TROPICAL DEFORESTATION AND ITS IMPACT ON ENVIRONMENT AND QUALITY OF LIFE

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Presentation Outline

- Importance and conservation of tropical forests
- Causes of deforestation in Southeast Asia
  - Rate of deforestation
  - Drivers of deforestation
- Case study of deforestation in SEA
  - Research by SEARRIN
- Impacts of deforestation
- Conclusion

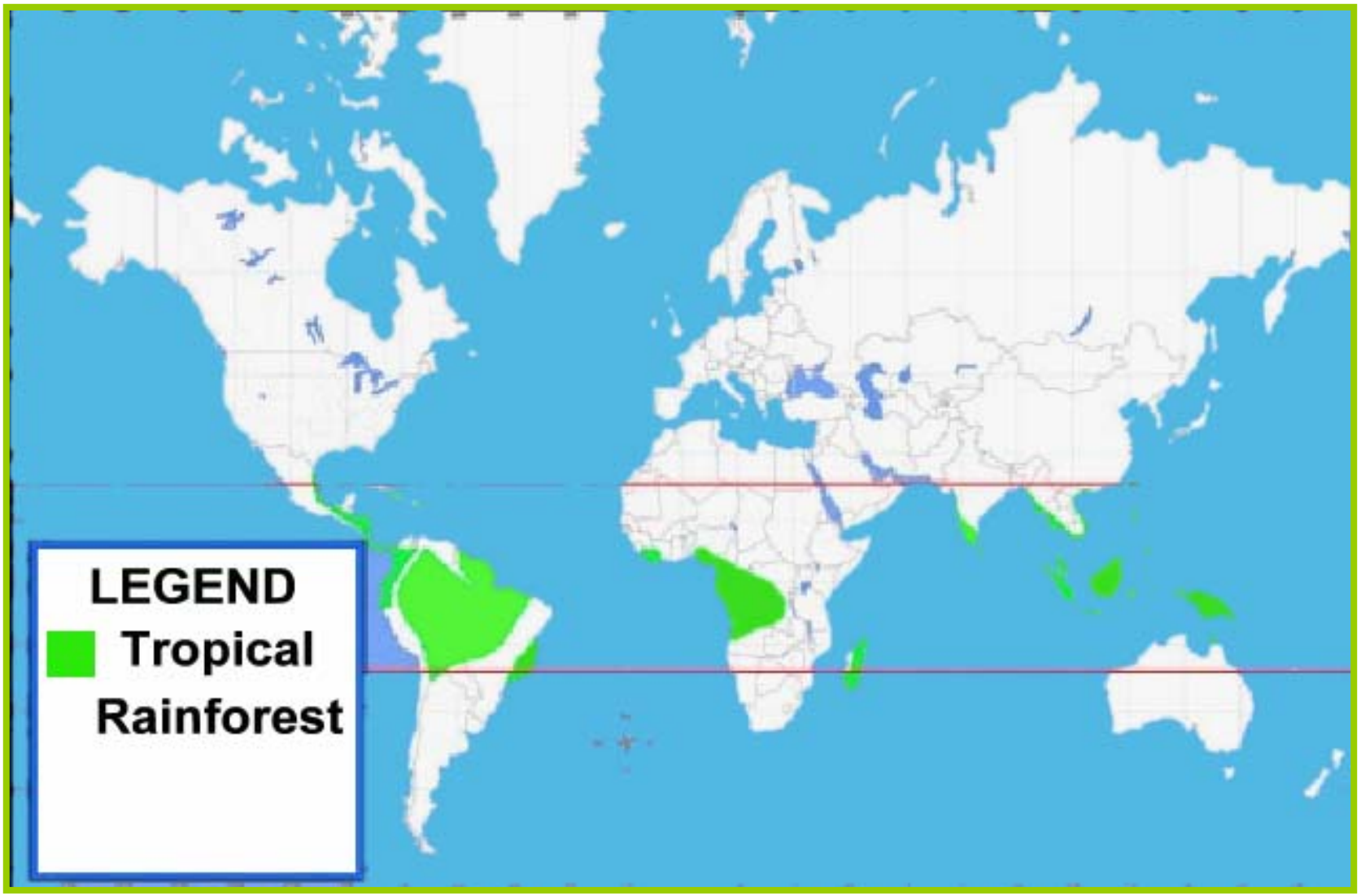
Introduction

- In the 1990's land use and land cover (LUCC) dynamics have been recognised as a key research imperative in global environmental change research.
- LUCC has been blamed for causing serious modification of the land surfaces on earth.
- Understanding LUCC and the factors that drive them are thus of utmost importance for understanding, modelling and predicting global environmental change. This knowledge can be utilised in managing and responding to the change in a most positive way that would benefit mankind.

Importance of tropical forests

- Tropical forests are homes to almost 50% of the world's species
- Forests help mitigate the impacts of global warming
- Forests are important as they play a role in the water recycle process and help balance the oxygen amount
- Many thousands of plants have been identified possessing anti-cancer properties
- Tropical forests provide precious wood for furniture, lumber and firewood; and
- Forests provide jobs and income for the people who live around them.

The extent of global tropical forests



Conservation of Tropical Forests

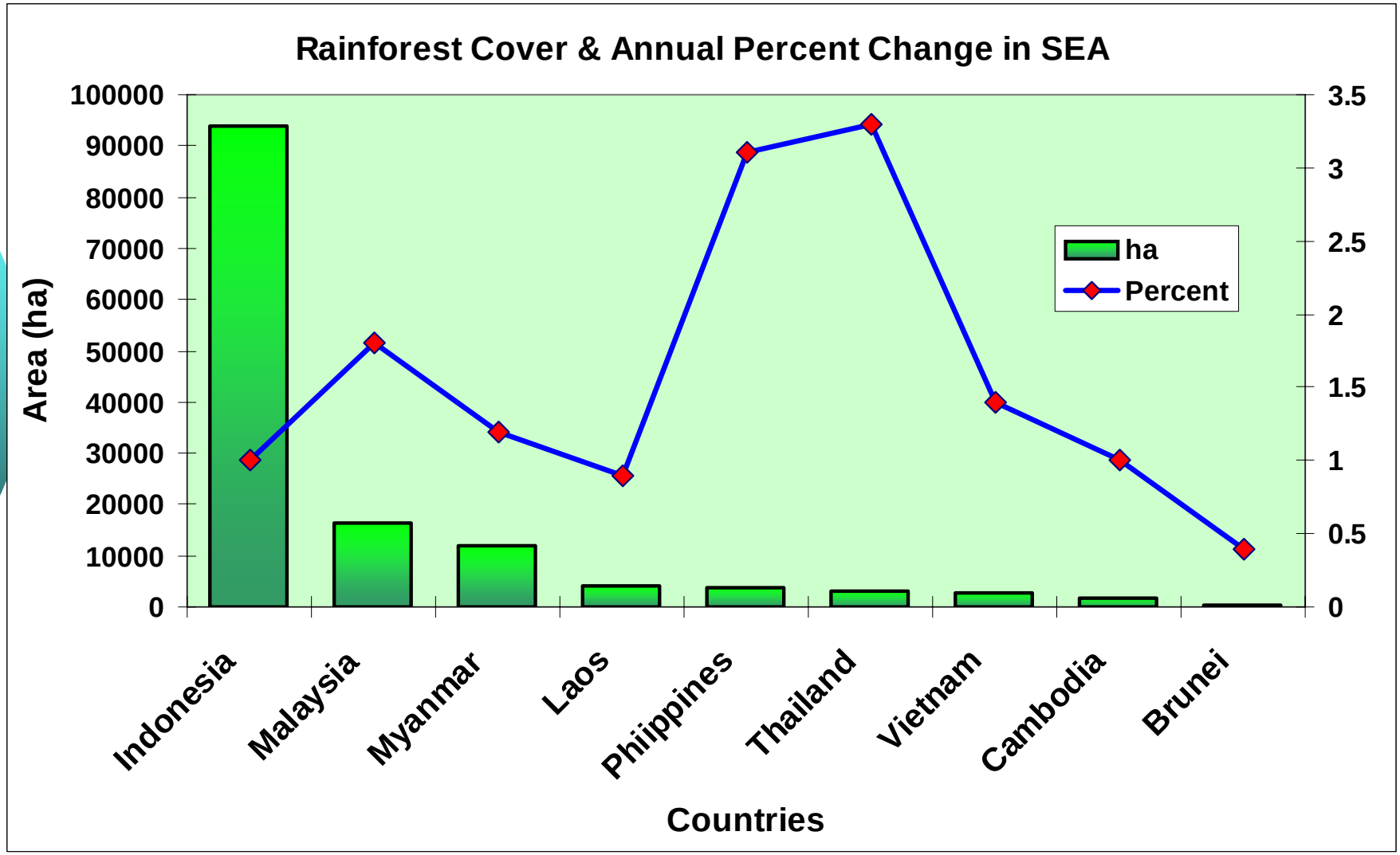
- Tropical forests are rich in biodiversity with unique and endangered species which are alive with the sounds of birds and animals.
- Tropical forests also play crucial roles for humans. They provide water, food, medicines, shelter and sources of livelihood for the communities that live in and around them.
- The forests also provide important environmental services for the planet. For instance, they function as temperature regulators by absorbing and storing carbon dioxide, and helps mitigate the impacts of global warming.
- Unfortunately, the fragile tropical ecosystem is under threat from deforestation, improper agricultural practices, tourism, development and forest fires.

The Tropical Rainforest

- Rainforest in its natural state or dynamic equilibrium comprise a mosaic of aging trees, clearing caused by storms, landslides, lightning or human activity with regenerating seedlings and area of mature and immature trees.
- They are genetically far more diverse with 50 to 200 or more tree species per hectare.
- Southeast Asia, with only 0.5% of the earth's total land area probably has 10% of all the plant species.
- The fast pace of tropical deforestation occurring in Southeast Asia has challenged the very existence of the forests in the future if no serious efforts are taken to combat them.

Extent of Tropical Deforestation

- The estimates of rainforest cover in nine countries in South East Asia (WRI, 1999):
- Indonesia with the largest land area of 181.16 million ha, recorded 94 million ha of rainforest cover and subjected to 1% annual change rate from 1981-1990.
- Malaysia has 16 million ha of rainforest but recorded higher change rate of 1.8%.
- Philippines and Thailand recorded highest annual change rate of 3.1% and 3.3% respectively.
- For the other countries the annual change rate of forest range from 0.4% to 1.4%.


Rainforest Cover & Annual Percent Change in SEA
Area (ha)
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
3.5
3
2.5
2
1.5
1
0.5
0
ha
Percent
Indonesia
Malaysia
Myanmar
Laos
Phiippines
Thailand
Vietnam
Cambodia
Brunei
Countries

Satellite data analysis of forest areas and the rate of deforestation in Southeast Asia

Country	Forest Area in 1973	Forest Area in 1985	Forest Area Change	% Change	Deforestation Rate Per Year
Cambodia	5.25	3.98	1.27	24	0.11
Laos	18.28	16.52	1.76	10	0.15
Thailand	22.56	16.74	5.81	26	0.49
Vietnam	19.92	16.15	3.77	19	0.31
Myanmar	48.71	44.82	3.88	8	0.32
Total	114.70	98.21	16.49	14	1.37

Discrepancies of forest statistics

- Problems in documenting rainforest statistics differ in different countries. United Nation bodies also derive their data from government statistics which in many cases register larger areas of forest.
- There is obviously lack of geographically reference data at high spatial resolution and derived from a single consistent method for the whole of Southeast Asia.
- Other areas of data difficulties include, distinguishing rates of new deforestation, abandonment and regrowth.
- Currently, the best method is via the use of satellite remote sensing method as it can resolve discrepancies in data output and spatial variations in rainforest cover statistics.

Tropical Deforestation

- Definition of deforestation

Mather *et al* (1998) summarise it as:

- '…The study of the causality of trend in forest cover…does not readily yield the simplicity and elegance of explanation that would reward the ideal scientific endeavour. In the real word of human-driven change in land and land cover there are numerous problems and difficulties that confound such an endeavour. The field cannot be successfully tilled as a disciplinary preserve, and neither reductionism nor holism alone seems to offer the approach necessary for success'.

Tropical Deforestation

- Tropical deforestation includes both quantitative loss of woody vegetation as well as qualitative changes such as loss or reduction in species biodiversity.

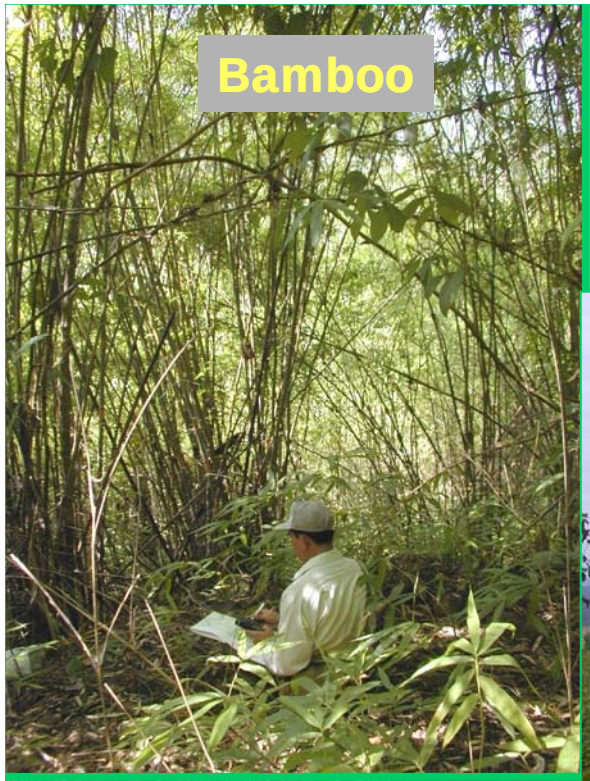
- There are various degrees of tropical deforestation ranging from reductions in vigour and/or species diversity to a decline in regeneration, in the changes such as in species diversity, thinning altered regeneration or resistance to pest, diseases and invasion of undesirable species.

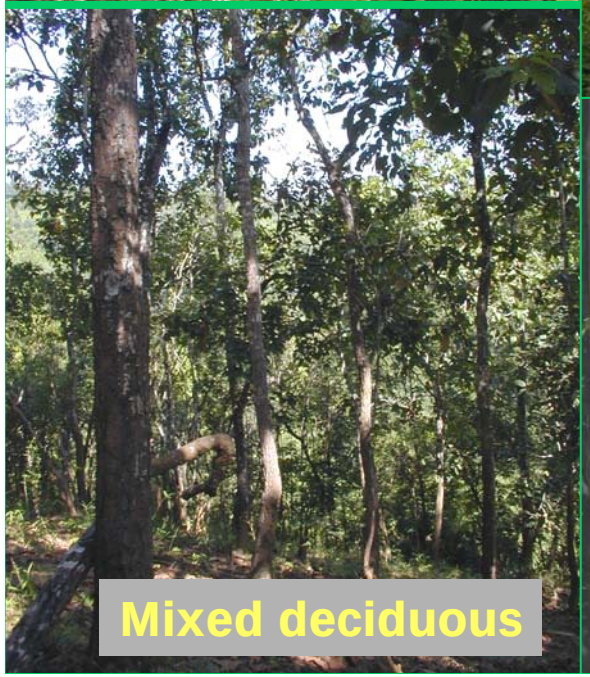
- Among the impacts of tropical deforestation are the altered local or regional hydrology, altered climate and serious environmental problems such as flood damage and siltation.

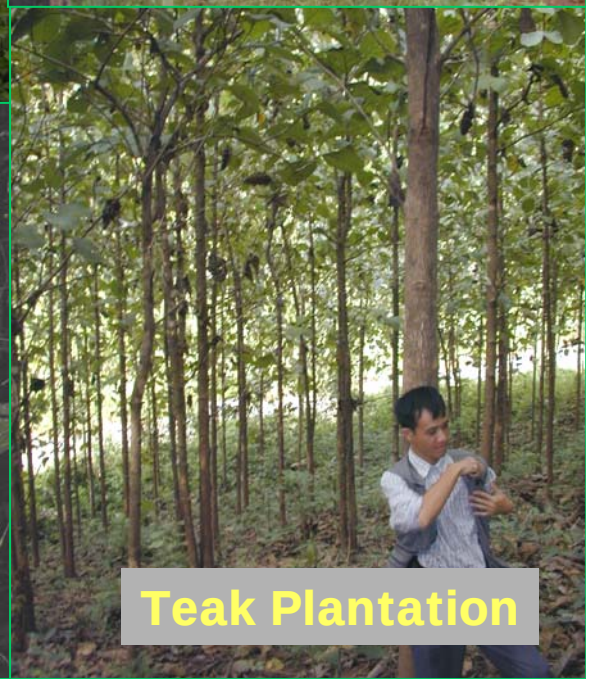
Annual Rate of Deforestation

Country	National Land Area Covered By Forest (%)		Annual Deforestation Rates (1,000 ha/yr)	
	1980	1990	1976-80	1981-90
Kampuchea	70	69	15	131
Indonesia	61	61	550	1,212
Laos	58	57	125	129
Malaysia	63	54	230	396
Burma	47	44	96	401
Vietnam	30	26	65	137
Thailand	33	28 [1988]	333	515
Philippines	26	24 [1987]	101	316

Tropical Forest Cover Types in SEA







Drivers of Deforestation

- Understanding the drivers of tropical deforestation is not a straightforward case. For example in LUCC research, key questions have been to seek answers to what seems to be simple questions.

- These questions are:

➢ How much forest is lost in the study area over 10 year time period?

➢ What are the factors that cause forest to change to other land uses?

➢ What is the trend of future changes?

Continue

- The causes attributed to deforestation are multivariate in nature, interrelated and differ at local, national as well as regional scale.
- The drivers of tropical deforestation can be summed up as complex socio-economic processes that are impossible to isolate a single cause.
- It consists of a complex of social, political, economic, technological and cultural variables that constitute initial conditions in the human-environmental relations that are structural (or systematic) in nature.
- In terms of spatial scale, underlying drivers may operate directly at local level or indirectly from the national or global level.

Actions and factors in deforestation

3 clusters are involved in deforestation are:

a) Proximate causes: Agricultural expansion

Wood extraction

Expansion of infrastructure

b) Underlying causes: Demographic

Economic

Technological

Policy/ institutional

Cultural or socio- political factors

Continue

c) Other factors (land characteristics, biophysical drivers, and social trigger events)

Land characteristics
Biophysical environment

War

Health and economic crisis
Government policy failures

(i) Population pressures

Past and Projected population and land area in Southeast Asia

Country	Population (million)				Land (10^6 ha)	Per Capita Land (ha/person)			Per Capita Crop Land, 2000
	1950	2000	2025	2050		2000	2025	2050	
Indonesia	79.54	206.5	275.2	318.3	181.16	0.88	0.6	0.57	0.16
Kampuchea	4.34	10.7	16.9	21.4	17.65	1.64	1.04	0.83	0.39
Laos	1.76	5.3	10.2	13.9	23.08	4.31	2.26	1.66	0.19
Malaysia	6.11	21.4	31.6	38.1	32.86	1.53	1.04	0.86	0.39
Myanmar	17.83	47.6	67.6	80.9	65.76	1.38	0.97	0.81	0.23
Philippines	20.99	72.1	105.2	130.5	29.82	0.41	0.28	0.23	0.14
Thailand	20.01	59.6	69.1	72.9	51.09	0.86	0.74	0.70	0.35
Vietnam	29.95	77.9	110.1	129.8	32.55	0.42	0.30	0.25	0.09

(ii) Improved infrastructure and utilities network

- Analyses of land use and road maps in the Philippines and Malaysia show that the closer the forest to the road the higher the rate of deforestation.
- 78% of the 2.1 million ha of forest within 1.5 km from the roads in 1934 was removed by 1988. On the other hand only 39.5% of forest between 15.0 and 16.5 km from the road were lost.
- In Malaysia, LUCC study showed that a kilometre increase in the distance of a pixel from a road network reduces the odds of forest clearing by a factor of 0.68.
- This means that access to road network increases the probability of land being cleared for other uses. Lambin and Giest (2001) showed that extension of infrastructure in combination with other proximate causes explained 110 out of 152 cases of deforestation (72%).

(iii) Land settlement scheme

- In Malaysia, land development scheme entails the conversion of forest into smallholdings. The scheme was carried out to alleviate poverty, overdependancy on rubber, ethnic and rural-urban disparity.

- The government implemented a drastic scheme to provide public assistance to the poor so that they are directly involved and benefit from the exploitation and development of the resources of the country.

- Between 1971-1980, 866,058 ha of forestland were cleared for agriculture. In 1980's a further 647,374 ha were cleared for land development.

- A further 180,750 ha were cleared up to year 2000 (EPU 2000, 6th Malaysia Plan). The large conversion of forestland to agriculture has generated financial and economic returns and socio-economic benefits to the country. Poverty was reduced drastically at the expenses of the rainforest.

(iv) Large scale commercial agriculture

- In Southeast Asia, 80% of forest conversion is to agriculture.
- In 1980's, 30% of the cultivated land area in the Philippines was converted to cash crop production for export of mainly bananas, pineapples and sugar cane.
- In the island of Negros, forest decreases by 20,000 ha which is gained by sugar estate that produce 68% of the Philippines sugar crop.
- In Thailand, between1973-1982, cassava exports to EEC rose from 1.5 million tons to 8 million tons. Other major plantations include oil palm, peanuts, rubber and soybeans.
- In Peninsular Malaysia, between 1966-1990, plantation agriculture increased from 2.7 million ha to 4.7 million ha. All agricultural gains were at the expense of forest land.

(v) Commercial logging, demand for timber, woodchips, pulps and forest products

- In Malaysia, from 1986-1990, the annual felling rate of log increased by 5.8% to reach 41 million cu m in 1990, 43.5 million cu m in 1992 and 35 million in 1995 (a drop of 20% production in 3 years).

- Export of wood and wood based products in 1991 was RM 9.3 billion and 43% of it was logwood. Malaysia is the largest exporter of tropical hardwood logs in 1991. Sarawak accounted for 15.7 million cu m of log exported and the remaining was from Sabah.

- The government of Malaysia has banned export of logs. Downstream processing of wood based industry was encouraged. This is an attempt to reduce deforestation and damage due to the tropical rainforest. In Indonesia in 1985, 40% of the forestland was leased to timber companies for economic purposes.

(vi) Other factors

- Shifting cultivation, which is associated to poverty is the primary agent that brought about 40% to 95% of forest loss.

- Poverty represents demographic, economic, technological policy and institutional meanings namely resource-poor farming, survival economies, insufficient food production, chronic food deficit, limited land endowment, land scarcity, landlessness, low living standard, joblessness, social deprivation, and marginalization.

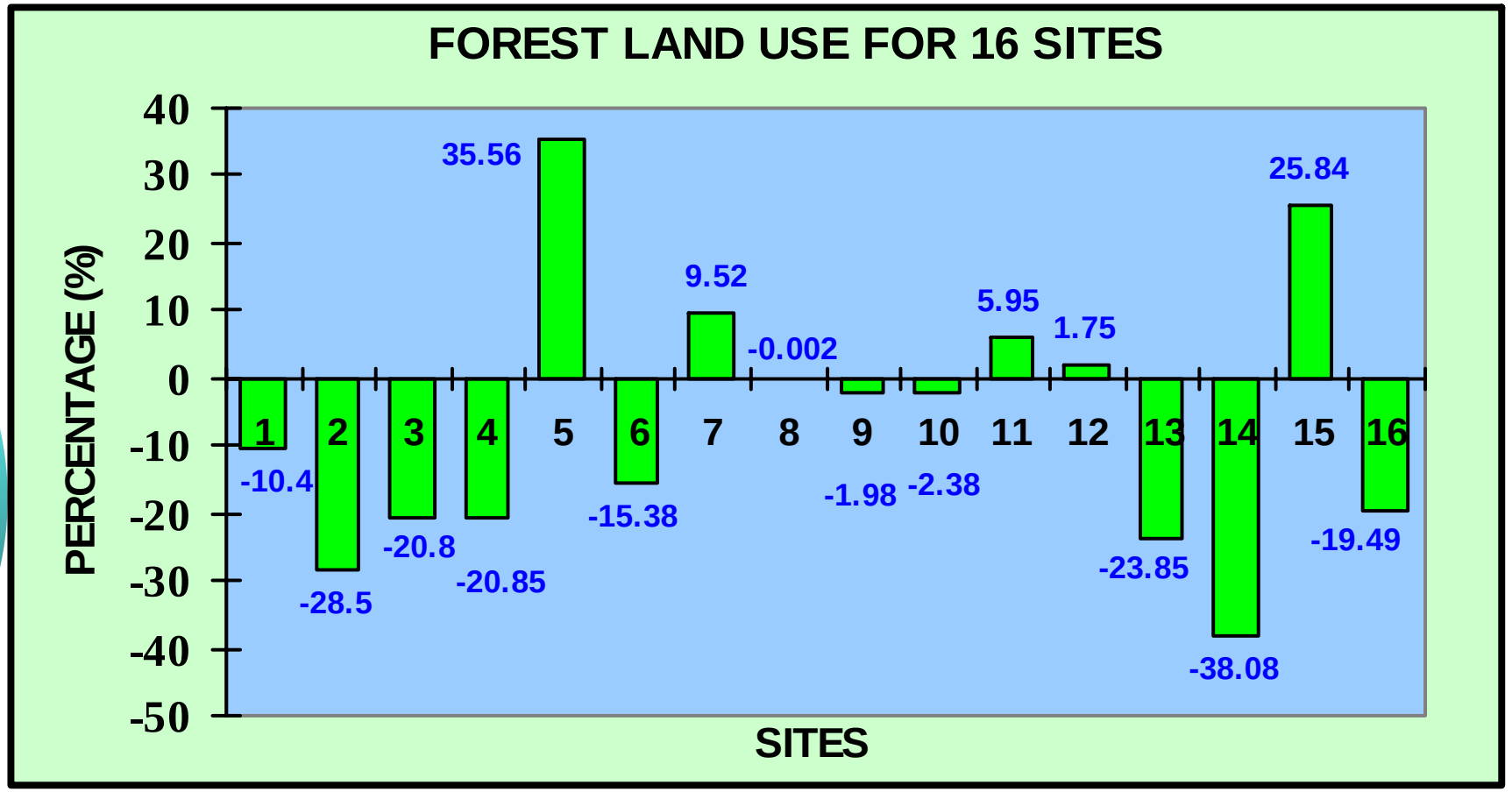
- In Southeast Asia poverty is an underlying social process of deforestation in 42% of the cases.
- As proximate factors, about half of the poverty-driven cases are associated with traditional and shifting cultivation, permanent small holder and subsistence farming.
- 80% of the poverty-driven cases are related to human factor under the sections of population dynamics and land scheme policy.

Example: hydroelectricity dams

- The forest is also under increasingly threat as Southeast Asian countries build hydroelectricity dams in rainforest areas such as the Kenyir and Bakun Dam (69, 500 ha) in Malaysia.
- No mitigating measures and reforestation programmes taken could compensate for the loss of pristine tropical forest.
- The net downstream impacts include degradation of the forest, erosion, water pollution and reduction on aquatic life, habitat fragmentation, reduction of habitat diversity and loss of regional biodiversity.
- Two totally protected species, 68 protected species of plant, 1,230 species of significant plants were lost. It is estimated that an annual cost of displacement of forest resources ranges from RM10 to 22 billion.

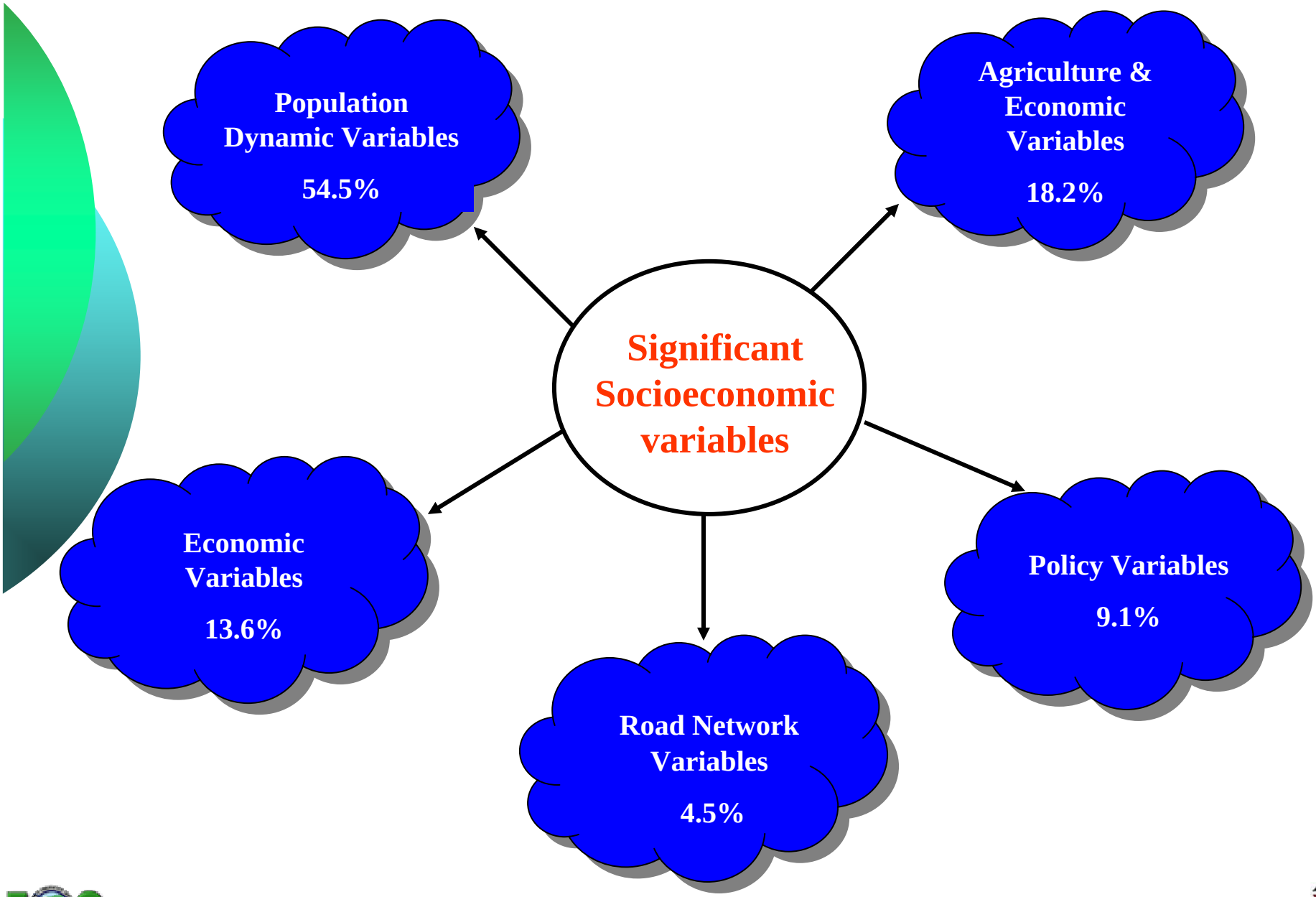
DEFORESTATION IN SOUTHEAST ASIA: LUCC CASE STUDY

- Southeast Asia Regional Research Network (SEARRIN) had involved in land use and land cover change research since 1976. Among the research activities are:
  - Developing case studies to determine deforestation dynamics.
  - Determining whether annual rates of deforestation have been significantly different from the decadal mean rate over 16 selected study areas.
  - Developing diagnostic models of the deforestation process to better understand and quantify the deferential controls on the rate of deforestation and abandonment .



Site:

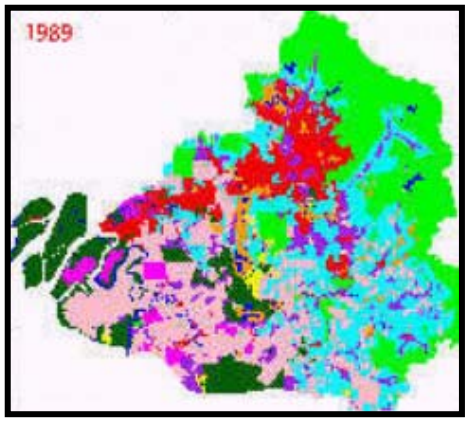
1. Klang-Langat (10 yrs)
2. Kayan-Sempadi (10 yrs)
3. Citarum (12 yrs)
4. East Kalimantan 1 (5 yrs)
5. East Kalimantan 2 (5 yrs)
6. Jambi (6 yrs)
7. Magat (9 yrs)
8. Puerto Princesa (10 yrs)
9. Mae Chaem (9 yrs)
10. Lin Thin (11 yrs)
11. Phusithan (10 yrs)
12. Eastern Forest (11 yrs)
13. Ao Sawi (11 yrs)
14. Tamdao (24 yrs)
15. Kg. Cham (13 yrs)
16. Nam Thuen (3 yrs)

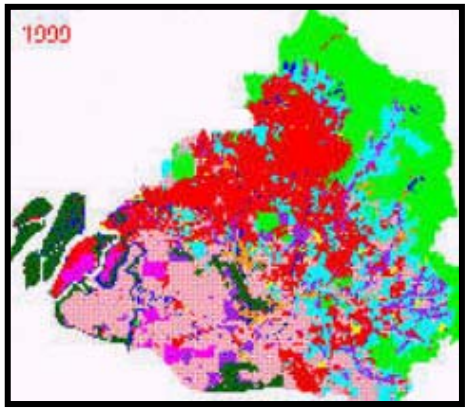

Population Dynamic Variables
54.5%
Agriculture & Economic Variables
18.2%
Significant Socioeconomic variables
Economic Variables
13.6%
Policy Variables
9.1%
Road Network Variables
4.5%

Driving Forces of Change

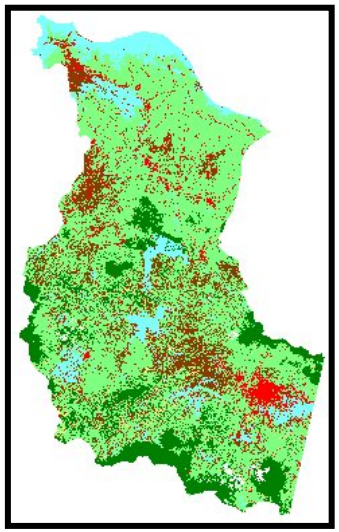
Country	Variable
Malaysia	▪ Road distance from forest areas ▪ Land classes suitability ▪ Population density ▪ Agricultural employment ▪ Forest reserve and non reserve areas
Indonesia	▪ Rate growth in the number of school going children ▪ Change in the total number of school going children ▪ Number of industrial establishments
Philippines	▪ Number of households using charcoal as fuel ▪ Number of households using wood as fuel ▪ Farm size ▪ Literacy rates ▪ Areas planted with permanent crop ▪ Rural population ▪ Areas planted with temporary crops ▪ Woodland and forest in farm areas
Thailand	▪ Population structure ▪ Population age ▪ Number of households with pick up trucks ▪ Number of shops ▪ Number of rice mills ▪ Number of households practising agriculture

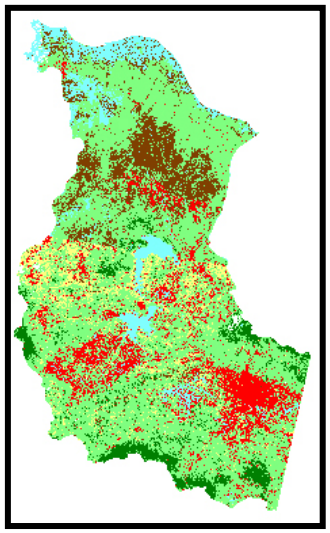
Land use changes in Malaysia, Indonesia, Vietnam



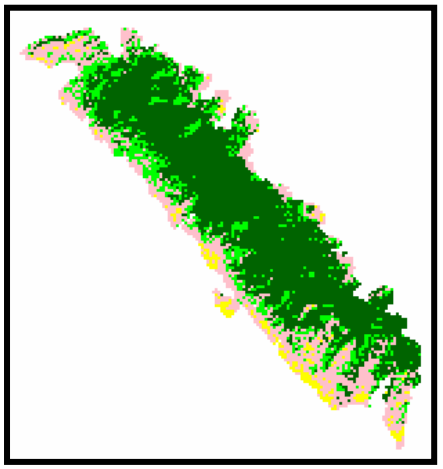


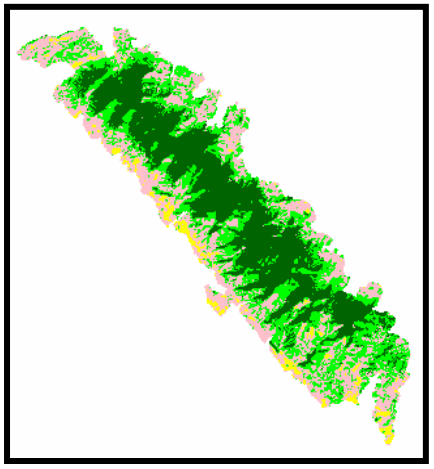
1989-1999





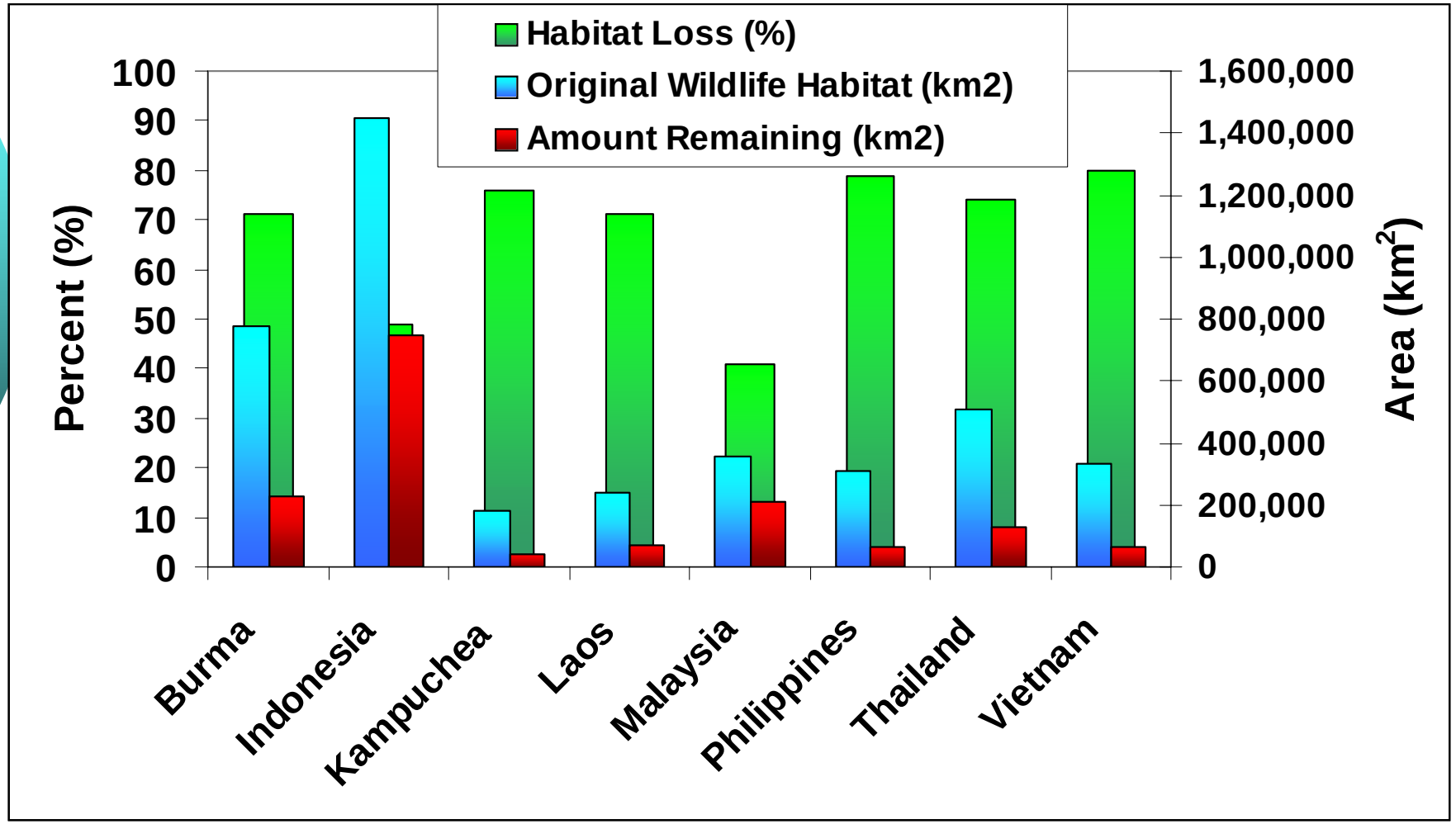
1989-1998





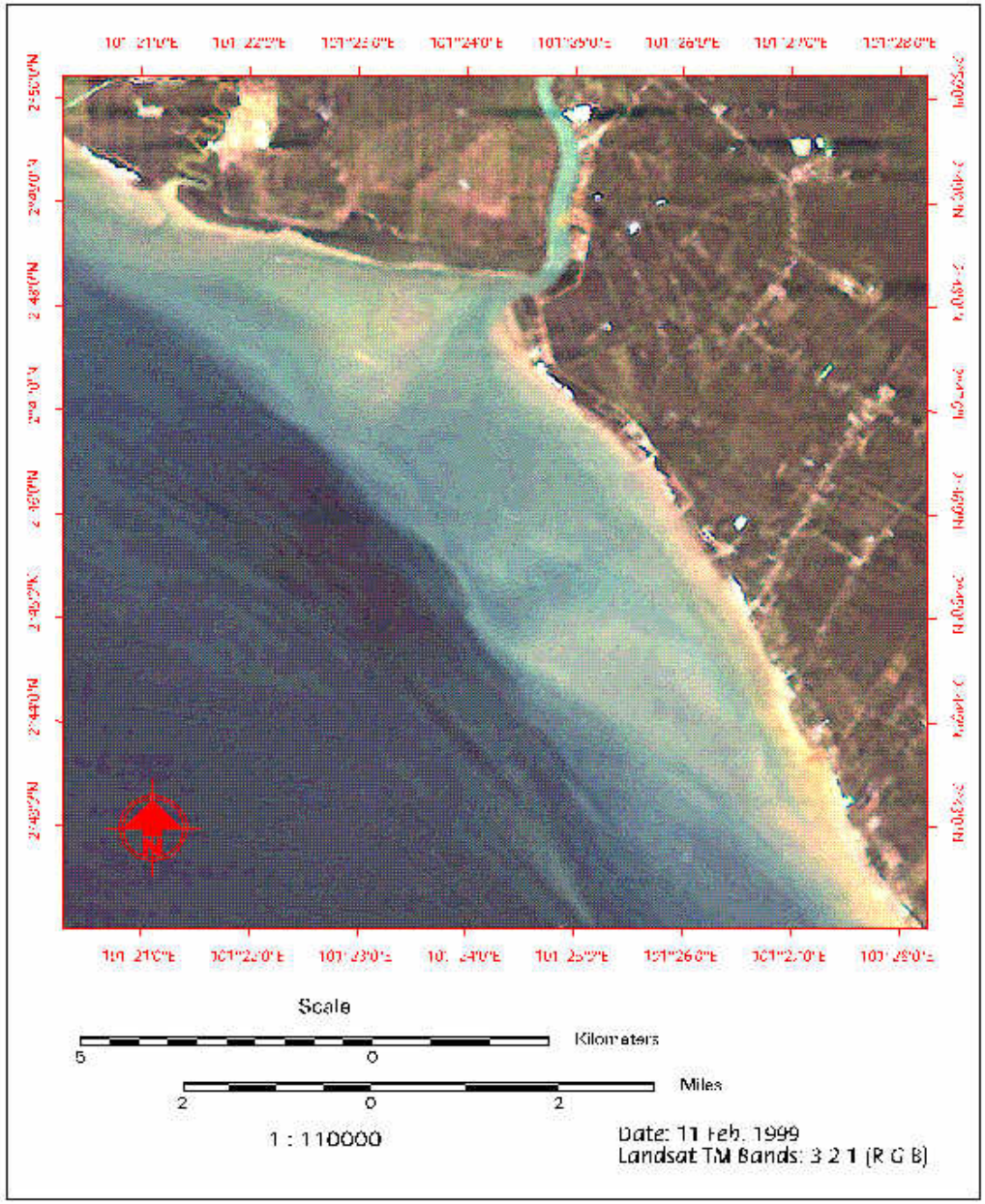
1975-1999

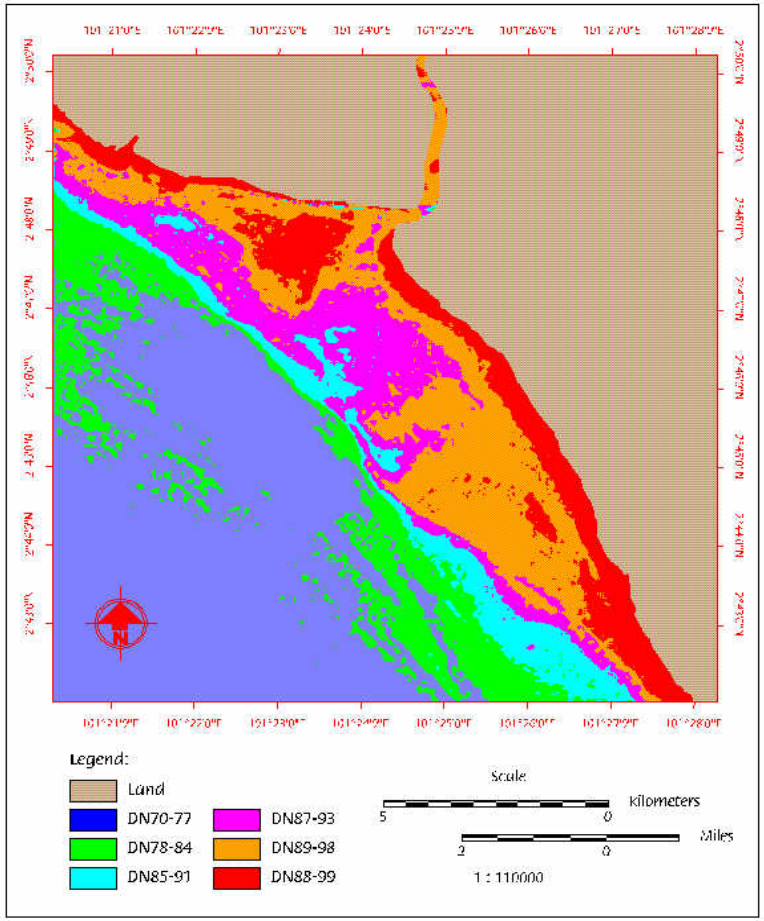
Impact of tropical deforestation



Source: IUCN/UNEP, 1986

Soil erosion and sedimentation





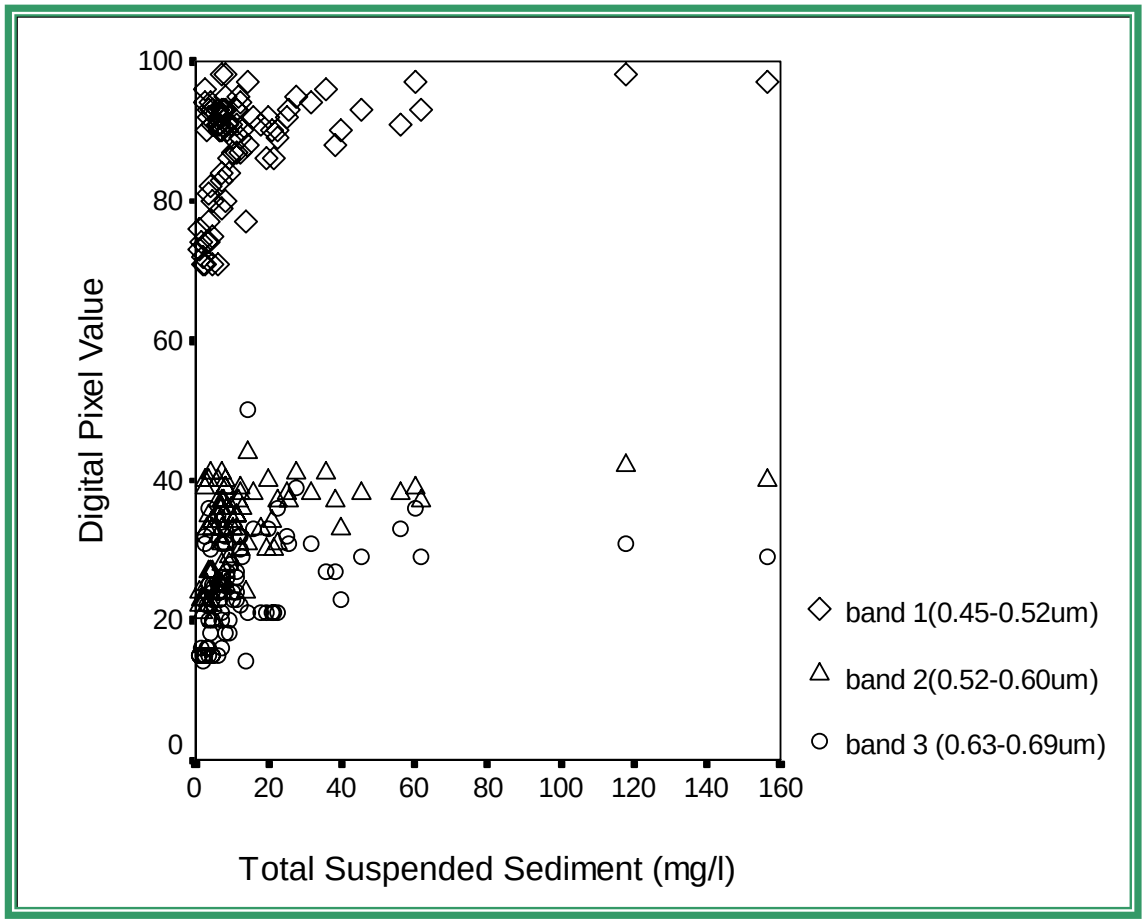
Landsat TM
Image at offshore
Of the Klang river
In Selangor,
Malaysia

Soil erosion and sedimentation

Satellite analysis on suspended sediments
at the Klang river in Selangor, Malaysia.

Landsat TM bands 1,2, 3 showed 2 clusters:
Bands 1 and 2 & 3.

High DN values Correspond to high Total suspended Sediments.



- Excessive depositions of sediments in rivers and offshore can smother bentic organisms and cause shallowing effects.
- In the case of Klang and Langat rivers in Malaysia, depositions reduced storage capacity due to bottom deposition. Expensive dredging or frequent removal of the sediment were done.
- The river beds of lower reaches of Klang-Langat would be raised gradually and increase the frequency of downstream flooding.
- Approximately 1000,000 m^3 sediments have been removed in the upstream reaches of Klang River.
- About 200,000 m^3 and 400,000 m^3 of silt have been removed from Batu River and Gombak River respectively. It was estimated that the silt removed from major tributaries of the Klang River amounted to approximately 300,000 m^3 per annum.

Deforestation and the greenhouse effect

- Deforestation and carbon emission effects have been extensively documented.
- Forest absorbed carbon dioxide but deforestation adds considerable quantities of carbon dioxide to the atmosphere.
- Deforestation contributes between one 25% to 50% of the five billion tons released from burning of fossil fuel.
- The release of carbon attributed to land cover conversion is a major biogenic source of carbon in Southeast Asia.
- The current net flux of carbon from land cover conversion in the tropics is expected to rise if deforestation issues are not abated.

Anthropogenic C Emissions: Land Use Change

Borneo, Courtesy: Viktor Boehm

Tropical deforestation

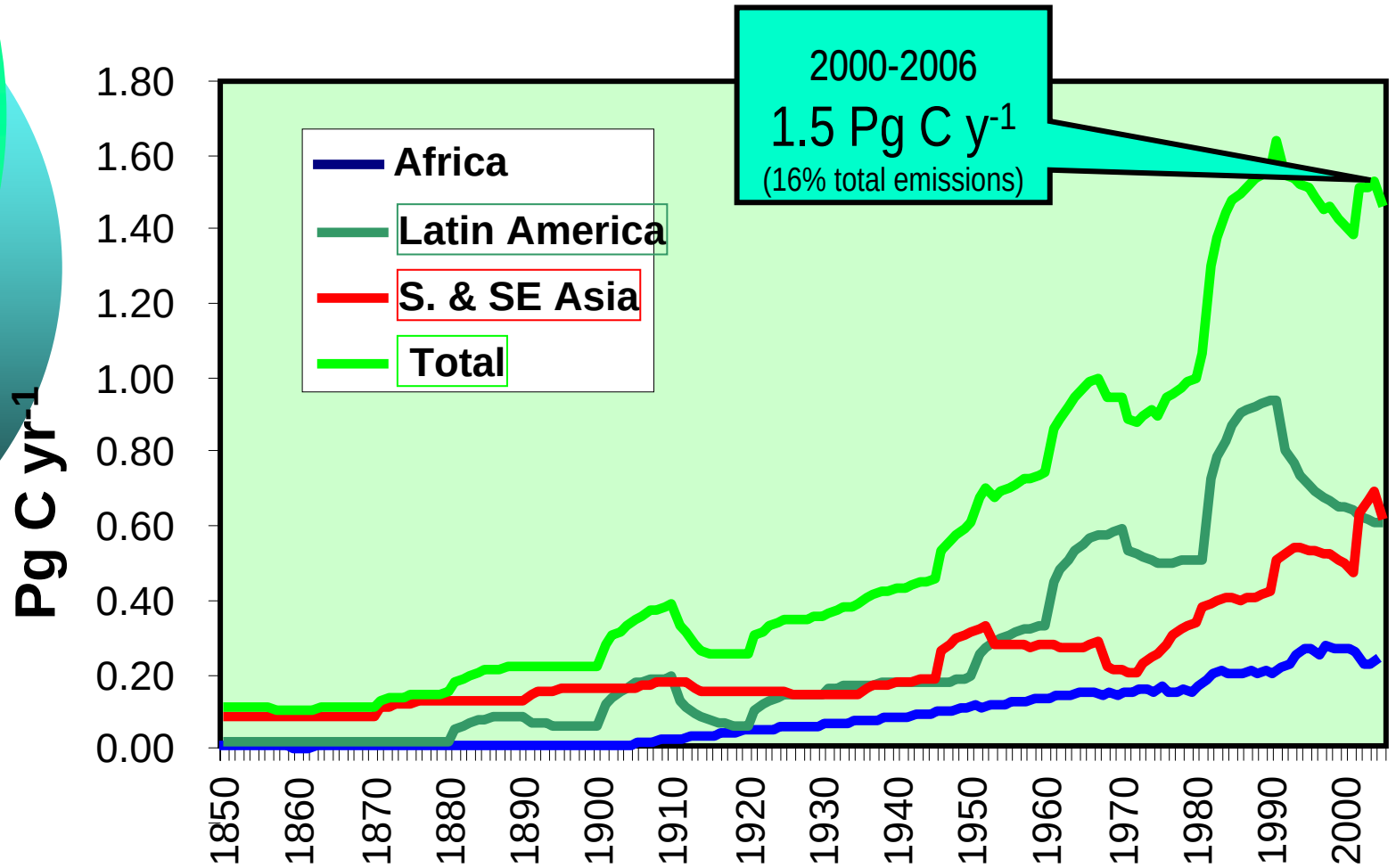
13 Million hectares each year

2000-2005	
Tropical Americas	0.6 Pg C y^{-1}
Tropical Asia	0.6 Pg C y^{-1}
Tropical Africa	0.3 Pg C y^{-1}
	1.5 Pg C y^{-1}

Source: FAO-Global Resources Assessment 2005; Canadell et al. 2007, PNAS

Anthropogenic C Emissions: Land Use Change

Carbon Emissions from Tropical Deforestation



Source: FAO-Global Resources Assessment 2005; Canadell et al. 2007, PNAS

Houghton, unpublished

Forest fires & transboundary haze

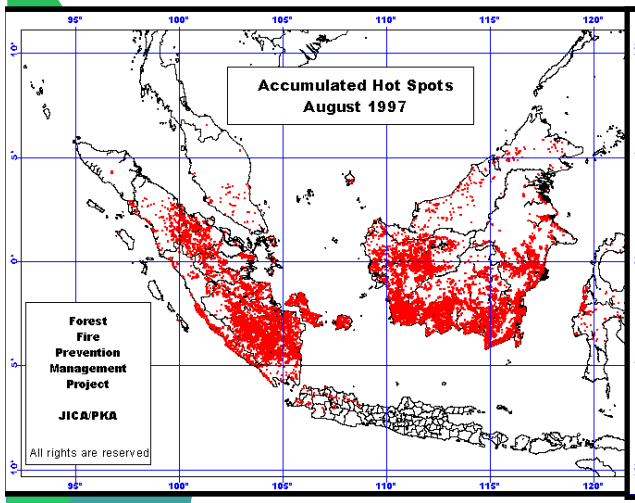
- In Southeast Asia, uncontrolled burning from the large-scale land clearing processes can result in transboundary haze, poor visibility and the degradation of the local air quality between the neighbouring countries.
- The haze events appear to be an annual event during the burning season, which occur from June to October.
- The 1997 haze caused by the forest fires in Indonesia was one of the notable events that caught the world's attention due to its magnitude and its coincidence with the dry major El Nino event.

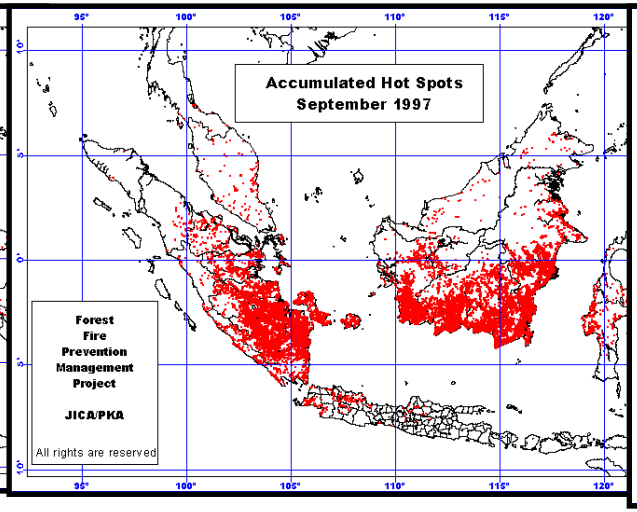

Forest fires at Doi Inthanon National Park,
21 February 2004, Thailand
in mixed deciduous forest

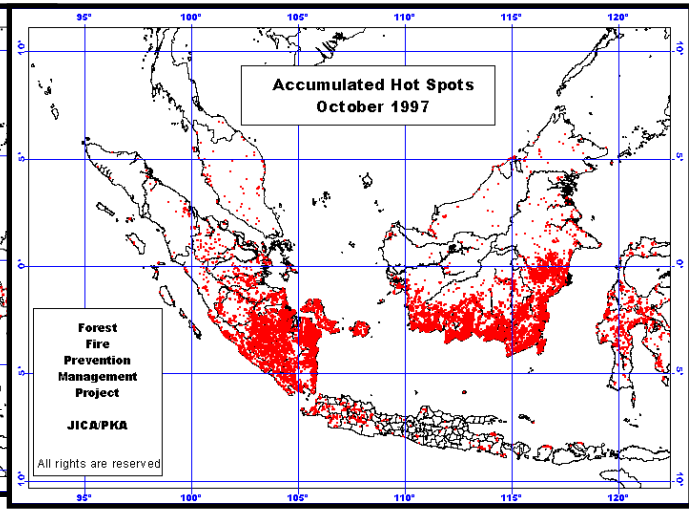
Greenhouse gas emitter

- Indonesia is rated as the world's top three greenhouse gas emitters in the world from land use change and deforestation, significantly by the release of carbon dioxide from deforestation.
- Deforestation and land conversion are the largest sources of emissions of the greenhouse gases, with forest fires accounting for 57% of the contribution.
- Indonesia has maintained its position as one of the top twenty emitters of greenhouse gases from land-use, land use change and forestry since 2000.
- This is due to the very large stock of carbon stored in the vegetation and soil that amounted to approximately 24 billion tons, and where deforestation accounts for 85% of the annual emissions of GHG in Indonesia.

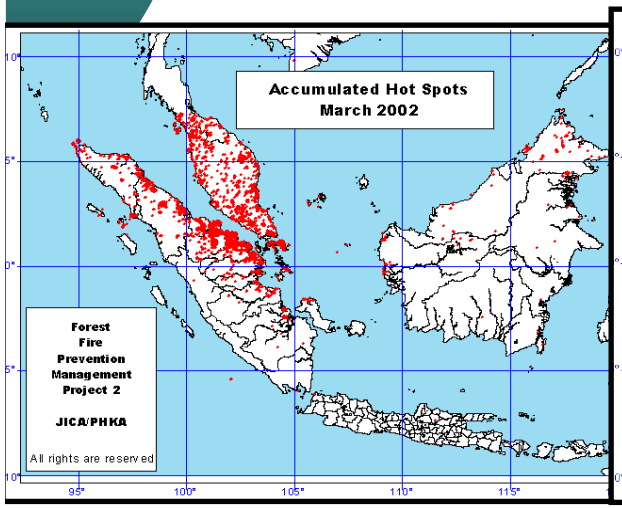
FFPMPII PROJECT (JICA-PHKA: Indonesia & Japan)

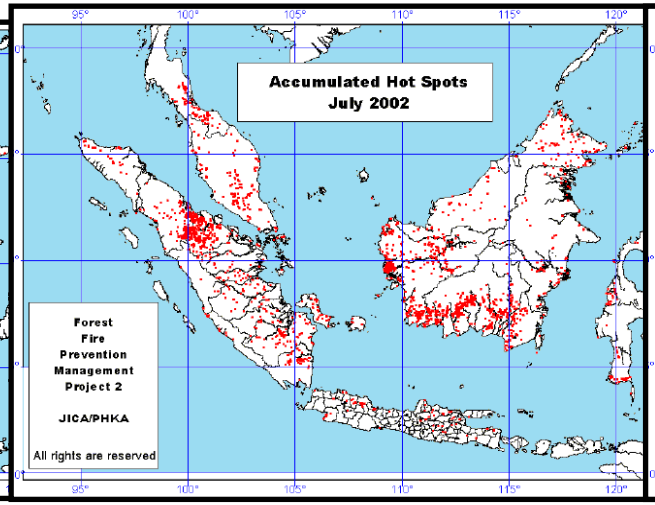


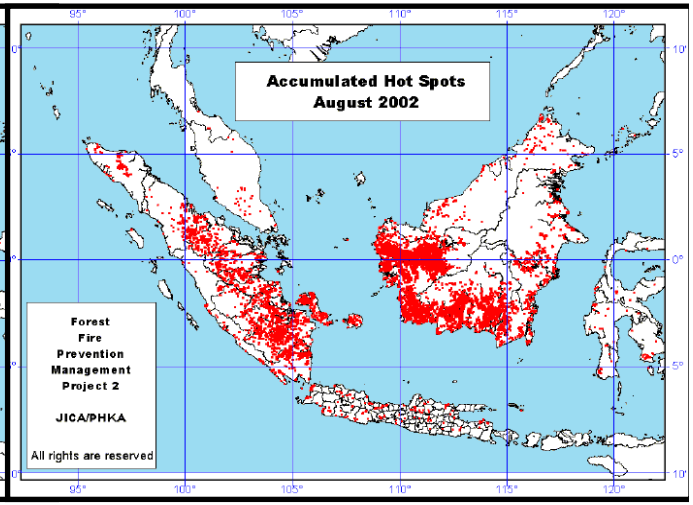




August 1997 September 1997 October 1997







March 2002 July 2002 August 2002

FOREST FIRE IN SABAH

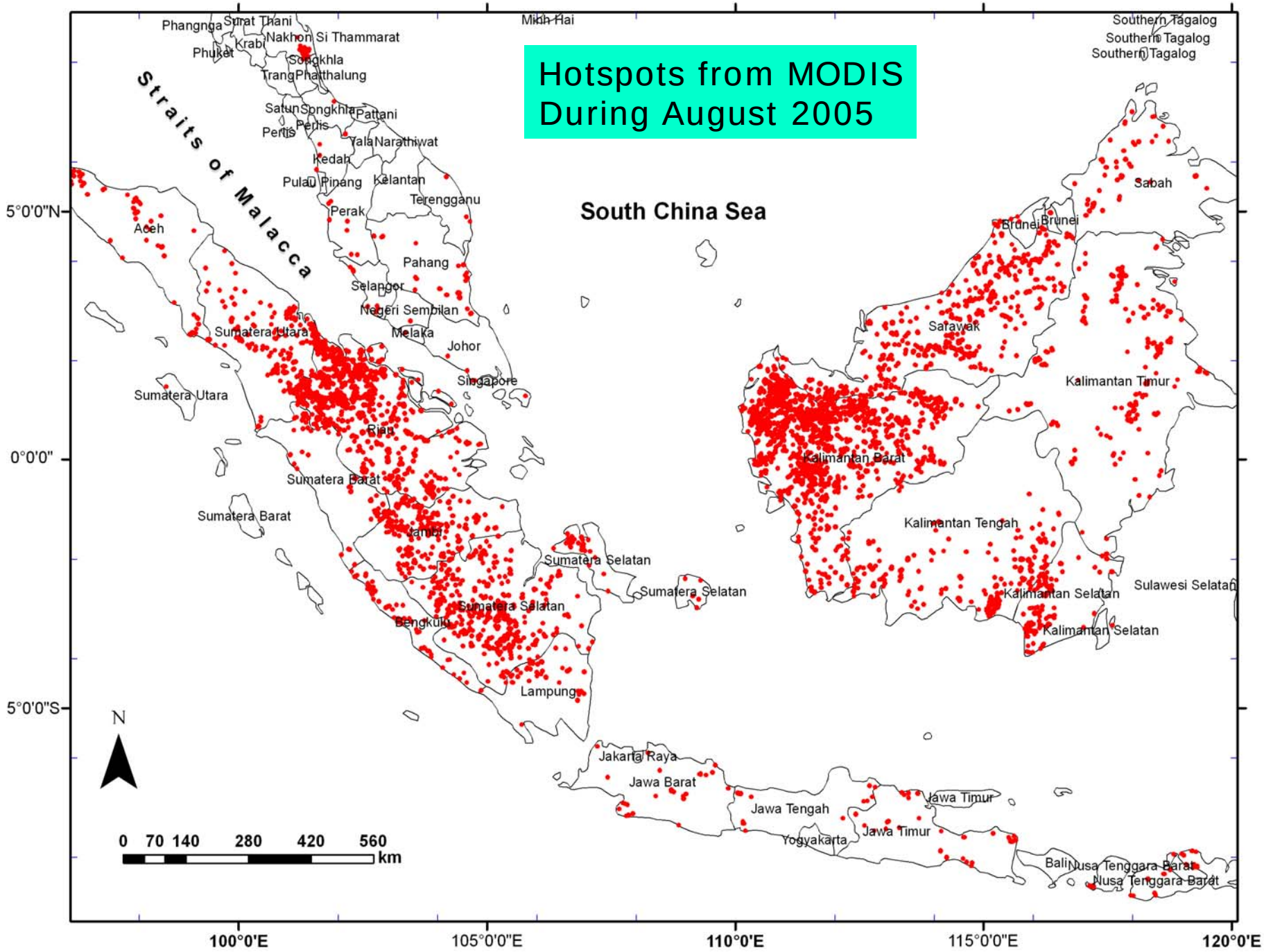
Burnt area in Ulu Sungai Milian FR

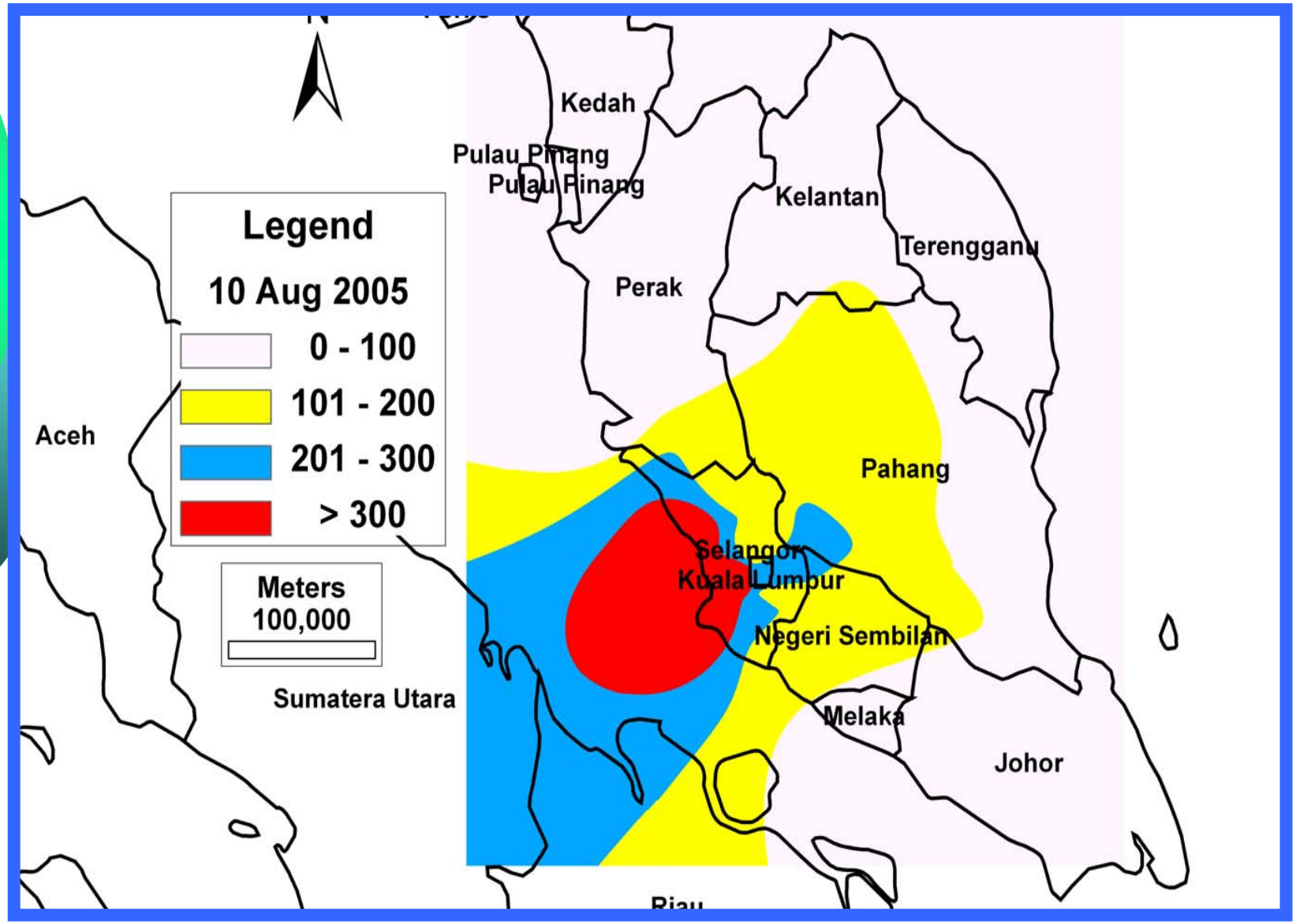
Open burning conducted south of Ulu Tongod Forest Reserve

Burnt area in Tatulit FR

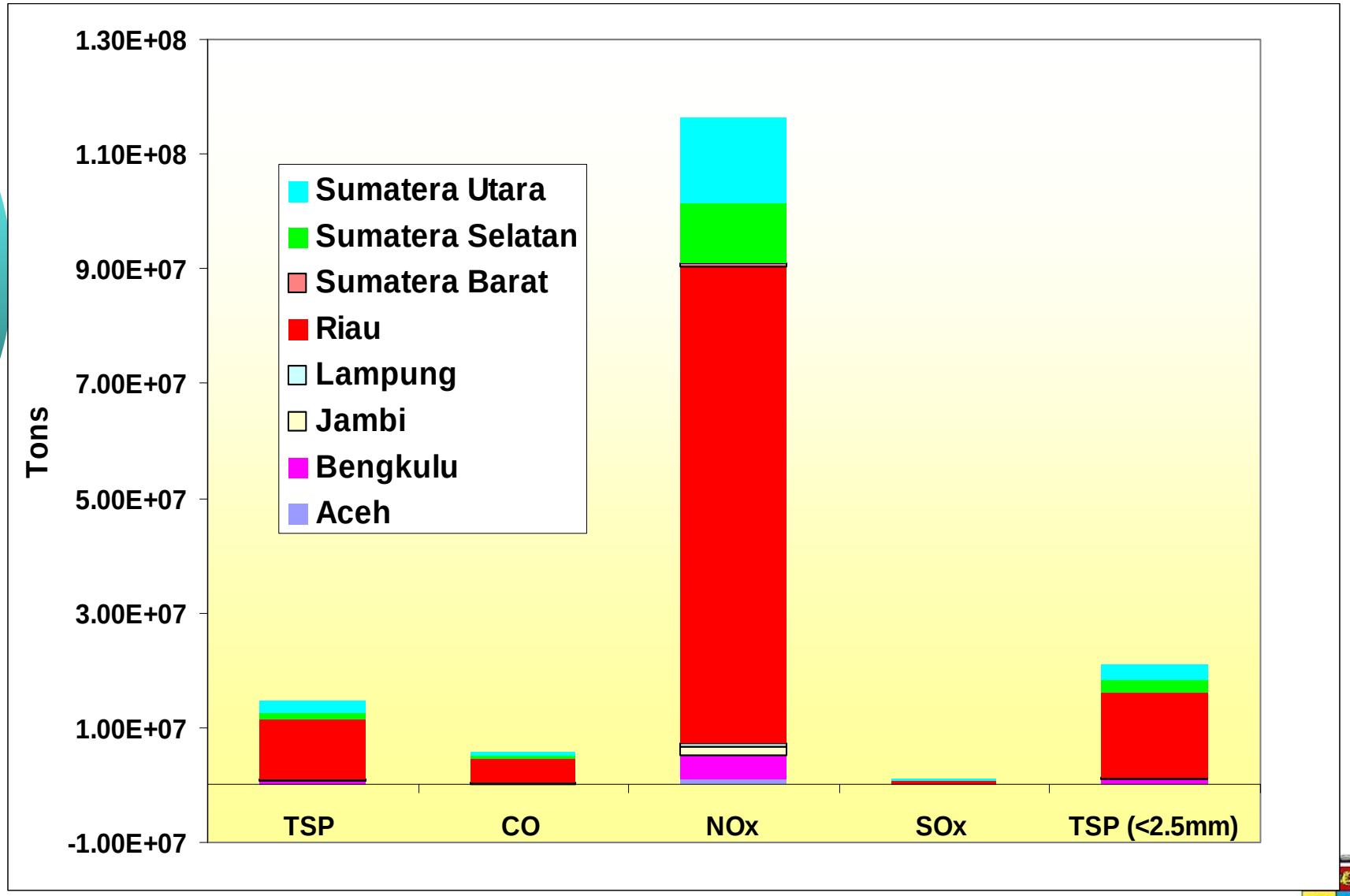
Burnt area in Tatullt FR

SOURCE :http://www.sabah.gov.my/hutan


Hotspots from MODIS
During August 2005
Straits of Malacca
South China Sea
Phangnga
Surat Thani
Nakhon Si Thammarat
Krabi
Phuket
Songkhla
Trang
Phatthalung
Satun
Pattani
Perlis
Yala
Narathiwat
Kedah
Pulau Pinang
Kelantan
Terengganu
Perak
Aceh
Pahang
Selangor
Negeri Sembilan
Melaka
Johor
Singapore
Sumatera Utara
Riau
Sumatera Barat
Jambi
Sumatera Selatan
Bengkulu
Lampung
Mindi Hai
Southern Tagalog
Sabah
Brunei
Sarawak
Kalimantan Timur
Kalimantan Barat
Kalimantan Tengah
Kalimantan Selatan
Sulawesi Selatan
Jakarta Raya
Jawa Barat
Jawa Tengah
Jawa Timur
Yogyakarta
Bali
Nusa Tenggara Barat
5°0'0"N
0°0'0"
5°0'0"S
100°0'0"E
105°0'0"E
110°0'0"E
115°0'0"E
120°0'E
N
0 70 140 280 420 560
km


Legend
10 Aug 2005
0 - 100
101 - 200
201 - 300
> 300
Meters
100,000
Kedah
Pulau Pinang
Pulau Pinang
Kelantan
Terengganu
Perak
Aceh
Pahang
Selangor
Kuala Lumpur
Negeri Sembilan
Melaka
Johor
Sumatera Utara
Riau

Estimates of gases and particulates in Aug 2005



Conclusion

- **The dynamics of tropical deforestation are very complex. It is multivariate in nature that are made up of interrelationship between proximate as well as underlying factors.**
- **The multivariate causes in tropical deforestation make it extremely difficult to develop a widely accepted and applicable policy that can manage the issues of deforestation.**
- **Current policies introduced to manage deforestation are often simplistic on the drivers of change or only understood part of the process.**
- **Therefore, any attempt to control and manage deforestation must be prepared to invest on the understanding of the causal factors.**
- **It is imperative that commitment and willpower of the people and decision makers be made for the survival of humans in the light of global warming.**

TERIMA KASIH
THANK YOU
ARIGATO