Pilot testing of GBEP Sustainability Indicators in Indonesia

Project updates & lessons learnt

Activity Group 2

"Raising awareness and sharing of data and experiences from the implementation of the GBEP indicators"

IRENA Offices in Bonn, Germany, July 3-4, 2014

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PILOT TESTING OF GBEP SIB IN INDONESIA

Presentation's content:

- Project overview
  - Goals of the project
  - Country Actors
- Status update
  - Challenges & possible solutions
  - Indicators we are completing
  - **Indicator 8** – Measurement updates
- Lessons learnt & Recommendations

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PILOT TESTING THE INDICATORS

Goals of the project:

- **Assess and enhance the capacity** of the country **to measure the GBEP Indicators** and use them to inform policy making; and
- **Learn lessons about** how to apply the indicators as a tool for sustainable development and how to enhance the **practicality of the tool**

Country actors

- Ministry of Energy and Mineral Resources
  - Dadan Kusdiana, Director of Bioenergy, Directorate General of New and Renewable Energy and Energy Conservation

- Consultants at Bogor Agricultural University (IPB) have a team comprising **18 members**.

- LUC and peatland experts from

Indonesian Soil Research Institute:
  - Dr. Fahmuddin Agus

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CHALLENGES & LIMITATIONS

Indonesia is a vast and complex country;

The analysis performed during the first phase of the project:

- **Geographical coverage *not at the national level***
- **Representativeness of some indicators *is not optimal***
- **Multiple bioenergy forms *have different weight in the bioenergy portfolio* and project constraints have to be considered**

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COUNTERMEASURES

1) Geographical coverage not at the national level

- **Enhanced use of *remote sensing* techniques and information for selected indicators**

- **Enhanced use of *GIS tools* for the elaboration of the information and graphic representation of the results**

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COUNTERMEASURES

2) Representativeness less-than optimal

In addition to increased geographical coverage:

- **Enhance *spectrum of stakeholders* = *provide further access to information***

- **Enhance *participatory approach* to the assessment of indicator values = *chance to discuss all aspects of the measurement, cross cutting issues, discover implications, etc.***

COUNTERMEASURES

3) Multiple bioenergy forms have different weight in the bioenergy portfolio

- **Focus on main modern bioenergy type at present (*ex-post*)**

Palm Oil Biodiesel represents the major current modern bioenergy type produced and employed in Indonesia

- Since 2010, fuel ethanol production has been discontinued

- Modern solid & gaseous biomass applications at the operator level

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WHAT INDICATORS?

Indicator 1 – *Lifecycle assessment of GHG:*

- Include GHG emission **from LUC**
- **Revise calculations**
- Assess presence of **CH_4 capture systems**
- Capacity development – Intl. experts' support
    - **Training: 2 sessions in the country**

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WHAT INDICATORS?

Indicator 2 – *Soil quality:*

- Include considerations on **SOC**
- If possible, include **changes in SOC**
- **Maps of soil type & feedstock cultivation**
- Maps of soil quality parameters (erosion, salinization, subsidence, etc)

WHAT INDICATORS?

Indicator 3 – *Harvest levels of wood resources*:

- Include disaggregated values of **sustained yield/net annual growth**

- **Include statistics on woodfuel production and use**

WHAT INDICATORS?

Indicator 5 – *Water use and efficiency*:

- Include data on water requirement based on **annual evapotranspiration**
- **Couple watershed level TARWR with OP cultivation surfaces in the watershed**
- Include timeseries for TAWW

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WHAT INDICATORS?

Indicator 7 – *Biodiversity in the Landscape***:**

- Conduct research on **status of HCV areas and** national recognition of HCV areas and OP plantation development overtime

- Conduct research on **invasive species associated with feedstock production**

- Incidence of biodiversity **conservation practices**

WHAT INDICATORS?

Indicator 8 – *Land Use and Land Use Change*:

- **Include maps of LUC due to OP in Indonesia from 1990 to 2010 (and related GHG emissions)**
- **Estimate share attributable to bioenergy production;**
- **Based on BD refineries location, estimate possible pertinence plantations**

WHAT INDICATORS?

Indicator 23 – *Infrastructure and logistics*:

- Inclusion of **maps of transportation system** and infrastructures.

- **Determine the capacity (ton/year, etc) of each of the distribution systems identified.** --> Calculate/estimate how much biodiesel/biodiesel feedstock is moved on each road, port, etc.

- Learn about the status of these infrastructures is relevant for other indicators as well

Indicator 8 – Land Use and Land Use Change

Indicator 8 Land use and land-use change related to bioenergy feedstock production

Description:

(8.1) Total area of land for bioenergy feedstock production, and as compared to total national surface and (8.2) agricultural land and managed forest area

(8.3) Percentages of bioenergy from:

(8.3a) yield increases,

(8.3b) residues,

(8.3c) wastes,

(8.3d) degraded or contaminated land

(8.4) Net annual rates of conversion between land-use types caused directly by bioenergy feedstock production, including the following (amongst others):

- arable land and permanent crops, permanent meadows and pastures, and managed forests
- natural forests and grasslands (including savannah, excluding natural permanent meadows and pastures), peatlands, and wetlands

Measurement unit(s):

(8.1-2) hectares and percentages

(8.3) percentages

(8.4) hectares per year

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INDICATOR 8

8.1 – Total area of land for bioenergy feedstock production as compared to total national surface:

Total national surface in 2012 was **181.9 million ha** (adjusted from Landsat Imagery and FAO as per Gunarso et al, 2013)

Total Crude Palm Oil produced in 2012 was **26.5 million tonnes** (Ministry of Agriculture)

Total agricultural land in 2011 was **54.5 million ha** (FAOSTAT)

Total forest area in 2011 was **93 million ha** (Ministry of Forestry)

Total surface cultivated with oil palm was **9.2 million ha** (Landsat Imagery, Ministry of Agriculture)

Total Biodiesel produced domestically from CPO was **1.8 million tonnes** (Pertamina, 2012)

Total area of land *attributable* to production of bioenergy feedstock:**7.54 % of total area for CPO** (based on BD output), **~ 690.000 ha**

Total area of land *attributable* to production of bioenergy feedstock as compared to total national surface: **0.38%**

8.2 – Total area of land for bioenergy feedstock production as compared to total agricultural and forest area:

Total area of land *attributable* to production of bioenergy feedstock as compared to agricultural land: **1.26%**

Total area of land *attributable* to production of bioenergy feedstock as compared to forest area: **0.74%**

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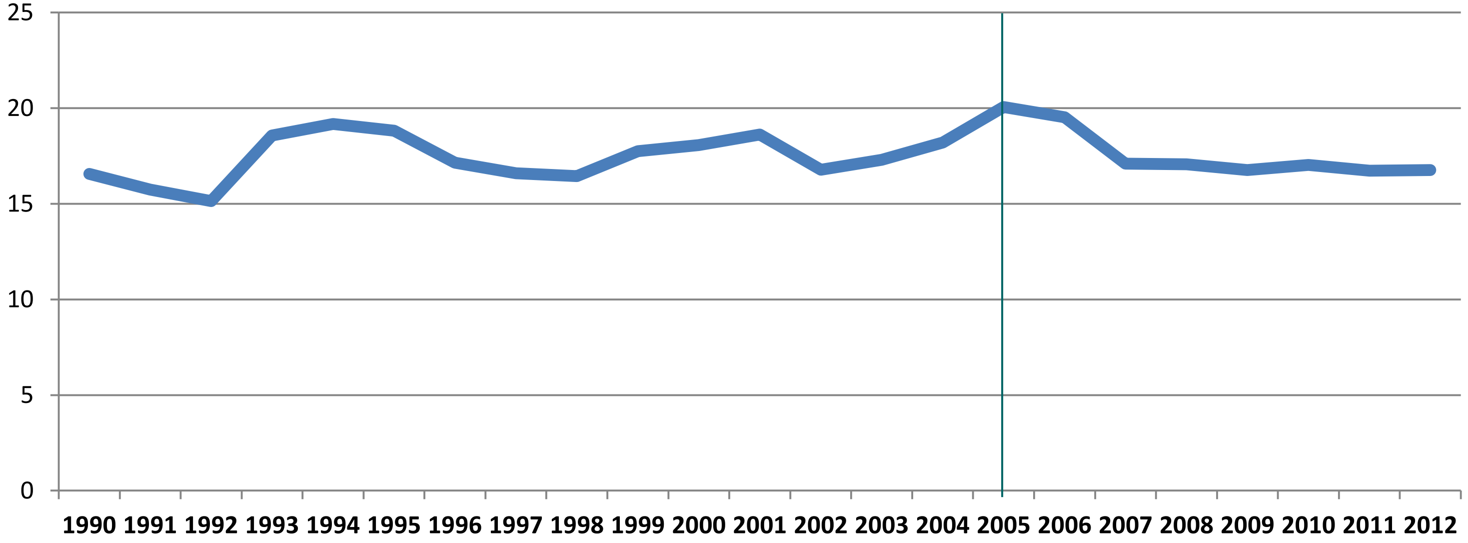
Indicator 8

8.3 – Percentages of bioenergy (biodiesel) from:

8.3a – yield increase
8.3b – residues
8.3c – wastes
8.3d – degraded or contaminated land

FFB yields in Indonesia between 1990 and 2012 in ton/ha



Source: FAOSTAT, 2013

FFB yields overall stable; from 2005 slightly declining

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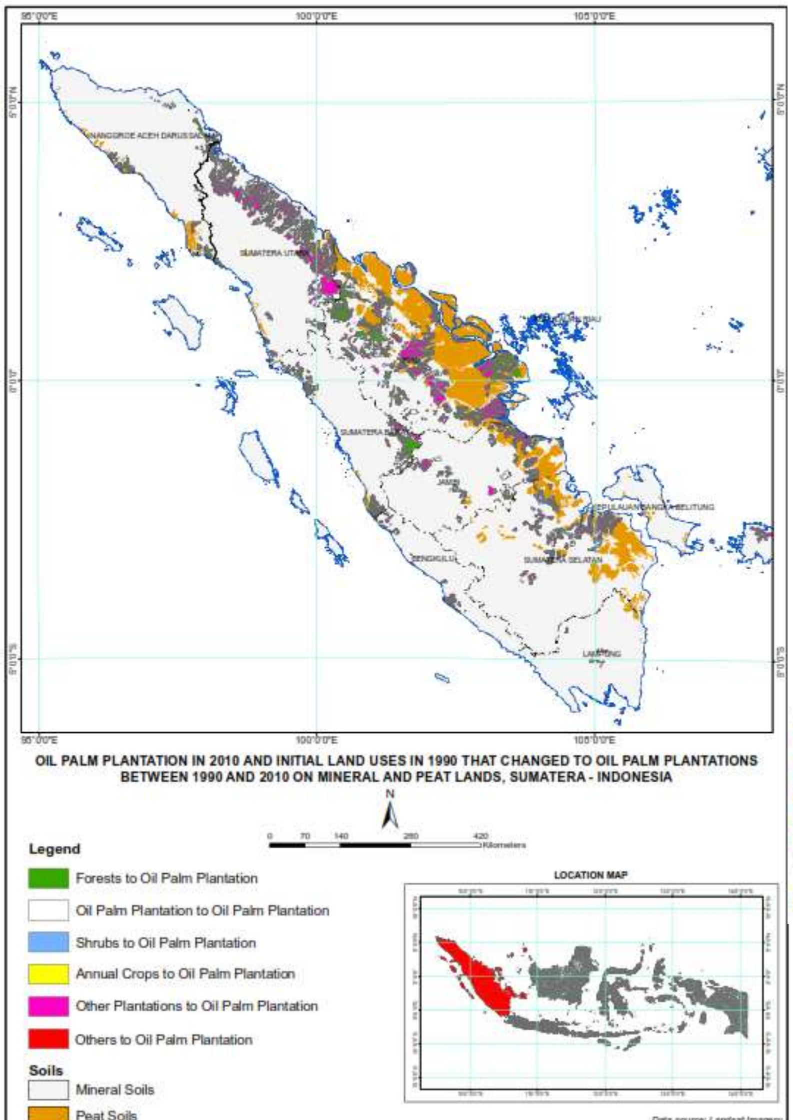
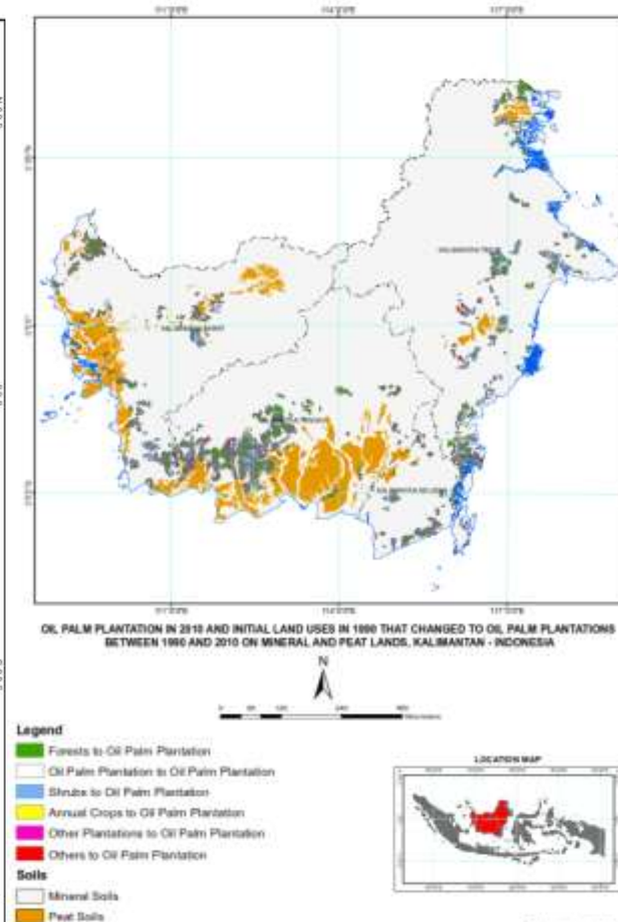
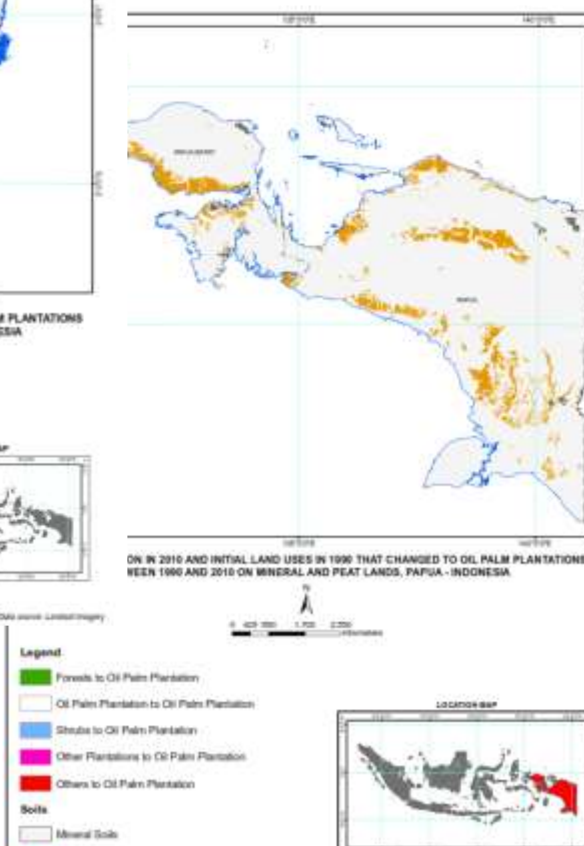
INDICATOR 8.4 - Net annual rates of conversion between land use types caused directly by bioenergy feedstock production







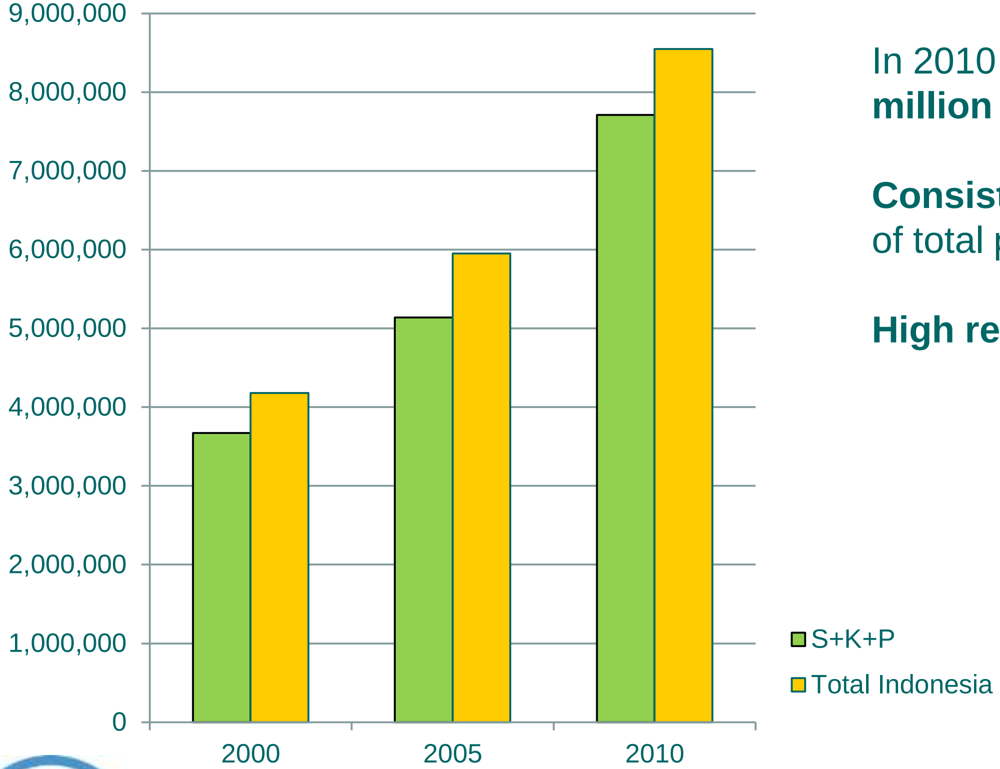
INDICATOR 8

Methodology:

- Maps of Sumatera, Kalimantan, Papua
- Land cover maps for 1990, 2000, 2005, 2010
- Scale: 1:250,000
- Landsat imagery (for cover types)
- Survey maps (soil types)
- Indonesian Soil Research Institute: GIS expert + LUC and GHG expert

LUC to OP (1990 – 2010) Enhanced representativeness

Oil palm planted area in Sumatera + Kalimantan + Papua vs total surface in Indonesia (hectares)



In 2010 in Indonesia about **8.5 million hectares** were planted with oil palm

In 2010 in Sumatera + Kalimantan + Papua about **7.7 million ha** of land planted with OP

Consistently, from 2000 to 2010**, S+K+P have 90.5%** of total planted area

High representativeness of the study

LUC to OP land cover categories

Forests
- Undisturbed Forest
- Disturbed Forest
- Undisturbed Swamp Forest
- Undisturbed Mangrove
- Disturbed Swamp Forest
- Disturbed Mangrove

Plantations (perennial crops)
- Rubber Plantation
- Oil Palm Plantation
- Timber Plantation
- Mixed Tree Crops

Shrubs
- Schrubs
- Swamp Shrubs

Annual crops
- Dry Cultivation
- ~~Settlement~~
- Grass
- Swamp Grass
- Rice Field

Others
- Coastal Fish Pond
- Bare Land
- Mining
- Water Body
- No data (cloud)

→ Mineral soils

→ Peat soils

Legend
- Forests to Oil Palm Plantation
- Oil Palm Plantation to Oil Palm Plantation
- Shrubs to Oil Palm Plantation
- Annual Crops to Oil Palm Plantation
- Other Plantations to Oil Palm Plantation
- Others to Oil Palm Plantation

Soils
- Mineral Soils
- Peat Soils

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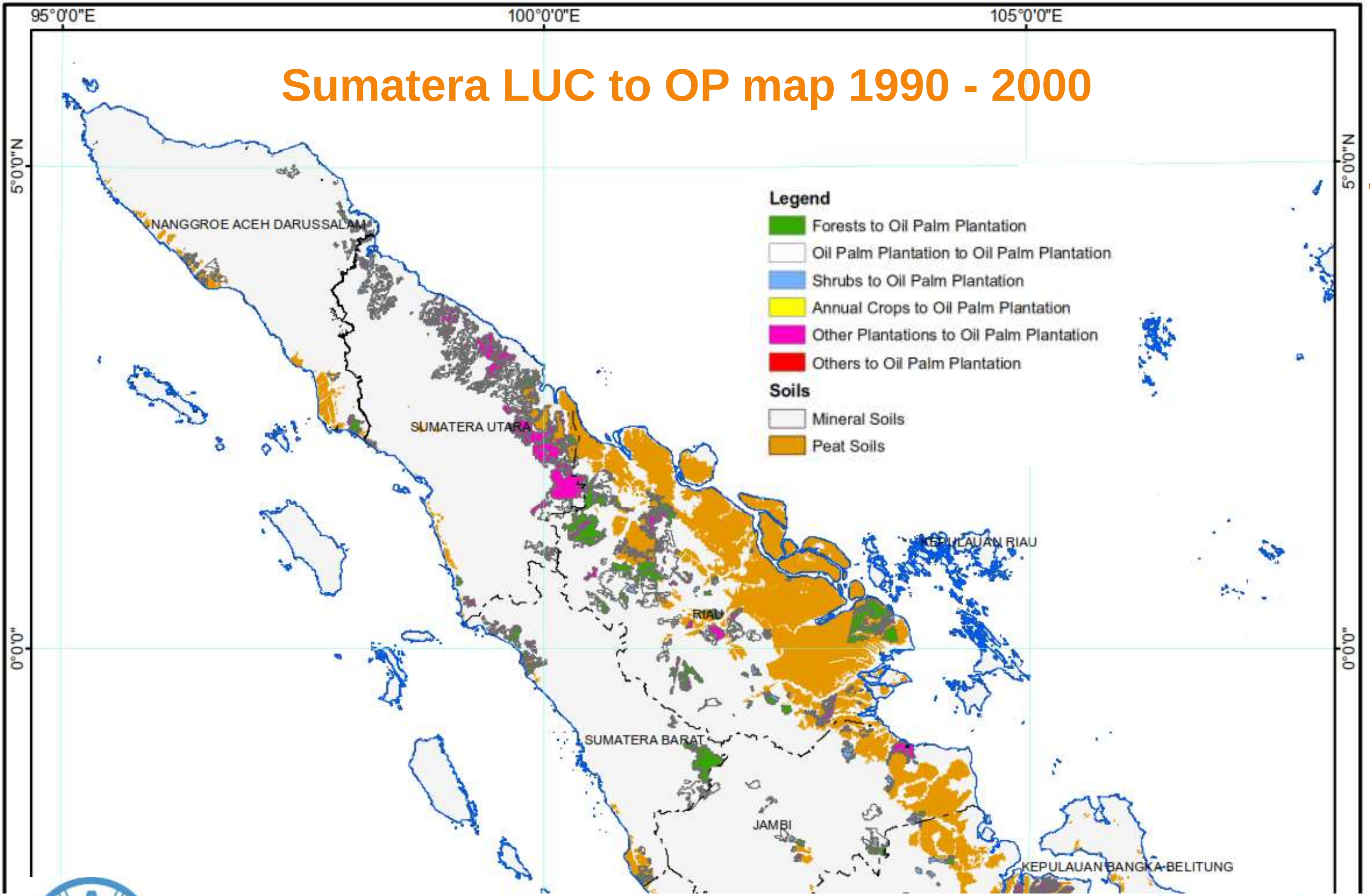
Sumatera LUC to OP map 1990 - 2000



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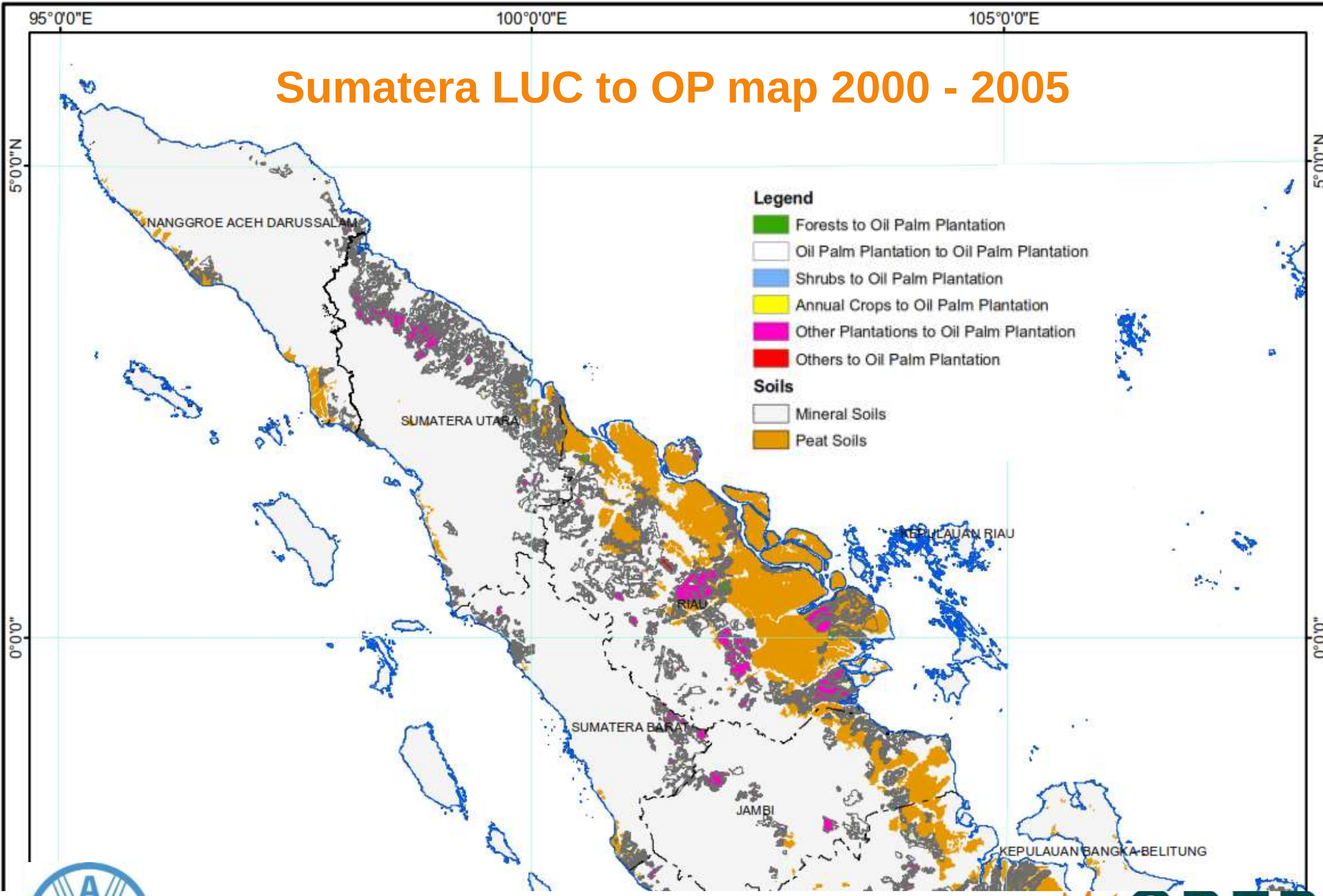
Sumatera LUC to OP map 2000 - 2005



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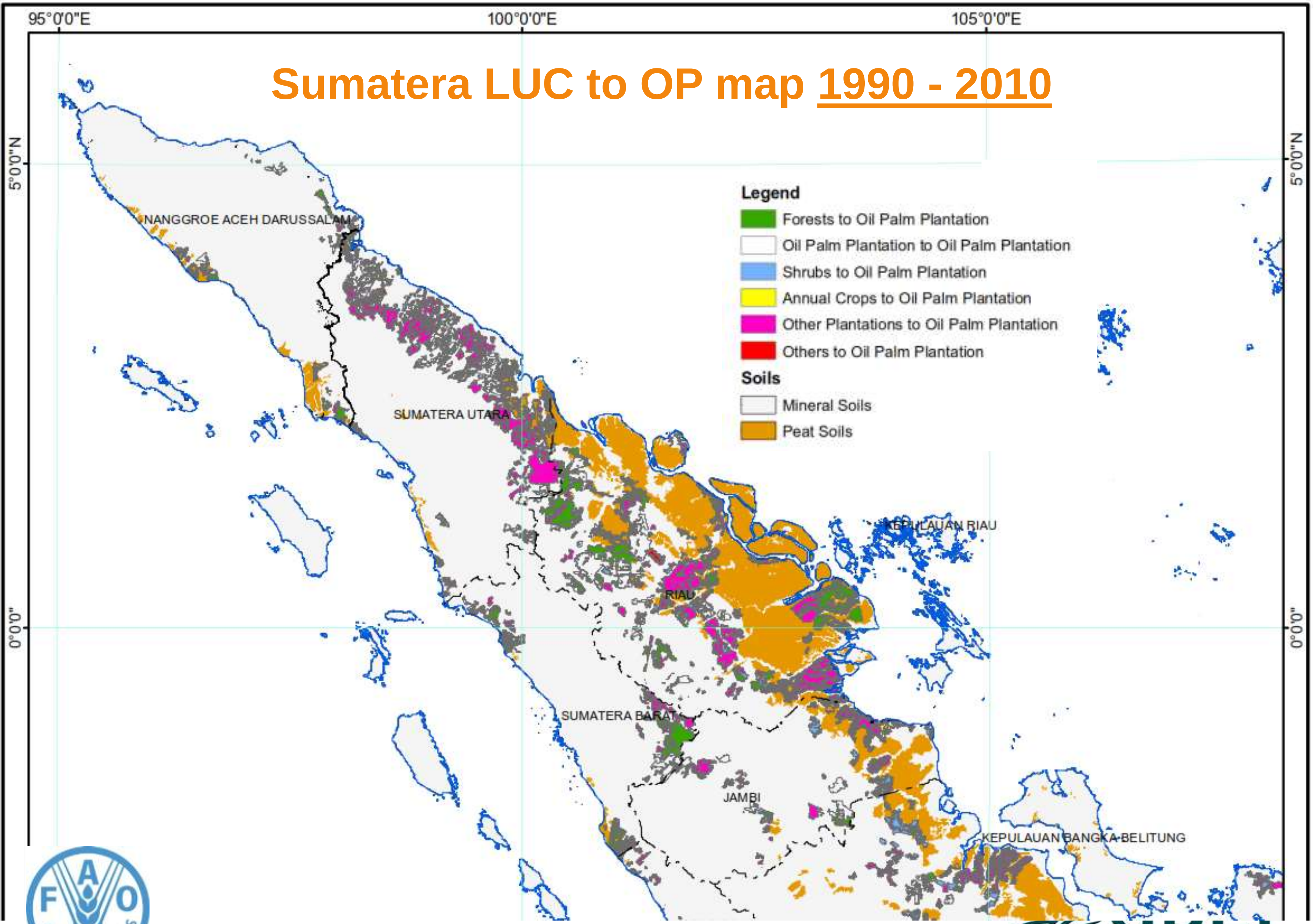
Sumatera LUC to OP map 1990 - 2010



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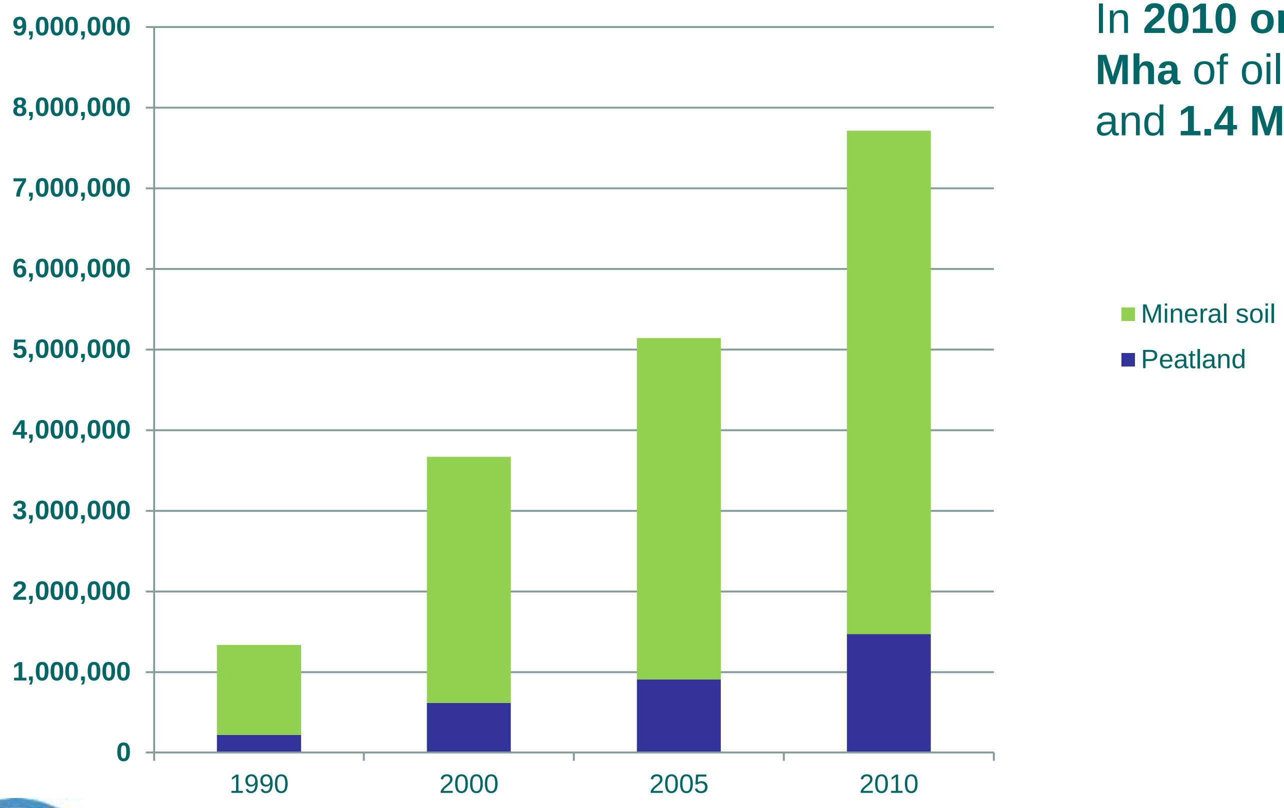
	Peat Sumatra				Peat Kalimantan				Peat Papua			
Initial land use	1990-2000	2000-2005	2005-2010	1990-2010	1990-2000	2000-2005	2005-2010	1990-2010	1990-2000	2000-2005	2005-2010	1990-2010
Forests	233,700	41,526	88,194	350,836	12,049	2,166	149,284	163,499	0	192	206	398
Shrubs	7,960	14,115	122,140	144,214	3,714	7,307	68,945	81,242	0	0	242	242
Oilpalm	221,116	597,854	876,498	221,116	500	18,010	28,697	500	0	0	1,280	
Other plantations	135,057	215,401	123,144	473,602	167	46	1,391	1,604	0	1,088	0	1,088
Annual crops	21	7,603	3,422	244,726	1,473	0	5,360	6,833	0	0	0	
Others	0	0	3,091	3,091	0	0	0	-	0	0	0	
Sum	597,854	876,498	1,216,489	1,216,489	17,901	27,529	253,677	253,677	0	1,280	1,728	1,728
Rate of conversion (ha/yr)	37,674	55,729	67,998	49,769	1,740	1,904	44,996	12,659	-	256	90	86
	1990	2000	2005	2010	1990	2000	2005	2010	1990	2000	2005	2010
Oil palm	221,116	597,854	876,498	1,216,489	500	17,901	27,529	253,677	0	0	1,280	1,728
Net change	376,737	278,644	339,991	995,373	17,402	9,518	224,980	251,900	0	1,280	448	1,728
	Mineral Sumatra				**Mineral Kalimantan**				**Mineral Papua**			
Initial land use	1990-2000	2000-2005	2005-2010	1990-2010	1990-2000	2000-2005	2005-2010	1990-2010	1990-2000	2000-2005	2005-2010	1990-2010
Forests	440,279	24,615	54,792	519,686	319,266	97,901	645,942	1,063,109	17,315	4,774	11,438	33,527
Shrubs	169,262	39,015	101,459	309,736	254,444	202,585	799,771	1,259,049	0	1,287	762	2,050
Oilpalm	997,838	2,288,468	3,101,303	997,838	85,242	719,307	1,067,270	85,242	28,745	47,565	67,638	28,745
Other plantations	676,350	715,285	198,416	1,590,052	9,034	26,524	50,504	86,061	1,505	13,789	2,064	17,359
Annual crops	4,740	18,864	50,041	73,645	10,698	19,296	79,566	109,560	0	0	0	
Others	0	15,055	9,528	24,583	40,253	0	0	40,253	0	222	0	222
Sum	2,288,468	3,101,303	3,515,539	3,515,539	718,937	1,065,612	2,643,053	2,643,275	47,565	67,638	81,903	81,902
Rate of conversion (ha/yr)	129,063	162,567	82,847	125,885	63,369	69,261	315,157	127,902	1,882	4,014	2,853	2,658
	1990	2000	2005	2010	1990	2000	2005	2010	1990	2000	2005	2010
Oil palm	997,838	2,288,468	3,101,303	3,515,539	85,242	718,937	1,065,612	2,643,053	28,745	47,565	67,638	81,903
Net change to OP	1,290,630	812,835	414,236	2,517,701	633,695	346,305	1,575,784	2,555,784	18,820	20,072	14,265	53,158
Oil palm	1990	2000	2005	2010	1990	2000	2005	2010	1990	2000	2005	2010
Peatland	221,116	597,854	876,498	1,216,489	500	17,901	27,529	253,677	0	0	1,280	1,728
Mineral soil	997,838	2,288,468	3,101,303	3,515,539	85,242	718,937	1,065,612	2,643,053	28,745	47,565	67,638	81,903
Net change, total	**1,667,367**	**1,091,479**	**754,227**	**3,513,074**	**651,097**	**355,824**	**1,800,764**	**2,807,684**	**18,820**	**21,352**	**14,713**	**54,886**

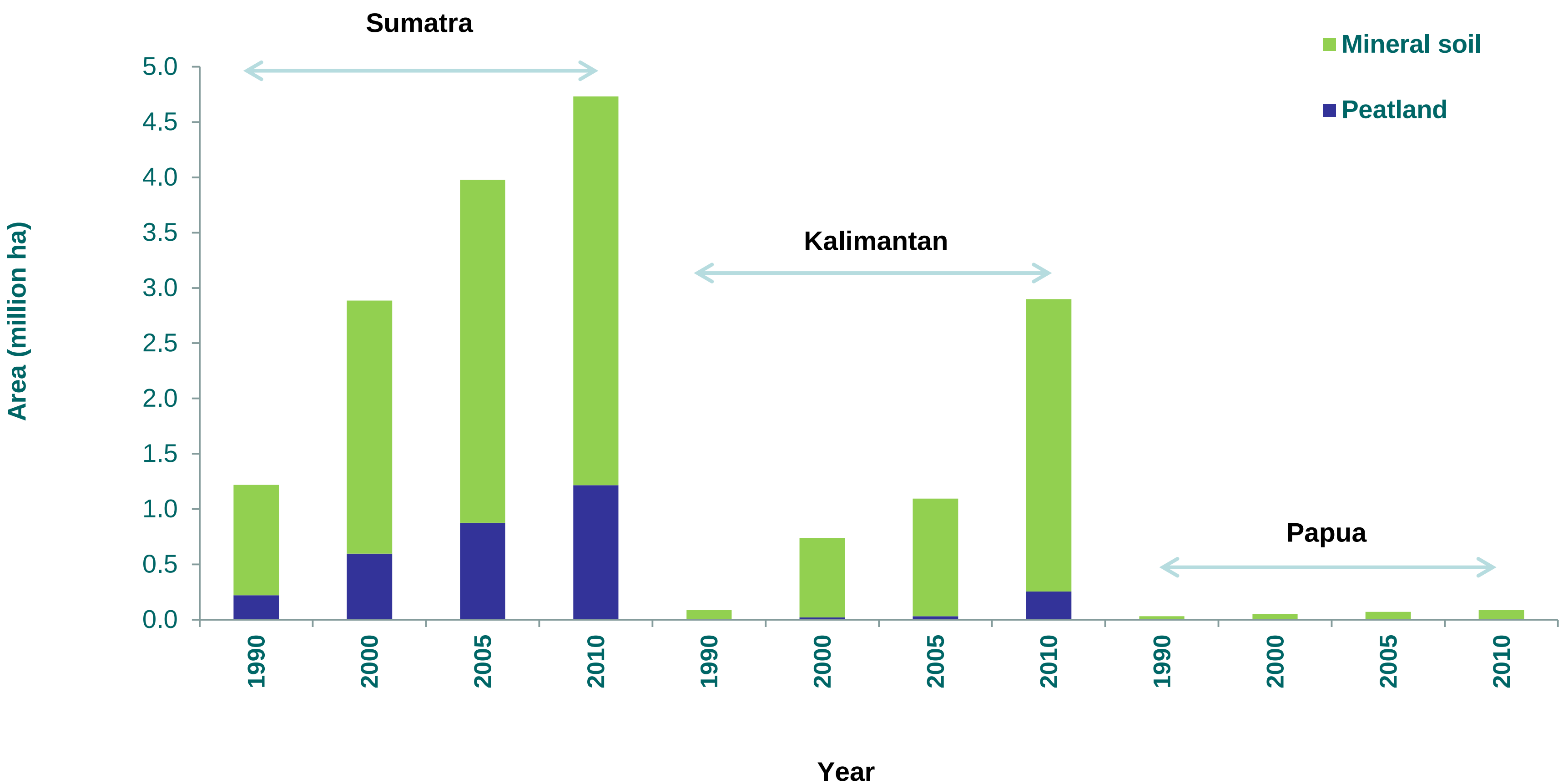
LUC to OP (1990 – 2010)

Cumulative OP planted area in Sumatera + Kalimantan + Papua (hectares)



In **2010 on S+K+P** there were **6.2 Mha** of oil palm on mineral soils and **1.4 Mha** on peat soils

LUC to OP by island (1990 – 2010)



Historically Sumatera has been the **island** were the majority of LUC to OP has taken place;

LUC to OP on **peat** mostly in Sumatera;

After 2005 in Kalimantan a considerable OP expansion has taken place;

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Summary LUC to OP (1990 – 2010)

Total LUC to OP of the three islands (Peat+Mineral)			
Initial land use	1990-2000	2000-2005	2005-2010
Forests	1,022,609	171,173	949,857
Shrubs	435,378	264,308	1,093,320
Oilpalm (beginning year)	1,333,442	3,671,204	5,139,859
Other plantations	822,112	972,133	375,520
Annual crops	16,931	45,764	138,389
Others	40,253	15,277	12,619
Total OP (end year)	3,671,204	5,139,859	7,712,390
Conversion rate (ha/year)	233,728	293,731	513,941

INDICATOR 8.4 - Net annual rates of conversion between land use types caused directly by bioenergy feedstock production

Attribution of LUC to bioenergy feedstock

Initial land use	1990-2000	2000-2005	2005-2010
Forests	0	0	71,619
Shrubs	0	0	82,436
Other plantations	0	0	28,314
Annual crops	0	0	10,435
Others	0	0	951
Rate of conversion (ha/year)	N/A	N/A	38,751

Attribution is difficult, still under debate

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GHG emission from LUC

Annual emission (tonnes of CO_{2e}) from peat decomposition, above-ground biomass on both peat and mineral soils attributable *directly* to bioenergy feedstock production

Source	1990-2000	2000-2005	2005-2010
Peat decomposition	0	0	4,033,027
AG Peatland	0	0	1,441,766
AG Mineral land	0	0	4,455,454
Total	**N/A**	**N/A**	**9,930,247**

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Lessons learnt & Recommendations

- The **GBEP SIB are suitable** for the Indonesian context;
- They provide a useful structure for organizing research and debate;
- Methodological approach for some indicators needs revision and needs to offer **further guidance** for indicator's measurement;

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Lessons learnt & Recommendations (cont'd)

- For the **effective** measurement of the GBEP SIB In Indonesia (and similar country context) the use of **remote sensing** techniques and GIS tools is required;

- Local stakeholders, particularly technical staff, should be involved **since project inception** (data availability, capacity assessment, etc);

- **Consistency is key**: A) stakeholders representation (e.g. government, academia, private); B) stakeholders participation;

Lessons learnt & Recommendations (cont'd)

- Primary data collection, verification and editing is **time and resource intensive**, yet **necessary** for specific indicators;

- The **support of the GBEP SIB community of practice** to knowledge exchange and **capacity development** concerning selected indicators is also needed (e.g. training, workshops, etc);

- Measuring all 24 indicators is an exercise which maximizes benefits for policy **in many country contexts** (cross cutting issues e.g. Ind. 10, 23, etc);

Thank you

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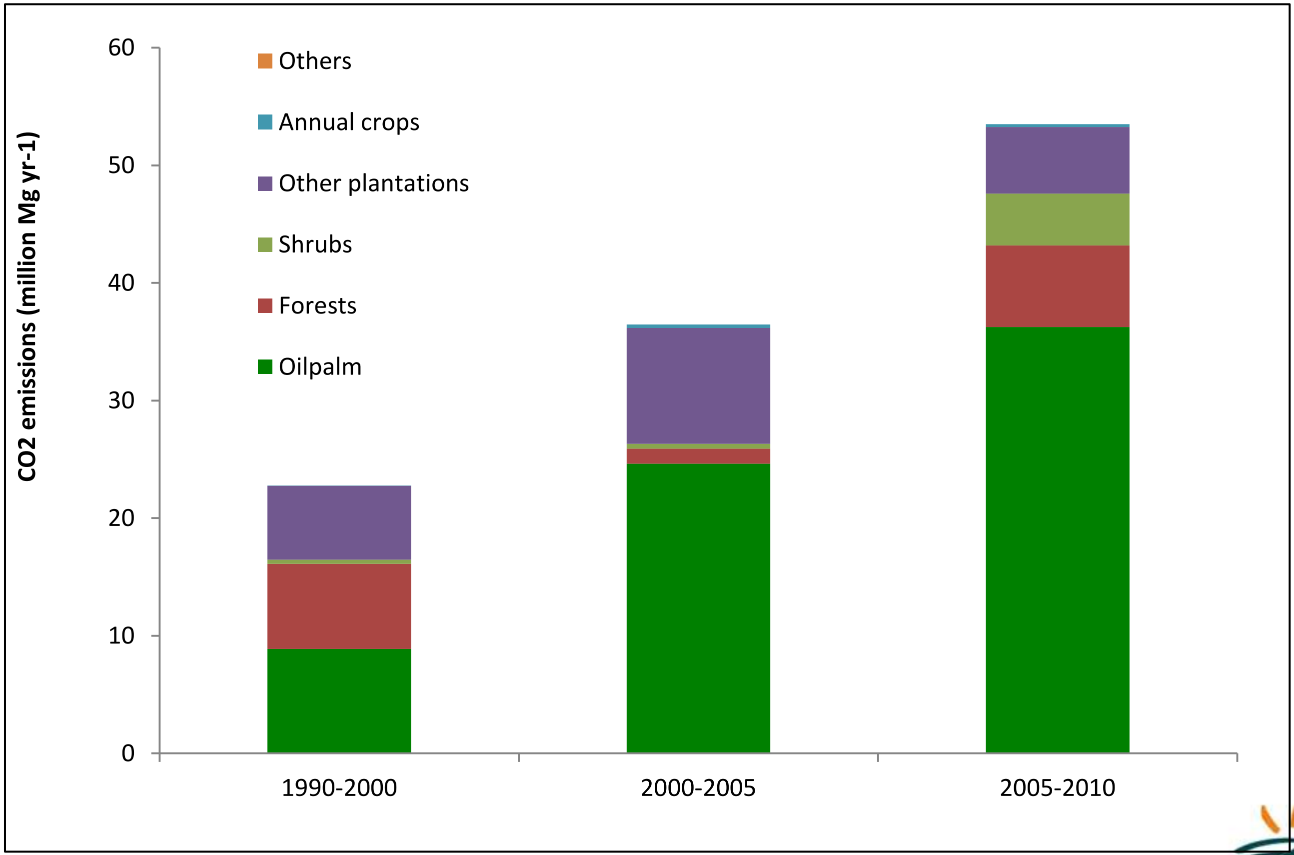
Further details on GHG emissions from LUC due to Indonesian OP

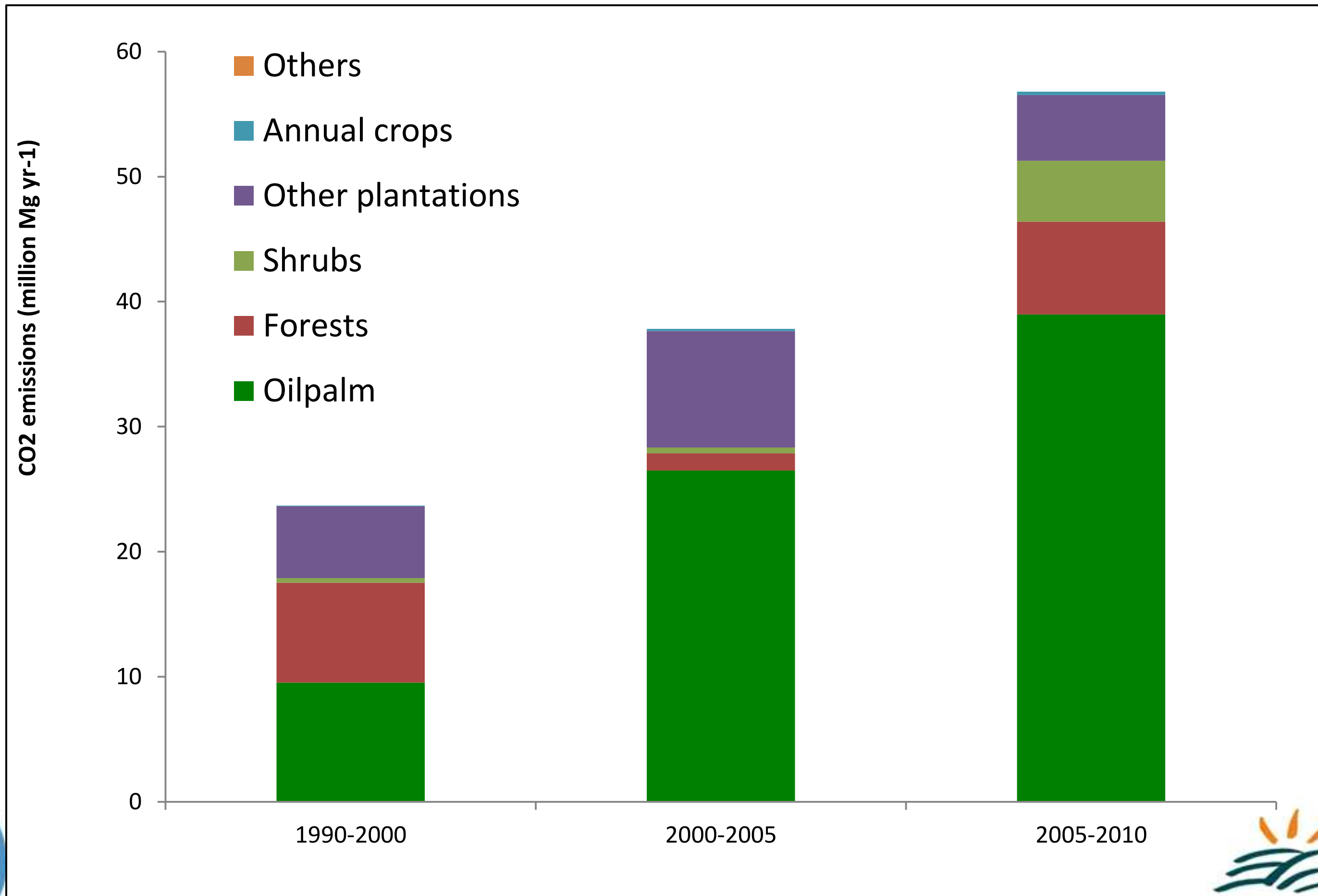
GHG emission from LUC

Annual **peat decomposition** emissions from oil palm plantations by initial land uses using IPCC (2013) emission factors.



GHG emission from LUC

Annual **peat decomposition** emissions from oil palm plantations by initial land uses using Agus et. al (2013) emission factors – **including root respiration**.



GHG emission from LUC

Above ground C stock of different land uses (Agus et al. 2014)

Symbol	Initial land use	AG C-Stock (Mg C/ha)	Emission factor (Mg CO_2/ha)
UDF	Undisturbed Forest	195	569
DIF	Disturbed Forest	169	473
USF	Undisturbed Swamp Forest	196	573
UDM	Undisturbed Mangrove	170	477
DSF	Disturbed Swamp Forest	155	422
DIM	Disturbed Mangrove	120	294
CPL	Rubber Plantation	63	84
OPL	Oil Palm Plantation	40	0
TPL	Timber Plantation	64	88
MTC	Mixed Tree Crops	30	-37
SCH	Schrubs	30	-37
SSH	Swamp Shrubs	30	-37
DCL	Dry Cultivation	10	-110
SET	Settlement	4	-132
GRS	Grass	4	-132
SGR	Swamp Grass	4	-132
RCF	Rice Field	2	-139
CFP	Coastal Fish Pond	0	-147
BRL	Bare Land	2.5	-138
MIN	Mining	0	-147
WAB	Water Body	0	-147
NCL	No data (cloud)	0	-147

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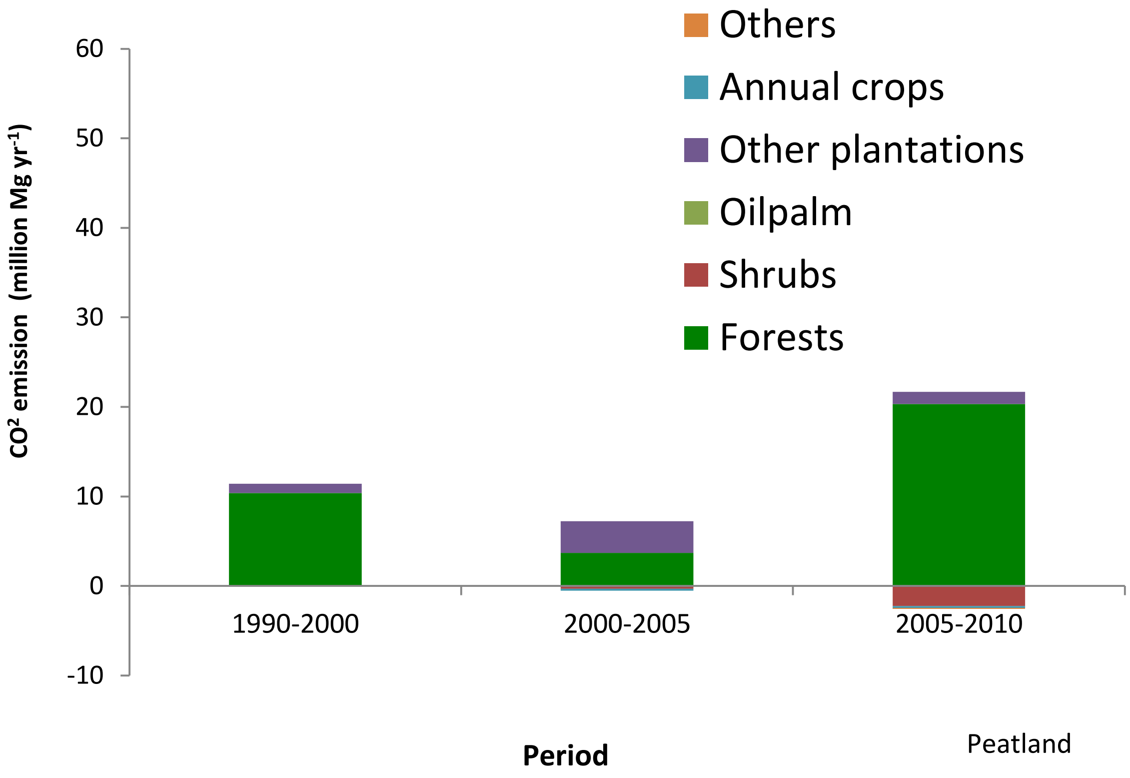
GHG emission from LUC

Above-ground biomass **annual emissions** due to land use change **on peat soils** in Sumatra, Kalimantan and Papua.



GHG emission from LUC

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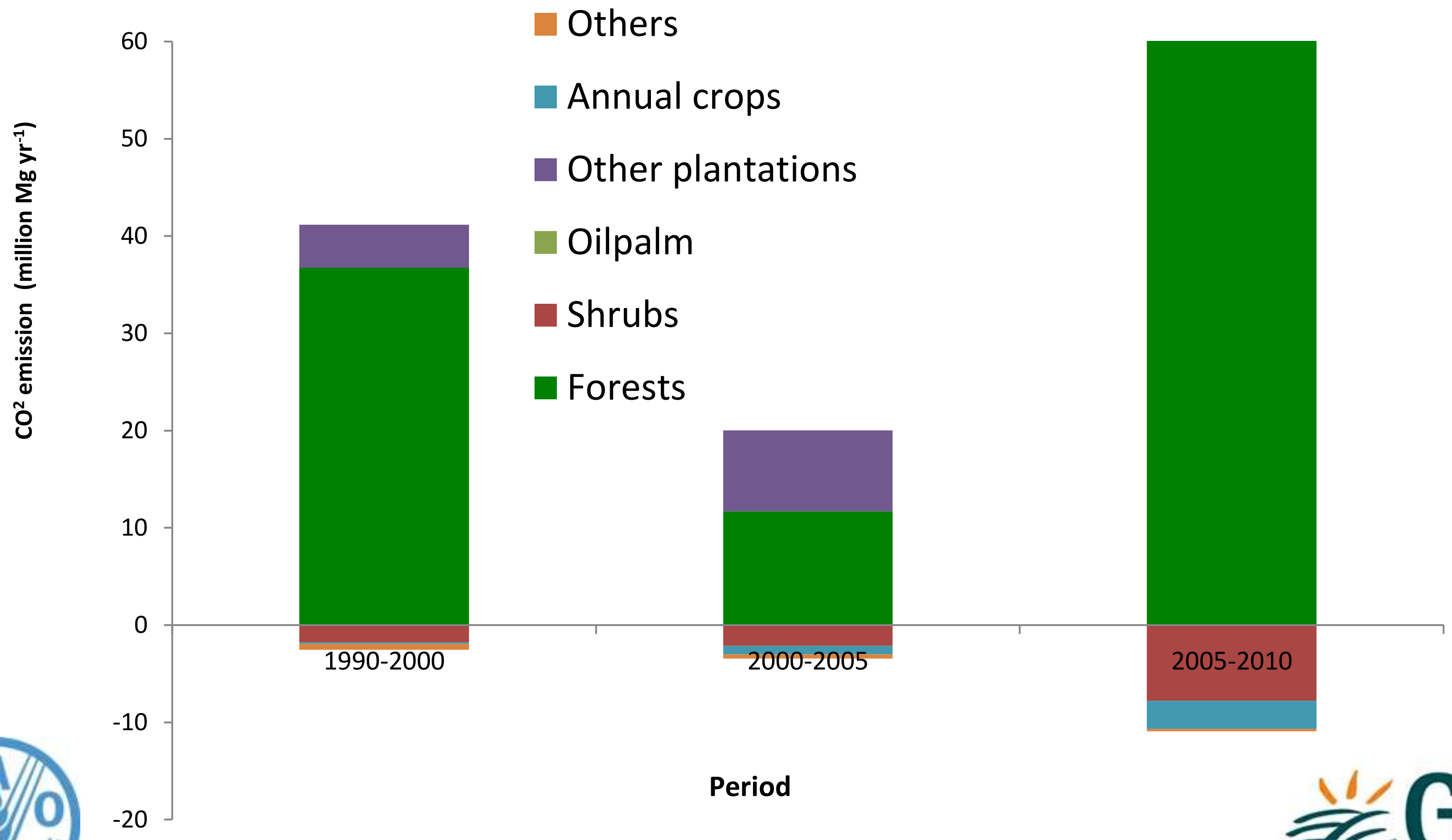
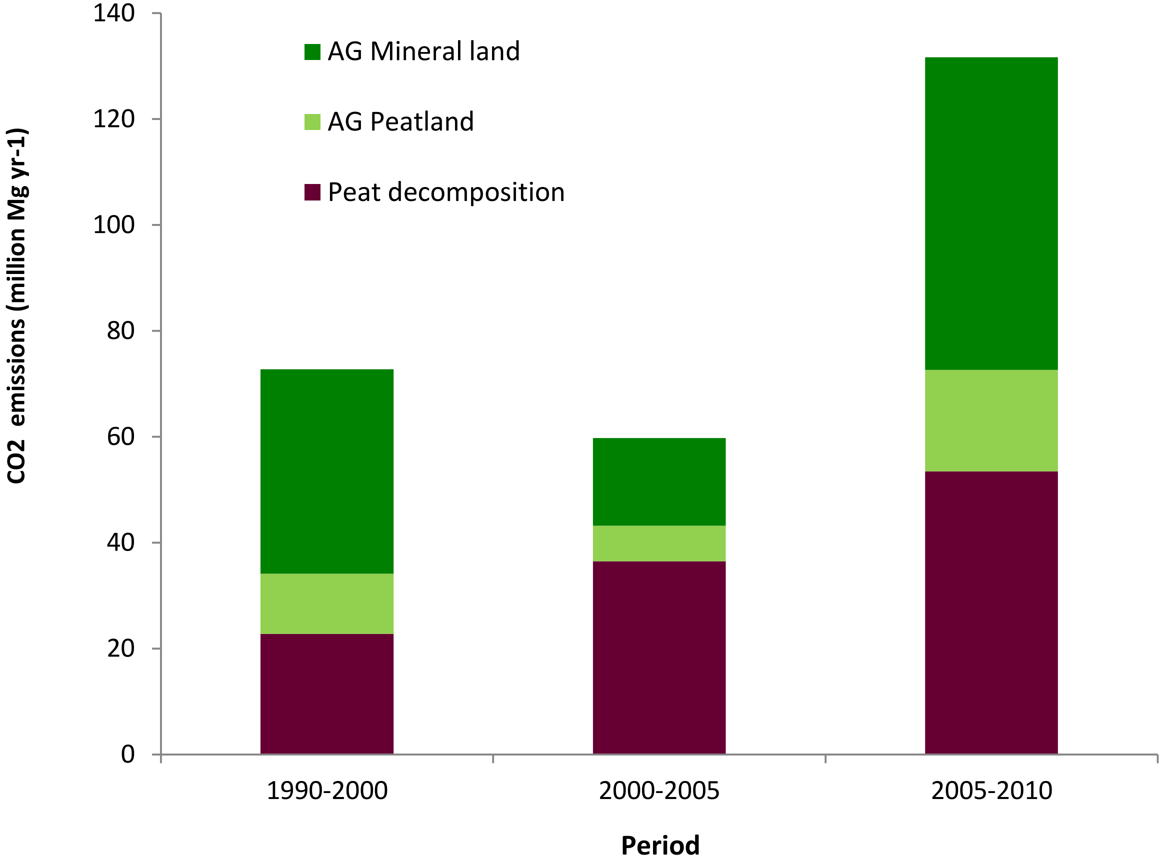


GHG emission from LUC

Above ground and **peat decomposition CO_2 emissions from oil palm plantation in Sumatra, Kalimantan and Papua**



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GHG emission from LUC

Above ground and **peat decomposition CO_2 emissions from oil palm plantation in Sumatra, Kalimantan and Papua**

Source	1990-2000	2000-2005	2005-2010
Peat decomposition	22,779,184	36,454,995	53,488,418
AG Peatland	11,364,167	6,737,305	19,121,570
AG Mineral land	38,622,293	16,582,024	59,090,903
Total	72,765,644	59,774,323	131,700,891

GHG emission from LUC

Annual emission (tonnes of CO_{2e}) from peat decomposition, above-ground biomass on both peat and mineral soils attributable *directly* to bioenergy feedstock production

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