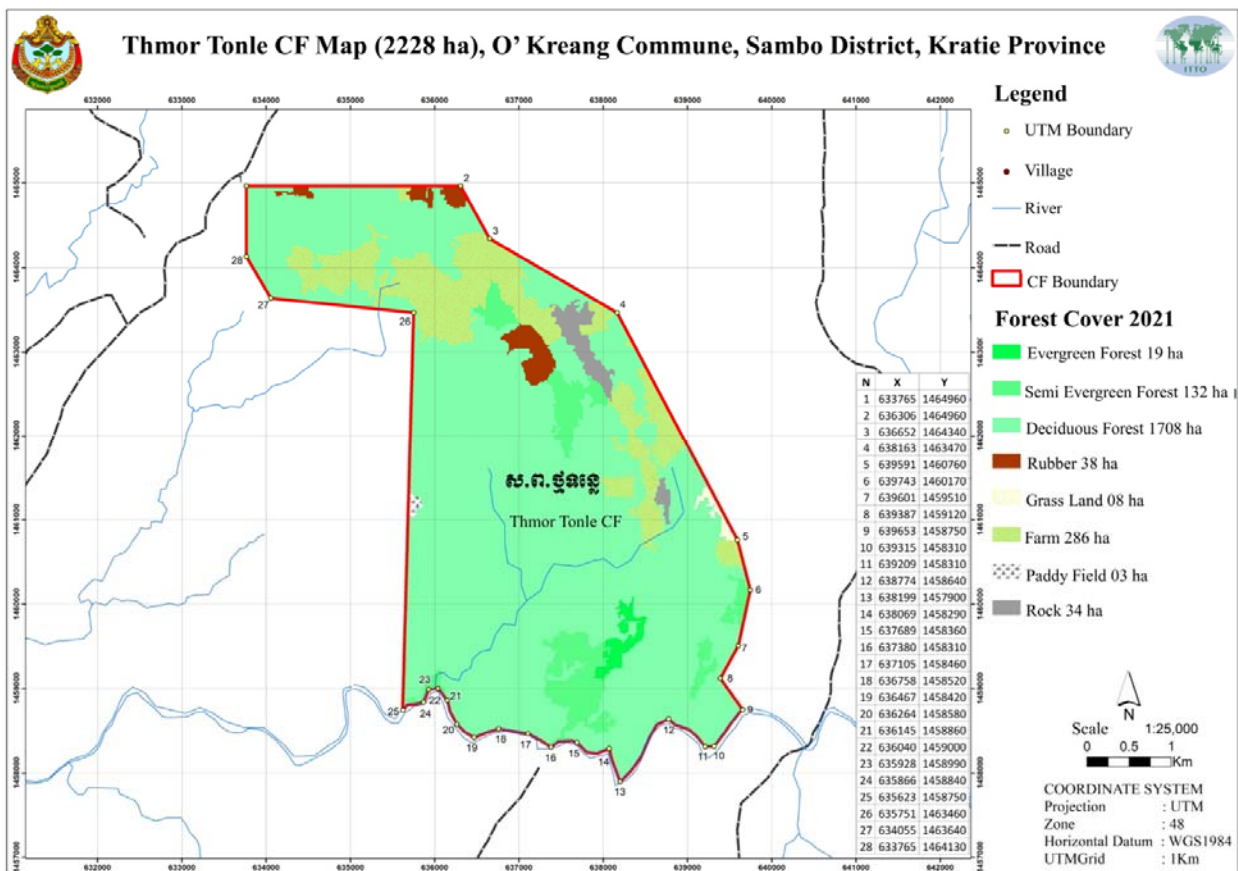
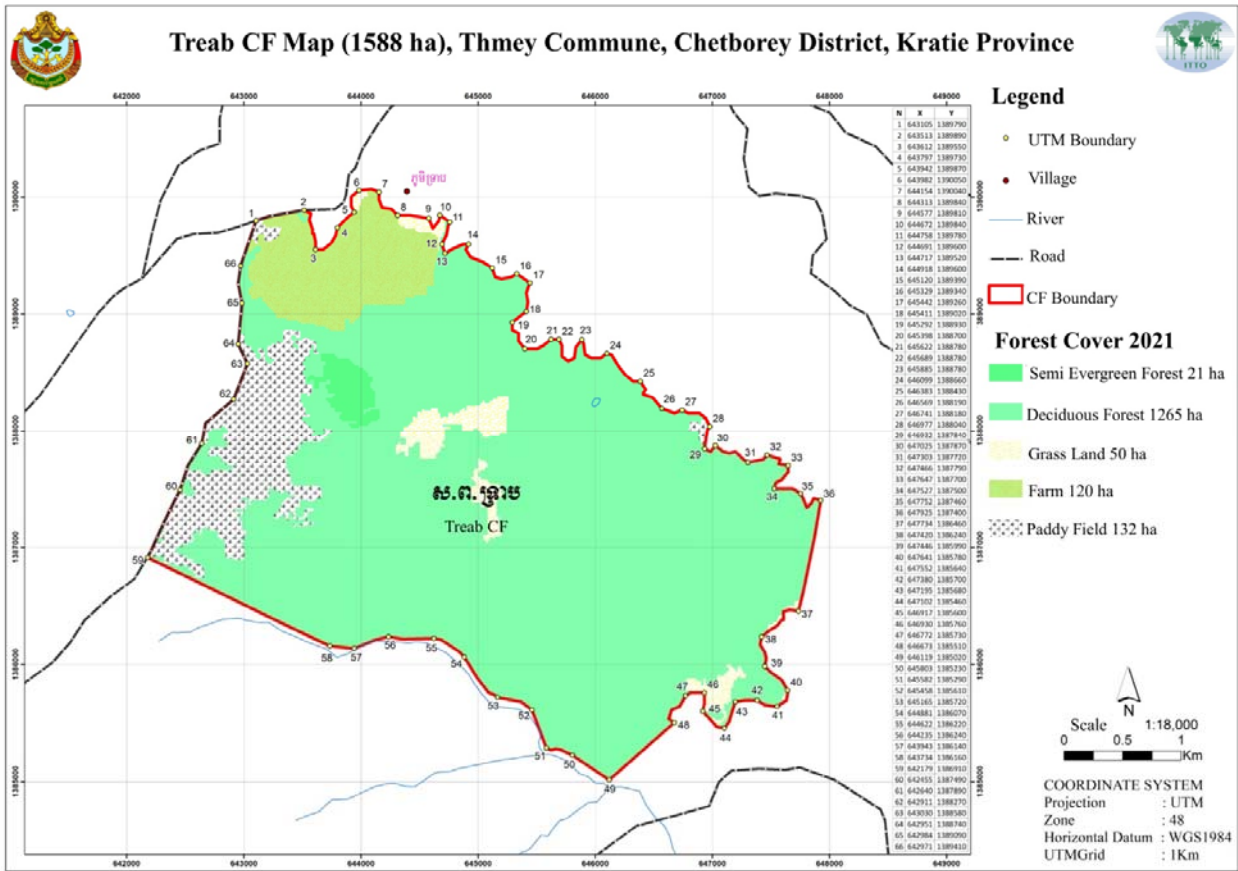


Antoung Vein CF Map (692 ha), Kantout Commune, Chetborey District, Kratie Province



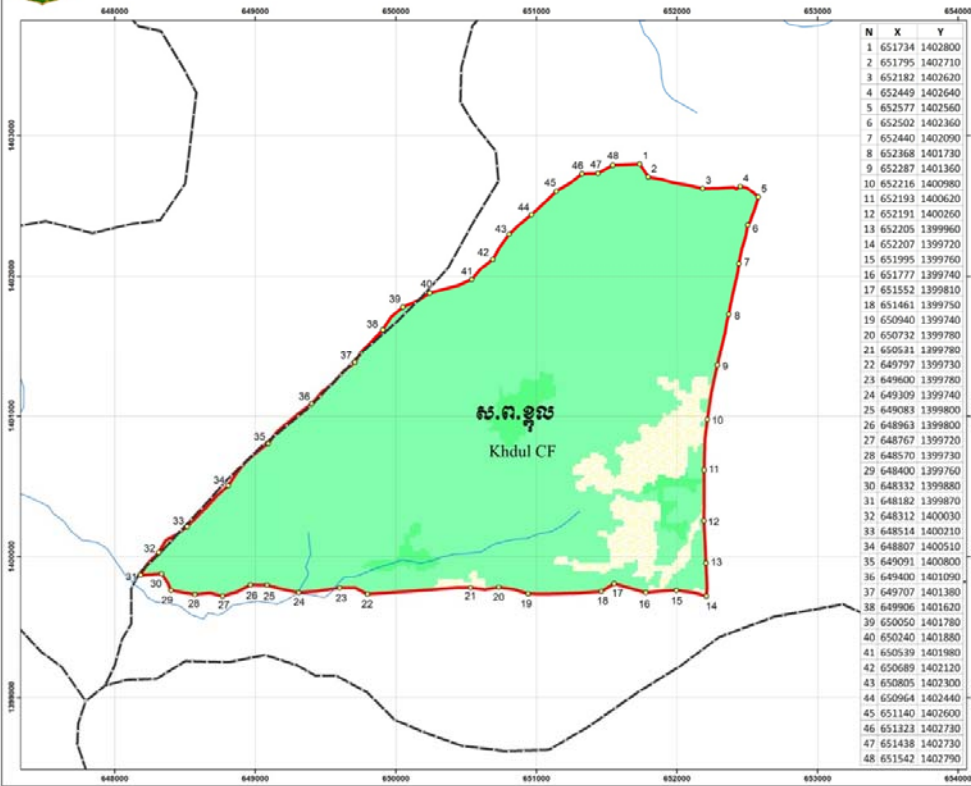
Romeas Ponnchul CF Map (543 ha), Kantout Commune, Chetborey District, Kratie Province







Khdul CF Map (798 ha), Thmey Commune, Chetborey District, Kratie Province



N	X	Y
1	651734	1402800
2	651795	1402710
3	652182	1402620
4	652449	1402640
5	652577	1402560
6	652502	1402360
7	652440	1402090
8	652368	1401730
9	652287	1401360
10	652216	1400980
11	652193	1400620
12	652191	1400260
13	652205	1399960
14	652207	1399720
15	651995	1399760
16	651777	1399740
17	651552	1399810
18	651461	1399750
19	650940	1399740
20	650732	1399780
21	650581	1399780
22	649797	1399730
23	649600	1399780
24	649309	1399740
25	649083	1399800
26	648963	1399800
27	648767	1399720
28	648570	1399730
29	648400	1399760
30	648332	1399880
31	648182	1399870
32	648312	1400030
33	648514	1400210
34	648807	1400510
35	649091	1400800
36	649400	1401090
37	649707	1401380
38	649906	1401620
39	650050	1401780
40	650240	1401880
41	650539	1401980
42	650689	1402120
43	650805	1402300
44	650964	1402440
45	651140	1402600
46	651323	1402730
47	651438	1402730
48	651542	1402790

Legend

- UTM Boundary
- Village
- River
- Road
- ▭ CF Boundary

Forest Cover 2021

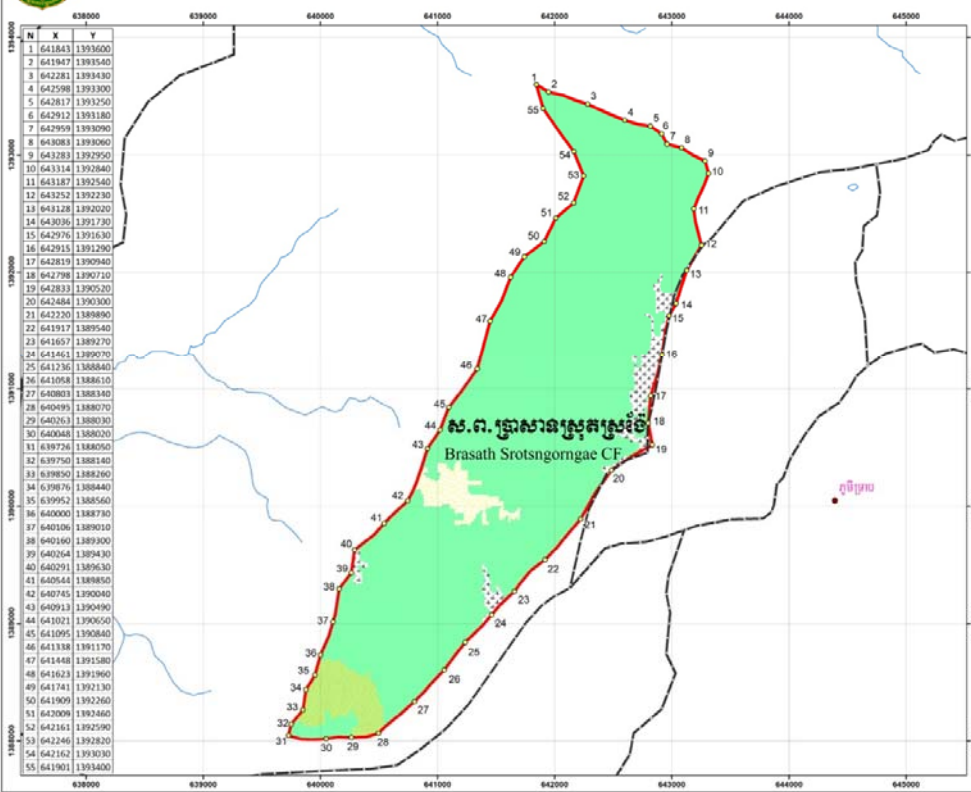
- Semi Evergreen Forest 24 ha
- Deciduous Forest 714 ha
- Grass Land 60 ha

Scale 1:15,000
0 0.5 1 Km

COORDINATE SYSTEM
Projection : UTM
Zone : 48
Horizontal Datum : WGS1984
UTMGrid : 1Km



Brasath Srotsngorgae CF Map (733 ha), Thmey Commune, Chetborey District, Kratie Province



N	X	Y
1	641843	1393600
2	641847	1393640
3	642281	1393430
4	642598	1393300
5	642817	1393250
6	642912	1393180
7	642959	1393090
8	643083	1393090
9	643181	1392920
10	643314	1392840
11	643187	1392540
12	643252	1392230
13	643128	1392020
14	643036	1391730
15	642976	1391630
16	642915	1391290
17	642819	1390940
18	642798	1390710
19	642833	1390520
20	642484	1390300
21	642220	1389890
22	641917	1389540
23	641657	1389270
24	641461	1389070
25	641236	1388840
26	641058	1388610
27	640803	1388340
28	640493	1388070
29	640261	1388030
30	640048	1388020
31	639726	1388050
32	639750	1388140
33	639850	1388260
34	639676	1388440
35	639952	1388560
36	640000	1388730
37	640106	1389010
38	640160	1389300
39	640264	1389430
40	640291	1389630
41	640544	1389850
42	640745	1390040
43	640913	1390490
44	641021	1390650
45	641095	1390840
46	641388	1391170
47	641448	1391580
48	641623	1391960
49	641741	1392130
50	641909	1392240
51	642006	1392440
52	642161	1392590
53	642246	1392820
54	642167	1393030
55	641901	1393400

Legend

- UTM Boundary
- Village
- River
- Road
- ▭ CF Boundary

Forest Cover 2021

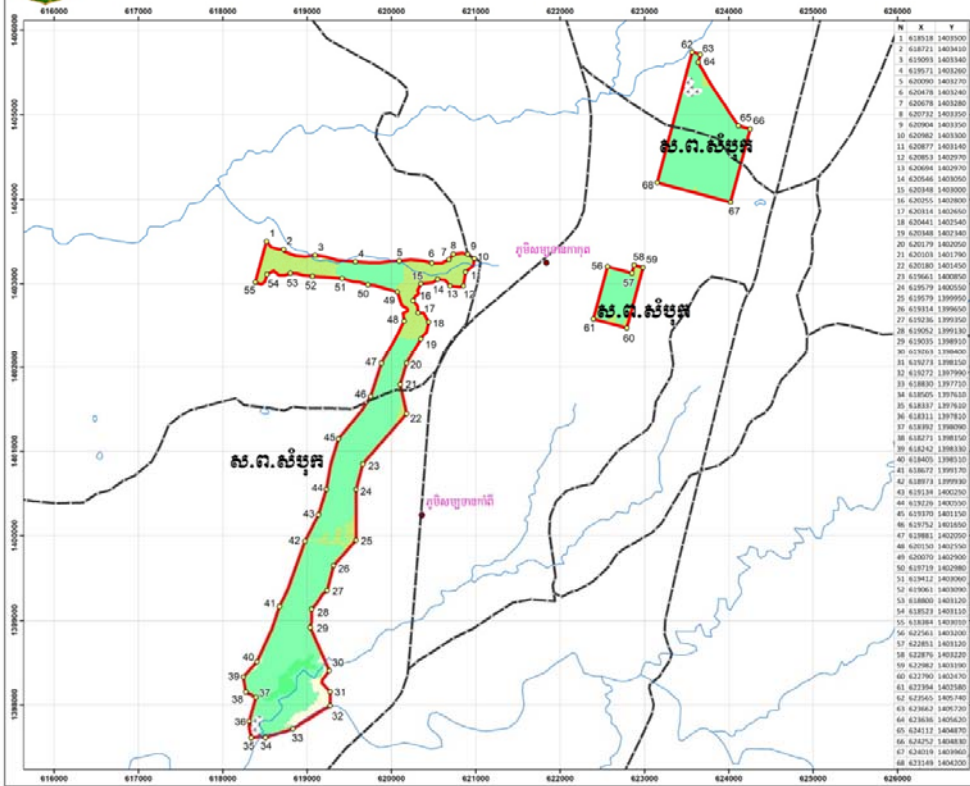
- Deciduous Forest 657 ha
- Grass Land 20 ha
- Farm 31 ha
- ▨ Paddy Field 25 ha

Scale 1:18,000
0 0.5 1 Km

COORDINATE SYSTEM
Projection : UTM
Zone : 48
Horizontal Datum : WGS1984
UTMGrid : 1Km



Phnom Toteong CF Map (463 ha), Sambok Commune, Chetborey District, Kratie Province



Legend

- UTM Boundary
- Village
- River
- Road
- CF Boundary

Forest Cover 2021

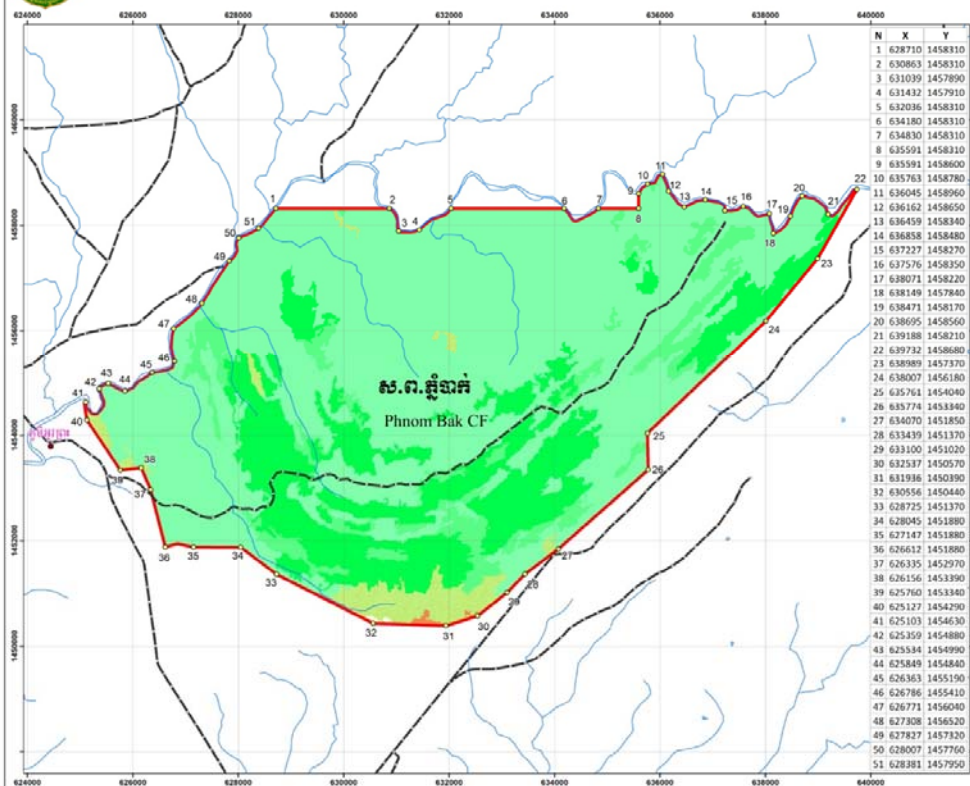
- Semi Evergreen Forest 09 ha
- Deciduous Forest 354 ha
- Grass Land 13 ha
- Farm 80 ha
- Paddy Field 07 ha

Scale: 1:25,000
0 0.5 1 Km

COORDINATE SYSTEM
Projection : UTM
Zone : 48
Horizontal Datum : WGS1984
UTMGrid : 1Km



Phnom Bak CF Map (7205 ha), O' Kreang Commune, Sambo District, Kratie Province



Legend

- UTM Boundary
- Village
- River
- Road
- CF Boundary

Forest Cover 2021

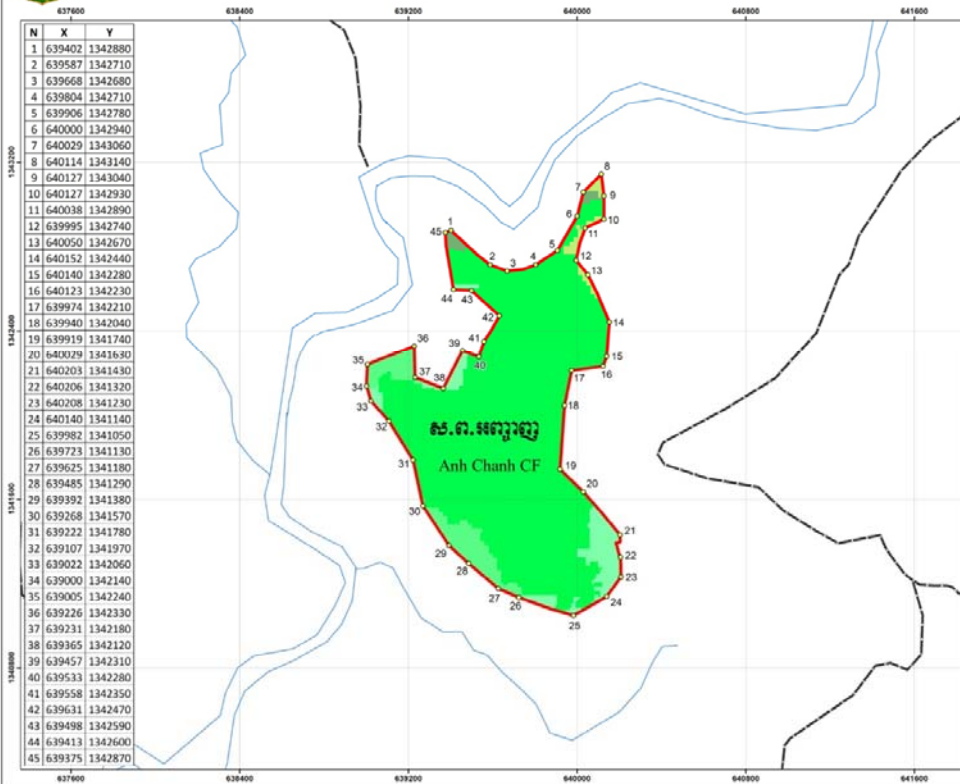
- Evergreen Forest 1518 ha
- Semi Evergreen Forest 563 ha
- Deciduous Forest 4868 ha
- Forest Plantation 10 ha
- Grass Land 04 ha
- Farm 240 ha
- Lake 02 ha

Scale: 1:140,000
0 1 2 Km

COORDINATE SYSTEM
Projection : UTM
Zone : 48
Horizontal Datum : WGS1984
UTMGrid : 2Km



Anh Chanh CF Map (123 ha), Srae Cha Commune, Snoul District, Kratie Province

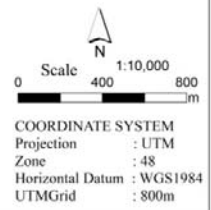


Legend

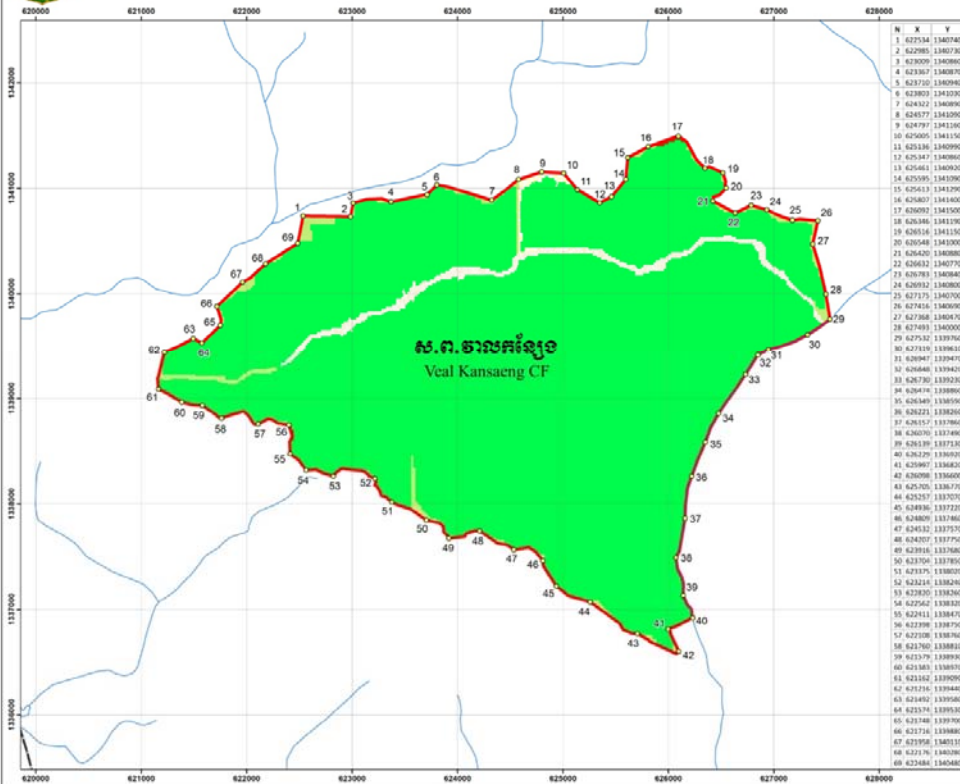
- UTM Boundary
- Village
- River
- Road
- CF Boundary

Forest Cover 2021

- Evergreen Forest 104 ha
- Semi Evergreen Forest 08 ha
- Deciduous Forest 08 ha
- Regrow Forest 01 ha
- Farm 02 ha



Veal Kansaeng CF Map (1624 ha), Domrey Phong Commune, Chhlong District, Kratie Province

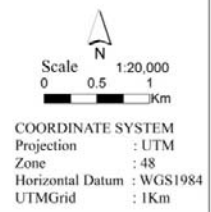


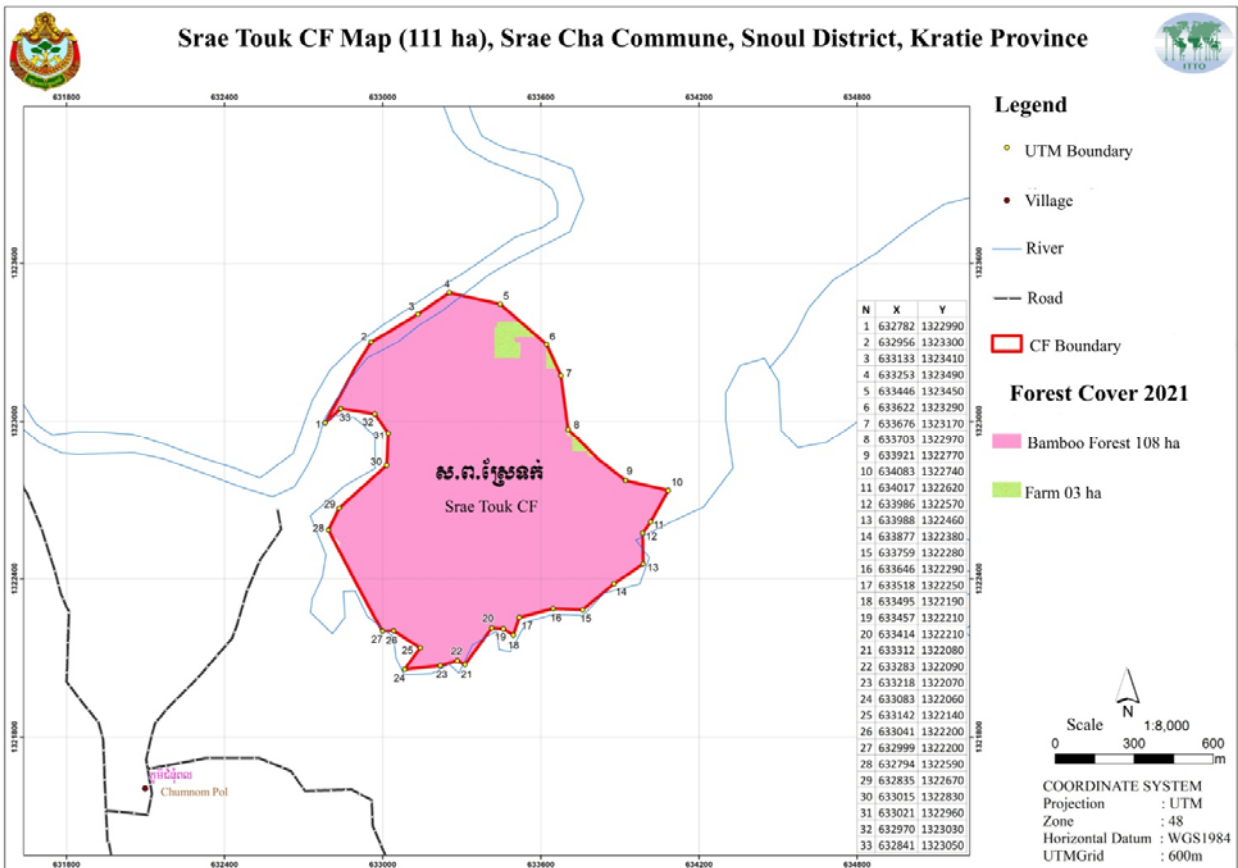
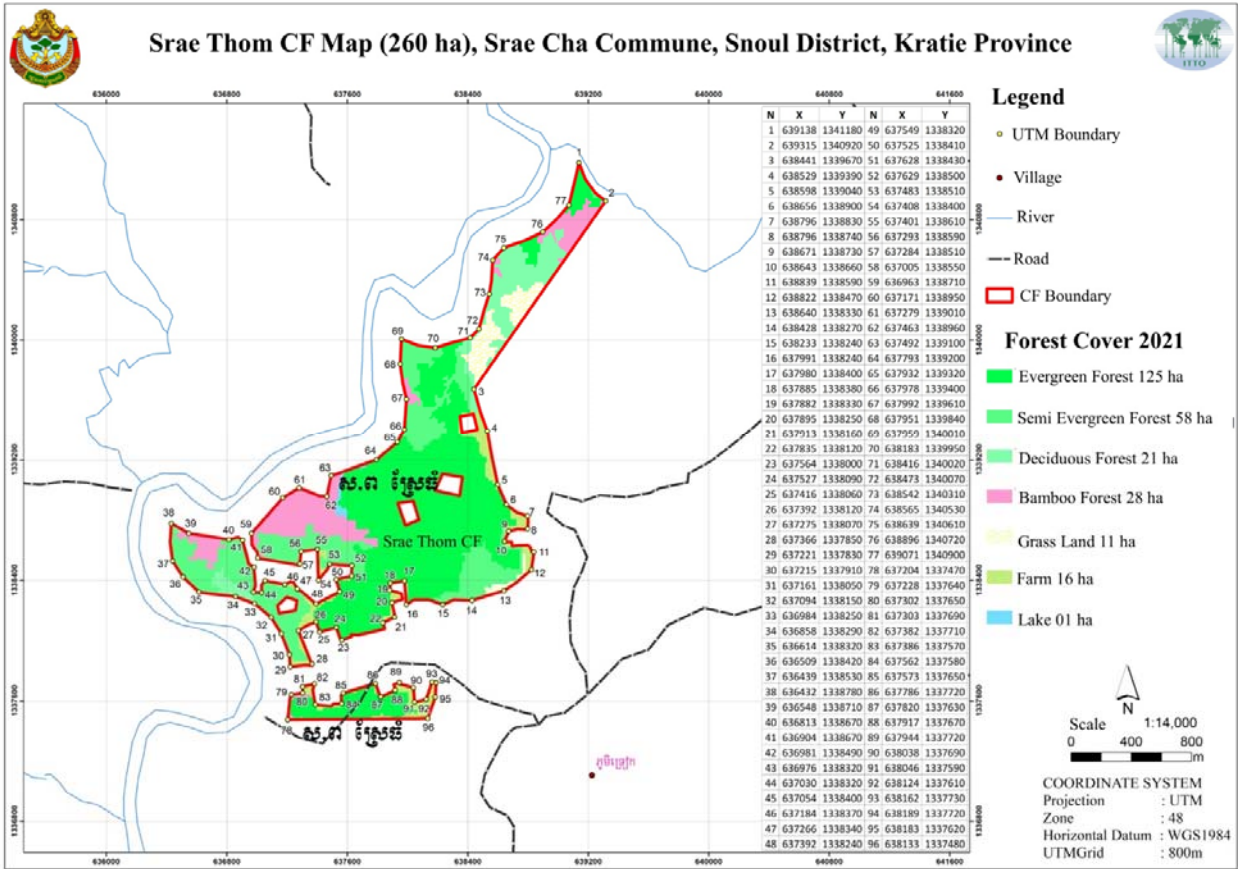
Legend

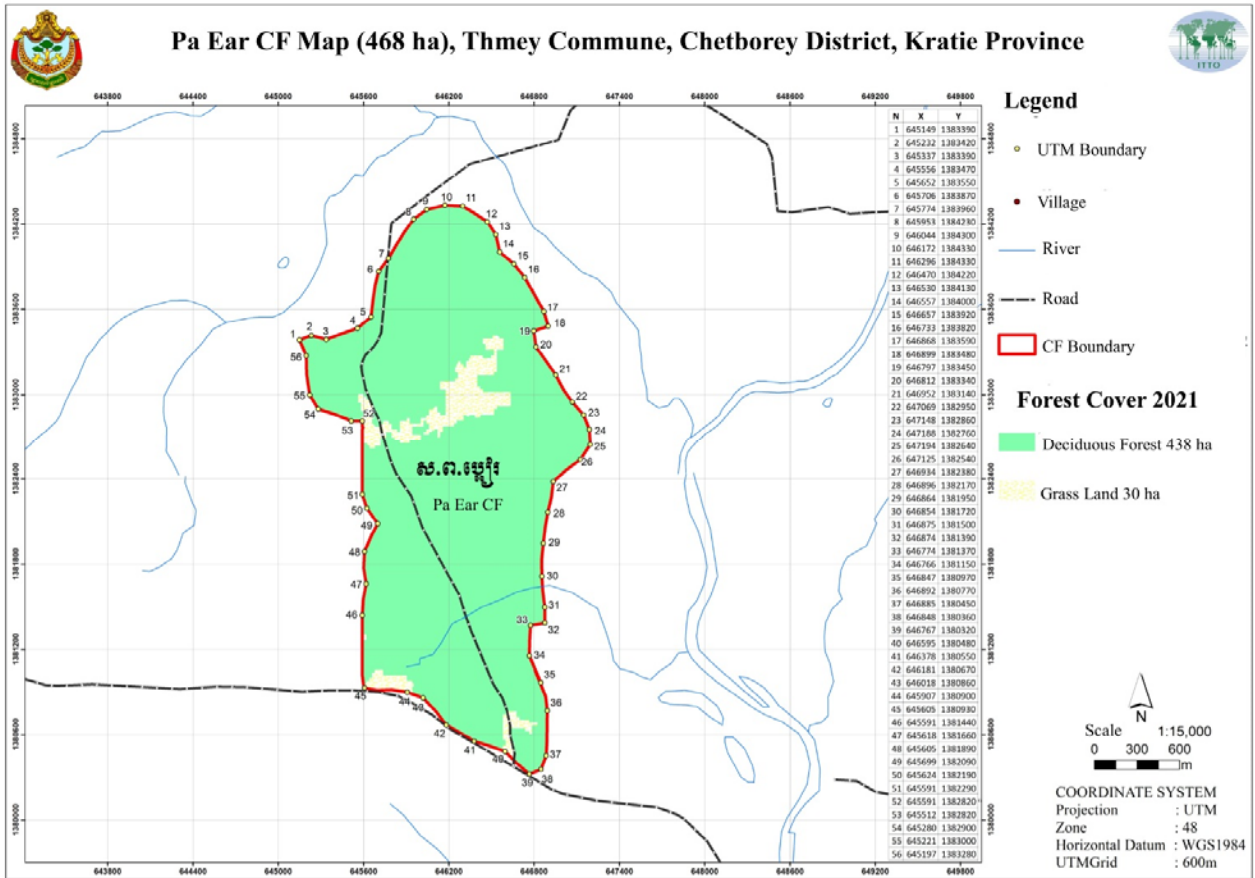
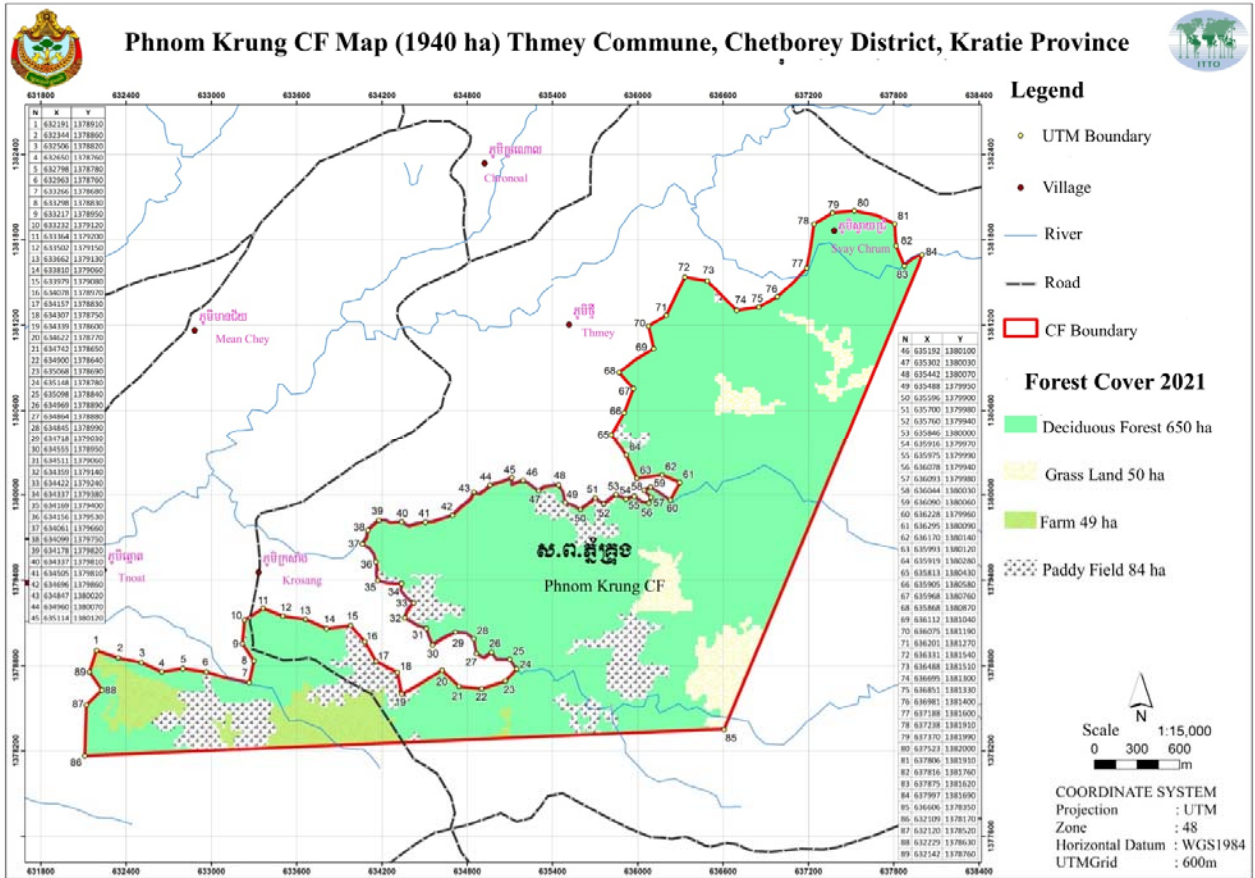
- UTM Boundary
- Village
- River
- Road
- CF Boundary

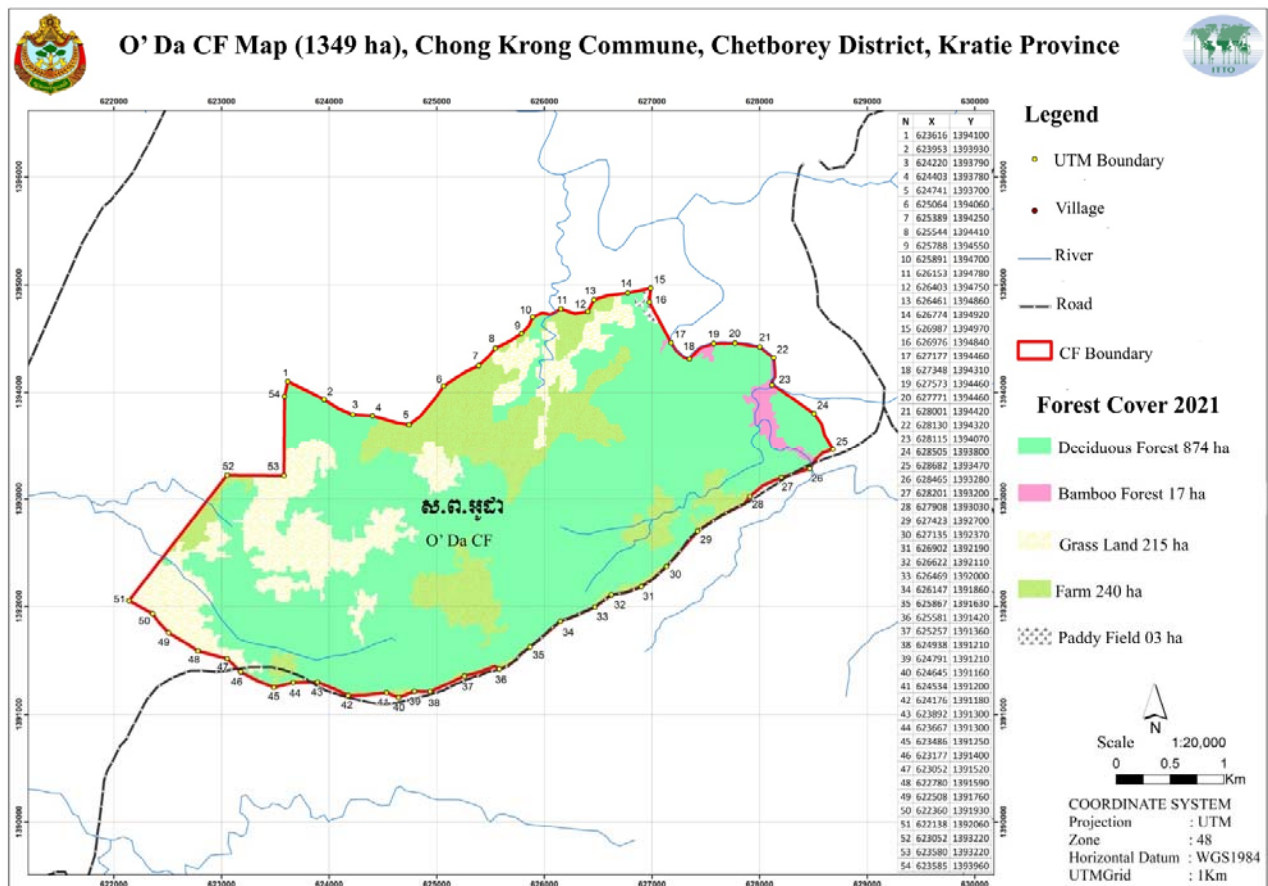
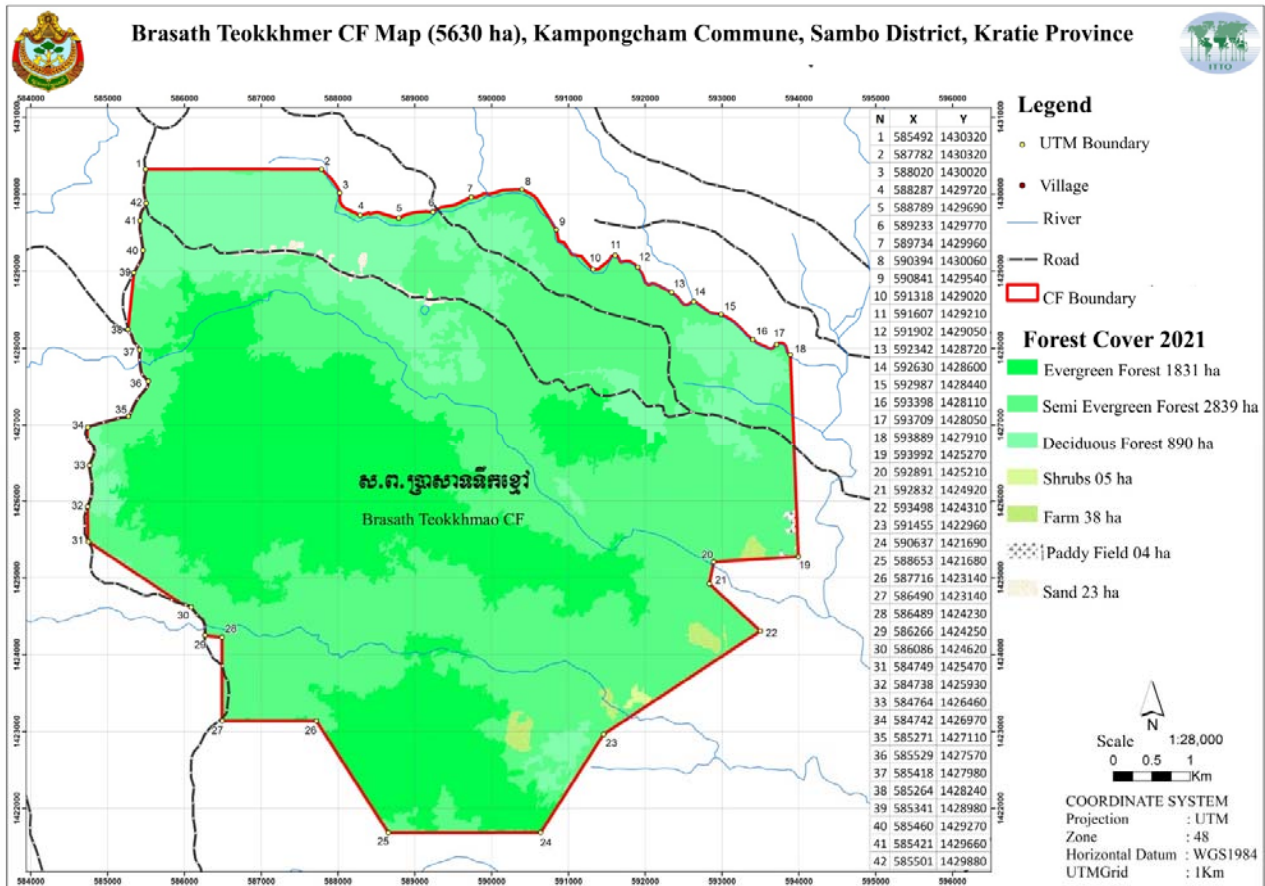
Forest Cover 2021

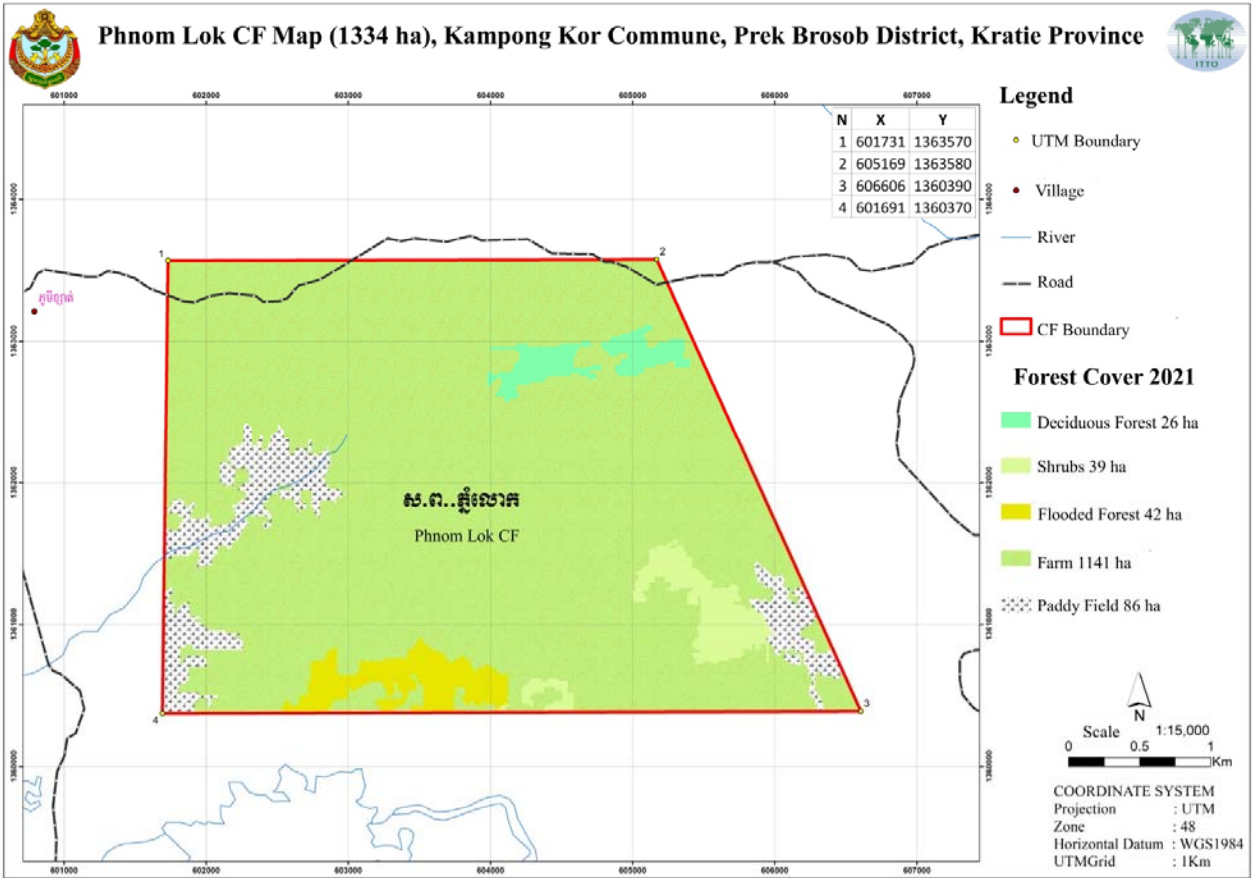
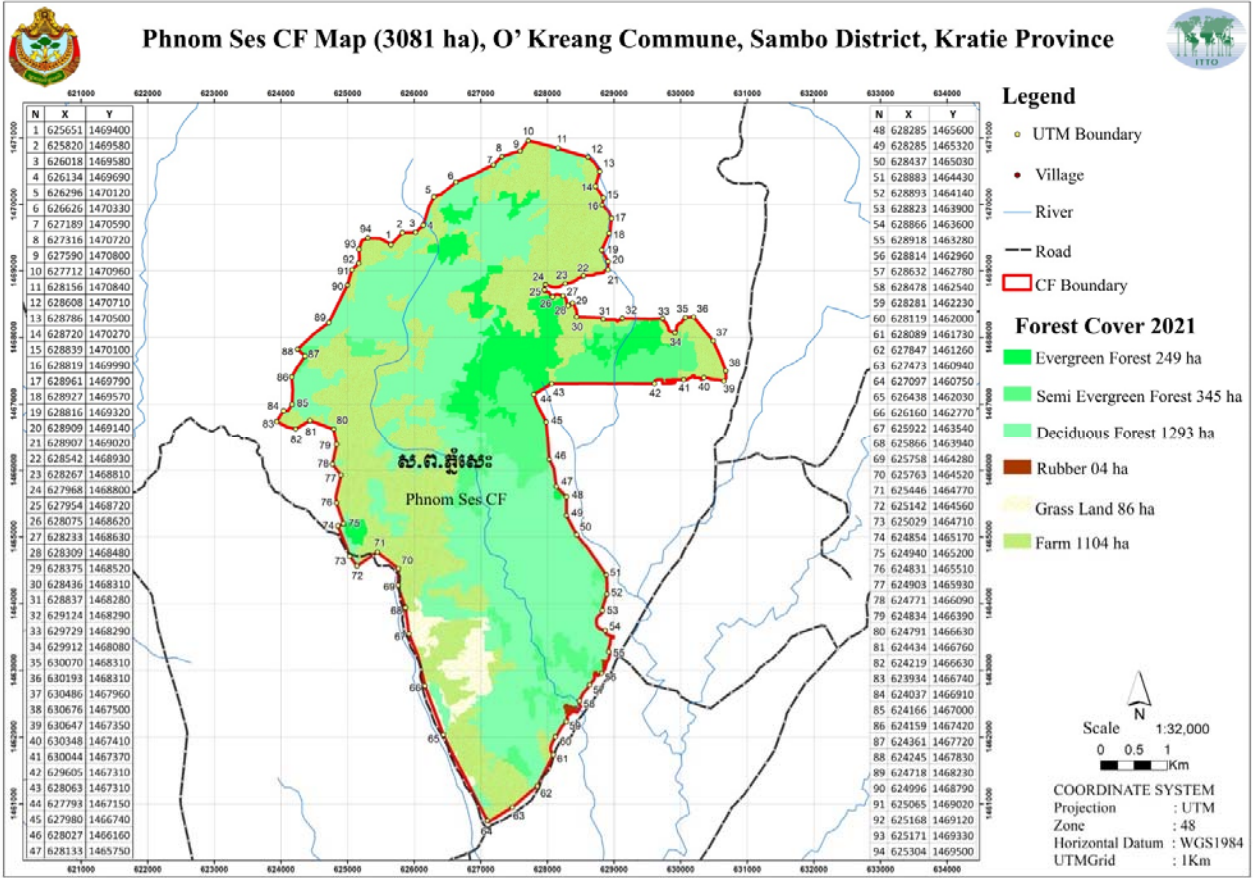
- Evergreen Forest 1549 ha
- Rubber 01 ha
- Grass Land 07 ha
- Farm 34 ha
- Sand 33 ha

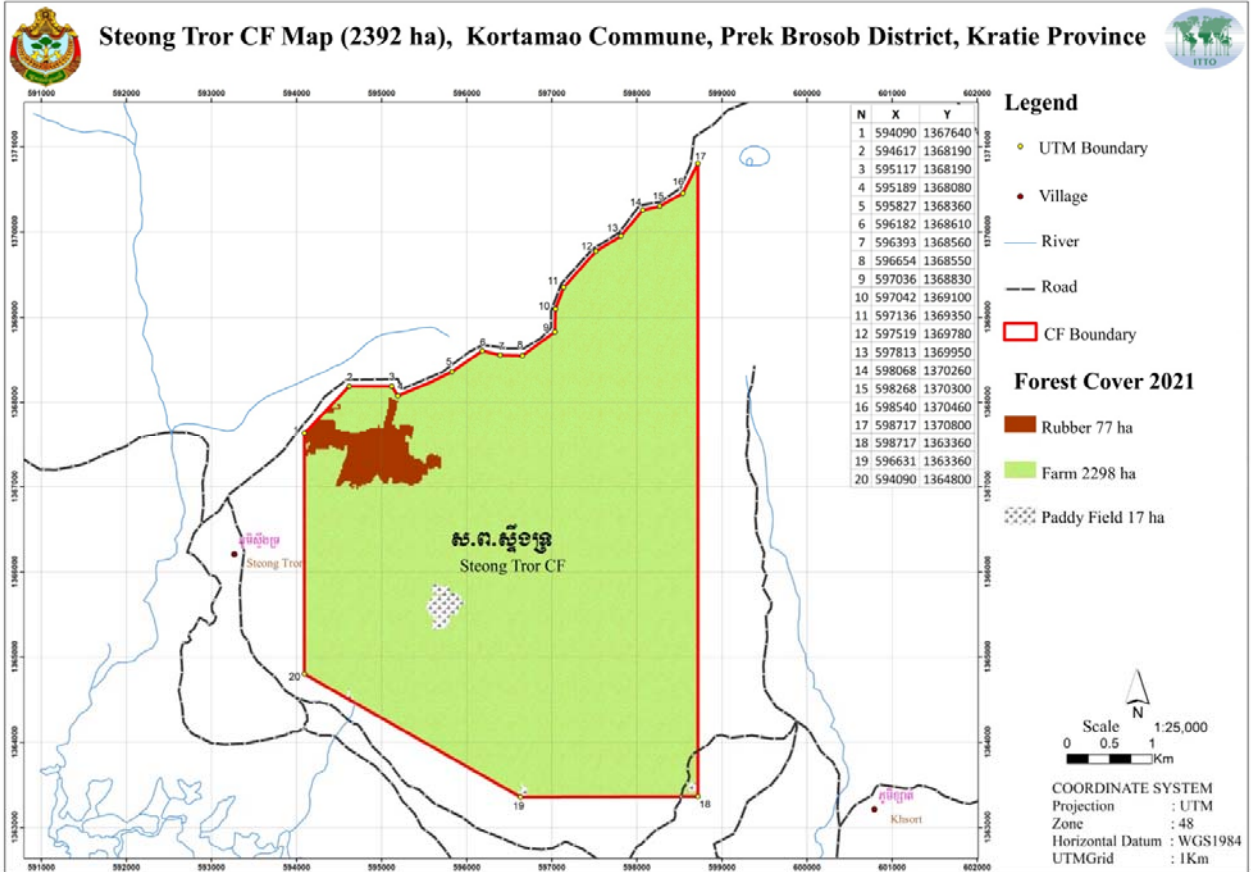
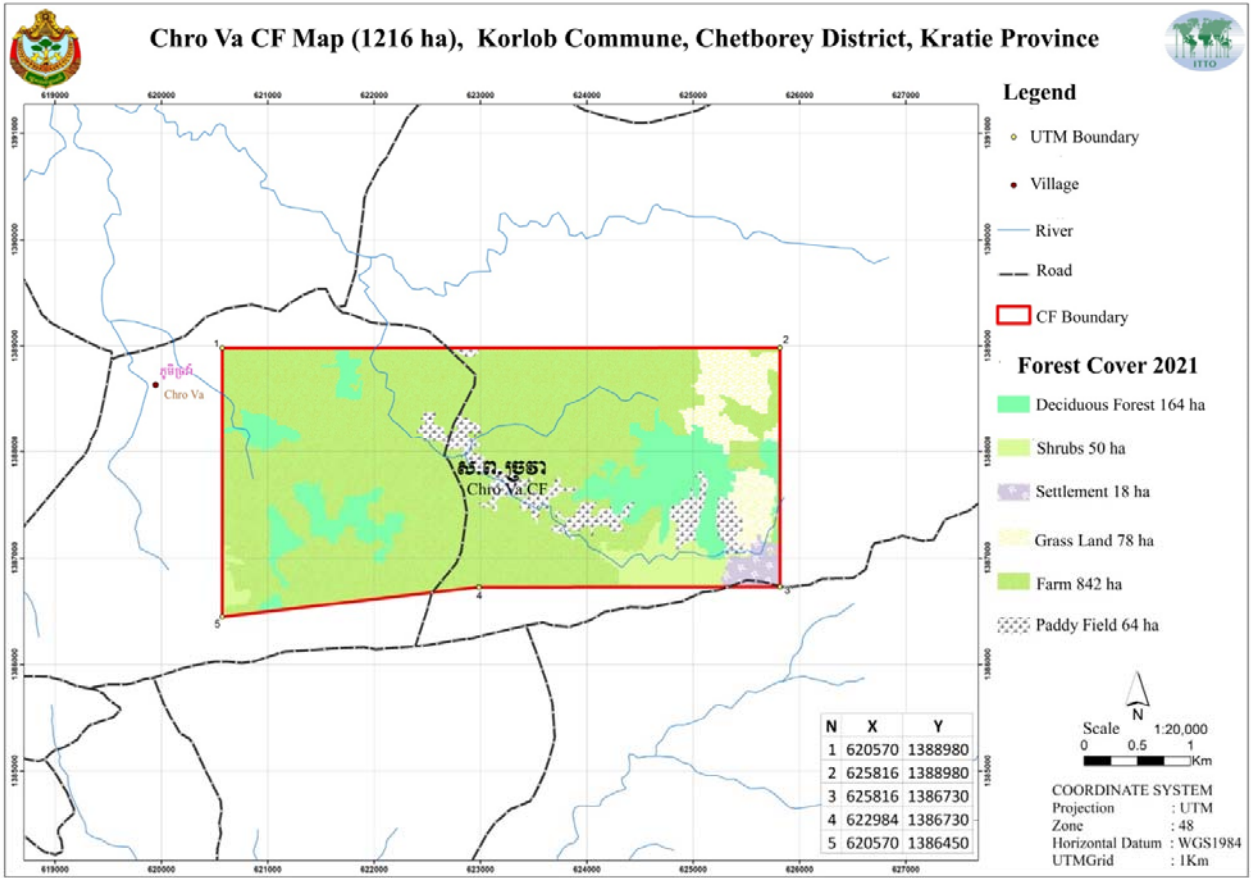




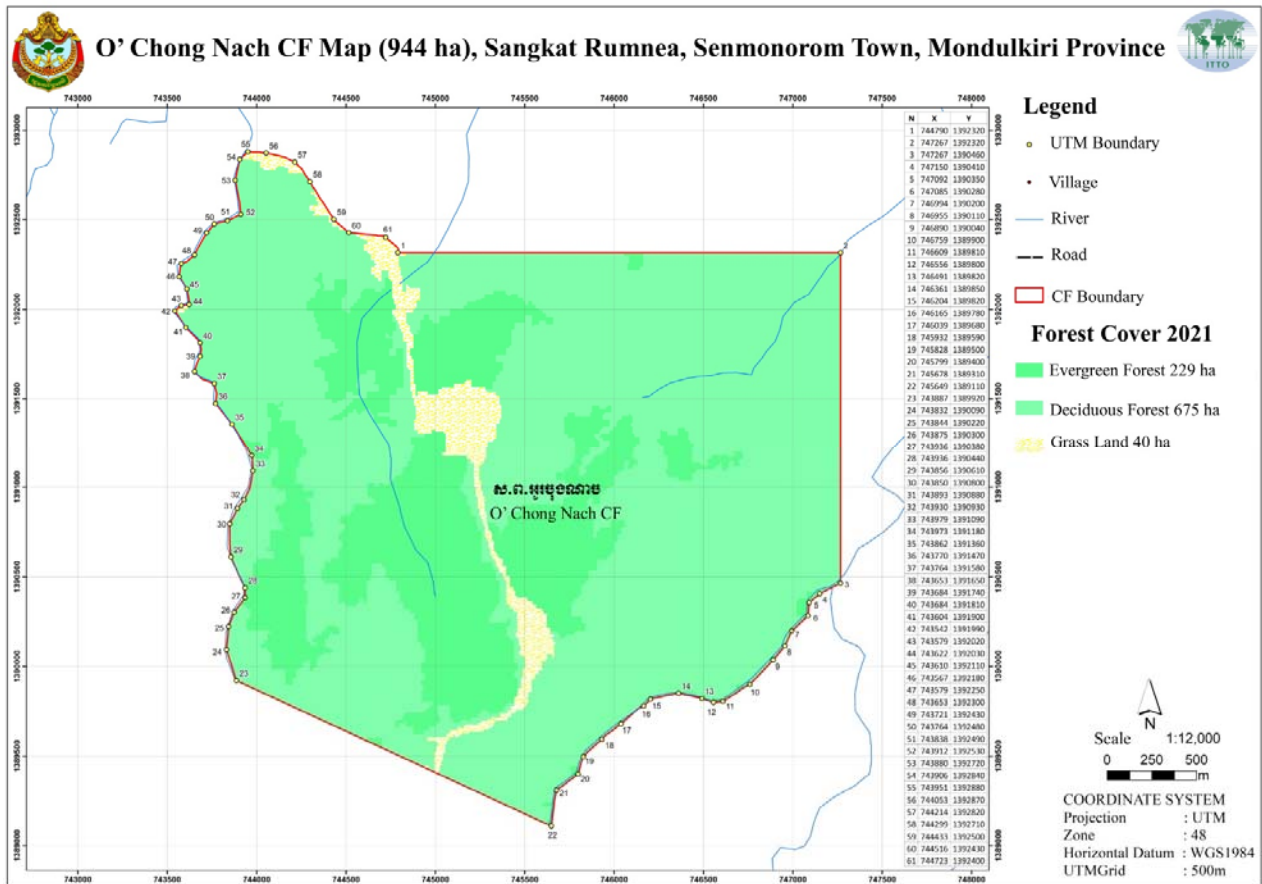
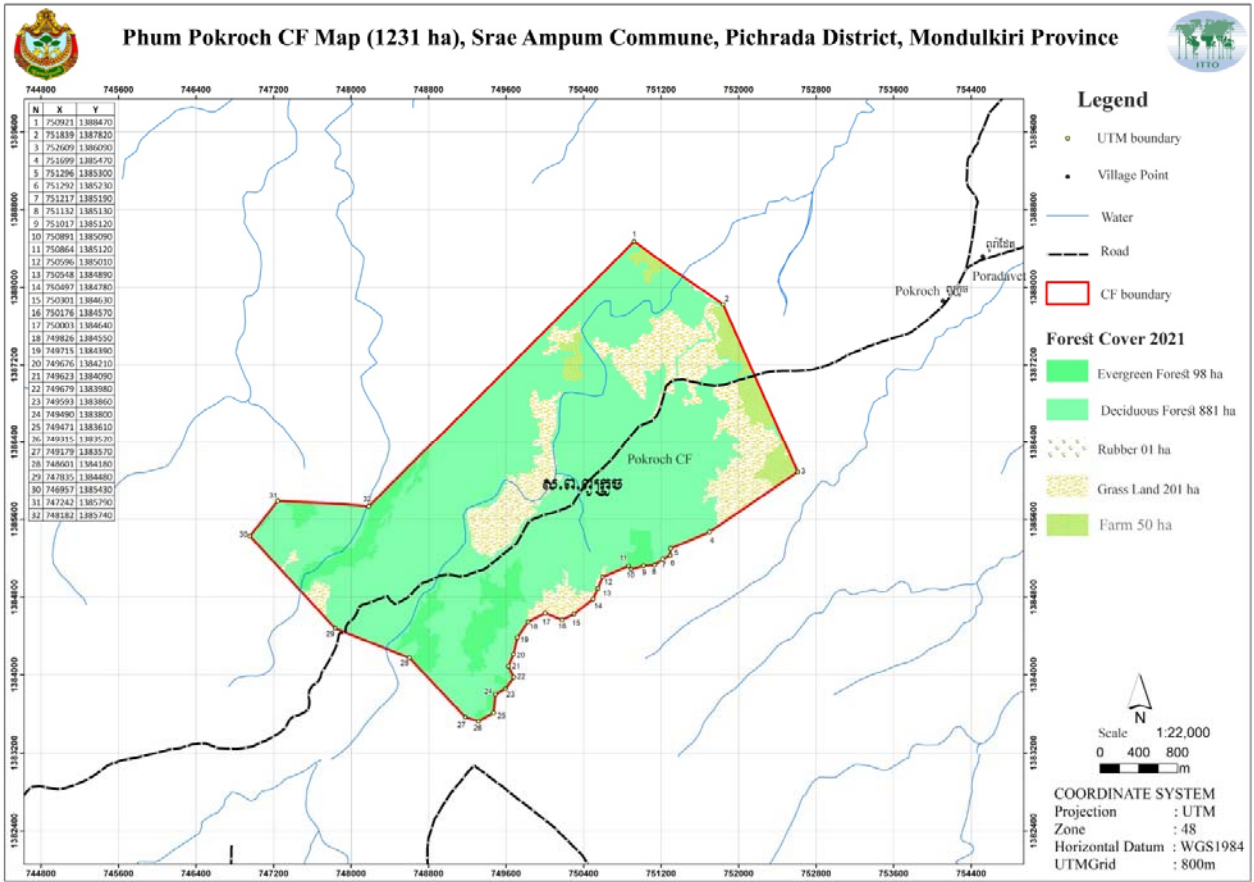


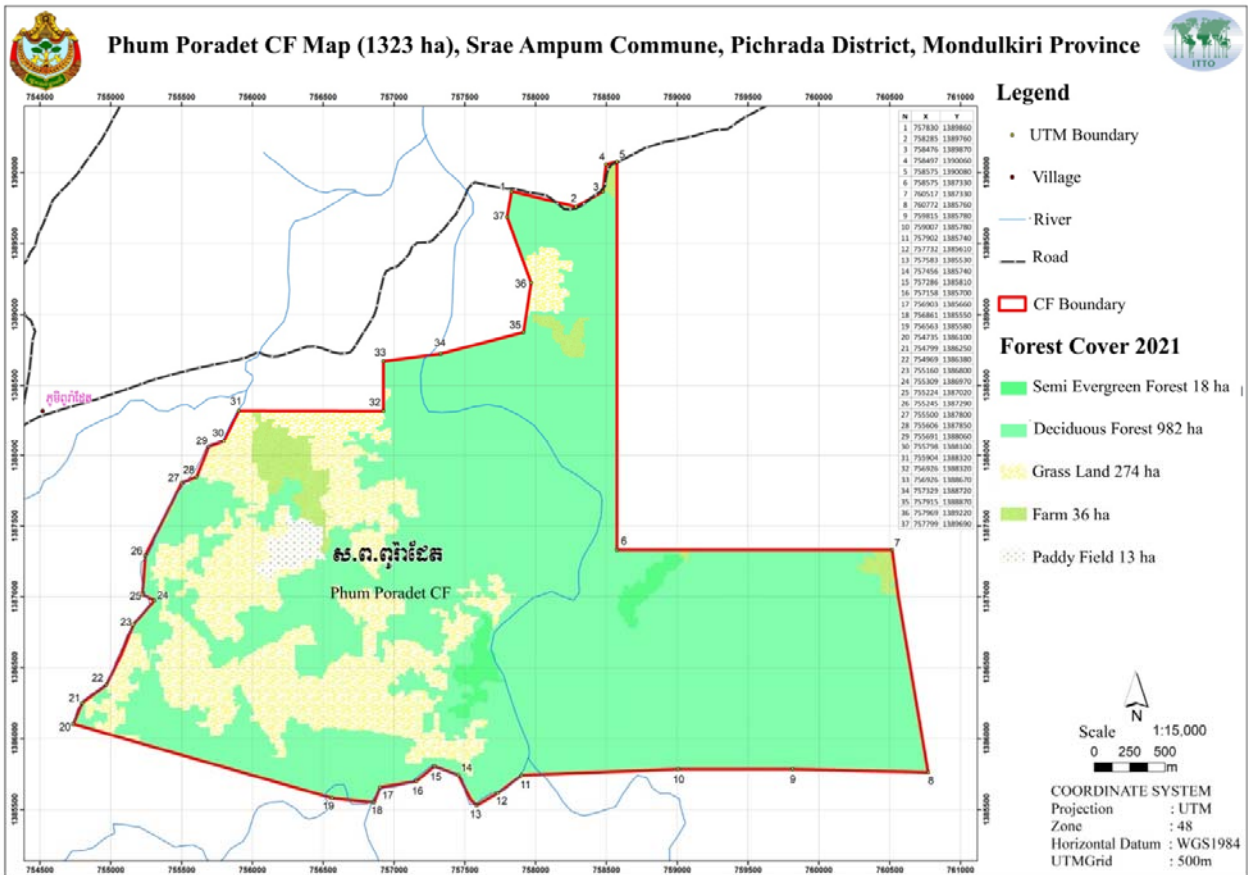
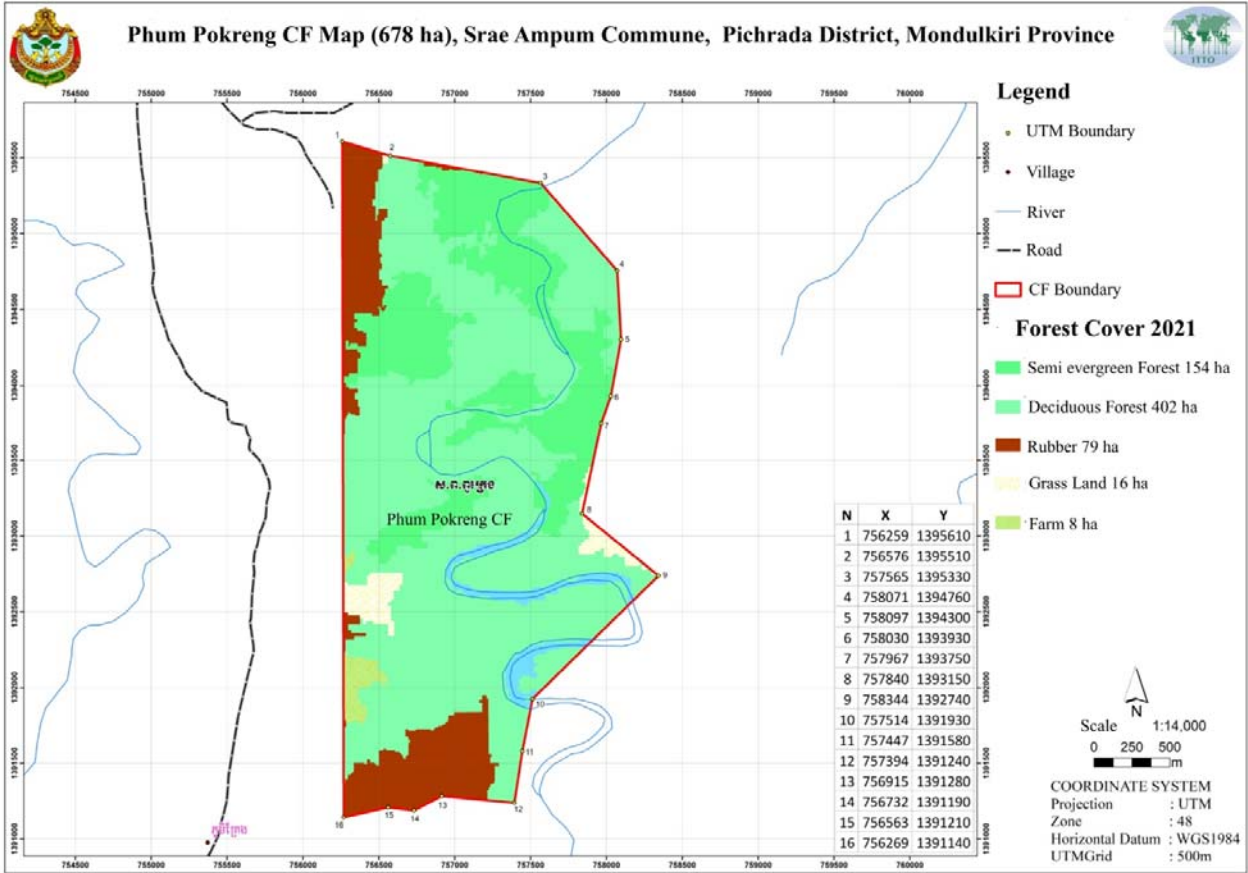


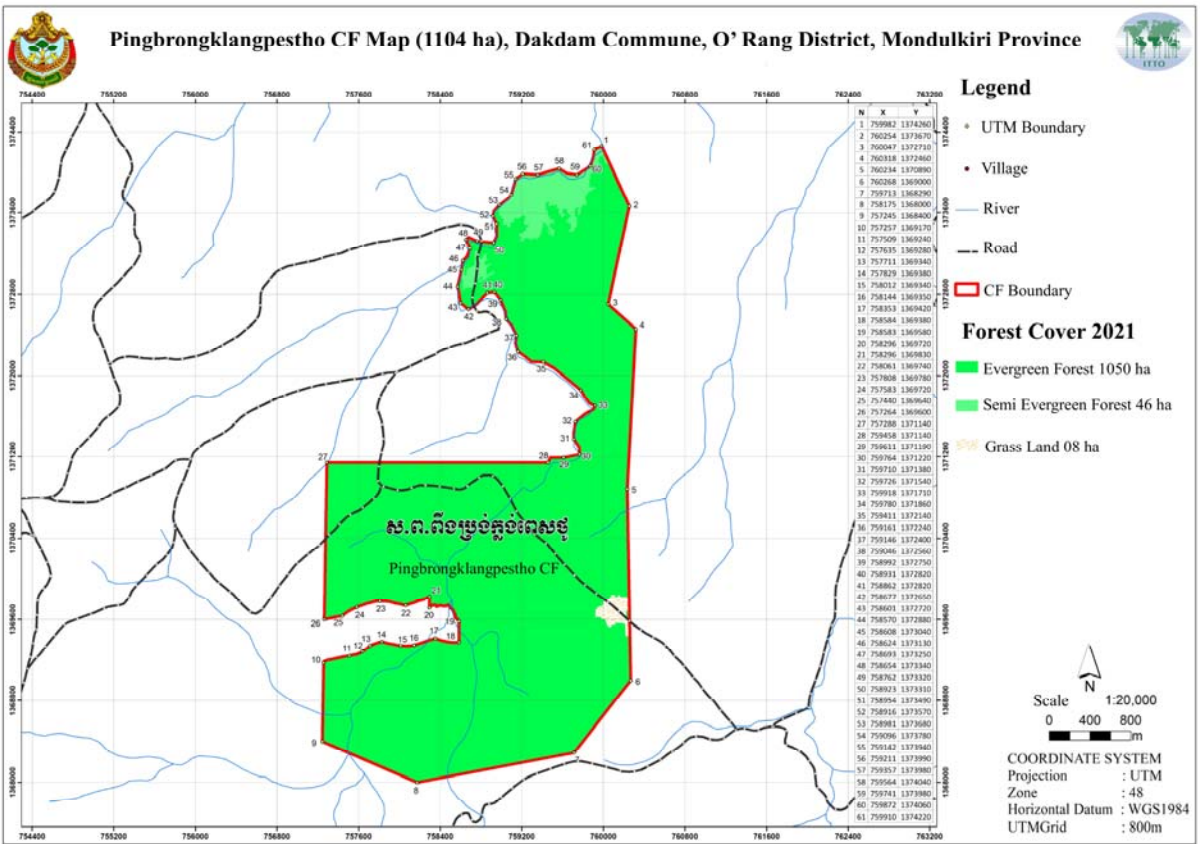




Community Forest Cover Map in Mondulkiri







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**Department of Forest Management and Community Forestry,
Forestry Administration**

#40, Norodom Blvd, Phsar Kandal 2, Khan Daun Penh, Phnom Penh, Cambodia

Phnom Penh Cambodia

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