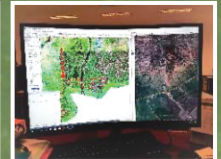
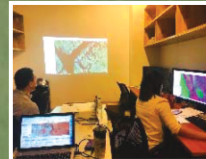




KINGDOM OF CAMBODIA  
NATION RELIGION KING

# CAMBODIA FOREST COVER 2018



DECEMBER 2020



## Preface

The sustainable forest resources management is to protect, preserve, conserve biodiversity to ensure an environment stability for the use of natural resources and Greenhouse-gas emissions reduction from the forest sector into the atmosphere.

The Royal Government of Cambodia (RGC), led by **Samdech Akka Moha Sena Padei Techo Hun Sen**, Prime Minister of the Kingdom of Cambodia, has issued a number of legal documents to serve as a roadmap for the Ministry of Environment, relevant government institutions, development partners and civil society organizations in Cambodia to participate in organizing and implementing appropriate activities to strengthen the effectiveness of natural resource protection. Recently, RGC has launched important strategic plans, including: National Environmental Strategic Action Plan, National Protected Areas Strategic Management Plan 2017-2031 and National REDD+ Strategy 2017-2026. In addition, RGC has set out a number of specific strategies such as the decentralization reforms and co-decentralization reforms, vision of long-term forest management through “Reduce greenhouse gas emissions from the forest sector at the level of 0% before the 2040” and Land Policy. All legal documents mentioned above showed the political wills and strong commitment for the protection, maintenance and conservation of natural resources in terms of contributing to the economic development of society through poverty reduction by implementing REDD+ Cambodia Programme, using natural resources, forests and sustainable ecosystem services.

The Ministry of Environment implemented the strategic plan set out by protected area management activities within its jurisdiction. In addition, during the year 2020, the Ministry of Environment has established 66 additional protected areas with an area of biodiversity corridor conservation, protected area system, making an area of forest cover equivalent to 41% of country land area.

Cambodia land use/cover was updated every two years is a core strategy devised by the Ministry of Environment to obtain sufficient data for planning effective management of protected areas. In 2020, the Ministry of Environment which has the General Directorate of Environment and Knowledge Information (GDEKI) has continued to prepare and publish the “**Cambodia Forest Cover 2018**”. The main purpose is to ensure the current updated of Cambodia land use/cover

change, which are transparency, consistency and accurate data for users, as well as additional data on existing data in Cambodia Forest Cover 2016 published in March 2018.

As the Minister of Environment, I would like to express my appreciation to senior management of the Ministry of Environment, the Technical Working Group (REDD +) of the General Directorate of Environmental Knowledge and Information (GDEKI) and General Directorate of Administration for Nature Protection and Conservation (GDANCP) and all development partners for their dedicated efforts to assist in the preparation making this publication feasible and available for public. Finally, I would like declare official launching the booklet for use from now on.

Phnom Penh, December 07, 2020



**SAY Samal**

**Minister of Environment**

## Acknowledgment

We would like to express our profound gratitude to H.E **Say Samal**, Minister of Environment, Excellences, ladies and gentlemen, leaders of the Ministry of Environment as whole for making physical and emotional effort in formulating the policy and strategic plan of management and protection, conservation of forest resources and protected areas. In this regard, the “**Cambodia Forest Cover 2018**” has played an important role in providing information and data for developing the sustainable management, protection, conservation plan.

We are the technical team, would like to extend our special thanks to all General Department of Environmental Knowledge and Information, General Directorate of Administration for Nature Protection and Conservation (GDANCP) and General Department of Local Communities of the Ministry of Environment and development partners, including the United Nations Food and Agriculture Organization (FAO), Japanese International Cooperation Agency (JICA) Cambodia, Forest Carbon Partnership Fund (FCPF) and Forestry and Forest Products Research Institute (FFPRI) of Japan , which have collaborated in supporting for development of the publication.

We sincerely hope to receive support from Your Excellency, ladies and gentlemen and friends abroad who apply it to their daily performance as they face any potential issues and can use it for future reference according. Therefore, we also would like to express our pleasure and gratitude in advance for any meaningful and constructive feedback to mend our shortcoming and for improvement of our future publication in the future.

Finally, we would like to wish His Excellency Minister, Excellences, ladies and gentlemen, all the leaders of the MoE, including foreign friends a success and May the four gems of Buddhist blessing: Longevity, Nobility, Health, and Strength - be with you.



## Content

Preface .....	i
Acknowledgment .....	iii

### Chapter 1 General Information

1 . 1 Introduction .....	1
1 . 2 Objective .....	1
1.3 Historical of Cambodia’s Forest Cover Assessment .....	2
1.4 Cambodia REDD+ Programme .....	3
1.4.1 National REDD+ Strategic Plan (NRS) .....	4
1.4.2 Forest Reference Levels (FRL) .....	4
1.4.3 National Forest Monitoring System (NFMS) .....	5
1.4.4 Safeguard Information System (SIS).....	5

### Chapter 2 Land use/cover Assessment Methodology

2.1 Download satellite imageries .....	6
2.1.1 Google Earth Engine .....	6
2.1.2. Planet .....	6
2.2 Satellite imageries analysis .....	8
2.3 Land use/cover change .....	9
2.4 Accuracy Assessment Methods .....	9
2.4.1 Selection point for accuracy assessment .....	10
2.4.2. Collect Earth .....	10
2.4.3 Forest Inventory Methods (Bitterlic Sampling).....	11
2.4.4 Drone Technology .....	11

### Chapter 3 Result of Land use/cover Assessment

3.1 Current Update Land use/cover 2018 .....	13
3.1.1 Results of National Land use/cover Assessment .....	13
3.1.2 Result of Land use/cover Assessment for Cambodia REDD+ .....	15
3.2 Land Use/Cover Change between 2016 - 2018 .....	17
3.2.1 Results of National Land use/cover Changes .....	17
3.2.2 Result of Land use/cover change for Cambodia REDD + .....	19

3.3 Forest Cover Change statistic from 1965 - 2018 .....22

**Chapter 4**  
**Conclusion**

Conclusion .....24

**Annex**

Annex 1 : Forest Definition.....25  
Annex 2 : Description of Land use/cover Classes 2018 .....26  
Annex 3 : Provincial Land use/cover Statistic 2018 .....27  
Annex 4 : Accuracy assessment results 2018.....28  
Annex 5 : Forest cover change date 2016-2018.....29

**REFERENCES**



## **Figures**

Figure 1: Four key elements in applying REDD+ Programme .....	4
Figure 2: Google Earth Engine .....	6
Figure 3: Planet .....	7
Figure 4: Satellite imageries used for classification and accuracy assessment 2018 .....	8
Figure 5: Diagram of implementation staged of Land use/cover map 2018.....	9
Figure 6: Location of verified data on reliability of Land use/cover data for 2018 .....	10
Figure 7: SEPAL .....	10
Figure 8: Collect Earth .....	11
Figure 9: Tree demarcation in sample plot to be measured .....	11
Figure 10 : Drone technology .....	12
Figure 11: Map of National Land use/cover 2018 .....	13
Figure 12: National Land use/cover rate in 2018 .....	15
Figure 13: Map of Land use/cover 2018 for Cambodia REDD+ .....	15
Figure 14: Land Use/Cover rate in 2018 for Cambodia REDD+ .....	17
Figure 15: Map of National Land use/cover change 2016-2018 .....	17
Figure 16 : Map of land use/cover change, 2016 -2018 for Cambodia REDD+.....	19
Figure 17 : Map of National Land use/cover change from 2006-2018 .....	23
Figure 18: Map Land use/cover change for Cambodia REDD+ from 2006-2018 .....	23

## **Table**

Table 1 : Satellite imageries types .....	7
Table 2: Statistics of National Land use/cover 2018 .....	14
Table 3: Statistics of Land use/cover 2018 for Cambodia REDD+ .....	16
Table 4: Statistics of national land use/cover change 2016-2018 .....	18
Table 5: Statistics of Land use/cover change 2016-2018 for Cambodia REDD+ .....	20
Table 6: Statistics of Land use/cover change 2006-2018 for Cambodia REDD+.....	21

## **Graphics**

Graphic 1: National Land use/cover change 2016 -2018.....	18
Graphic 2: Land use/cover change 2016-2018 for Cambodia REDD+ .....	20
Graphic 3: Land use/cover change rate 2006-2018 for Cambodia REDD+ .....	21
Graphic 4: National Forest cover change rate 1965-2018 .....	22



## List of acronyms

Acronyms	Full Word
RGC	Royal Government of Cambodia
MoE	Ministry of Environment
MAF	Ministry of Agriculture Forestry and Fishery
GDEKI	General Directorate of Environment and Knowledge Information
GDANCP	General Directorate of Administrative Nature Conservation and Protection
FA	Forestry Administration
FiA	Fishery Administration
UNDP	United Nation Development Programme
FAO	Food and Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FFPRI	Forestry and Forest Product Research Institute (Japan)
FRL	Forest Reference Level
FRM	Forest Resource Management
GHG-I	Green House Gas Inventory
ITTO	International Tropical Timber Organization
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
MRC	Mekong River Commission
MRV	Measuring, Reporting and Verification
NFMS	National Forest Monitoring System
NFP	National Forest Programme
NPASMP	National Protected Area Strategic Management Plan
NRS	National REDD+ Strategy
REDD+	Reduction Emission from Deforestation and Forest Degradation
SIS	Safeguard Information System
UNFCCC	United Nation Framework Convention on Climate Change
LU/LC	Land Use/Land Cover
E	Evergreen
SE	Semi-Evergreen
D	Deciduous

B	Bamboo
Ws	Wood Shrub
M	Mangrove
Mr	Mangrove Rear
Fr	Forest Regrow
Ff	Flooded Forest
P	Pine
PCA	Principle Componence Analyses
Pp	Pine Plantation
Tp	Tree Plantation
Po	Palm Oil
Rp	Rubber Plantation
G	Grass
Hr	Paddy Field
Hc	Crop Land
Bt	Village
Bu	Build up Area
R	Rock
S	Sand
W	Water

# Chapter 1

## General Information

### 1. 1 Introduction

The Royal Government of Cambodia (RGC) has taken many important policies aimed at addressing climate change issues, deforestation and forest degradation being faced in the process of developing agriculture, forestry as well as the conservation of biodiversity. In this context, the Ministry of Environment collaborated with United Nations Development Program (UNDP) under Forest Carbon Partnership Project (FCPF-II), Food and Agriculture Organization of the United Nations (FAO), Japanese International Cooperation Agency ( JICA), and Forestry and Forest Products Research Institute of Japan (FFPRI) produce current updated maps of Land use/cover 2018 by using technology of geographic information systems with satellite images analysis every 2 years.

Current updated land use/cover assessment, REDD+ technical team of the Ministry of Environment used key inputs in for preparing protected area management plan, in particular have contributed to the implementation of action plans for implementing National Protected Areas Strategic Management Plan 2018-2022 and National REDD+ Strategic Plan 2017-2026.

The results showed that the rate of forest cover loss in this last period has declined dramatically, in response to the policies of RGC has made effective reform in the forestry sector at the national and sub-national levels, which will contribute to improving the management of natural forests and biodiversity.

### 1. 2 Objective

The main objective of the assessment is to provide specific information on land use/cover throughout Cambodia to contribute to the formulation of policies, development plans and national strategic plans for the management of Cambodia's forest resources and to support the implementation of the National Protected Areas Strategic Management Plan (2017 - 2031) and National REDD+ Strategic Plan (2017 - 2026).

The assessment has two main objectives:

1. To be update and produce Land use/cover map 2018
2. Assessment Land use/cover changes 2016-2018



### 1.3 Historical of Cambodia's Forest Cover Assessment

Cambodia has been conducted land use/cover assessment eight times and evaluated the land use/cover change of the protected areas system from 2006 - 2016 by using the technology of satellite image Landsat 8 and Sentinel 2. The purposes of the assessment of the country's forest land use/cover is to update forest land cover and support the sustainable forest management planning. As a result, the evaluation for each year is indicated as follows:

- Forestry Statistics before 1970: Forest cover assessment 1958-1965 divides 09 classes (Source: Forestry Administration and Forestry, 1995), shown that forests cover an area **13,227,100 hectares** equal to **73.04%** of total country land area

- 1992/93 and 1996/97: The evaluation of Forest cover resource carried out by the MRC/GTZ in cooperation with the Forestry Administration show that in 1992/93 shown that forest covers an area of **59.82%** and **58.60%** in 1996/97 of the total country land areas, through the interpretation of satellite images Landsat TM in the form of hardcopy with a scale 1:250.000 and divided into 14 classes (Source: Forestry Administration, forest cover resources 2004)

- 2002: The assessment of the forest cover resource in 2002 carried out by the Forest Resource Management (FRM) in collaboration with the Forestry Administration, interpretation of satellite images Landsat 7ETM of the United States with a scale 1:250.000 showed that forests cover an area of **61.15%** of the total country land. Forest Cover 2002 divided 05 classes including Evergreen Forest, Semi-evergreen Forest, Deciduous Forest, Other Forest and Non-Forest (Source: Forestry Administration, forest cover resources change 2002 - 2006)

- 2006: With financial support from the Danish Embassy through the DANIDA, the Forestry Administration conducted a 2006 forest cover assessment from the US Landsat 7ETM satellite image with a scale of 1:250.000 showed that forest cover area of **59.09%** of the total country land area and divided into 05 classes as stated in 2002 forest classification (Source: Forestry Administration, forest cover resources change 2002-2006)

- 2010: Forestry Administration, in collaboration with development partners, including international tropical forests organizations (ITTO) and DANIDA conduct evaluation of forest cover resources using US Landsat 5TM images with a scale 1:250.000 showing forests cover an area of **57.07%** of the total country land. The 2010 forest classification divided into 05 classes which

are the same as the forest classes in 2002 (Source: Forestry Administration, forest cover resources Cambodia in 2010).

- 2014: Forest Administration in cooperation with Food and Agriculture Organization of the United Nations (FAO), Japan International Cooperation Agency (JICA), Forestry and Forest Products Research Institute of Japan (FFPRI) for interpretation of US Landsat 8 satellite images. The results showed that forests cover **49.48%** of the total country land, divided into 22 classes, which 13 are forest classes. Based on strategic data requirements and technical conditions of the United Nations Framework Convention on Climate Change (UNFCCC), which Cambodia is a member.

- 2016: Monitoring Reporting and Verification Technical Working Group (MRV ) in cooperation with Food and Agriculture Organization of the United Nations (FAO), Japan International Cooperation Agency (JICA), Forest Carbon Partnership Fund (FCPF) and the Forestry and Forest Products Research Institute of Japan (FFPRI) to interpret US Landsat 8 images, by dividing it into 22 classes same as 2014. (Source: Ministry of Environment, Cambodia's Forest Cover 2016), the data showed that the forests cover **48.14%** of total country land.

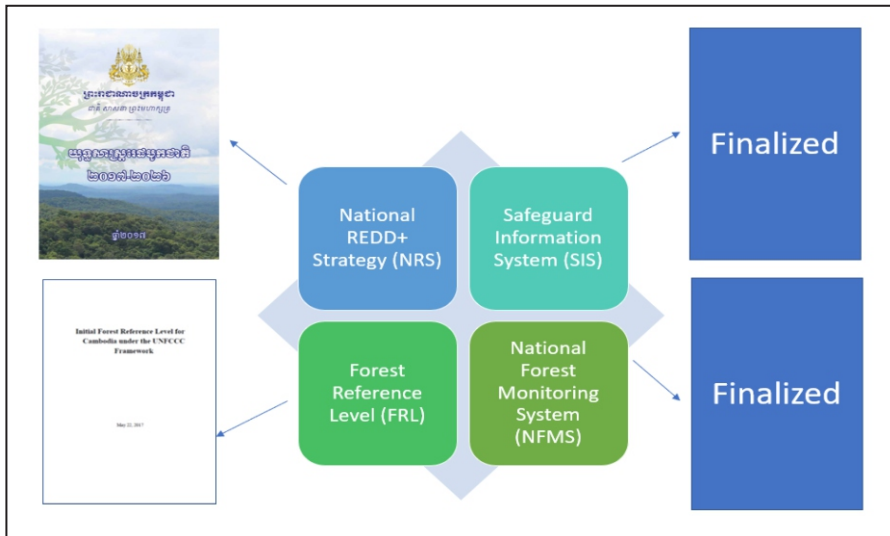
- 2018: REDD+ Technical Working Group of Geographic Information System of the General Directorate of Administrative Nature Conservation and Protection in cooperation with the Forest Carbon Partnership Fund (FCPF), Food and Agriculture Organization of the United Nation (FAO), Japan International Cooperation Agency (JICA) and Forestry and Forest Products Research Institute of Japan (FFPRI). The results show that forests cover **46.86%** of the total country land area.

#### **1. 4 Cambodia REDD+ Programme**

Cambodia REDD+ Programme conformed to resolution of the United Nations Framework Convention on Climate Change (UNFCCC). Cambodia REDD+ has significantly contributed to reducing erosion of deforestation and forest degradation and sustainable forest management, conservation and enhancement carbon stocks. The implementation of Cambodia REDD+ is divided into three phases: 1) Preparatory, phase: 2) Implementation, and phase: 3) Result-Based Payment (RBP) of reducing greenhouse gas emissions from forest sector and land use.

In order to receive result-based payment, Cambodia needs to prepare four main strategic documents, including:

- 1) National REDD+ Strategic Plan (NRS)
- 2) Forest Reference Level (FRL)
- 3) National Forest Monitoring System (NFMS)
- 4) And, Safeguard Information System (SIS).



**Fig. 1:** The four key elements of implementing REDD+

### 1.4.1 National REDD+ Strategic Plan

The national REDD + strategy is implemented in two phases:

- Phase I, 2017-2021: An action plan will be developed and the institutional arrangement for the implementing of the NRS will be finalized. Drivers will be address through improved implementation of existing management framework such as National Forest Program (NFP), National Protected Area Strategic Management Plan (NPASM), Strategic plan for the fisheries sector and sub-decree on Economic Land Concessions (ELCs) and Social Land Concessions (SLC).

- Phase II, 2022-2026: The NRS focus during this phase will be complete the transition from readiness to implement and prioritized the achievement of measurable result.

### 1.4.2 National Forest Reference Levels

Cambodia’s first Forest Reference Level (FRL) document is part of four



important ones designed for REDD+. The FRL is the basic data for measuring the implementation of REDD+ policies and measures in reducing the emission deforestation and forest degradation.

Developing countries should be prepared to be transparent by selecting the existing data in the past and can be adjusted according to the national circumstances. In preparing this strategy document, the new principles and guidelines of the Intergovernmental Panel on Climate Change (IPCC2003 and IPCC 2006) are utilized to estimate emissions. The report shows FRL is consistent with the decision of the United Nations Convention framework on Climate Change (UNFCCC).

### **1.4.3 National Forest Monitoring System**

The National forest monitoring system is the basis for forest management effectively. Cambodia started implementing forest monitoring in 1965, and from 2002 the forest assessments were performed every 4 years; the forest inventory is developed on a systematic manner and a reporting mechanism is formulated to transmit information from the national and sub-national level. Cambodia has decided to establish national forest monitoring systems in accordance with the purpose of implementing REDD+ and it is useful for forest management based on the existing mechanisms and methods.

### **1.4.4 Safeguard Information System (SIS)**

Establishment Safeguard Information System is one of the three requirements outlined by the UN Framework Convention on Climate Change and is linked to the results-based payment according to REDD+ policies. Safeguard Information system is set up according to each country's national circumstances, based on policies, regulations and laws and existing information sources to ensure the rights to effective implementation of REDD+ on a transparent and efficient manner.

## Chapter 2

# Land use/cover Assessment Methodology

### 2.1 Download satellite imagery

#### 2.1.1 Google Earth Engine

Google Earth Engine is an open source-based software to manage data for analyzing geographic information system, forest fire monitoring, deforestation forest degradation monitoring, drought, floods and weather forecasts monitoring -ect-. For Land use/cover assessment in 2018, Google Earth Engine application was used to download Landsat 8 images and Sentinel images in whole country with the cloud level of less than 10 percent.

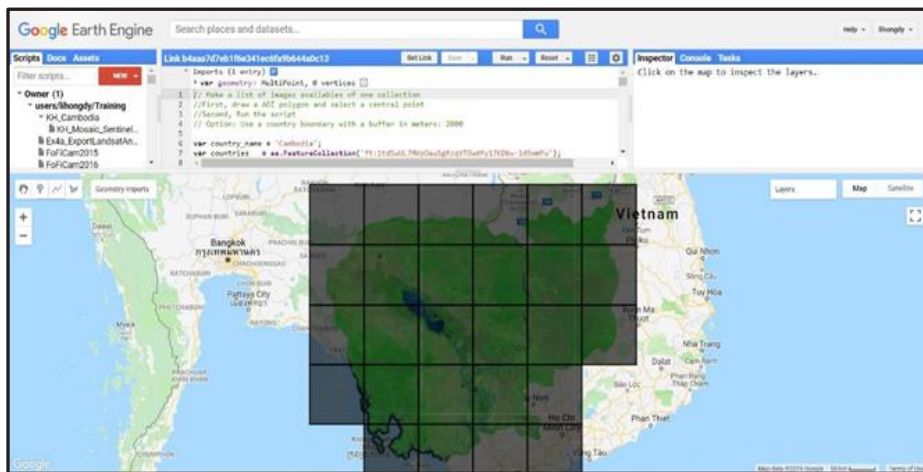
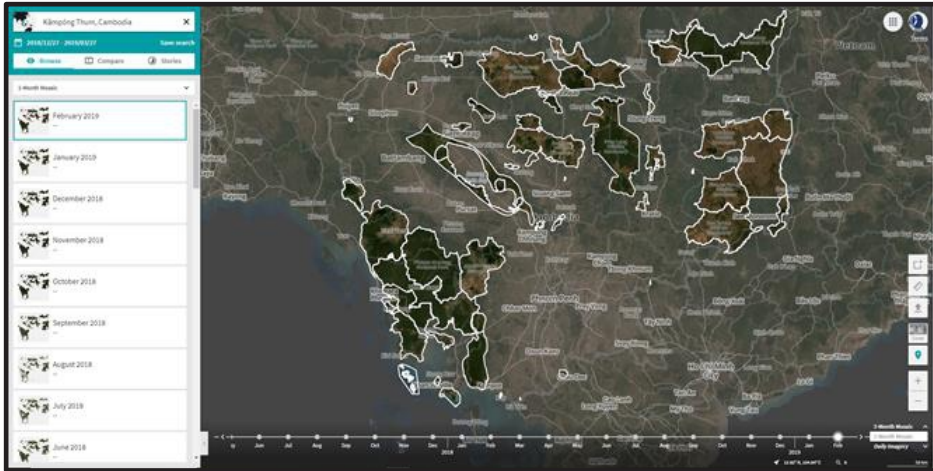


Fig. 2: Google Earth Engine

#### 2.1.2. Planet

Planet operate more than 150 satellites that together provide an unprecedented dataset of Earth observation imagery. With a unique combination of coverage, frequency, and resolution Planet delivers geospatial insights at the speed of change, helping you get the most nuanced understanding of changing ground conditions. Planet provided geospatial insights at the speed of change, equipping organizations with the data necessary to make informed, timely decisions (<https://www.planet.com>).

Planet platform is can be used to monitor the land use/cover through high-resolution satellite imagery. The technical teams used Planet to download high-resolution satellite images for land use/cover assessment.



**Fig. 3:** Planet platform operation

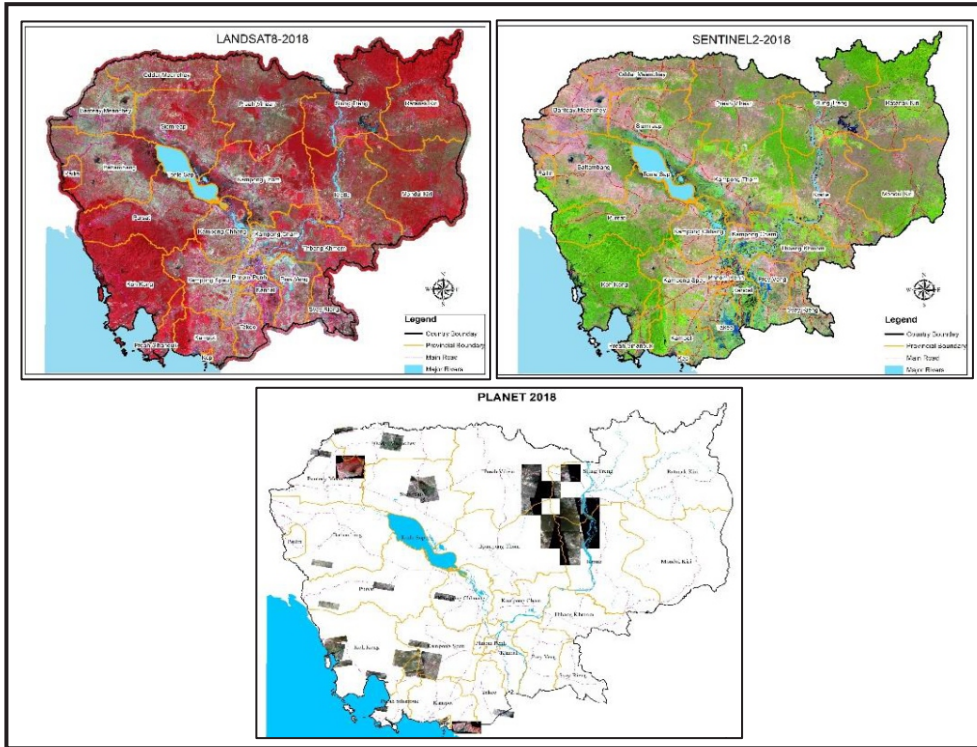
Land use/cover assessment 2018 uses four different types of satellite imagery, including:

**A. US Landsat 8 satellite** was used to assess and classify land use/cover 2018. 52 satellite images were selected by Google Earth Engine for assessment and classification from early October 2017 to May 2018.

**B. Satellite for reliability verification and evaluation**  
Sentinel-2 satellite imagery (2018), Rapid Eye satellite imagery and Google Earth Satellite Imageries are used to support the accuracy assessment of 2018 results and land use/cover change 2016 - 2018.

**Table 1:** Satellite image types

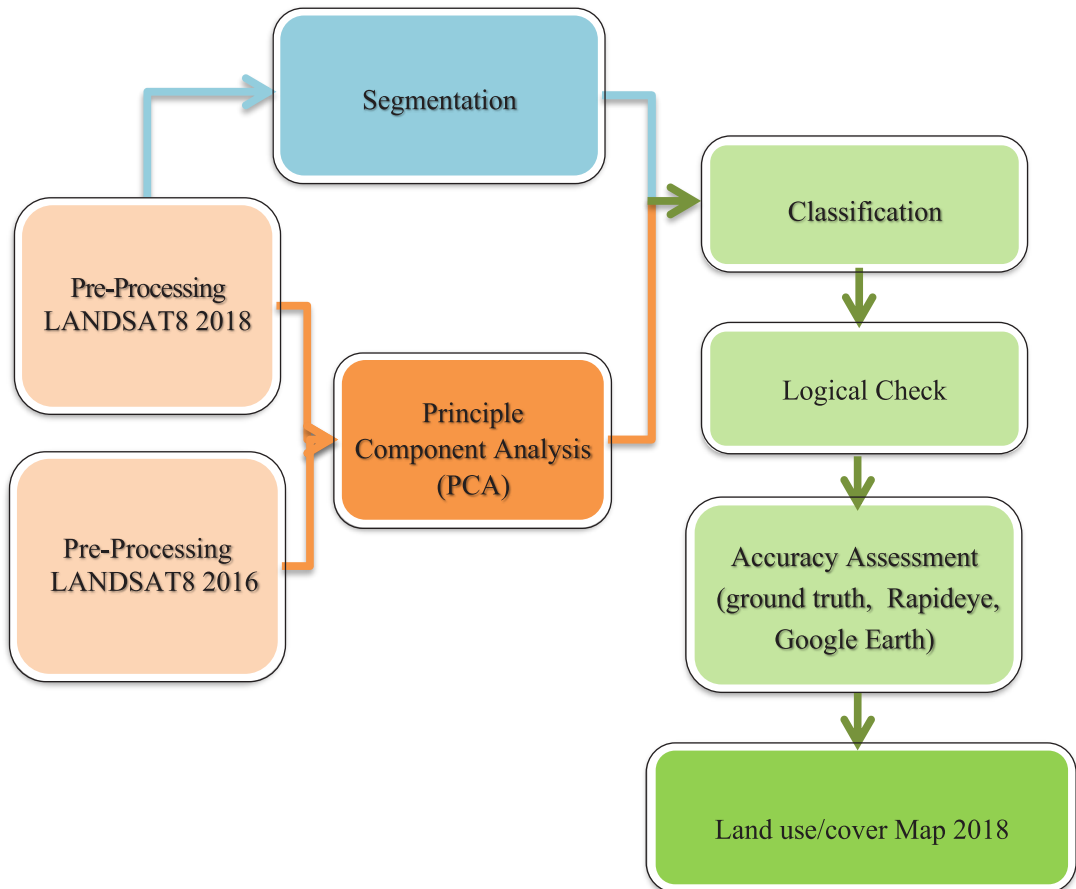
Area of Interest (AOI)	Cambodia Country area with 5km buffer
Landsat image product	USGS Landsat 8 Surface Reflectance Tire 1
Image collection period	2018 mosaic: 01/10/2017 to 30/03/2018
	2016 mosaic: 01/10/2015 to 30/03/2016
Percentage of cloud coverage	50%
Image composite method	Median surface reflectance values were calculated for all pixels from the collected image



**Fig. 4 :** Satellite imagery for 2018 forest cover resource assessment

## 2.2 Satellite imagery analysis

Land use/cover assessment 2018, Technical team chose satellite imagery Landsat8 2018 for the processing and analysis of through GIS/Remote Sensing by classifying a total of 22 Land use/cover classes including 13 classes of forest and 9 classes are non-forest by determining the minimum mapping unit 5 ha. For the Land use/cover change assessment 2016–2018, the Segmentation Method and Principle Component Analysis are used to conduct a preliminary Land use/cover change assessment 2016–2018, including five classes: Forest to Non-Forest, Non-Forest to Forest, Forest Stable, Change Forest Type and Non-Forest Stable. The step of assessment Land use/cover 2018 and Land use/cover changed 2016–2018, the technical stages as shown in the diagram below.



**Fig. 5:** Diagram showing the technical stages of forest land cover resource assessment in 2018

### 2.3 Land use/cover Changes

Forest land cover refers to soil types such as forest cover, grasslands, urbund, build-up area, or water, while the use of land use shows how people are using the land.

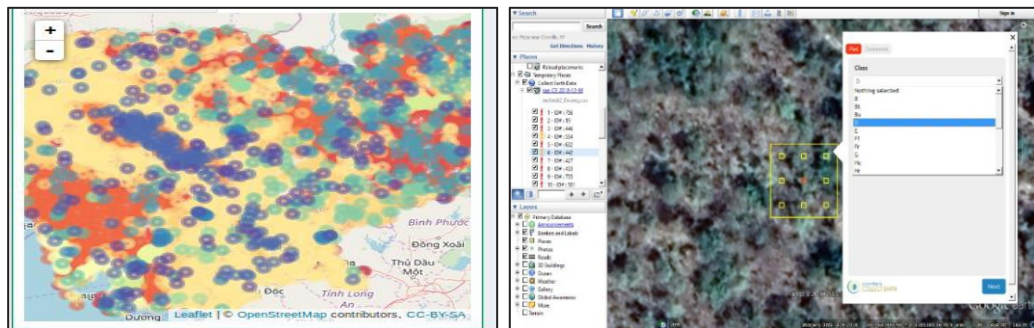
Land use/cover change refers to the change in land cover and land use through various human activities, for example, the conversion of forest cover area into agricultural land, which causes degradation and deforestation or reforestation to increase forest cover.

### 2.4 Accuary Assessment

The accuracy assessment is a step taken for verification of the results of classifying Land use/cover to verify the accuracy of each classes. The assessment was taken into two different steps by verifying forest classes with



high resolution satellite images and ground truth. The verification of land use/cover classification with 1055 verified points covering 25 capital-provinces nationwide.

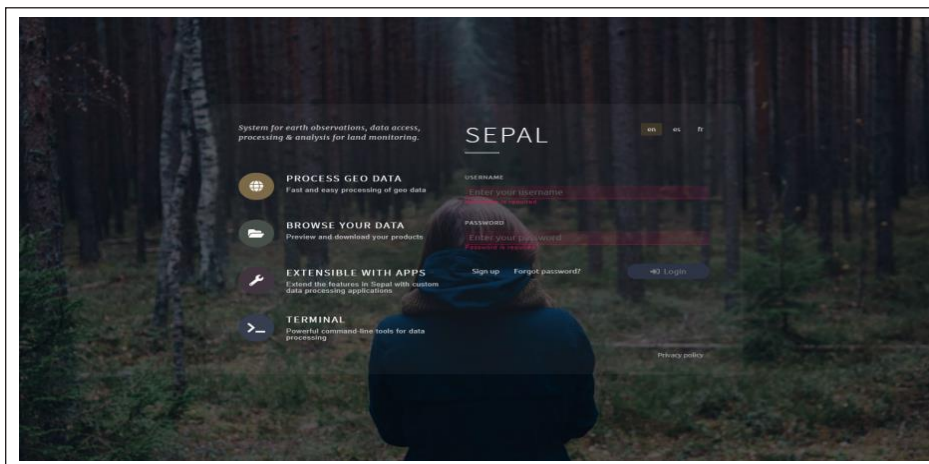


**Fig. 6:** Location for verifying the reliability of data on forest land cover 2018

### 2.4.1 Selection point for accuracy assessment

Using Sepal Software, which is a program developed by the Food and Agriculture Organization of the United Nations (FAO) is used to calculate the points for accuracy assessment by analyzing the number of points based on the size and land use/cover classes.

The team were downloaded Time Series Satellite Imagery and selected random points according to land use/cover classes and verification of the open field for supporting the accuracy assessment.



**Fig. 7:** SEPAL

### 2.4.2. Collect Earth

Collect Earth is a software developed by the FAO to support the forest inventory work, land use/cover change assessment, accuracy assessment through Google

Earth images. Users can analyze high resolution satellite imagery to classify land use/cover for ground truth.



**Fig. 8:** Collect Earth

### 2. 4. 3 Forest Inventory ( Bitterlic Sampling )

Bitterlich sampling: The Forestry and Forest Products Research Institute of Japan (FFPRI) provide technical support to verify land use/cover by conduct Bitterlich sampling inventory method and selecting the vague points on Google Earth images.



**Fig. 9:** Tree Demarcation in the plot to be measured

### 2.4.4 Drone technology

Drones are more formally known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes). Essentially, a drone is a flying robot that can be remotely controlled or fly autonomously through software-controlled flight plans in their embedded systems, working in conjunction with onboard sensors and GPS. Drones can be as large as an aircraft or as small as the palm of your hand.

Drone technology can be used to connect with mobile phones or iPad with a camera to capture the high-resolution aerial photo. Generally, drone used to design the land use planning and monitor deforestation and forest degradation and land use/cover assessment.



**Fig. 10:** Drone platform

The accuracy assessment was conducted in collaboration between the national and international technicians UNDP-FCPF, FAO-UNREDD, JICA-CAMREDD, and other international academics by the Overall Accuracy results is **93.53% ( 12 Classes)** for 2018 assessment.



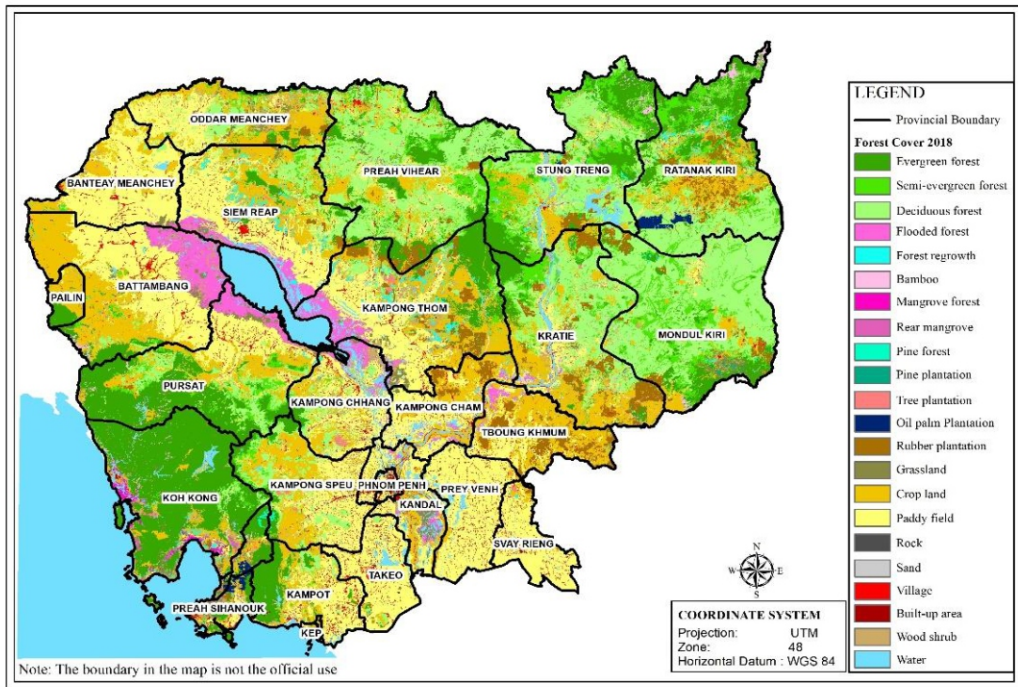
## Chapter 3

### Forest Land Cover Resources Assessment Results

#### 3.1 Current updated land use/cover 2018

##### 3.1.1 Result of national land use/cover assessment

According the assessment 2018, the results shows that forest land cover an area of **8.510.807** ha, equivalent to **46.86 %** of the country's total land area, (the results from the assessment included rubber plantation, palm oil plantation and other perennial crops) as provided in map and statistical data below.

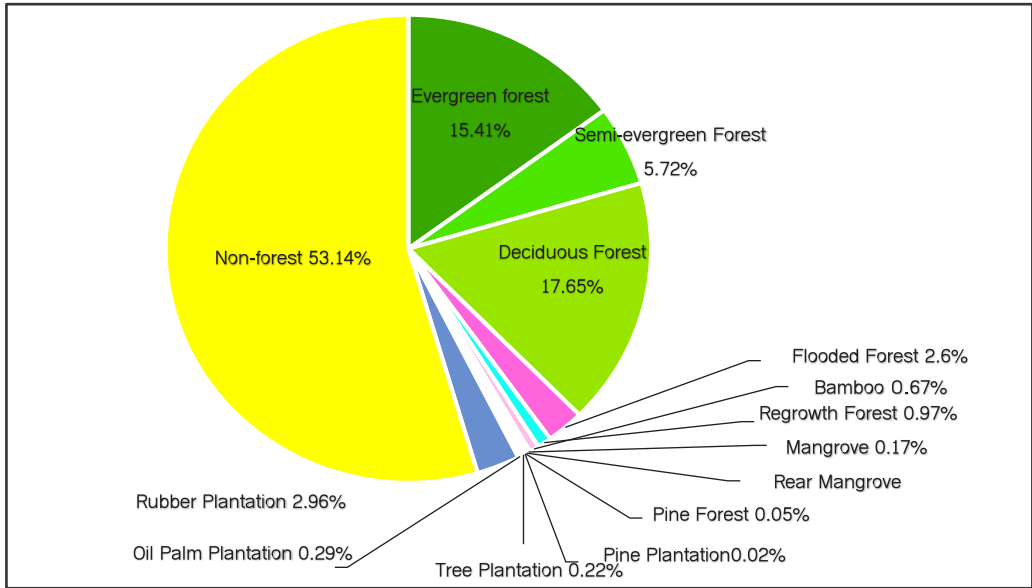


**Fig. 11:** National land use/cover map 2018

**Table 2: National land use/cover Statistics 2018**

No	Land Cover Classes	Forest Land Cover	
		Hectares (Ha)	Percentage (%)
1	Evergreen Forest	2,799,032	15.41
2	Semi-evergreen Forest	1,038,969	5.72
3	Deciduous Forest	3,205,830	17.65
4	Flooded Forest	471,599	2.60
5	Regrowth Forest	176,088	0.97
6	Bamboo	122,397	0.67
7	Mangrove	31,298	0.17
8	Rear Mangrove	25,755	0.14
9	Pine Forest	8,186	0.05
10	Pine Plantation	3,872	0.02
11	Tree Plantation	39,254	0.22
12	Oil Palm Plantation	51,792	0.29
13	Rubber Plantation	536,735	2.96
<b>Total Forest Land Cover</b>		<b>8,510,807</b>	<b>46.86</b>
14	Grassland	319,828	1.76
15	Crop Land	3,238,627	17.83
16	Paddy Field	4,286,026	23.60
17	Rock	2,341	0.01
18	Sand	41,564	0.23
19	Village	365,709	2.01
20	Build up Area	43,943	0.24
21	Water	758,273	4.18
22	Wood Shrub	593,556	3.27
<b>Total Non-Forest</b>		<b>9,649,867</b>	<b>53.14</b>
<b>Grand Total</b>		<b>18,160,674</b>	<b>100.00%</b>

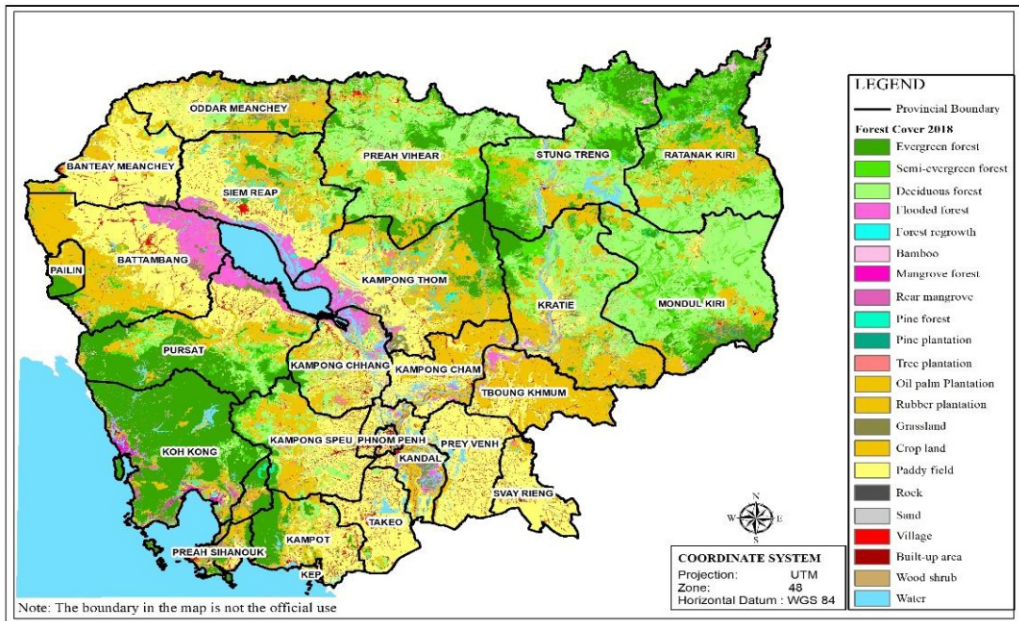




**Fig. 12:** National land use/cover rate 2018

### 3.1.2 Land use/cover assessment results for REDD +

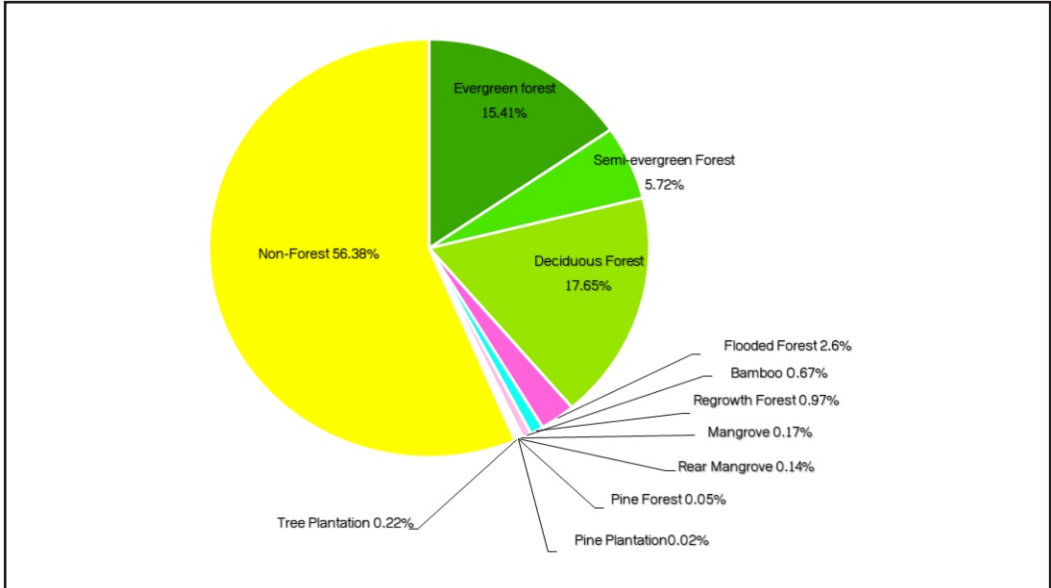
According to the assessment land use/cover for REDD+ 2018, the results showed that the area of forest cover **7.922.280 ha equal to 43.62 %** as shown in the maps and tables below:



**Fig. 13:** Land use/cover map 2018 (REDD+)

**Table 3: Land use/cover statistics 2018 (REDD+)**

No	Land Cover Classes	Forest Land Cover	
		Hectares (Ha)	Percentage (%)
1	Evergreen Forest	2,799,032	15.41
2	Semi-evergreen Forest	1,038,969	5.72
3	Deciduous Forest	3,205,830	17.65
4	Flooded Forest	471,599	2.60
5	Regrowth Forest	176,088	0.97
6	Bamboo	122,397	0.67
7	Mangrove	31,298	0.17
8	Rear Mangrove	25,755	0.14
9	Pine Forest	8,186	0.05
10	Pine Plantation	3,872	0.02
11	Tree Plantation	39,254	0.22
<b>Total Forest Land Cover</b>		<b>7,922,280</b>	<b>43.62</b>
12	Oil Palm Plantation	51,792	0.29
13	Rubber Plantation	536,735	2.96
14	Grassland	319,828	1.76
15	Cropland	3,238,627	17.83
16	Paddy Field	4,286,026	23.60
17	Rock	2,341	0.01
18	Sand	41,564	0.23
19	Village	365,709	2.01
20	Build-up Area	43,943	0.24
21	Water	758,273	4.18
22	Wood Shrub	593,556	3.27
<b>Total Non-Forest</b>		<b>10,238,394</b>	<b>56.38</b>
<b>Grand Total</b>		<b>18,160,674</b>	<b>100.00%</b>

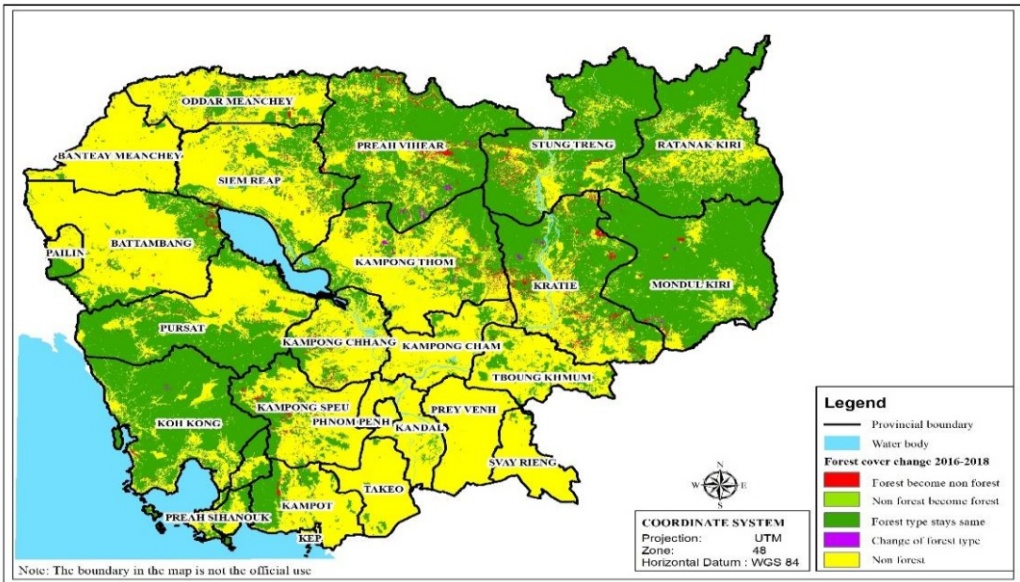


**Fig. 14:** Land use/cover rate 2018 ( REDD+)

### 3.2 Land use/cover Change 2016 – 2018

#### 3.2.1 Results of national land use/cover changes

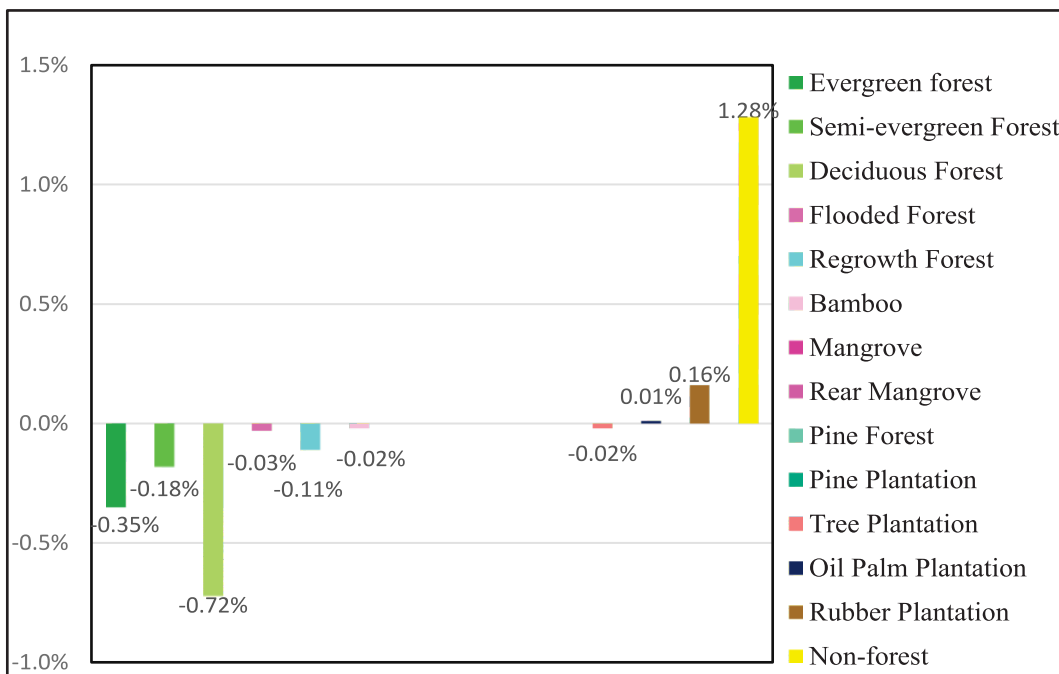
According to the national land use/cover change assessment 2016 – 2018 was change from **48.14%** in 2016 to **46.86%** in 2018, with an average annual variation rate of **0.64%** equal to **115.797** hectares compared to the country’s total land area as shown in the map and the table below:



**Fig. 15:** National land use/cover changes map of 2016 - 2018

**Table 4: National land use/cover changes 2016 - 2018**

No	Land Cover Classes	Forest Land Cover				Change	
		2016		2018		2016-2018	
		Ha	%	Ha	%	Ha	%
1	Evergreen Forest	2,861,233	15.76%	2,799,032	15.41	-62,201	-0.35%
2	Semi-evergreen	1,071,947	5.90%	1,038,969	5.72	-32,978	-0.18%
3	Deciduous Forest	3,336,349	18.37%	3,205,830	17.65	-130,519	-0.72%
4	Flooded Forest	477,813	2.63%	471,599	2.60	-6,214	-0.03%
5	Regrowth Forest	196,842	1.08%	176,088	0.97	-20,754	-0.11%
6	Bamboo	125,398	0.69%	122,397	0.67	-3,001	0.02%
7	Mangrove	31,226	0.17%	31,298	0.17	72	0%
8	Rear Mangrove	25,906	0.14%	25,755	0.14	-151	0%
9	Pine Forest	8,195	0.05%	8,186	0.05	-9	0%
10	Pine Plantation	3,870	0.02%	3,872	0.02	2	0%
11	Tree Plantation	43,122	0.24%	39,254	0.22	-3,868	-0.02%
12	Oil Palm Plantation	51,276	0.28%	51,792	0.29	516	0.01%
13	Rubber Plantation	509,224	2.80%	536,735	2.96	27,510	0.18%
<b>Total Forest Land Cover</b>		<b>8,742,401</b>	<b>48.14%</b>	<b>8,510,807</b>	<b>46.86%</b>	<b>-242,764</b>	<b>-1.28%</b>
<b>Total Non-Forest</b>		<b>9,418,273</b>	<b>51.86%</b>	<b>9,649,867</b>	<b>53.14%</b>	<b>242,764</b>	<b>1.28%</b>
<b>Grand Total</b>		<b>18,160,674</b>	<b>100.00%</b>	<b>18,160,674</b>	<b>100.00%</b>		

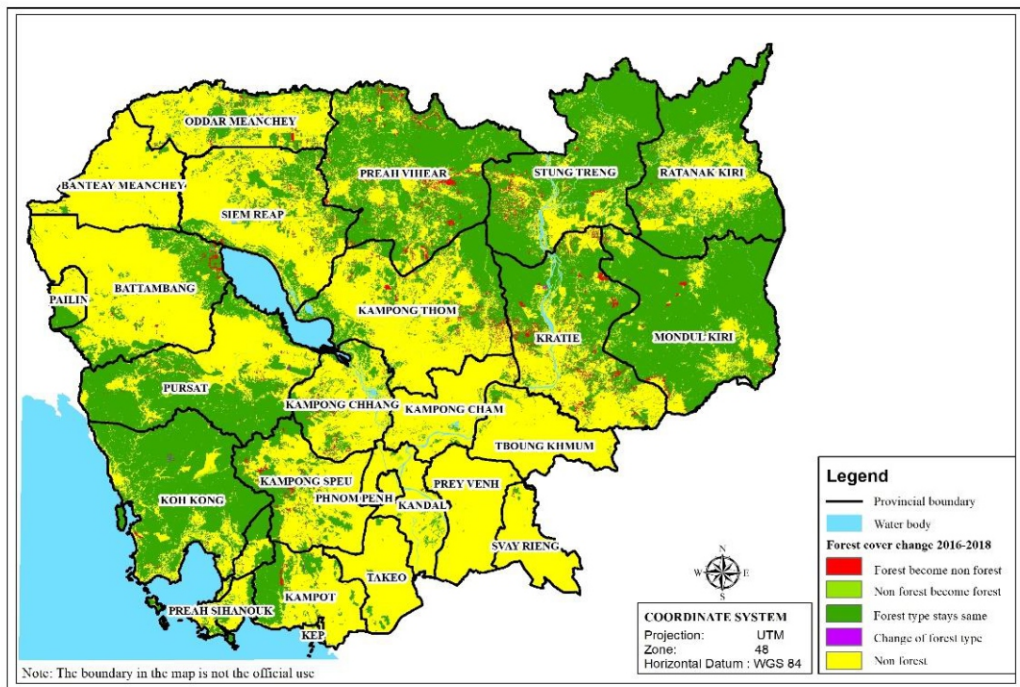


**Graphic 1: National land use/cover changes rate 2016 - 2018**

The above graph shows that between 2016 and 2018 the most significant change in forest cover types are: deciduous forest **0.72%** evergreen forest **0.35%**, semi-evergreen forest **0.18%**, and regrowth forest **0.11 %**.

### 3.2.2 Results land use/cover change for REDD+

According to the Redd+ land use/cover change assessment 2016 – 2018 was change from **45.05%** in 2016 to **43.62%** in 2018, with an average annual variation rate of **0.71%** equal to **129.810** hectares compared to the country’s total land area as shown in the map and the table below:

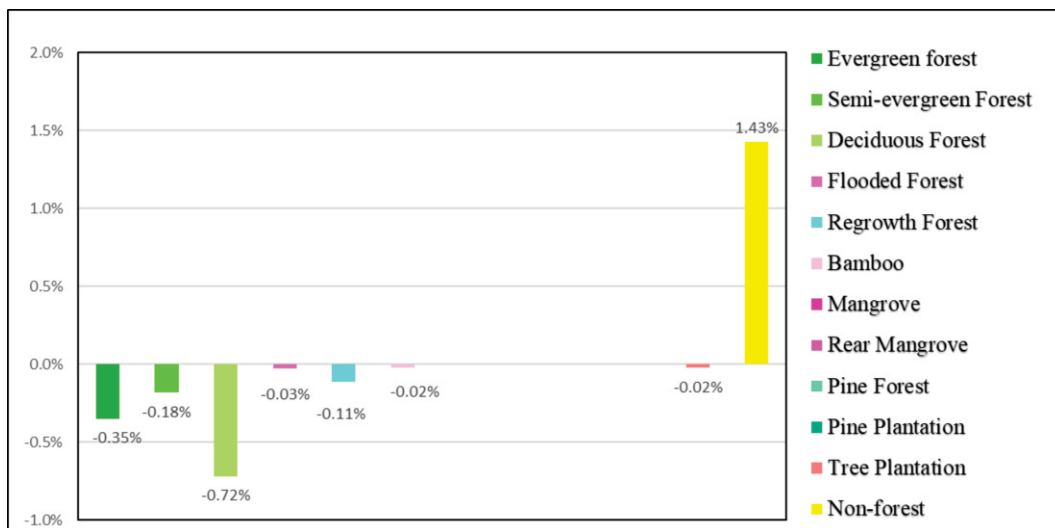


**Fig. 16 :** Land use/cover map 2016 - 2018 (REDD+)



**Table 5: Land use/cover change 2016 -2018 (REDD+)**

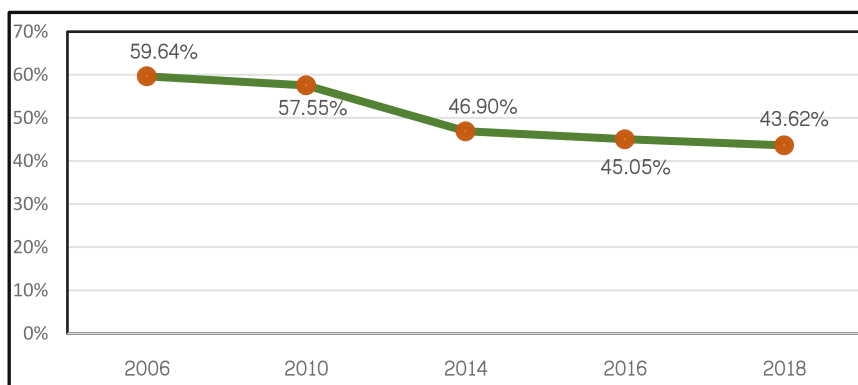
No	Land Cover Classes	Forest Land Cover				Change	
		2016		2018		2016-2018	
		Ha	%	Ha	%	Ha	%
1	Evergreen Forest	2,861,233	15.76%	2,799,032	15.41	-62,201	-0.35%
2	Semi-evergreen	1,071,947	5.90%	1,038,969	5.72	-32,978	-0.18%
3	Deciduous Forest	3,336,349	18.37%	3,205,830	17.65	-130,519	-0.72%
4	Flooded Forest	477,813	2.63%	471,599	2.60	-6,214	-0.03%
5	Regrowth Forest	196,842	1.08%	176,088	0.97	-20,754	-0.11%
6	Bamboo	125,398	0.69%	122,397	0.67	-3,001	0.02%
7	Mangrove	31,226	0.17%	31,298	0.17	72	0%
8	Rear Mangrove	25,906	0.14%	25,755	0.14	-151	0%
9	Pine Forest	8,195	0.05%	8,186	0.05	-9	0%
10	Pine Plantation	3,870	0.02%	3,872	0.02	2	0%
11	Tree Plantation	43,122	0.24%	39,254	0.22	-3,868	-0.02%
<b>Total Forest Land Cover</b>		<b>8,181,901</b>	<b>45.05%</b>	<b>7,922,280</b>	<b>43.62%</b>	<b>-259,621</b>	<b>-1.43%</b>
<b>Total Non-Forest</b>		<b>9,978,773</b>	<b>54.95%</b>	<b>10,238,394</b>	<b>53.38%</b>	<b>259,621</b>	<b>1.43%</b>
<b>Grand Total</b>		<b>18,160,674</b>	<b>100.00%</b>	<b>18,160,674</b>	<b>100.00%</b>		



**Graphic 2: Land use/cover change 2016 -2018 (REDD+)**

**Table 6: Land use/cover change 2016 -2018 (REDD+)**

No	Land Cover Classes	Change		Change		Change		Change		Change	
		2006-2010		2010-2014		2014-2016		2016-2018		2006-2018	
		Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
1	Evergreen Forest	-136,346	-0.75	-600,022	-3.30	-112,670	-0.62	-62,201	-0.35	-911,239	-5.02
2	Semi-evergreen	-62,324	-0.34	-282,797	-1.56	-36,373	-0.20	-32,978	-0.18	-414,472	-2.28
3	Deciduous Forest	-115,020	-0.63	-1,017,865	-5.60	-144,183	-0.80	-130,519	-0.72	-1,407,587	-7.75
4	Flooded Forest	-73,350	-0.40	-42,927	-0.24	-3,265	-0.02	-6,214	-0.03	-125,756	-0.69
5	Regrowth Forest	33,218	0.18	-20,781	-0.11	-31,718	-0.18	-20,754	-0.11	-40,035	-0.22
6	Bamboo	1,093	0.01	-253	0.00	-5,280	0.03	-3,001	0.02	-7,440	-0.04
7	Mangrove	-617	-0.01	1,559	0.01	1,776	0.01	72	0.00	-762	0.00
8	Rear Mangrove	-148	0.00	-1,464	-0.01	0	-0.00	-151	0.00	-1,764	-0.01
9	Pine Forest	0	0.00	0	0.01	-1	0.00	-9	0.00	29	0.00
10	Pine Plantation	11	0.00	3,699	0.02	160	0.00	2	0.00	3,872	0.00
11	Tree Plantation	-26,333	-0.15	27,074	0.15	-1,167	0.00	-3,868	0.02	-4,293	0.00
<b>Total Forest Land Cover</b>		<b>-379,815</b>	<b>-2.09%</b>	<b>-1,933,738</b>	<b>-10.85</b>	<b>-336,273</b>	<b>-1.85%</b>	<b>-259,621</b>	<b>-1.43</b>	<b>-2,909,447</b>	<b>-16.02</b>



**Graphic 3: Land use/cover change rate 2006 -2018 (REDD+)**

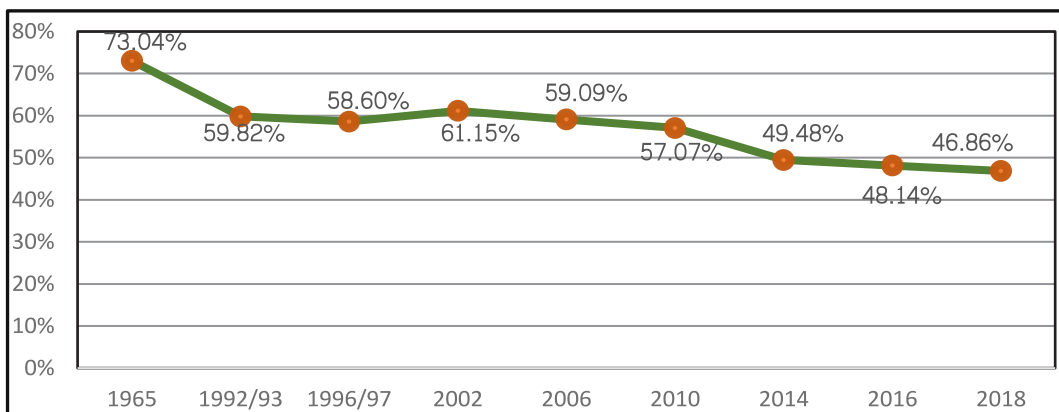
According to above graphic the rate of forest cover change from 2006 to 2010 is 2.09%, with an average annual change 0.52% compared to the country’s total land area, however the change rate drastically increases for the period 2010 to 2014, about 10.65 %, with an average annual rate 2.66 % 2014 to 2016 is 1.85%, with an average annual value of 0.93 % compared to the country’s total land area.

However, the current assessment of forest cover in 2018 has shown that the forest change rate from 2016 to 2018 is 1.43%, with an average annual value of 0.71 % compared to the country’s total land area. Meaning that the rate of forest cover loss is lower compared to the same for the duration of 2014 – 2016. This was due to the effective reform in forest management by government as well as

participation by local community, armed forces and authorities at all levels to prevent forest offences.

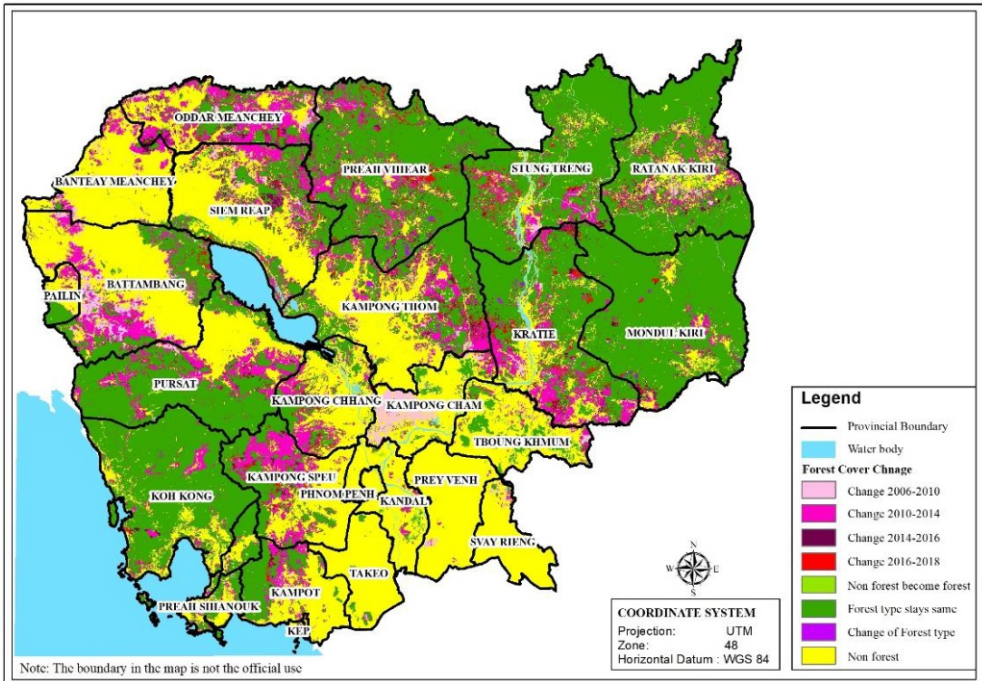
### 3.3 Forest Cover Change from 1965 - 2018

From 1965 until now, Cambodia has been conducted 8 national forest cover assessments. The assessments were made at different stage for 27 years between 1965 and 1992/93 for the country fall into civil conflict for almost three decades, giving heavy pressure on forest resource use and only from 1993 through to 2014 when regular assessments were made at an average 4 years interval. Moreover, now Cambodia had participated with international community to implement REDD+ program, therefore, data on forest cover becomes even more important in natural resource management planning and in support of the process to review, monitor and evaluate forest cover for Cambodia REDD+ implementation for which forest cover is assessed in every two years.

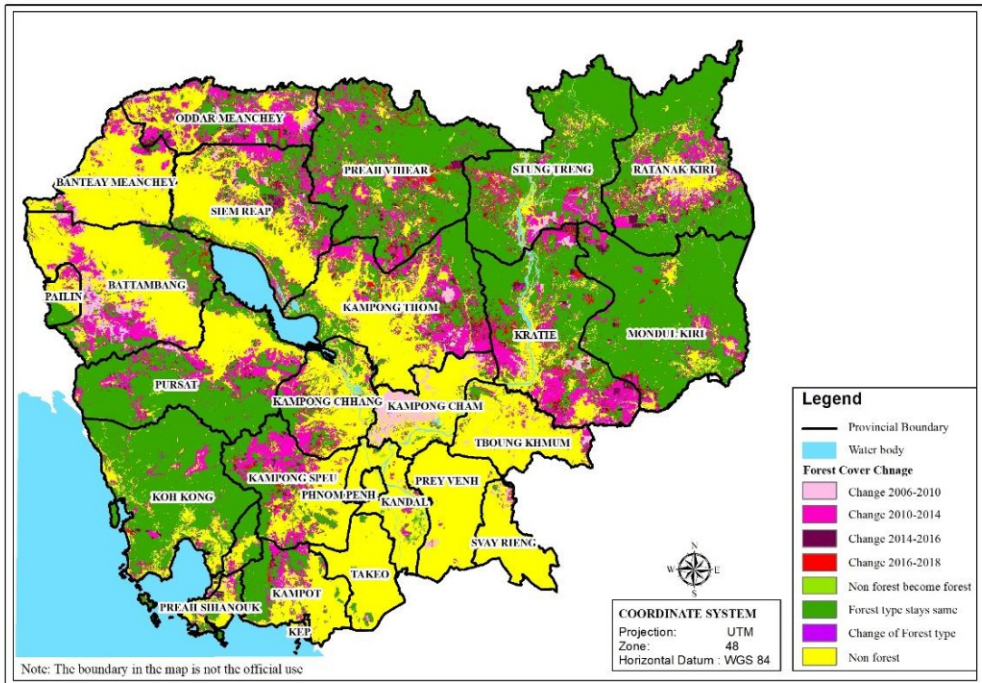


**Graphic 4:** The rate of variation in forest cover resources 1965 - 2018

From the chart above it shows that the forest cover for the duration of 1965 - 2018 has declined by **26.18 %** compared to the overall country area. Many underlying causes responsible for the decline include civil war, population increase, need of land for agricultural production, and other key factors.



**Fig 17: National Land use/cover change map 2006 - 2018**



**Fig. 18: Land use/cover change map 2006 - 2018 (REDD+)**

## Chapter 4

### Conclusion

The 2018 land use/cover assessment is produced by the national team (GDANCP/MoE, FA/MAFF, FiA/MAFF) with technical supervision provided by international expert from UNDP-FCPFII, FAO, JICA and selected other international academics. The results show that the country's forest cover is about **8.510.807** ha, equivalent to **46.86%** of the country's total area, and the average annual loss rate from 2016 to 2018 is about **0.64%**, equivalent to **115.797** ha compared to the total country's area.

Furthermore, the assessment of land use/cover for REDD+ in 2018, the result has shown is **43.62%** by excluding the area of rubber plantations and oil palm plantation. The annual average is **0.71 % equal to 129.810 hectares** compared to the area of the country.

It is projected that for the next 2 years the rate of forest cover loss would be further reduced depending on how effective is the implementation of the government's reform on PA management and conservation as well as participation by local communities, armed forces and authorities at all levels to prevent forest offences. In the sense, MoE will continue its tasks and responsibility as well as collaborate with development partners agencies and relevant stakeholders for environmental protection, natural resource protection, biodiversity conservation and sustainable development for the sustainable environment and natural resources.



## Annex

### **Annex 1 : Forest Definition**

#### **National Forest:**

**Forest** is the unit of the natural ecosystem or plantation in the forms of wetland, lowland and dry land which covers 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 plantations 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.

#### **REDD+ Program:**

**Forest** under the REDD+ programme refers to a unit of an ecosystem in the form of wetland and dry land, covered by natural or planted vegetation with height from 5 meters on an area of at least 0.5 hectares, and a canopy crown cover of more than 10%.

Areas also included in the REDD+ programme are forest regrowth and areas under afforestation or reforestation. Rubber, oil palm plantations and perennial crops are excluded from this definition

## Annex 2 : Description of Land use/cover classes

No	Land cover class	ID	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	Mangrove forest	M	Areas dominated by Mangroves i.e. coastal salt-tolerant species
7	Rear Mangrove	Mr	Mostly growing in coastal zone after mangrove spp. Salt tolerant species but only infrequent floods
8	Rubber plantation	Rp	Areas currently supporting, and areas reserved for, rubber plantation
9	Flooded Forest	Ff	This forest type is found in Tonle Sap Lake. Most of the forests are low and disturbed. In many cases, there is only a mosaic remaining
10	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, areas recovering from human-induced fire, etc.</p> <ul style="list-style-type: none"> <li>• Include forest where it is not possible to distinguish whether planted or naturally regenerated.</li> <li>• Include 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.</li> <li>• Include abandoned forest land and bare land which will regrow into forest within ten years</li> </ul>
11	Pine Tree	P	The area dominated by coniferous trees
12	Pine plantation	Pp	The area dominated by pine tree plantation
13	Oil palm	Po	The area is dominated by oil palm trees.
14	Tree plantation	Tp	This class includes the following type: teak, eucalyptus, acacia, jatropa, and others.
15	Paddy Field	Hr	Paddy field is a flooded parcel of <u>arable land</u> used for growing <u>semiaquatic rice</u> .
16	Crop Land	Hc	This category includes arable and tillage land and agro-forestry systems where vegetation falls below the thresholds used for the forest land category
17	Grassland	G	Grasslands are characterized as lands dominated by grasses rather than 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.
18	Built-up area	Bu	The patch of land with building and construction
19	Village	Bt	The patch of land with houses and garden surrounding house.
20	Rock	R	Land of naturally exposed rocks or strip mines, quarries, and gravel pits.
21	Sand	S	In general, land of sand having thin soil or sand including deserts, dry salt flats, beaches, sand dunes.
22	Water	W	Area of fresh and seawater

### Annex 3 : National forest cover resource data for provinces 2018

Province	Forest Types					Total Non-Forest (ha)	Grand Total (ha)
	Evergreen Forest	Semi-evergreen Forest	Deciduous Forest	Other Forest	Total Forest (ha)		
Banteay Meanchey	1,460	2,701	9,010	7,747	20,917	593,891	614,808
Battambang	59,131	15,983	18,504	165,035	258,654	928,558	1,187,211
Kampong Cham	350	59	623	49,122	50,153	405,022	455,175
Kampong Chhang	17,261	5,181	64,538	45,814	132,794	396,669	529,463
Kampong Speu	64,345	21,333	119,972	15,448	221,098	475,380	696,478
Kampong Thom	182,439	13,350	43,589	217,905	457,284	787,481	1,244,765
Kampot	122,841	3,805	26,341	5,300	158,287	310,122	468,409
Kandal	0	0	99	17,433	17,531	338,843	356,374
Kep	2,117	9	0	1,202	3,328	15,251	18,580
Koh Kong	788,101	9,594	23,367	75,633	896,696	203,432	1,100,128
Kratie	88,403	90,439	370,384	139,389	688,616	508,678	1,197,294
Mondul Kiri	126,915	209,725	800,373	70,480	1,207,494	159,395	1,366,889
Oddar Meanchey	45,621	17,001	99,805	16,498	178,926	484,242	663,168
Pailin	29,814	1,337	548	621	32,319	75,404	107,723
Phnom Penh	0	0	0	439	439	36,937	37,375
Preah Sihanouk	99,242	4,503	983	49,980	154,707	105,992	260,699
Preah Vihear	200,442	135,703	660,079	49,006	1,045,230	357,837	1,403,067
Prey Veng	18	0	92	1,575	1,685	474,474	476,159
Pursat	438,234	72,024	132,952	78,420	721,630	436,961	1,158,591
Ratanak Kiri	232,150	171,603	329,402	151,130	884,285	294,172	1,178,457
Siemreap	42,126	21,985	111,172	128,542	303,825	750,622	1,054,448
Stung Treng	255,588	242,495	384,813	60,853	943,750	257,906	1,201,656
Svay Rieng	28	0	0	5,039	5,067	281,758	286,826
Takeo	1,909	0	9,088	2,556	13,553	335,491	349,044
Thbong Khmom	495	138	96	109,577	110,306	382,816	493,122
Tonle Sap	0	0		2,233	2,233	252,530	254,763
<b>Total Area (ha)</b>	2,799,032	1,038,969	3,205,830	1,466,976	8,510,807	9,649,867	18,160,674
<b>Percentage (%)</b>	15.41	5.72	17.65	8.08	46.86	53.14	100

**Annex 4 : Accuracy Assessment Result 2018**

Forest Type	E	Se	D	B	Ff	Fr	M	Mr	P	Pp	Tp	NF	TOTAL	UA
E	99		1	2								4	106	93%
Se		27	2	1								3	33	82%
D		2	107									6	115	93%
B	1		1	33								1	36	92%
Ff					26							4	30	87%
Fr			1			20						4	25	80%
M							29					2	31	94%
Mr							2	28				4	34	82%
P		1							31			0	32	97%
Pp		2								23		2	27	85%
Tp			2								24	1	27	89%
NF	3	2	6	2	9	3	0	0	0	0	0	534	559	96%
<b>TOTAL</b>	103	34	120	38	35	23	31	28	31	23	24	565	1055	
<b>PA</b>	96%	79%	89%	87%	74%	87%	94%	100%	100%	100%	100%	95%		
PA adj	98%	90%	93%	48%	71%	72%	95%	100%	0%	0%	0%	0%		

**Annex 5. Forest Cover Change data 2016-2018**

Forest Type	Year 2018														Total	
	E	Se	P	D	B	M	Mr	Ff	Fr	Tp	Pp	NF	Ha	%		
<b>Year 2016</b>																
E	2,794,100	38		742	1,038	16		0	419	174		64,707	2,861,233	15.8%		
Se	30	1,038,612		646	36				177		8	32,438	1,071,947	5.9%		
P	0		8,186									10	8,195	0.0%		
D	37	75	0	3,202,247	224			0	249	1,092		132,425	3,336,349	18.4%		
B	41	8		186	120,973		52	0	0	27		4,110	125,398	0.7%		
M						31,157						68	31,226	0.2%		
Mr							25,663					243	25,906	0.1%		
Ff					0	7		460,271	37			17,499	477,813	2.6%		
Fr	212	3		7	0	110	37	46	173,421	24		22,982	196,842	1.1%		
Tp	0	0		4					0	37,369		5,749	43,122	0.2%		
Pp											3,864	6	3,870	0.0%		
NF	4,612	234	0	1,999	125	8	3	11,282	1,785	569	0	9,958,156	9,978,773	54.9%		
Ha	2,799,032	1,038,969	8,186	3,205,830	122,397	31,298	25,755	471,599	176,088	39,254	3,872	10,238,393	18,160,674	100.0%		
%	15.4%	5.7%	0.0%	17.7%	0.7%	0.2%	0.1%	2.6%	1.0%	0.2%	0.0%	56.4%	100.0%	100%		



## References

- The Ministry of Environment, National REDD+ 2017 - 2026 Strategy
- Ministry of Environment, Action Plan to implement the National Strategic Plan for the Protected Areas Management 2018 - 2022
- Ministry of Environment, Forest Cover Resources Book 2016
- Ministry of Environment database resources, forest cover change of Protected Area System year 2006-2016
- Cambodia Forestry Administration Forest Cover 2014
- Ministry of Environment, Glossary of Climate Change 2017
- Ministry of Environment, Forest Reference Level 2016