


# Status of Indonesian Soil Resources


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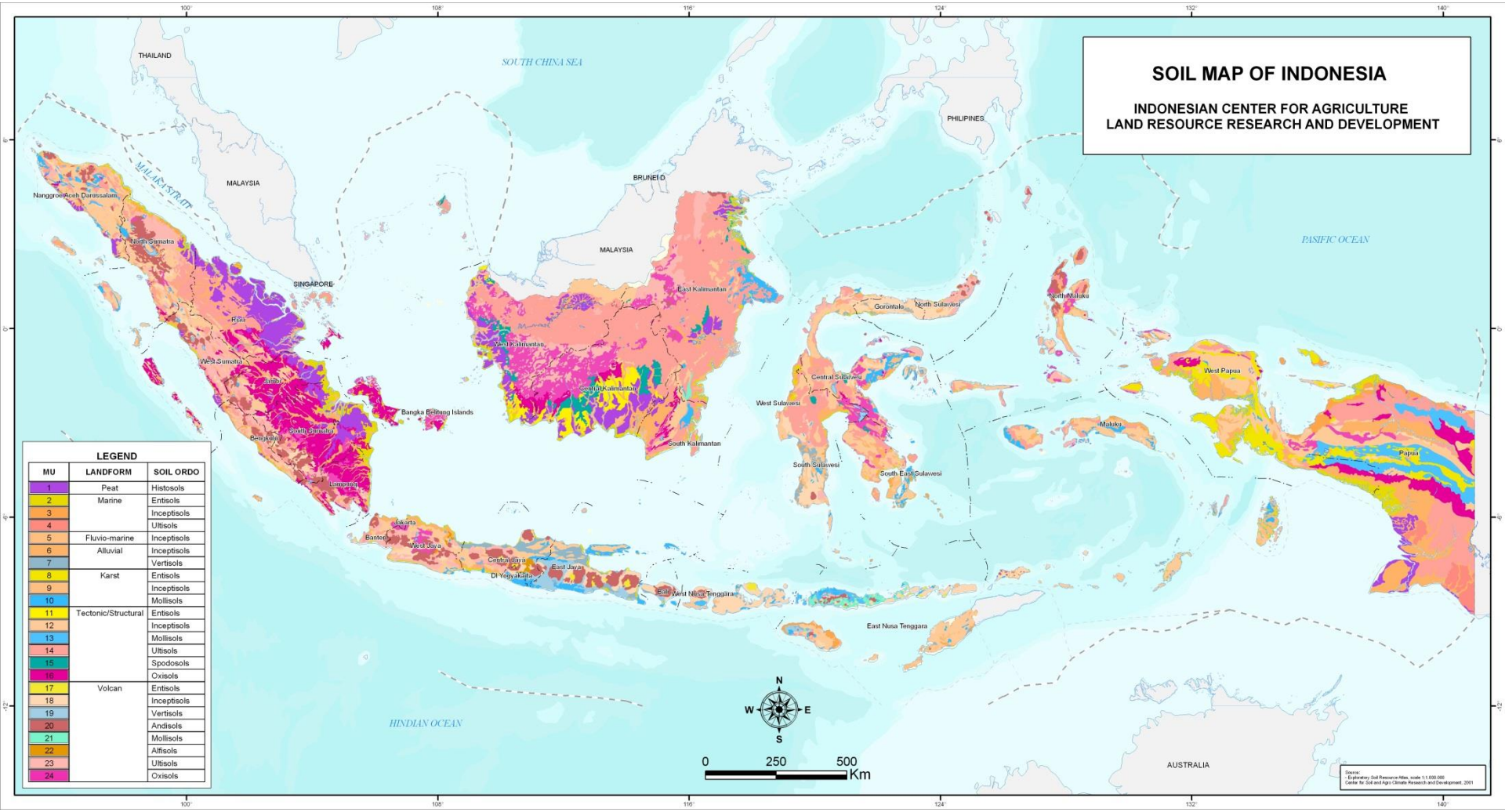
# Coverage

- Introduction (Indonesian Soils)
- Status of soil resources in the country (Land uses, management and land use changes):
- Main issues and soil threats
- Technology options for sustainable soil management

# Indonesian Soils




**LEGEND**

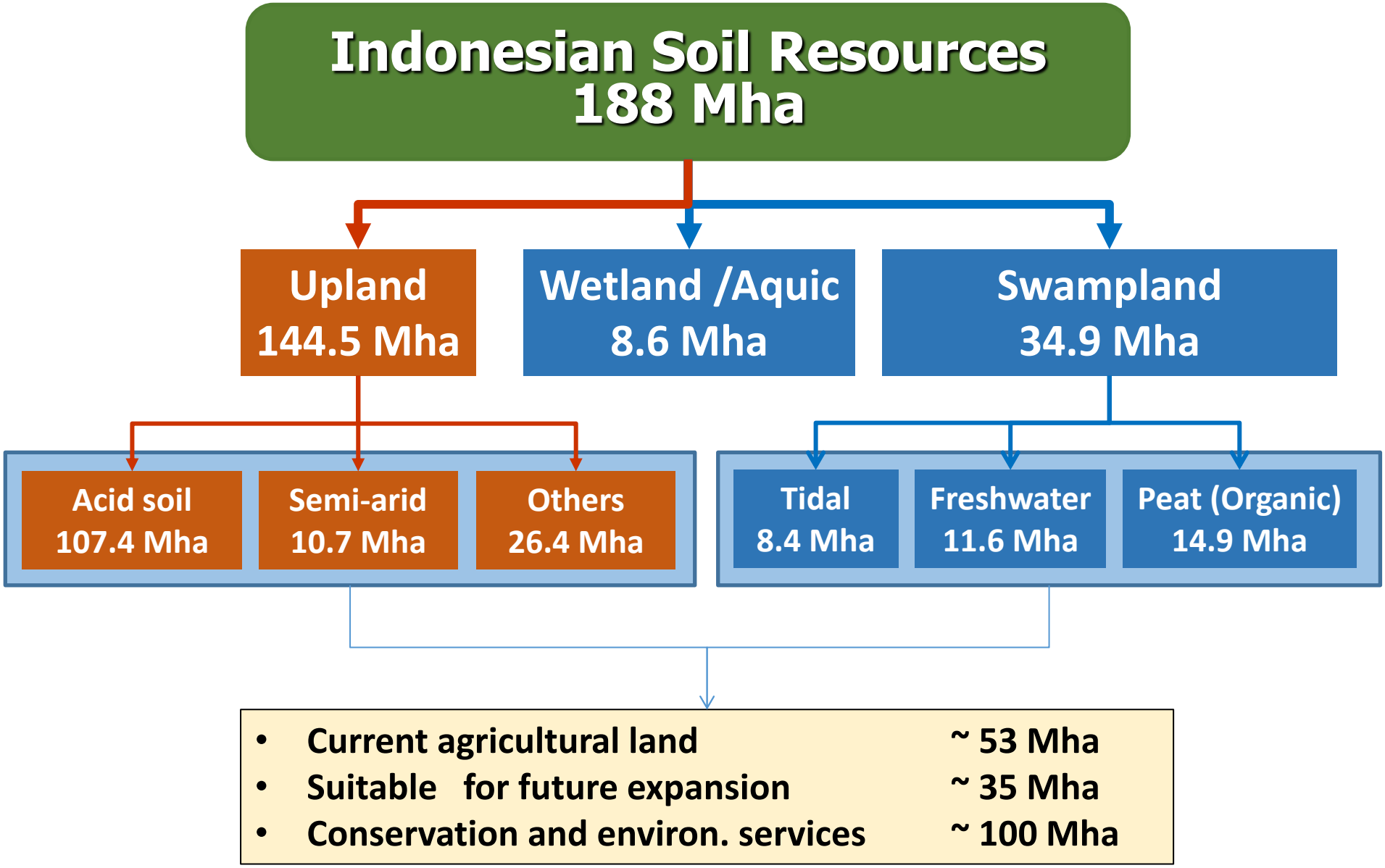
| MU | LANDFORM | SOIL ORDO |
|---|---|---|
| 1 | Peat | Histosols |
| 2 | Marine | Entisols |
| 3 | | Inceptisols |
| 4 | | Ultisols |
| 5 | Fluvio-marine | Inceptisols |
| 6 | Alluvial | Inceptisols |
| 7 | | Vertisols |
| 8 | Karst | Entisols |
| 9 | | Inceptisols |
| 10 | | Mollisols |
| 11 | Tectonic/Structural | Entisols |
| 12 | | Inceptisols |
| 13 | | Mollisols |
| 14 | | Ultisols |
| 15 | | Spodosols |
| 16 | | Oxisols |
| 17 | Volcan | Entisols |
| 18 | | Inceptisols |
| 19 | | Vertisols |
| 20 | | Andisols |
| 21 | | Mollisols |
| 22 | | Alfisols |
| 23 | | Ultisols |
| 24 | | Oxisols |

# Dominance of high rainfall areas (>2000 mm/annum)

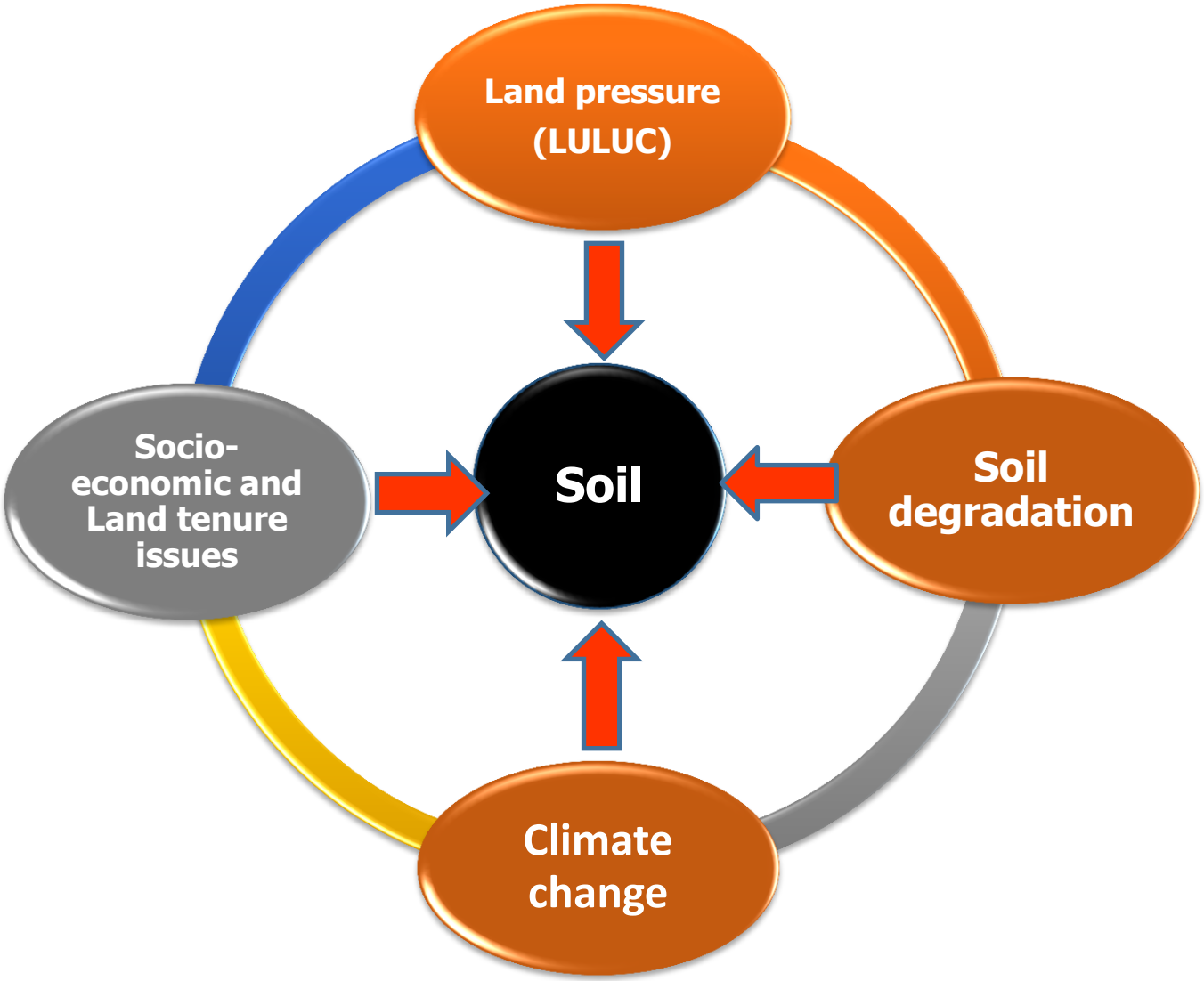
| Island | Annual rainfall (mm) | | | | |
|---|---|---|---|---|---|
| | >5000 | 3,500-5,000 | 2,000-3,500 | 1,000-2,000 | <1,000 |
| | ----------%---------- | | | | |
| Sumatra | 0.8 | 21.5 | 71.5 | 6.2 | - |
| Java | 1.9 | 12.6 | 56.0 | 29.5 | - |
| Bali, NTB, NTT | - | 2.1 | 16.3 | 69.6 | 12.0 |
| Kalimantan | - | 29.0 | 66.3 | 4.7 | - |
| Sulawesi | - | 23.0 | 66.1 | 30.9 | 0.8 |
| Maluku | - | 1.7 | 71.9 | 26.4 | |
| Papua | 10.3 | 33.7 | 40.3 | 15.7 | |
| Total | 2.6 | 20.5 | 59.7 | 16.2 | 1.0 |

# Steep slopes

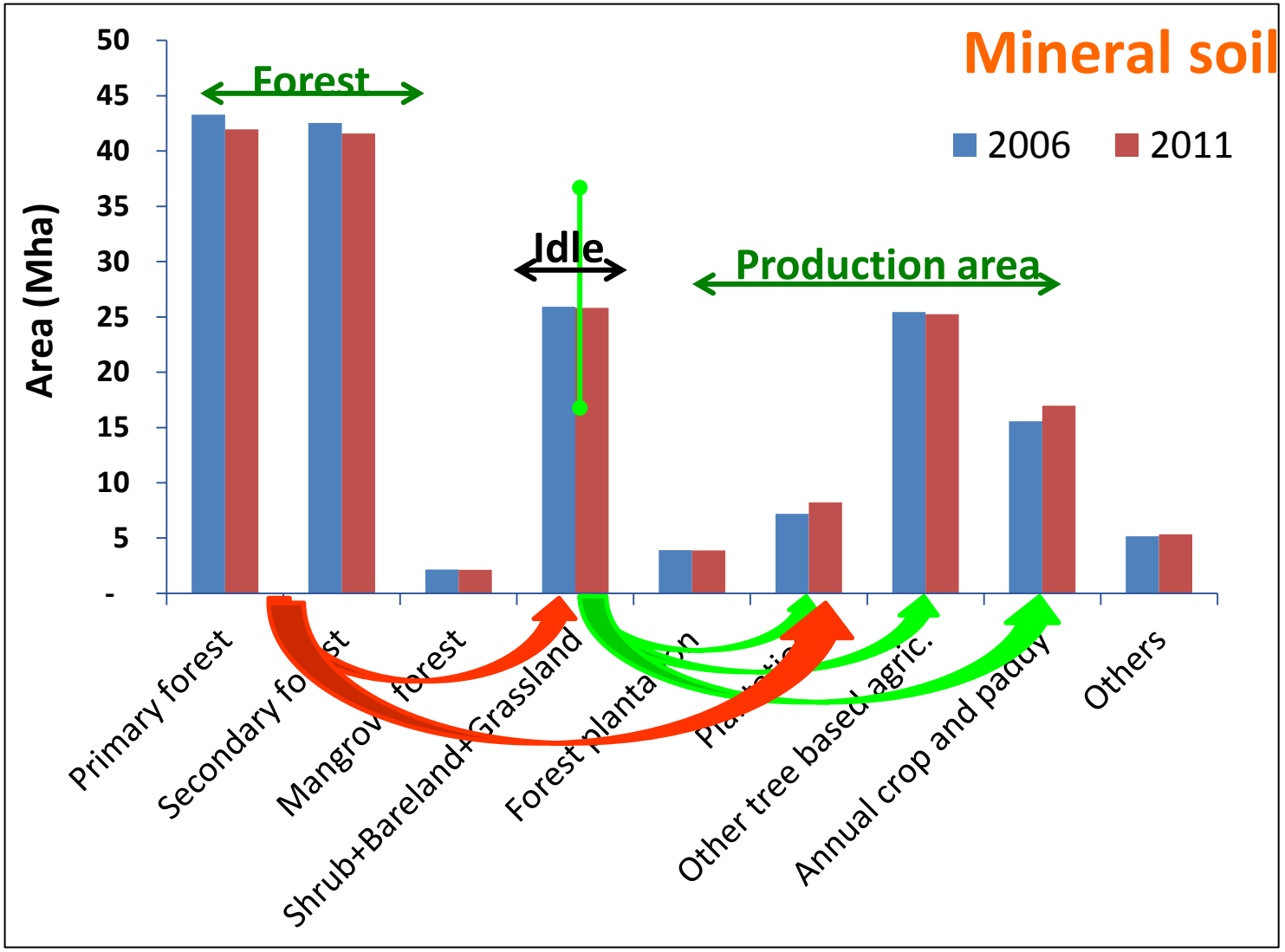
| Slopes | Slope (%) | Area (%) |
|---|---|---|
| Mountainous (very steep) | >30 | 27 |
| Hilly (moderately steep) | 15-30 | 20 |
| Undulating (strongly sloping) | 8-15 | 13 |
| Flat-sloping | 0-8 | 39 |


Indonesian Soil Resources
188 Mha
Upland
144.5 Mha
Wetland /Aquic
8.6 Mha
Swampland
34.9 Mha
Acid soil
107.4 Mha
Semi-arid
10.7 Mha
Others
26.4 Mha
Tidal
8.4 Mha
Freshwater
11.6 Mha
Peat (Organic)
14.9 Mha
• Current agricultural land ~ 53 Mha
• Suitable for future expansion ~ 35 Mha
• Conservation and environ. services ~ 100 Mha

# MAIN ISSUES AND SOIL THREATS



# Land use and land use change



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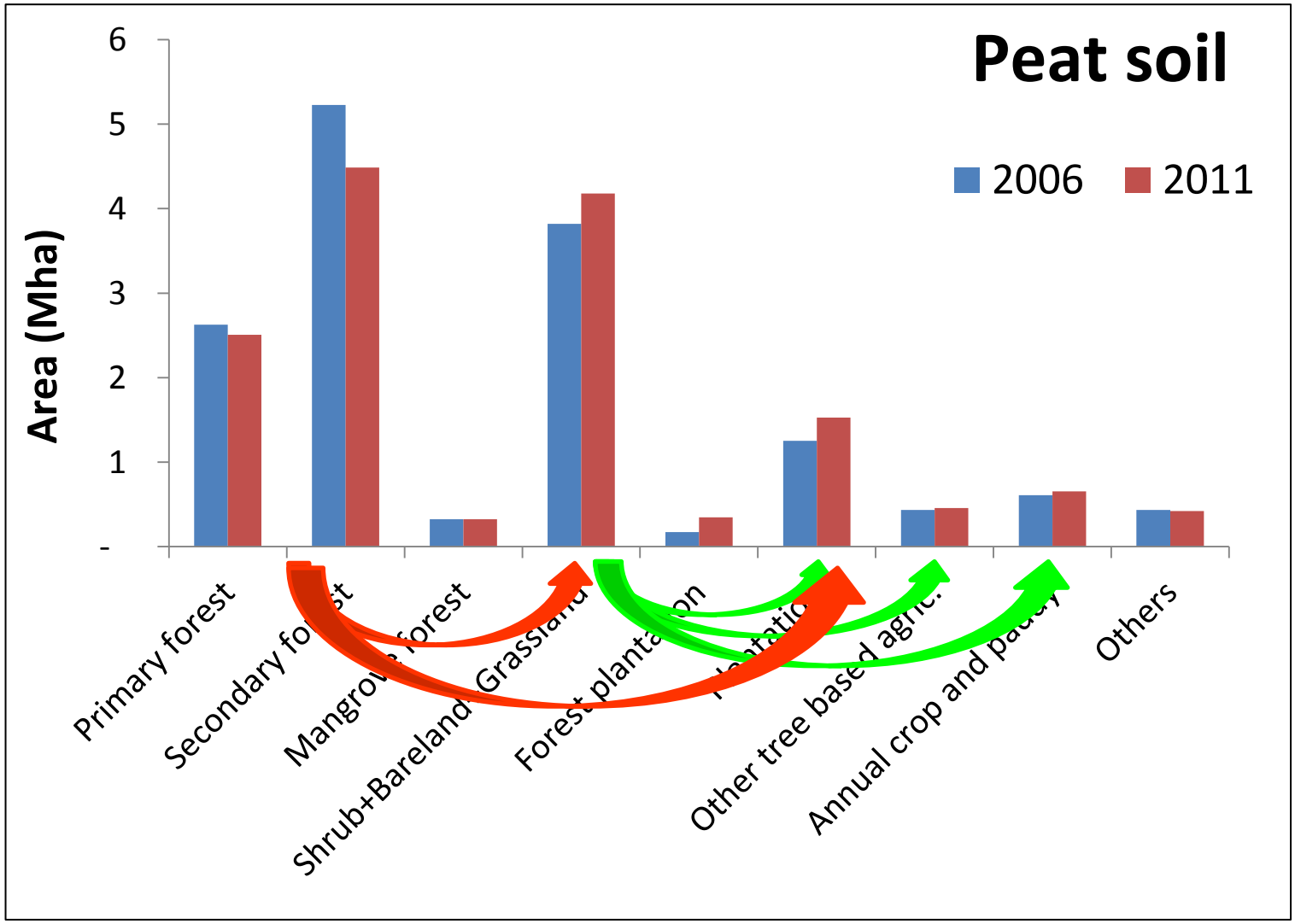
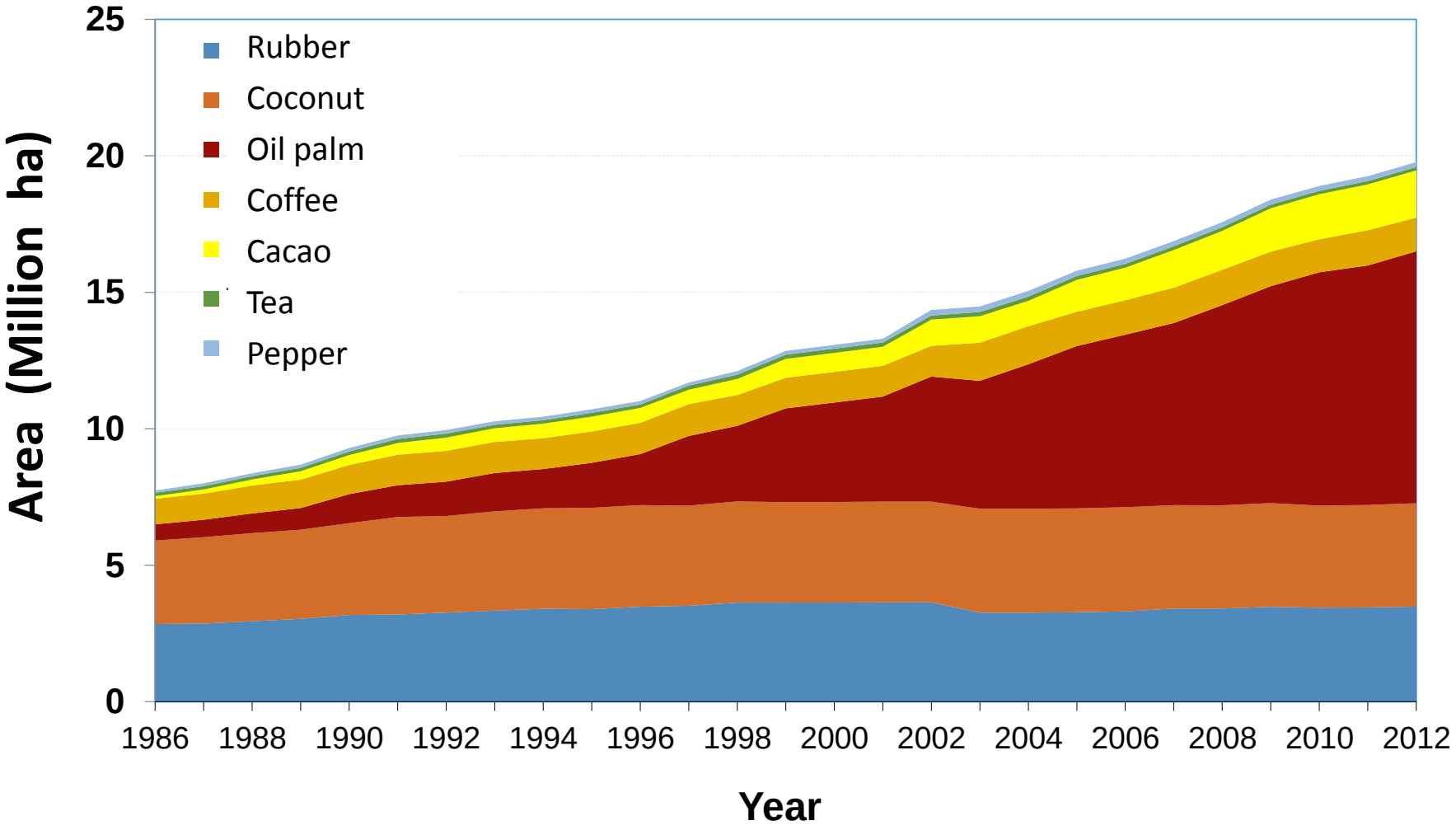


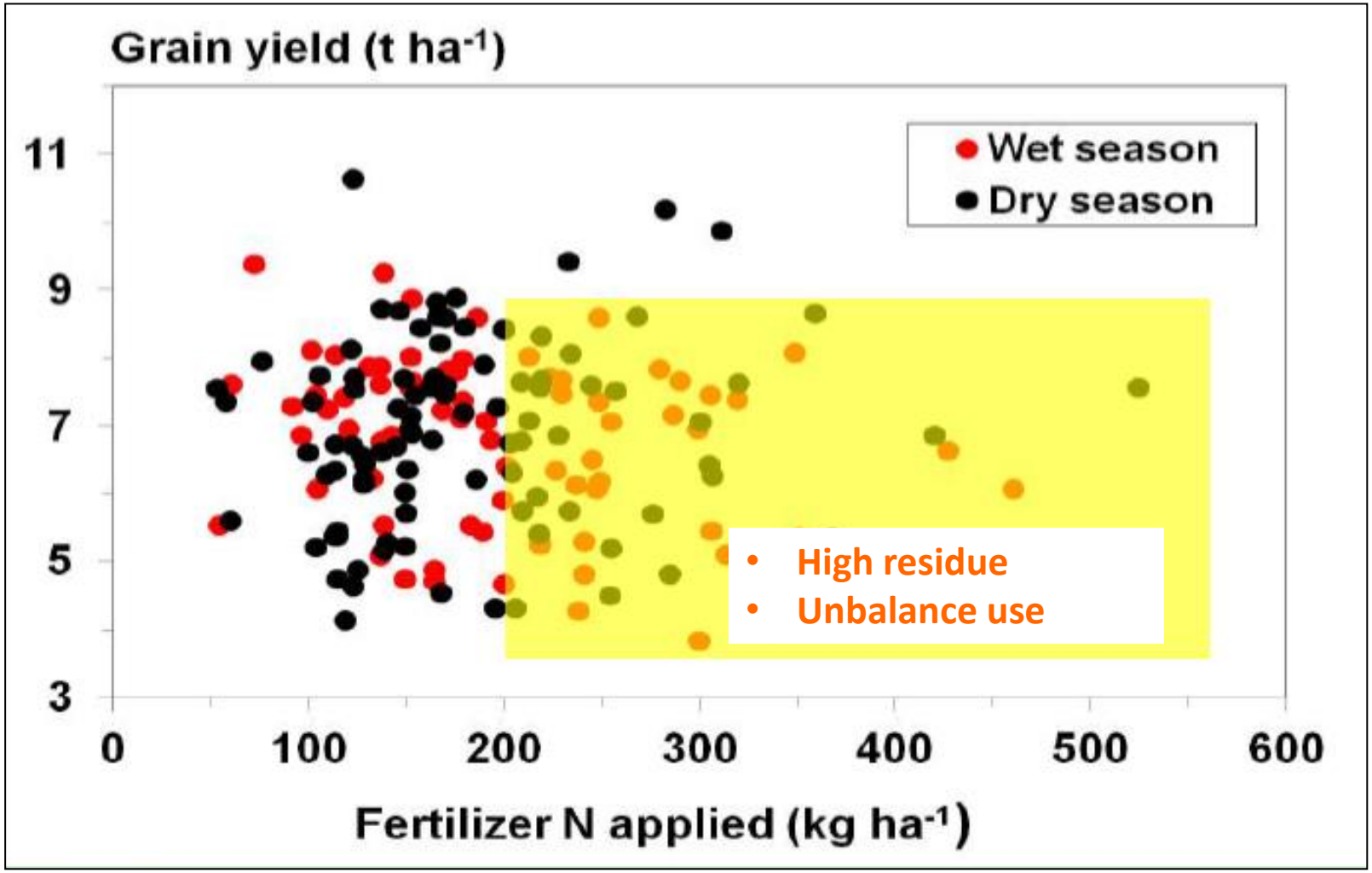



Sumber: BPS (1986-2013)

# Causes of land degradation

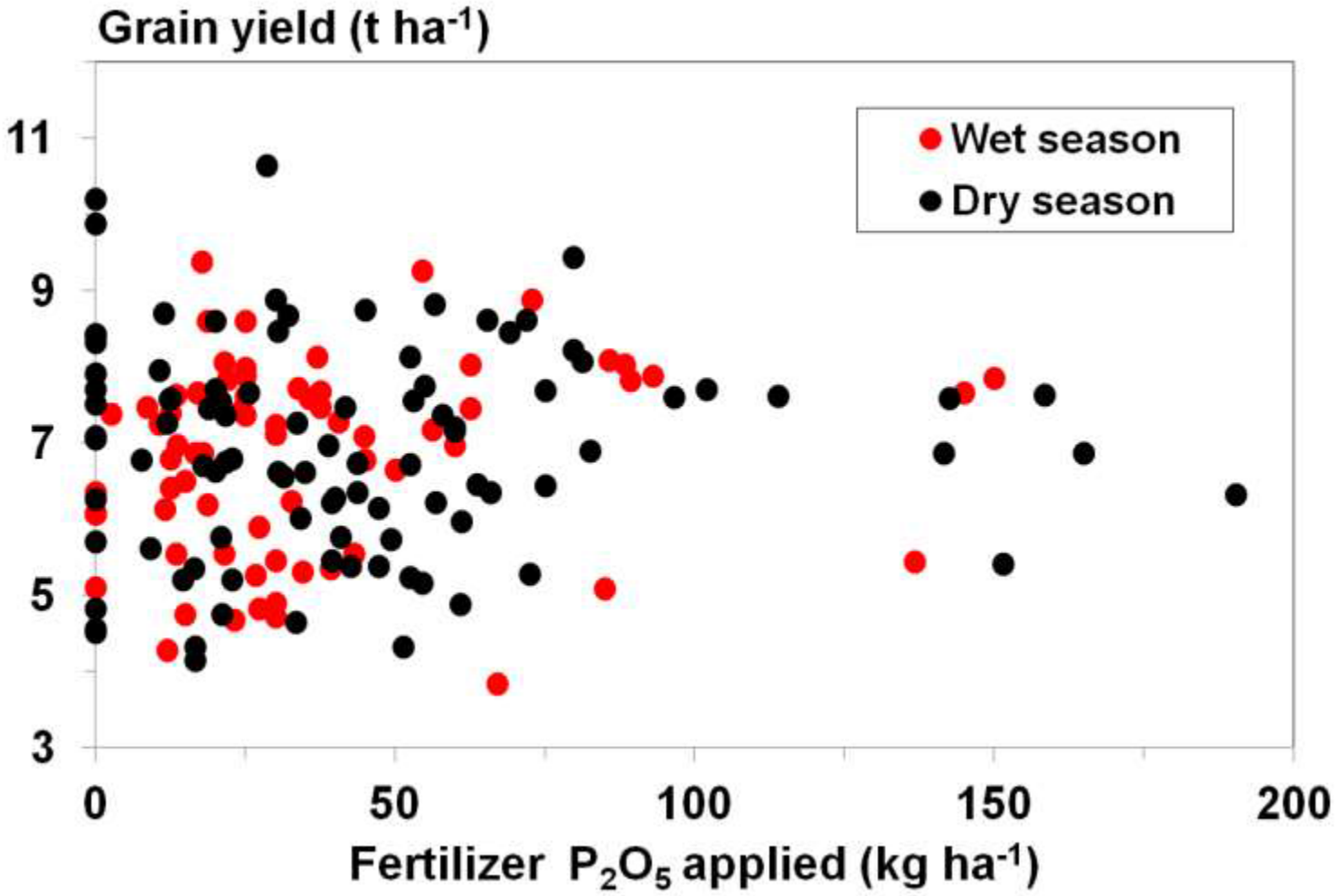
- **Natural factor**: slope, rainfall
- **Anthropogenic**:
  - Imbalanced fertilization: overuse, too little and imbalance
  - Intensive  steep slope agriculture
  - Open mining
  - Industrial wastes
  - Over-draining (in case of peatland)

# N fertilizer rates in Java do not ensure high yield




Source: Buresh et a. (2014)

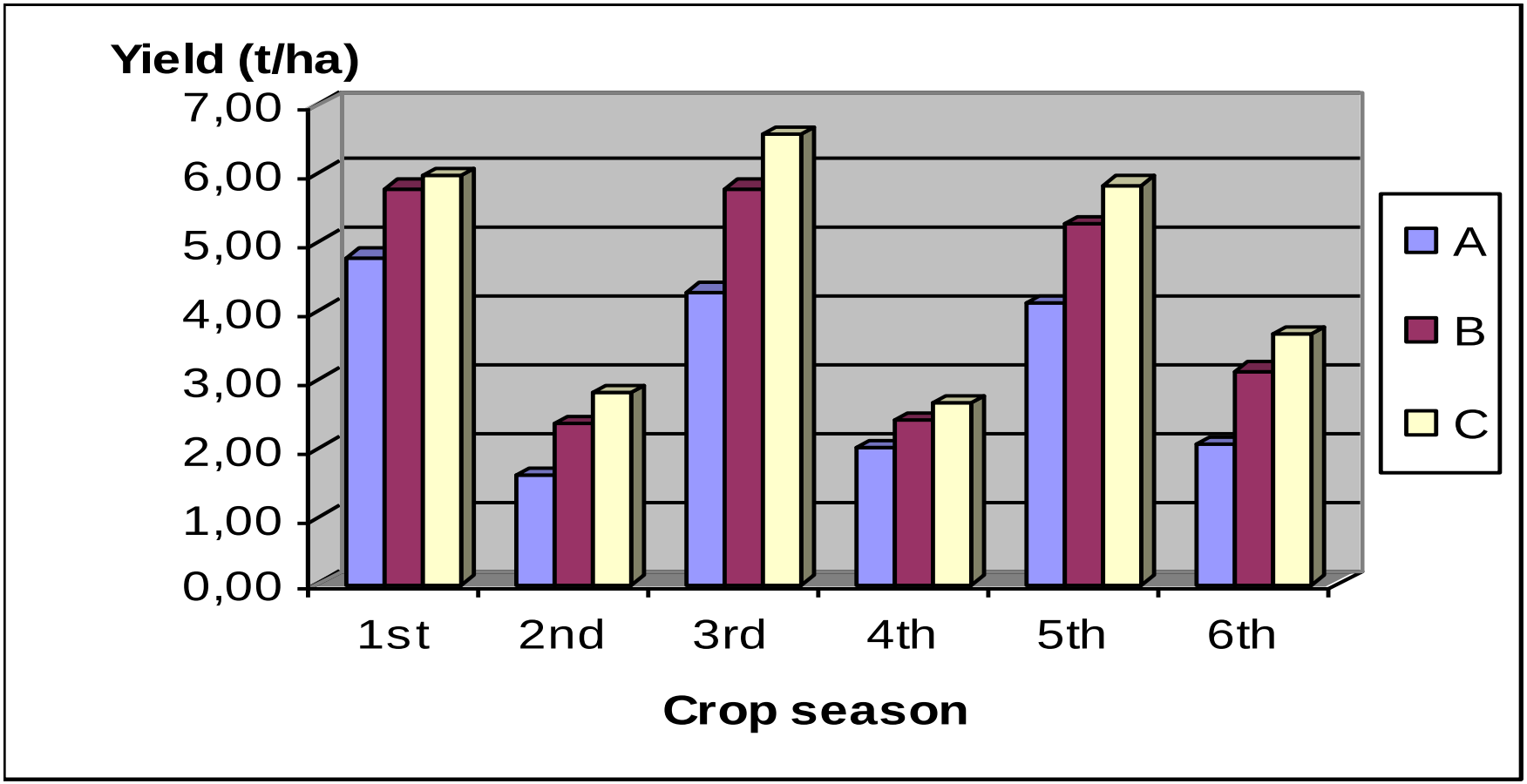
# $P_2O_5$ rates are not strongly related to rice yield (Buresh et al. 2014)



# Change of soil P status in lowland rice (West Java and Banten Provinces)

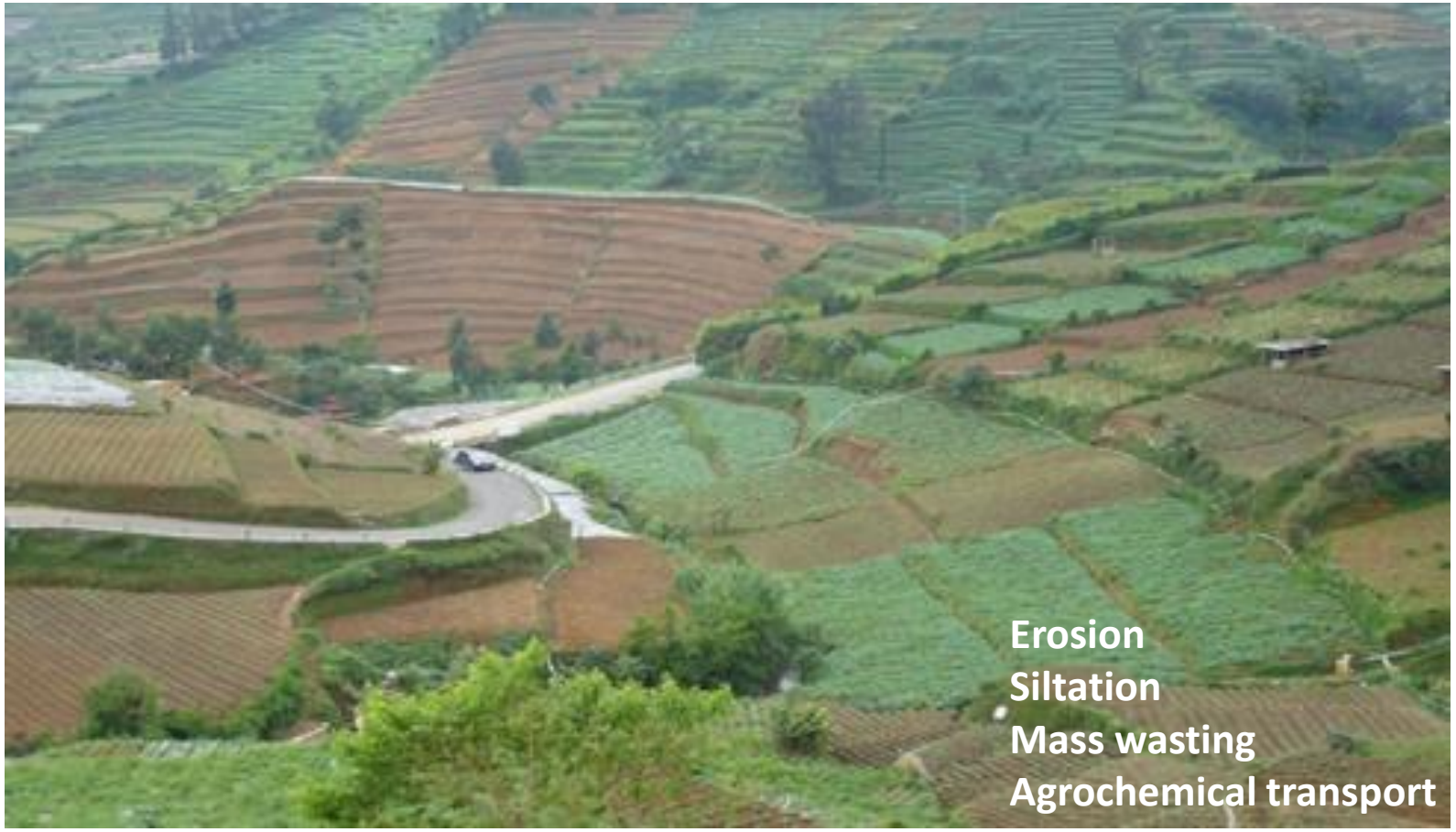
| Status of Soil P | Map of 2000 | | Updated map in 2010 | | Difference | |
|---|---|---|---|---|---|---|
| | Ha | % | Ha | % | Ha | % |
| Low | 235,621 | 19 | 64,084 | 6 | -171,537 | 73 |
| Middle | 454,396 | 38 | 304,681 | 27 | -149,715 | 33 |
| High | 523,348 | 43 | 755,520 | 67 | +232,172 | 44 |
| Total | 1,213,365 | 100 | 1,124,285 | 100 | - | - |

# Good response to additional manure and P on maize grain yield (Husnain et al.)




A: Rock Phosphate (RP) B: Chicken Manure (CM) C: RP+CM

# Intensive agriculture on steep slopes



# Climate change effects on soil

- Higher temperature → Higher ET → soil dryness
- Unpredictable and extreme weather
  - Extremely high rainfalls →Water saturation and inundation, Soil erosion and mass movement, Nutrient leaching and soil acidification
  - Low rainfall and long dry season →Drought, Salinization
- Sea level rise and salt water intrusion → Inundation, salinization



# Adaptation approaches

# Adaptation approaches to the harsher climate events?

| Effects on soil condition | Soil management approaches |
|---|---|
| **Soil dryness** | • **Irrigation**<br>• **Water harvesting**<br>• **Increase water holding capacity**<br>  ○ Mulching<br>  ○ Application of organic matter |
| Water saturation and inundation | • Improvement of drainage system<br>• Increase infiltration<br>• Cover crops |
| Soil erosion | • Increase infiltration<br>• Reduce slope steepness and length →terracing<br>• Cover crops |
| Mass movement | • Reduce soil burden<br>• Improve drainage system |

# How should we manage the soil (cont.)?

| Effects on soil condition | Management techniques and practices |
|---|---|
| Nutrient leaching and acidification | • Increase soil CEC<br>• Increase water holding capacity<br>• Increase soil organic matter<br>• Split application of leachable nutrients<br>• Cover crops |
| Salinization | • Leaching with fresh water |
| Inundation, salinization | • Drainage, leaching |

# Mulches

- Reduce transpiration
- Control erosion
- Regulate soil temperature
- Reduce weeds

Recycles plant residues and nutrients

# Life mulch and circle weeding of *Arachis pintoi* under pepper (*Piper nigrum*)

+ Runoff water almost totally filtered
+ N-fixing system

*Arachis pintoi* attracts snails

+ Good source of protein  for ducks

Bench terrace on very steep slope: paddy and secondary crops rotation with advantages and disadvantages

# Sediment and litter pits under coffee plantation

# Conservation tillage

- Ridge tillage
- Minimum tillage
- No tillage

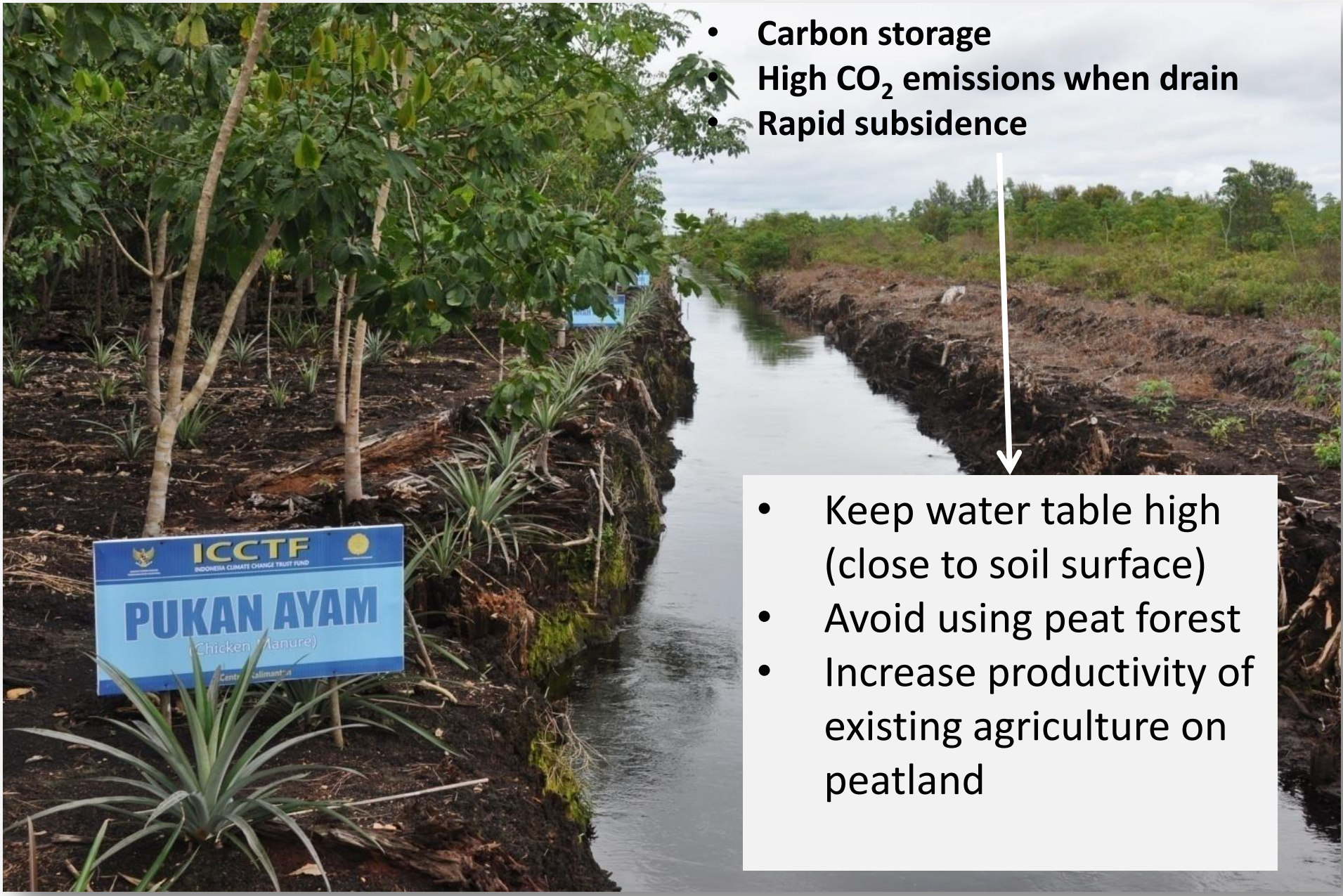
**Herbicide use becomes important under no tillage practice. Avoid excessive use.**

# Ameliorants

- Lime
- Organic matter
- Steel slag: Si, Ca
- Peat fertilizers: Ca, Mg, P
- Biochar

# Soil test kit for balanced fertilization


# The case of peat soil




- **Carbon storage**
- **High $CO_2$ emissions when drain**
- **Rapid subsidence**

- Keep water table high (close to soil surface)
- Avoid using peat forest
- Increase productivity of existing agriculture on peatland

# National Priorities

- Attainment of food security (rice, maize, soybean)
  - Subsidies and improvement of fertilizer distribution
  - Improvement of irrigation networks
  - Support on farm machineries, esp.for tillage and harvesting
- Extension and capacity building
  - Cropping calender
  - Fertilizer recommendation
  - Soil conservation

**Bottom-up planning to discuss: Designs, materials, costs, supporting institutions**

Build up from existing practices

# Lucrative vegetable farming