



PROVIDING ACTIVITY DATA AND EMISSION FACTOR: INDONESIA'S NATIONAL FOREST MONITORING SYSTEM TO SUPPORT NATIONAL GHG INVENTORY FOR THE 1ST BTR

Presented by:
Endah Riana & Anna Tosiani
Ministry of Environment and Forestry
INDONESIA

The 21st Workshop on GHG Inventories in Asia (WGIA21)
Dorsett Putrajaya, Malaysia, 9-12 July 2024

1. NATIONAL CIRCUMSTANCES

Population

275.773.8 million (2022)

Economy

GDP growth from IDR 13,589.8 trillion (2017) to 19,588 trillion (2022)

Area

1.92 million Km²

Poverty

31.02 million (2010) to 26.36 million in 2022

HDI

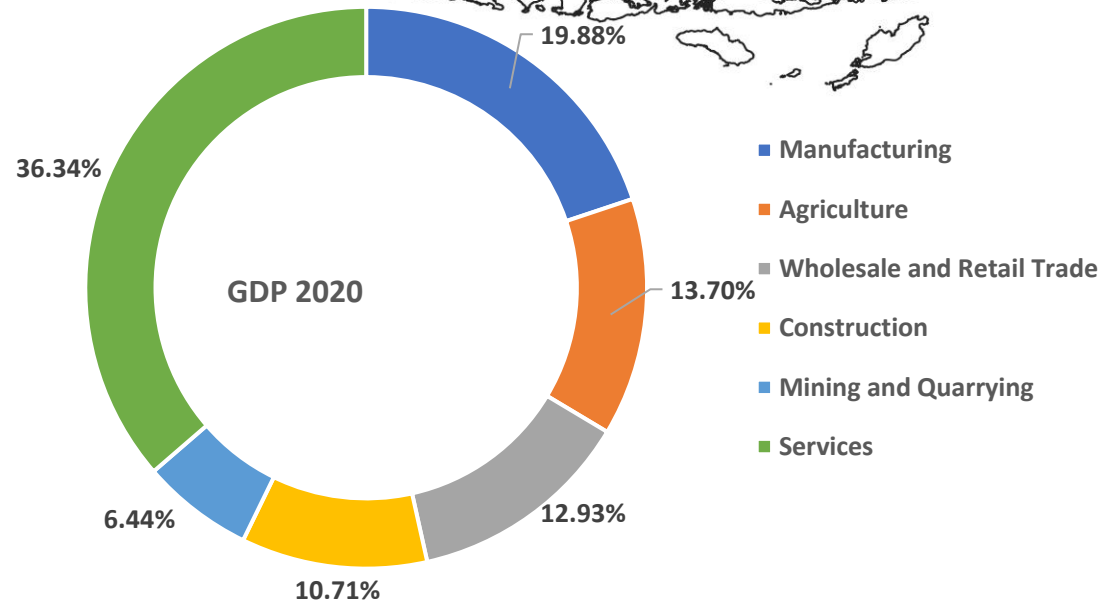
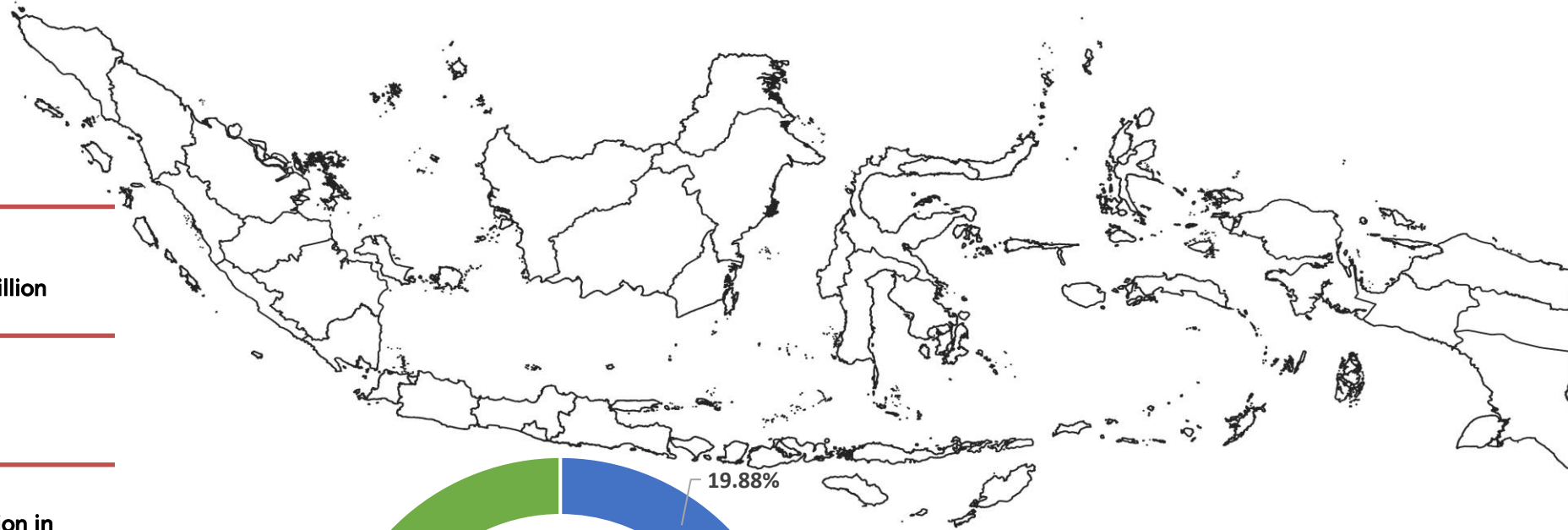
69.55 (2015) to 73.77 (2022)

Energy

146 million TOE (2000) to 237 million TOE (2019) → Average Rate 2.5% (BUR 3)

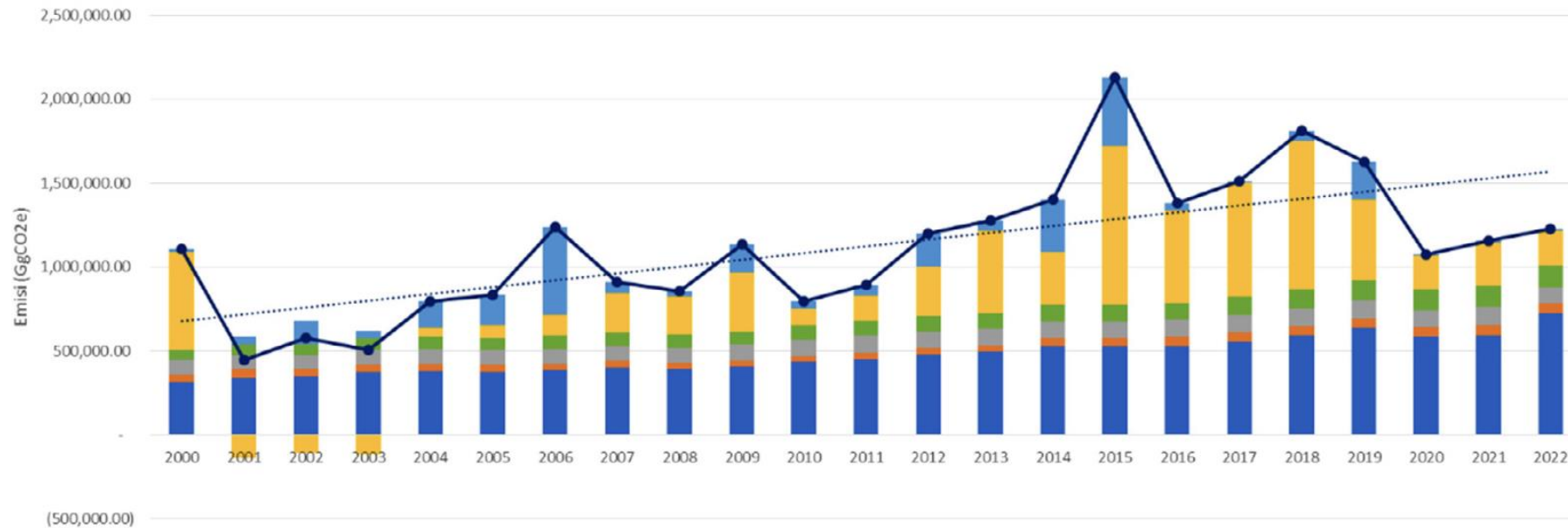
Forestry

The total Indonesia forest land use areas in 2019 was 120,285.7 thousand hectares (BUR 3)



GHG INVENTORY 1st BTR

National GHG Emissions Trend (incl. peat fire) in 2000 – 2022



- Primary contributors are Energy, which accounted for 59% of total GHG followed by FOLU, waste, Agriculture and IPPU, i.e., 18%, 11%, 7% and 5% respectively
- Using GWP values in IPCC AR2 → **Recalculating IPCC AR5**
- The 2022 National GHG of Emissions and Sinks Inventory shows the total of the three main gases (CO₂, CH₄, and N₂O) → **ON PROGRESS IN CALCULATING**
- Uncertainty of the Indonesia's National GHG inventory → **ON PROGRESS IN CALCULATING**

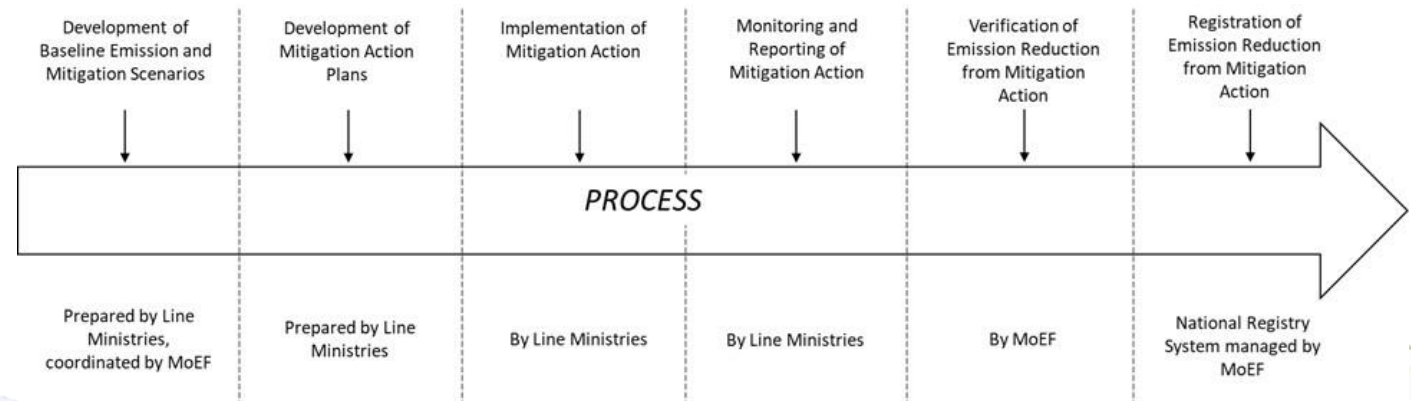
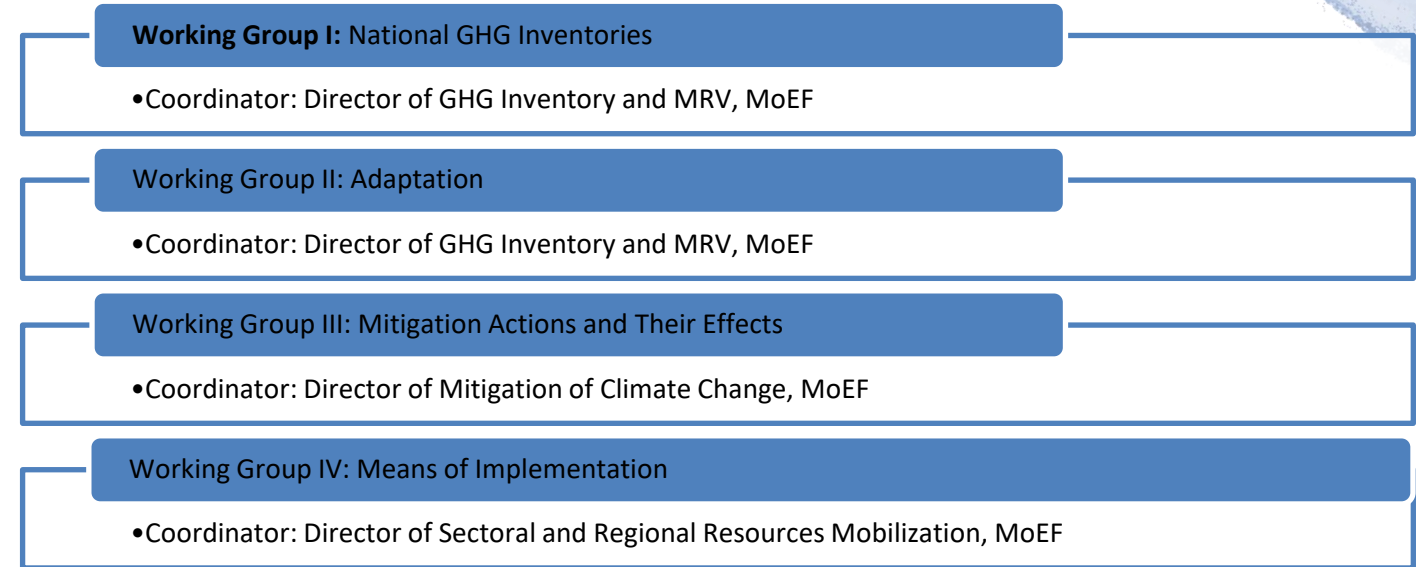
GHG EMISSION SECTORAL CONTRIBUTION



INSTITUTIONAL ARRANGEMENT FOR 1st BTR

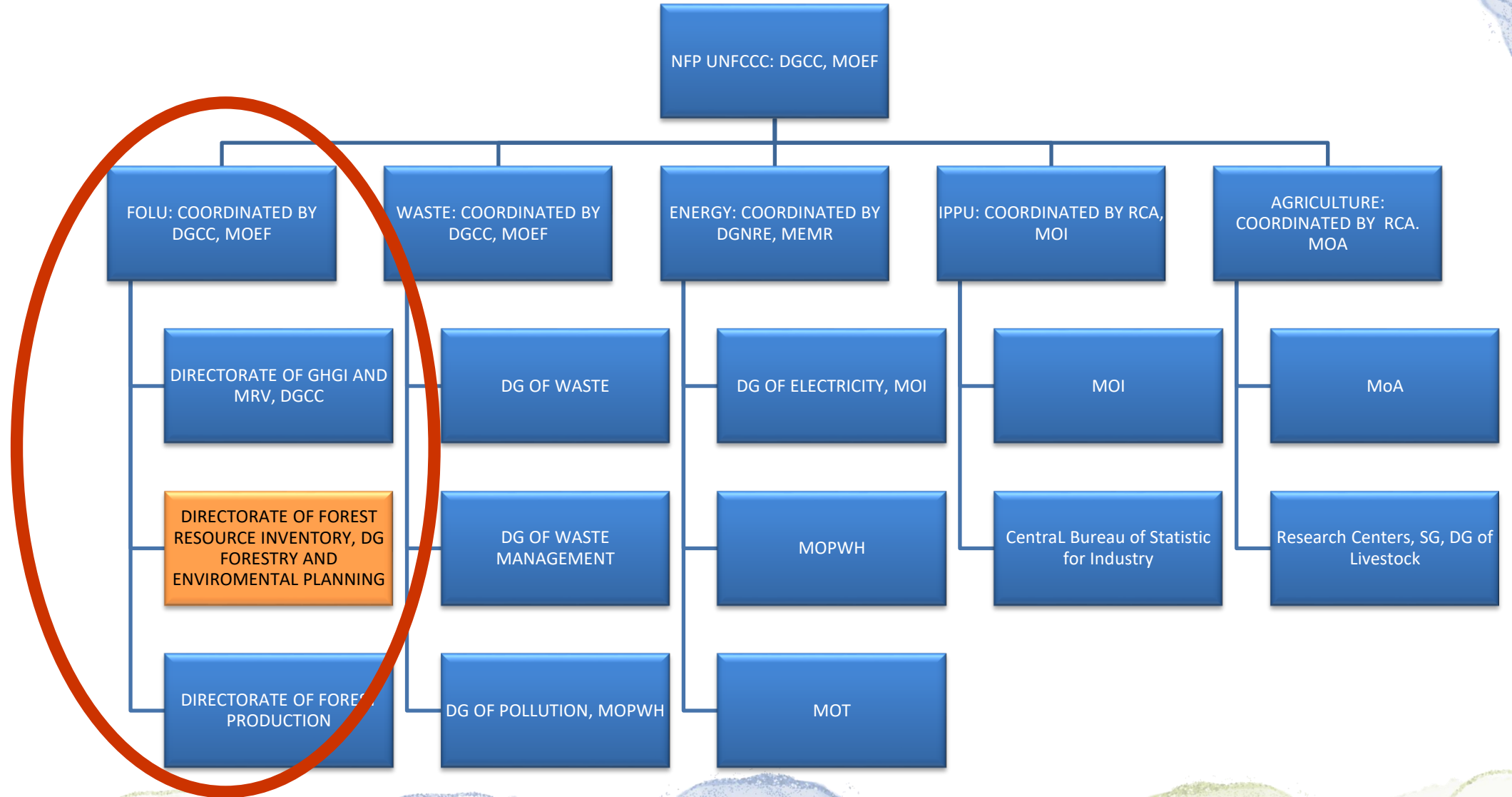
- Presidential Regulation No. 16/2016 stipulates DGCC as the leading institution for the coordination of climate change governance and implementation
- DGCC developed coordination and collaboration with other Ministries/Agencies for the preparation of the 1st BTR
- Following the ratification of the PA and submission of the first NDC, the mitigation action plan is prepared by the relevant ministries and coordinated by the MoEF,

Institutional Arrangement for the Development of 1st BTR



Institutional arrangement for the implementation of climate change mitigation at national level

INSTITUTIONAL ARRANGEMENT FOR THE DEVELOPMENT OF 1st BTR

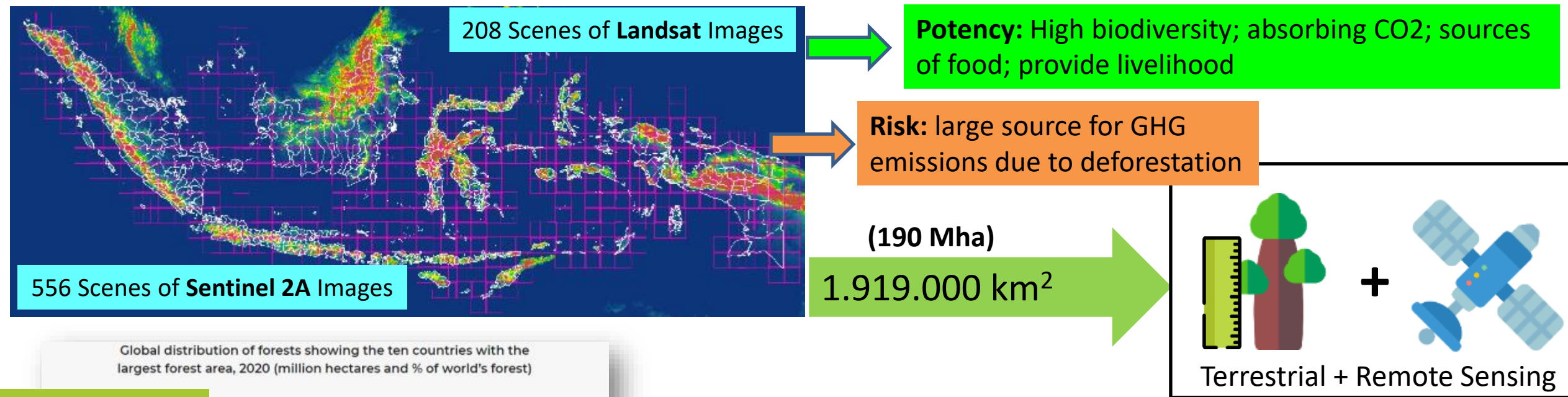




NATIONAL FOREST MONITORING SYSTEM

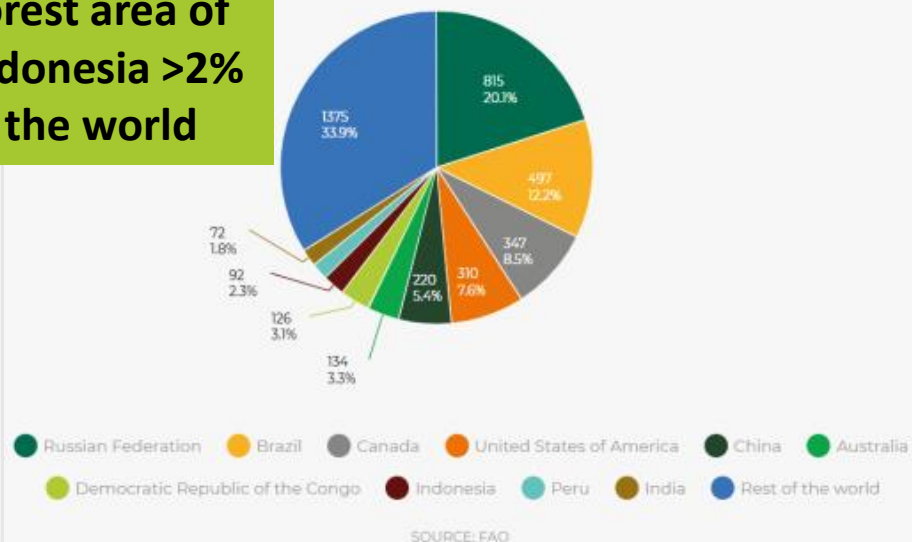


The huge area of Indonesia that needs to be monitored



Global distribution of forests showing the ten countries with the largest forest area, 2020 (million hectares and % of world's forest)

Forest area of Indonesia >2% in the world



1. To generate reliable data & information suits to Indonesia's condition
2. To support the sustainable forest management in Indonesia → provide baseline data as well as monitoring tool for SFM progress
3. **To support the national forestry planning as well as climate change mitigation action.**
4. To facilitate the international discussion & diplomacy
5. To prepare data & information for submit report to international
6. To provide basic forest information for many purposes

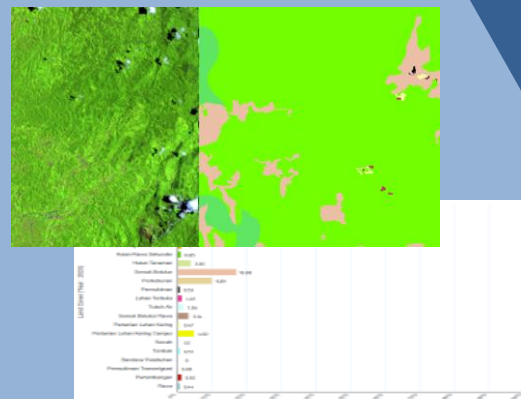
SIMONTANA

01



- Standing stock (timber & NFTP)
- Forest accounting
- Biomass

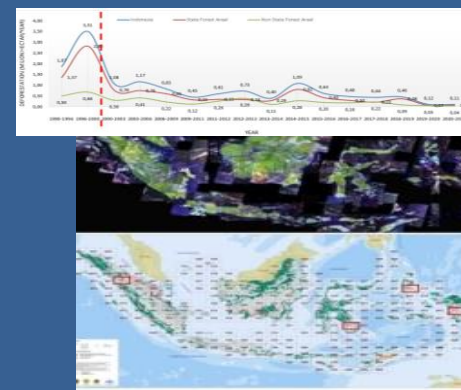
02



- Land Cover
- Forest cover

what to be monitored?

03



- Landcover changes
- Deforestation
- Reforestation

04

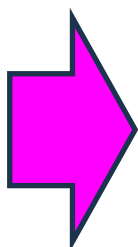


- De-vegetation
- Deforestation Alert System

Existing (Continuous) System and Data Establishment

<https://nfms.menlhk.go.id/>

Principles of National Forest Monitoring (FAO, 2017)



GOVERNANCE

SIMONTANA is operational & inherent with the MoEF of Indonesia organizational structure, not project based, Guarantee the continuity of system operation

SCOPE

Modalities for various needs, including forestry planning, implementation REDD+, other national development purposes

DESIGN

Integrated with other sources data & flexible with improving approach & method

DATA

Well-defined data & information supported by regulation for sharing data policy

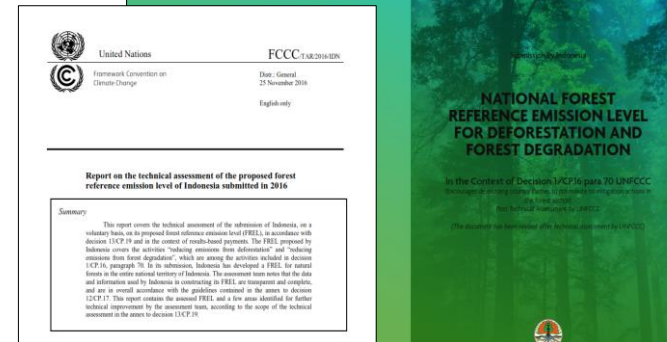
OVERALL

Based on TACCC (Transparency, Accuracy, Consistency, Completeness & Comparable) principles

DATA FOR GREENHOUSE GAS INVENTORY – FOLU SECTOR

DATA

- Based on the scientific process
- Most of the data are primary data



Step-wise approaches

based on historical data, taking into account, inter alia, trends, starting dates and the length of the reference period, availability and reliability of historical data, and other specific national circumstances (**UN Doc FCCC/SBSTA/2008/6 (SB 28 Bonn, June 2008) Annex III Main methodological issues**)

Use a **combination of remote sensing and ground-based forest carbon inventory approaches** for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes (**UN Doc FCCC/CP/2009/11/Add.1 (COP 15 Copenhagen, December 2009; 4/CP.15 Methodological guidance for activities REDD+; Para 1. (d), point (i))**)

Focusing on data needs and preferences

Activity Data (AD)

Emission Factors (EF)

TACCC PRINCIPLE

Transparency

Accuracy

Comparability

Completeness

Consistency

- 1st FREL (2015)
- 2nd FREL (2022)
- BUR
- National Communication
- GHG Inventory

FOREST RESOURCES INVENTORY & MONITORING DATA FOR GREENHOUSE GAS INVENTORY – FOLU SECTOR

DATA

FE

EMISSION FACTOR

ACTIVITY DATA

DA

NATIONAL FOREST
INVENTORY

- Systematic sampling
- Allometric Modelling
- Re-design the sample plot (on-going).

TERRESTRIAL INVENTORY



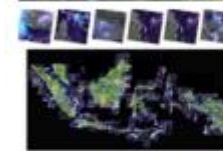
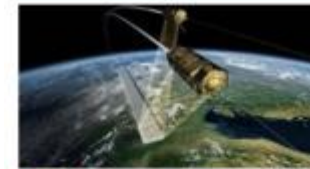
Potency data of tree & Biomass

No	Provincia	Spesies	Volume (m³)	Biomass (kg)	Carbon (kg)	GHG (kg CO₂e)
1	Sumatra	Meranti	100	1000	100	100
2	Sumatra	Meranti	200	2000	200	200
3	Sumatra	Meranti	300	3000	300	300
4	Sumatra	Meranti	400	4000	400	400
5	Sumatra	Meranti	500	5000	500	500



Terrestrial Survey

NON-TERRESTRIAL INVENTORY



Remote Sensing

LAND COVER

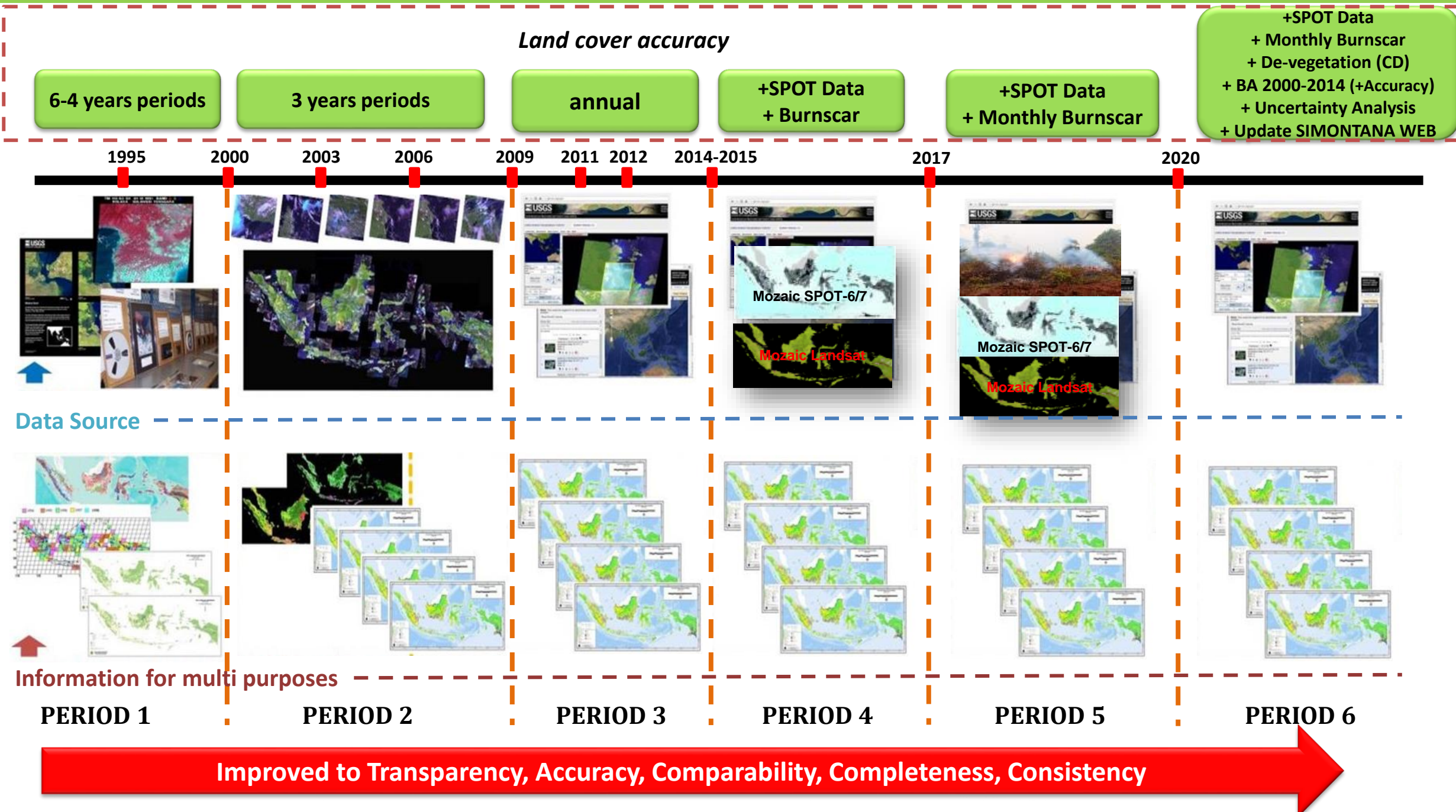
- Wall-to-wall mapping
- Include REDD+ activities other than deforestation & forest degradation;
- Accuracy & Uncertainty LCLCC assessment;
- Combination of automatic image processing & visual

- EF for peat fire
- EF for peat decomposition

$$\text{Emission} = \text{EF} \times \text{AD}$$

- Burn scar Map
- Peat land Map

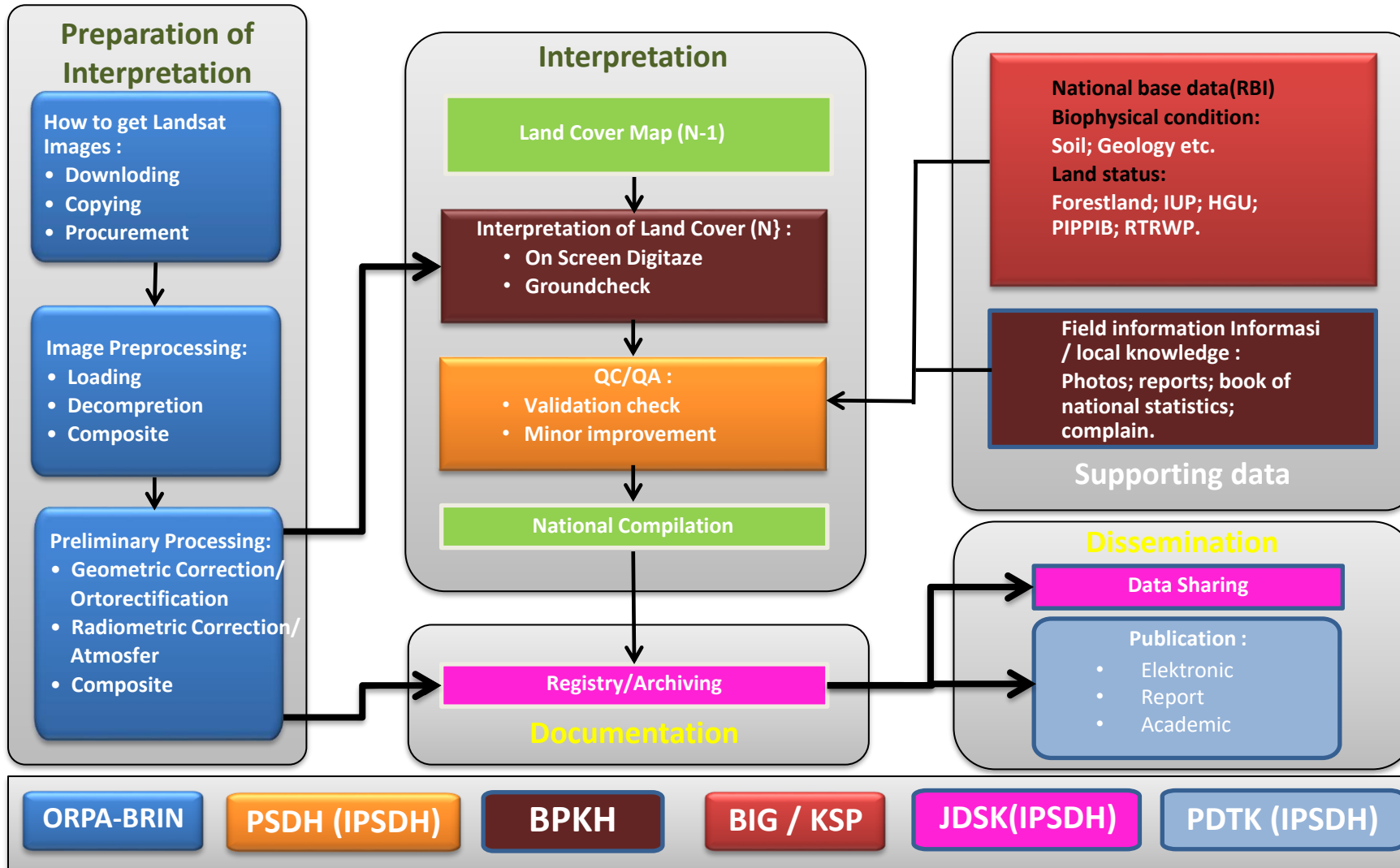
HISTORY AND IMPROVEMENT OF LAND COVER DATA INDONESIA





Institutional Arrangement for Operational Process

FLOWCHART OF INDONESIA'S FOREST MONITORING



Published annually



Support the needs of National and International Report

Land Cover of Indonesia



23 LAND COVER CLASSES OF INDONESIA

- The 23 complex classes are consisting of **forested areas** (forest cover) and **non-forested areas** (non-forest cover);
- The forested areas are including **natural forest** and **man-made forest**;
- The non-forested areas also covering **the other vegetation, non-vegetated classes** and **mixed**;
- The classification is flexible → can be re-classified based on the purpose , ex : IPCC classes

Gross Deforestation = Forest → Non-Forest
Reforestation = Non-Forest → Forest
Deforestation (Nett) = Gross Deforestation - Reforestation

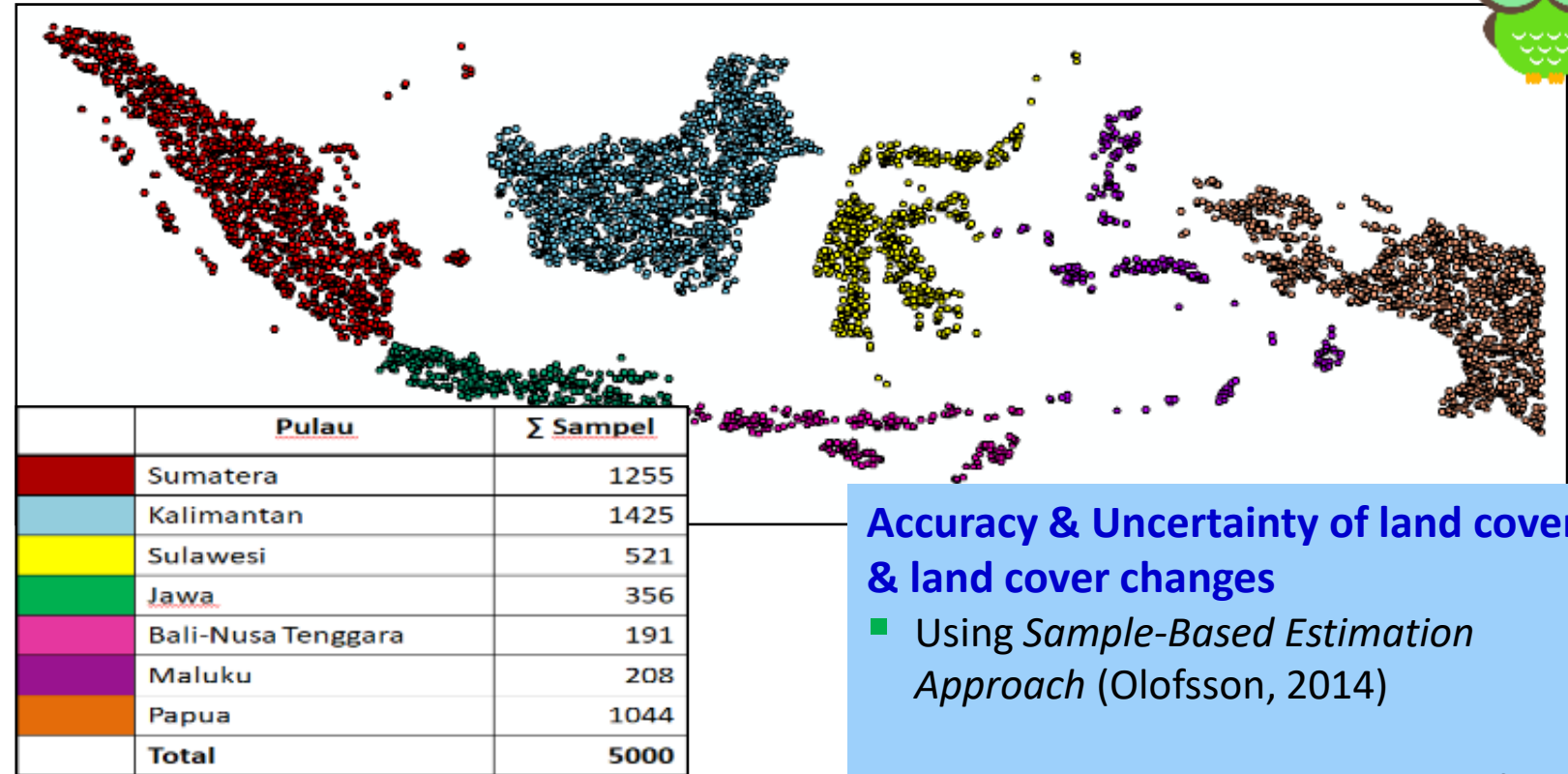
No	Land Cover Classification	Re-classification
1	Primary dryland forest	FOREST
2	Secondary dryland forest	
3	Primary mangrove forest	
4	Secondary mangrove forest	
5	Primary swamp forest	
6	Secondary swamp forest	
7	Plantation forest	
8	Dry shrub	NON FOREST
9	Wet shrub	
10	Savanna/Grasses	
11	Estate crop	
12	Pure dry agriculture	
13	Mixed dry agriculture	
14	Paddy field	
15	Fish pond/aquaculture	
16	Settlement areas	
17	Transmigration areas	
18	Port and harbour	
19	Bare land	
20	Mining areas	
21	Open swamp	
22	Open water	
23	Clouds and no-data	



No	MoEF LANDCOVER CLASS	No	IPCC CLASS
1	PRIMARY DRYLAND FOREST	1	FOREST LAND
2	SECONDARY DRYLAND FOREST		
3	PRIMARY SWAMP FOREST		
4	SECONDARY SWAMP FOREST		
5	PRIMARY MANGROVE FOREST		
6	SECONDARY MANGROVE FOREST		
7	PLANTATION FOREST		
8	DRYLAND AGRICULTURE	2	CROPLAND
9	SHRUB-MIXED DRYLAND AGRICULTURE		
10	TRANSMIGRATION AREA		
11	RICE FIELD	3	GRASSLAND
12	ESTATE CROP		
13	SAVANNA & GRASSES		
14	DRY SHRUB	4	WETLAND
15	WET SHRUB		
16	FISH POND/AQUACULTURE		
17	OPEN SWAMP	5	SETTLEMENT
18	OPEN WATER		
19	SETTLEMENT		
20	BARE GROUND	6	OTHER LAND
21	MINING AREAS		
22	PORT & HARBOUR		



- Method → **wall-to-wall mapping** through visual interpretation and interdependency method with *Minimal Mapping Unit* (MMU): 6,25 ha at digitizing scale 1:50.000 → the best method for Indonesia (23 classes)
- Data main source: Landsat (cover national area, free access with *continuity* available guarantee → data consistent)
- Mapping from 1990 & improving annually since 2011
- **Improvement :**
 - a. Hybrid method → combine with automatic data (de-vegetation → faster indicative for forest change - **deforestation early warning as well as forest degradation**)
 - b. Applied high resolution imagery (PLANET, SPOT, Sentinel)
 - c. Web-based NFMS development
 - d. 3 monthly deforestation monitoring

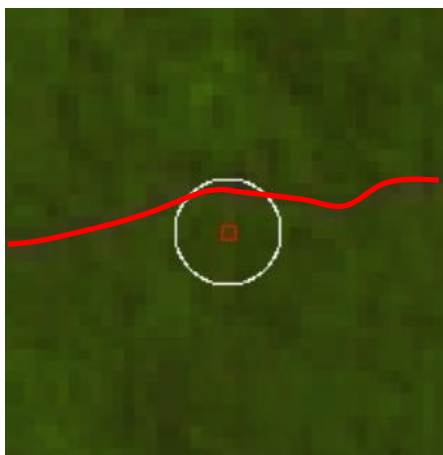
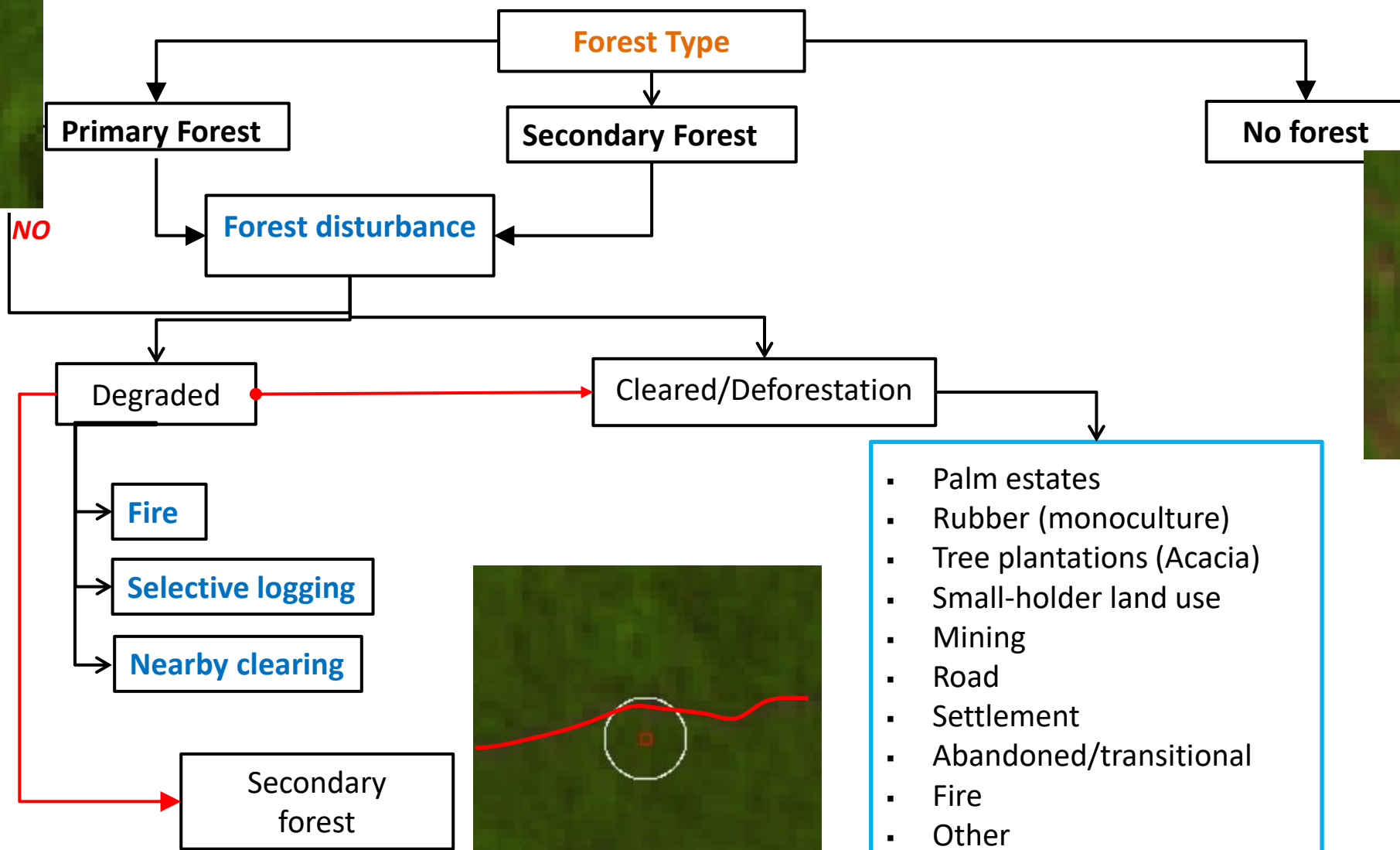
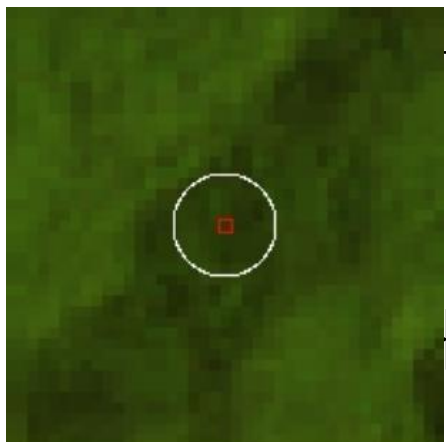


Accuracy & Uncertainty of land cover & land cover changes

- The **accuracy of land cover map** has also been calculated using *simple random sampling* method (5.000 point samples were distributed across Indonesia; time period: 1990-2000);
- Samples were interpreted using high resolution imagery such as SPOT 6/7 and Google Earth
- **overall accuracy (2022) 23 classes: 82,3%**
- **overall accuracy (2022) forest-non forest: 97,5%**

- Using *Sample-Based Estimation Approach* (Olofsson, 2014)
- Using high resolution imagery & field check data
- Uncertainty of **national deforestation** (2006-2020) in 2nd FREL < **15%**
- Uncertainty of **deforestation for FCPF Kalimantan Timur Province** (ERMRI-2019-2020) & **BioCF Jambi Province** (2006-2018) < **15%**

CHANGE TYPES



CALCULATION OF EMISSION FACTOR

National Forest Inventory

- Programme initiated in 1989, support by FAO and Worldbank
- 1989-2020: > 4,000 plots were established in 6 classess natural forest land cover, systematic sampling (grid 20x20 km)
- Total of 4,450 measurements of Permanent Sample Plots (100 m x 100 m, except mangrove forest 50 m x 50 m)
- Using Allometric for generated Above Ground Biomass (ABG) → carbon stock



Tree Stand Volume

Tree stand volume (5 cm up)

- Primary Dry Land Forest: 309,3 m³/ha
- Secondary Dry Land Forest: 221,5 m³/ha
- Primary Swamp Forest: 207,6 m³/ha
- Secondary Swamp Forest: 207,4 m³/ha
- Plantation Forest: 221,4 m³/ha

807 Models (As of 2013)
437 tree biomass
370 tree volumes

Using Allometric

Biomass

Allometric equation for biomass estimation:

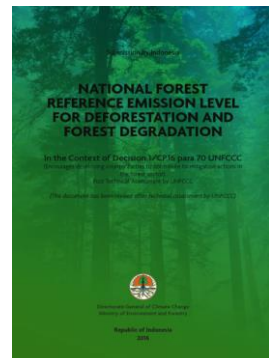
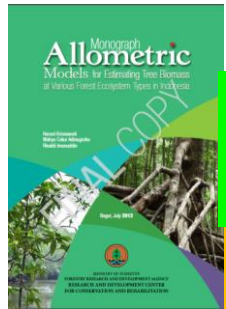
- Dry land forest & swamp forest (Manuri, 2017)
- Mangrove forest (Chave, et al, 2015)

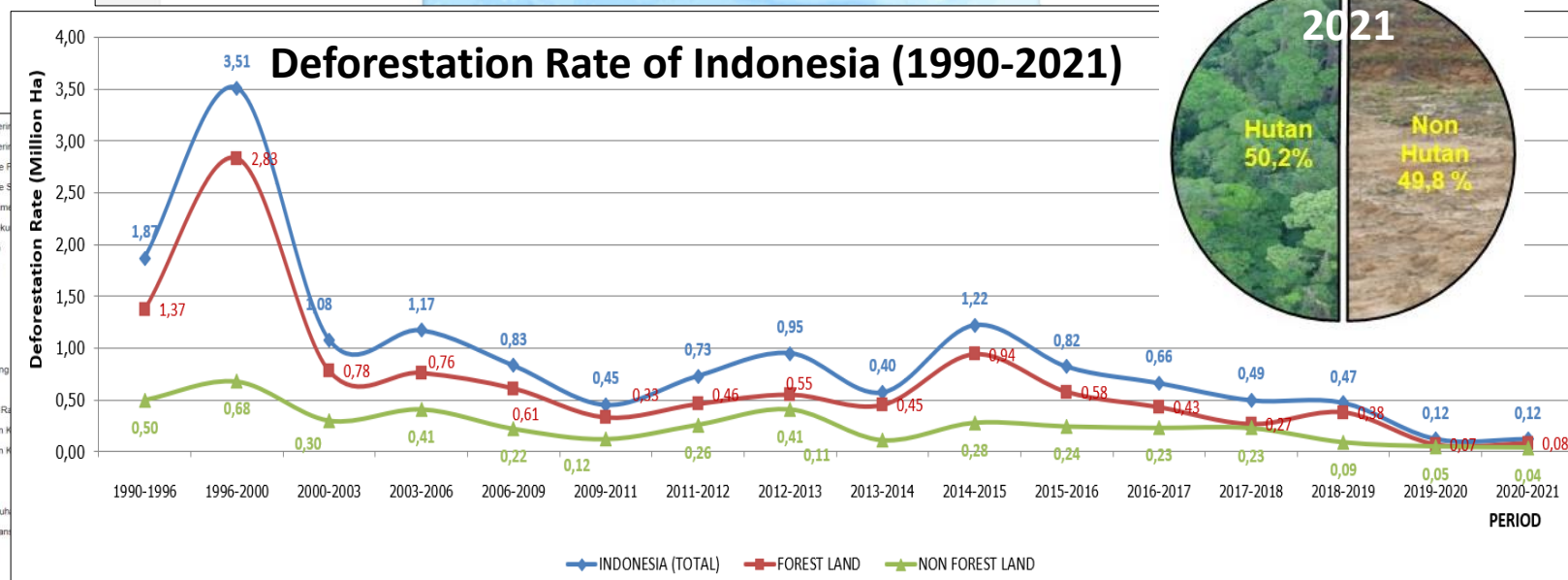
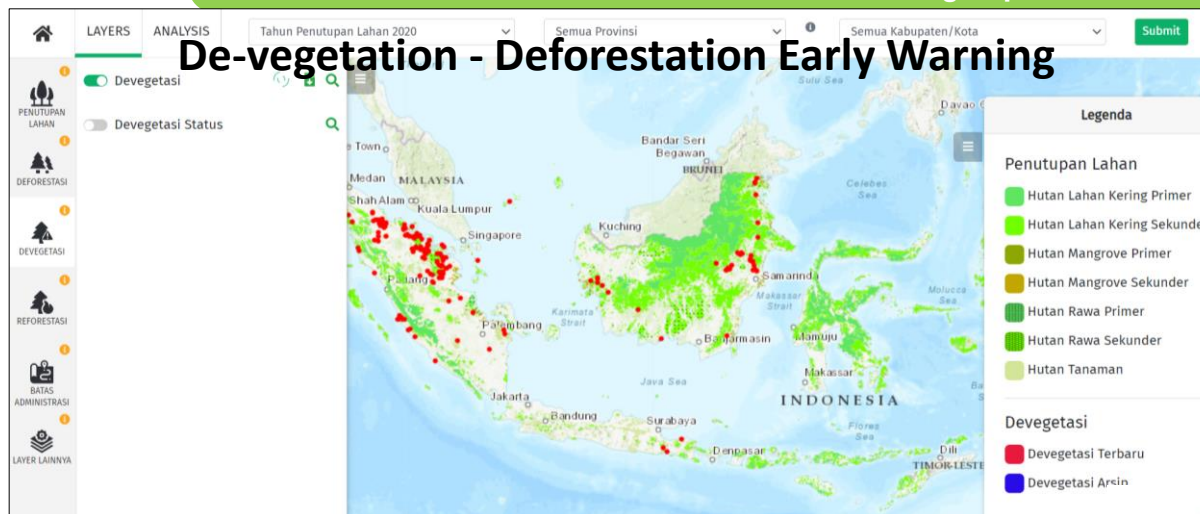
Cadangan Karbon (C)

Carbon conversion value = 0,47

Conversion value= 44/12

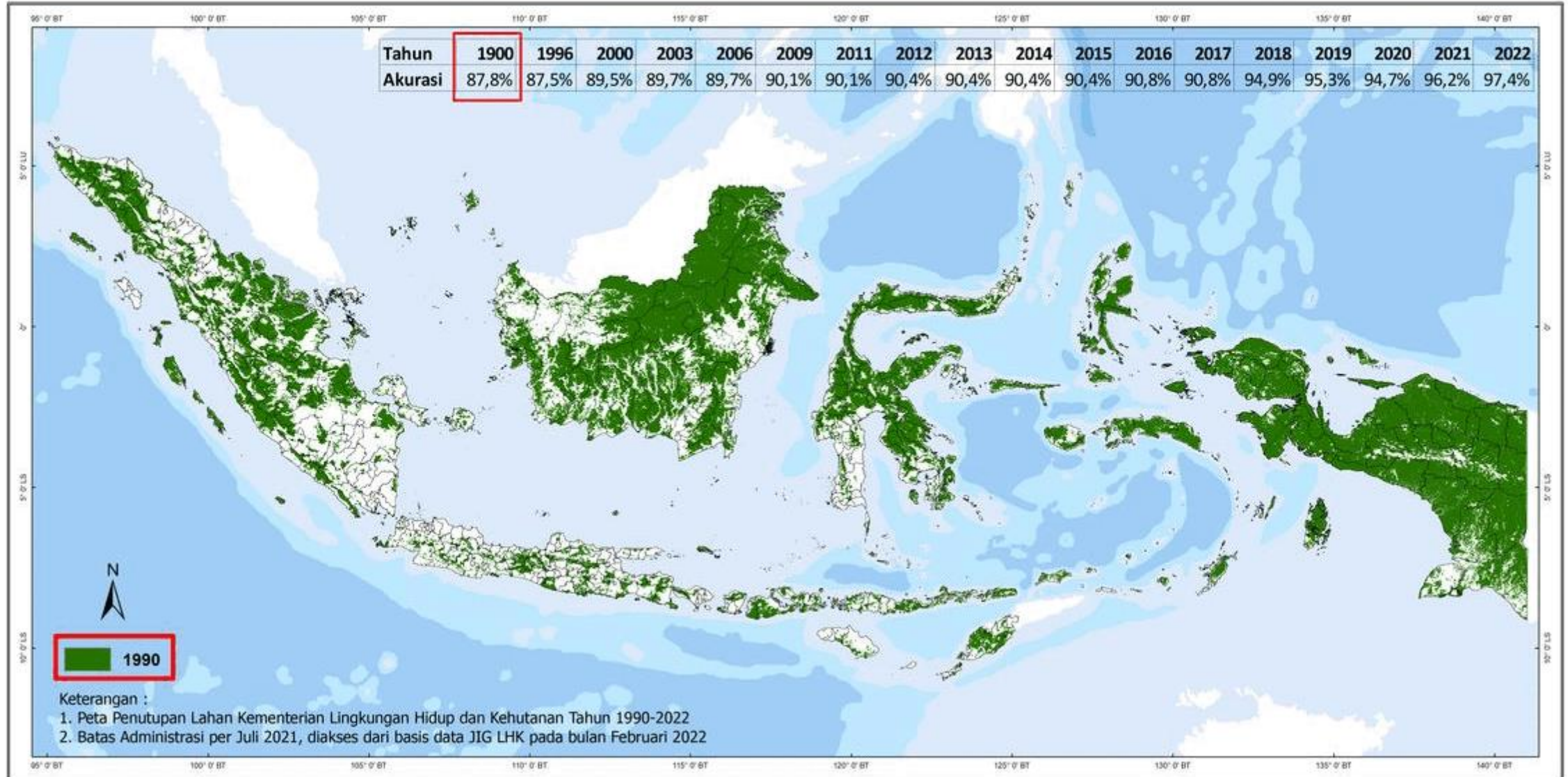
FAKTOR EMISI



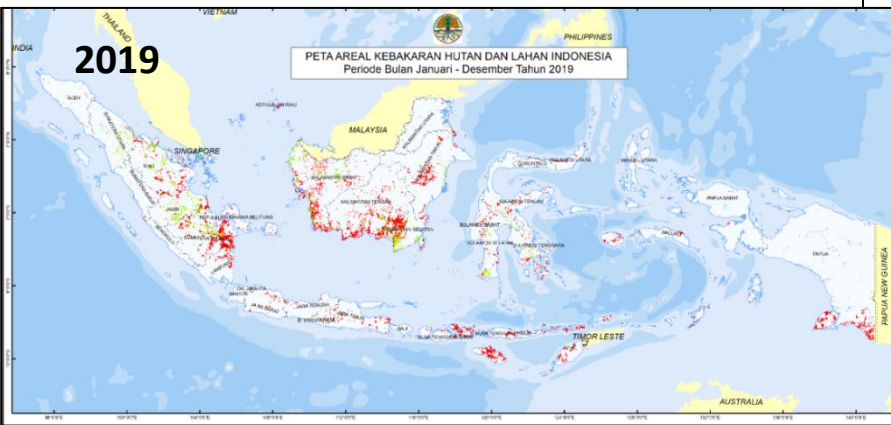




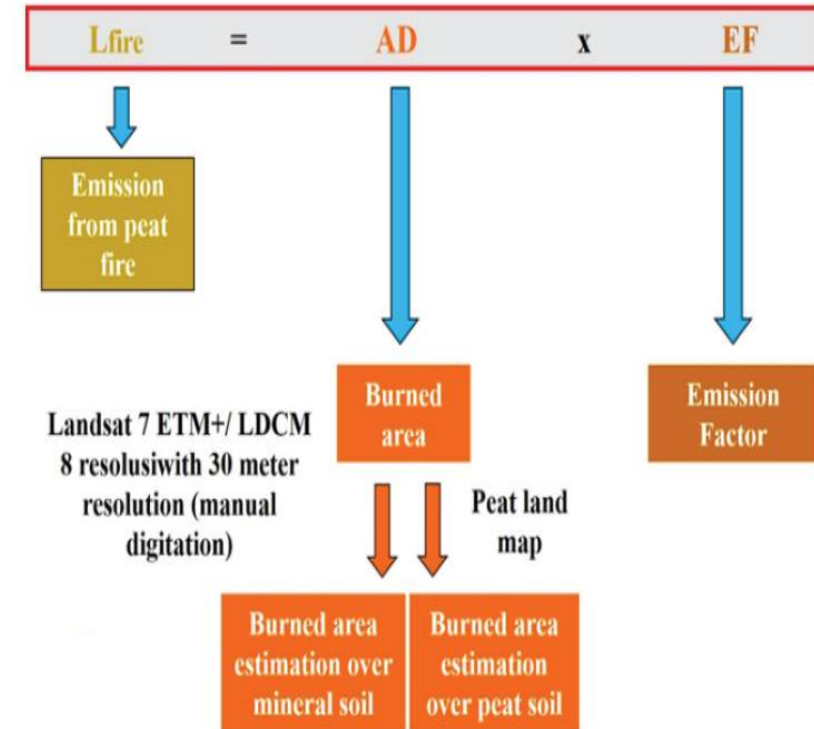
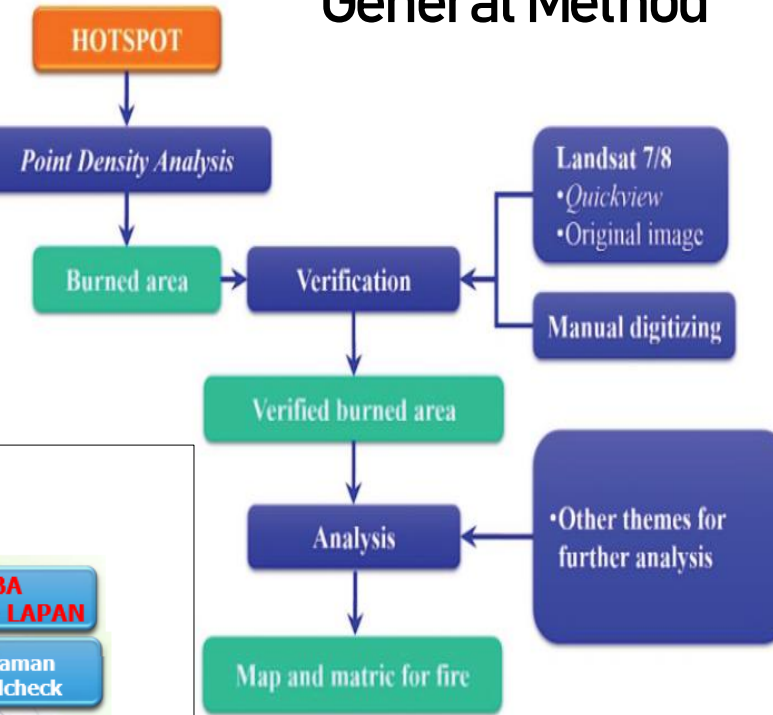
LAND COVER CHANGES OF INDONESIA PERIOD 1990-2022



BURN SCAR MAP



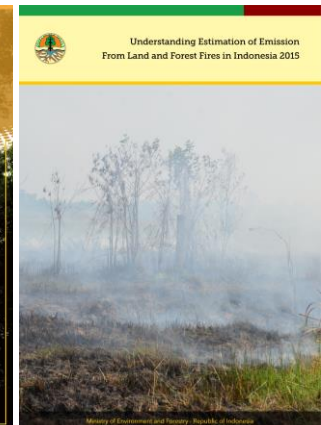
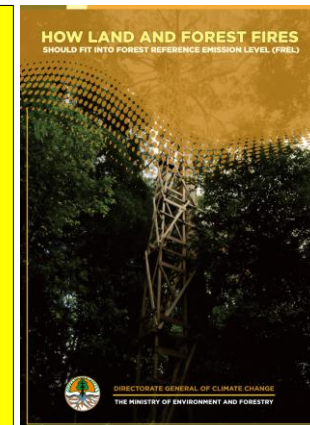
General Method



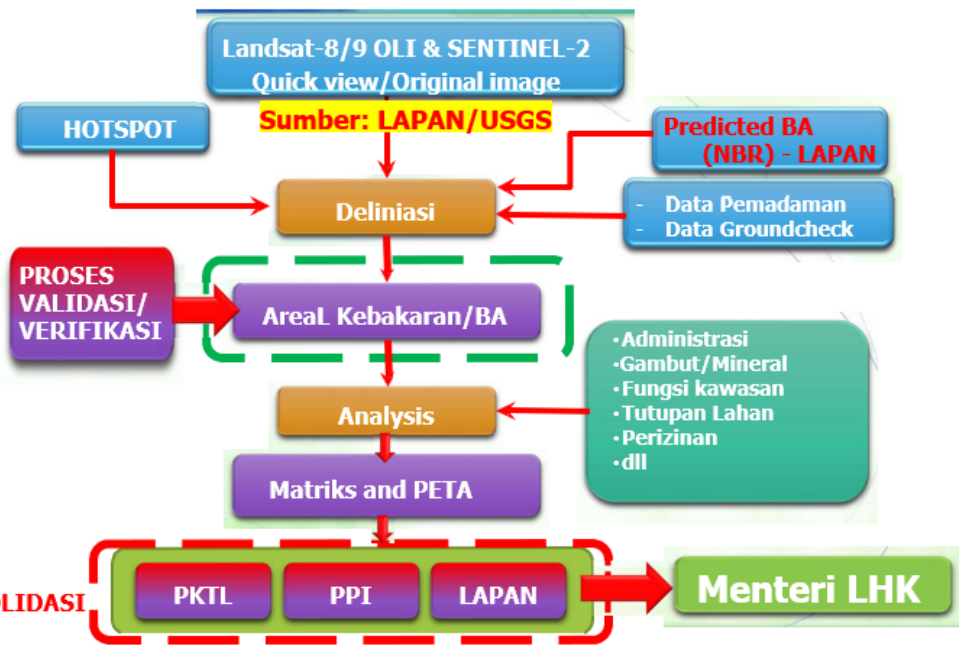
Burn scar map (2015-onward) → monthly

Burn scar map of 2000-2014 → were generated using the same method

Accuracy assessment of burn scar map were done (> 85%)

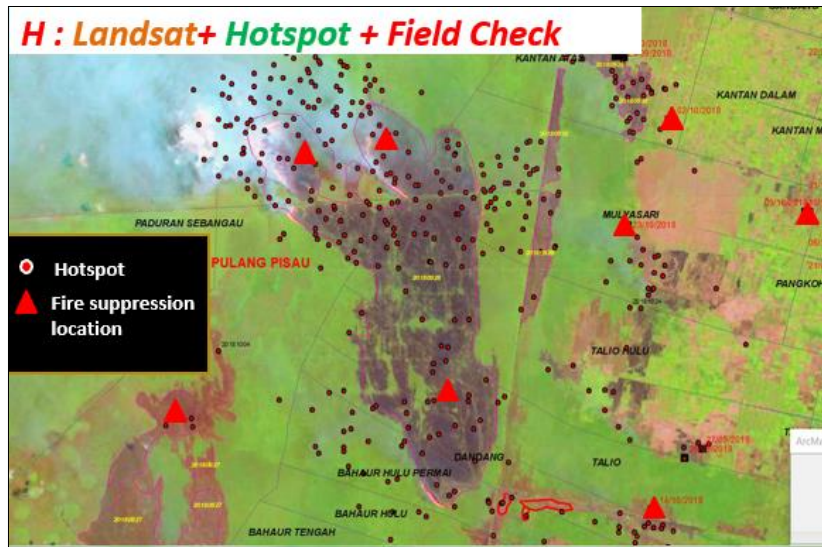


Operational process

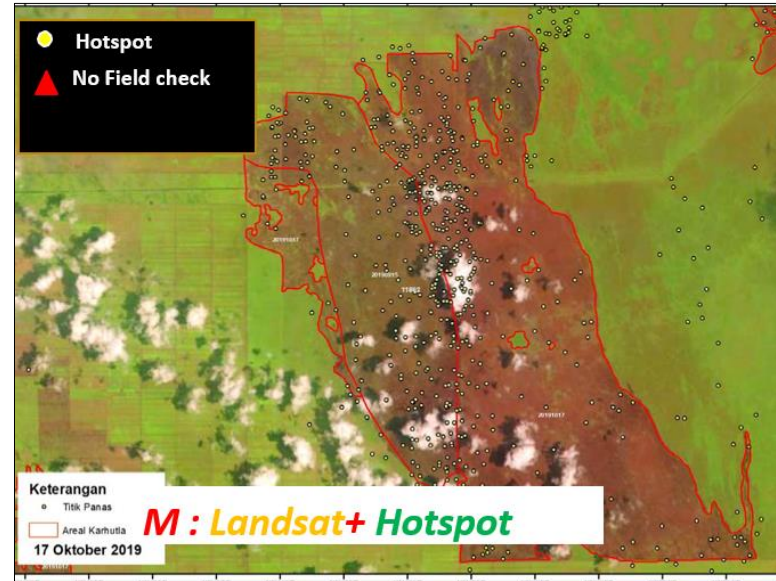


ACCURACY LEVEL OF BURN SCAR DATA

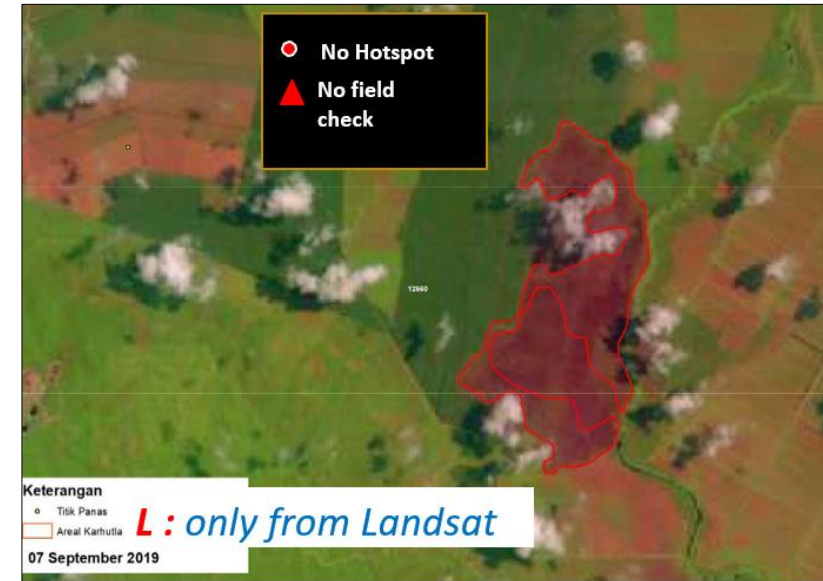
HIGH



MEDIUM



LOW



- Determination for accuracy level also refer to the correlation between date of image acquisition and hotspot including fire extinguishing/field check
- For “LOW (L)” data category → will check to the field or get confirmation from areal manager

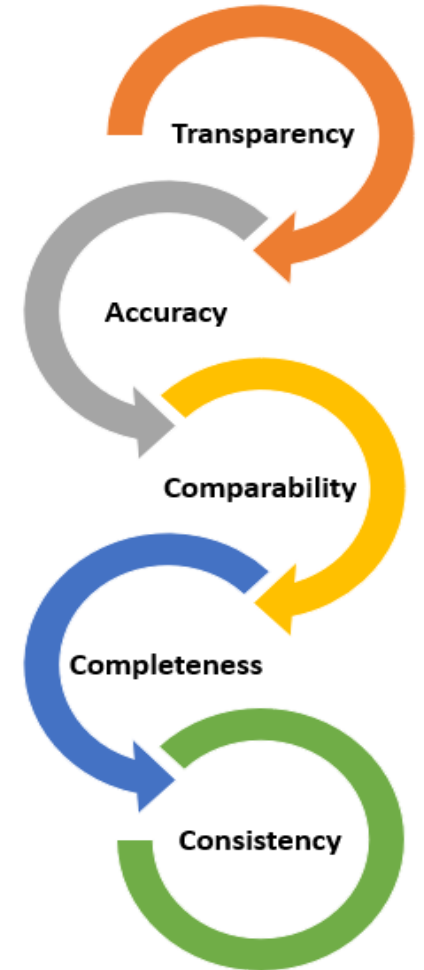
IMPROVEMENT OF NATIONAL FOREST MONITORING SYSTEM TO SUPPORT GHG, MRV, ACHIEVING NDC TARGETS AND OTHERS

- **Easy of access to information for the government, local government, public and society**
- **Transparent** → approach and methods should be explained and clear (data, data sources, calculation methods)
- **Accurate and up-to-date** → assessment of accuracy and uncertainty
- **Comparable** → can be compared with other data
- **Completeness** → includes a national area with 23 land cover classes and their changes
- **Consistent each period** → Definitions, classifications, methods, data sources used are consistent for all other publications and reports

FUTURE PLANS OF NATIONAL FOREST MONITORING SYSTEM

- **Improving the system** (web-based and online platform – on going process)
- **Re-design Sample Plot for National Forest Inventory** → on going process supporting by **FAO**
- **Integration between terrestrial and non-terrestrial data on NFMS web-based**

PRINSIP TACCC



GHG Inventory: Plan of Improvement

- Technical knowledge and capability for developing country-specific EFs
- Capacity to collect data, develop EFs and estimate emissions for some key sources
- Capacity to identify the sources of uncertainty and estimate the uncertainty level of AD for all sectors;
- Capacity to carry out QA/QC for and manage and archive inventory data as well as capacity to collect and report data in order to
- improve the completeness of the GHG inventory, and to implement QA/QC of reports in order to improve the transparency of reporting;
- **Update and improve the GHG Inventory System:**
- **Improve the quality of Activity Data and Emission Factors and level of accuracy (tier)**
- **Improve quality control system;**
- **Improve of archiving, security and documentation systems.**

Cross-cutting:

- Institutional system that links processes related to mitigation sectors with the GHG inventory in order to collect data for and coordinate BUR preparation and submission such that the process occurs in a timely manner

Thank You