

SURVEY OF BIOMASS, CARBON STOCKS, BIODIVERSITY, AND ASSESSMENT OF THE HISTORIC FIRE REGIME
FOR INTEGRATION INTO A FOREST MONITORING SYSTEM IN SOUTH SUMATRA, INDONESIA

Historic land cover change and carbon emission baseline

Palembang, October 2016

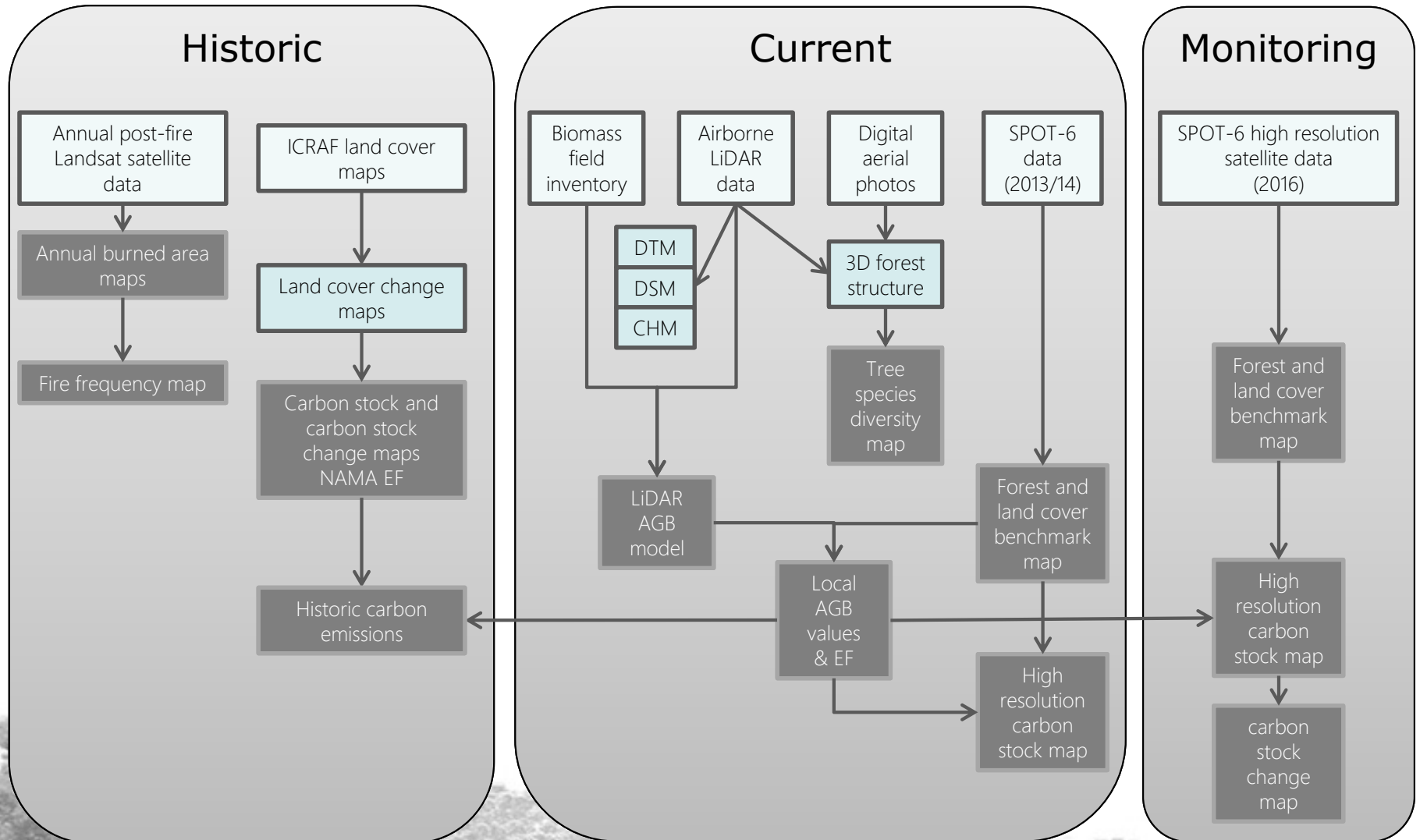
Peter Navratil
Werner Wiedemann
Sandra Enghart
Natalie Cornish
Florian Siegert

*RSS Remote Sensing Solutions GmbH
Biodiversity and Climate Change Project*



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Concept of the monitoring system



Historic component: Land cover change and carbon emission baseline

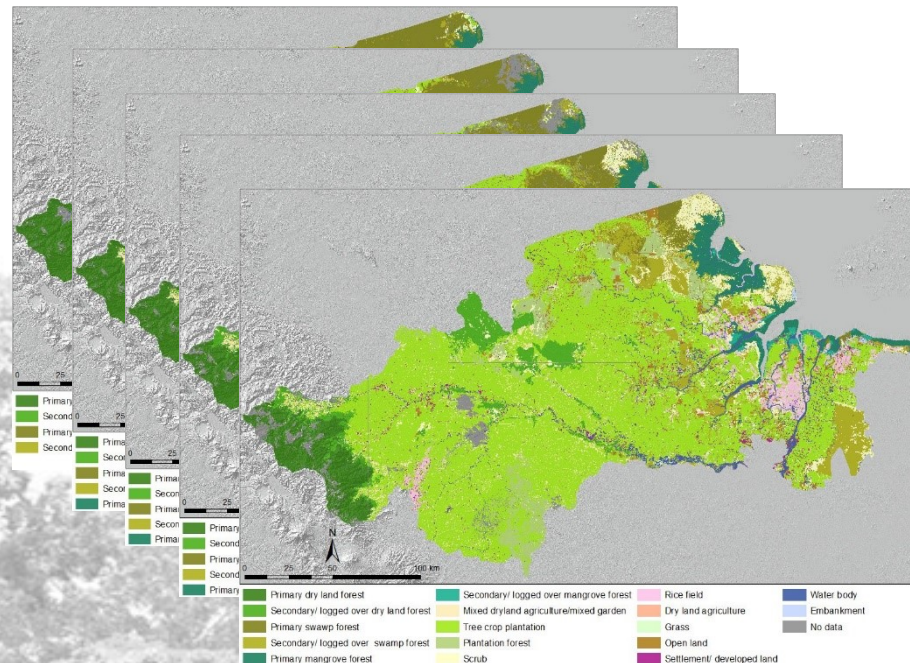
Objectives:

- Utilize existing (ICRAF) land cover data for assessing land cover change in the period 1990 - 2014
- Assess land cover change related historic carbon emissions
- Assess the drivers of deforestation and GHG emissions
- Compatible with national classification scheme for GHG reporting

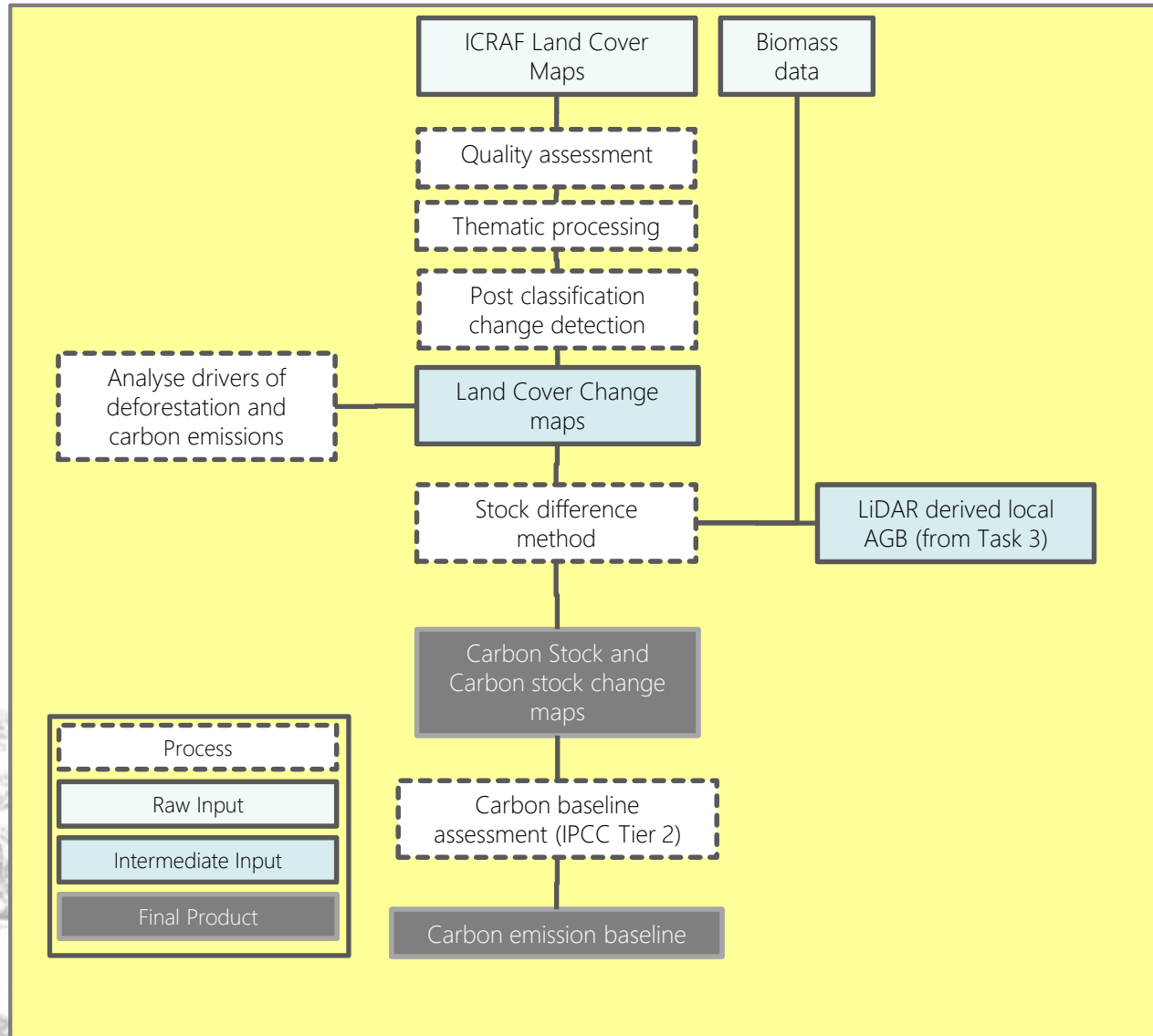


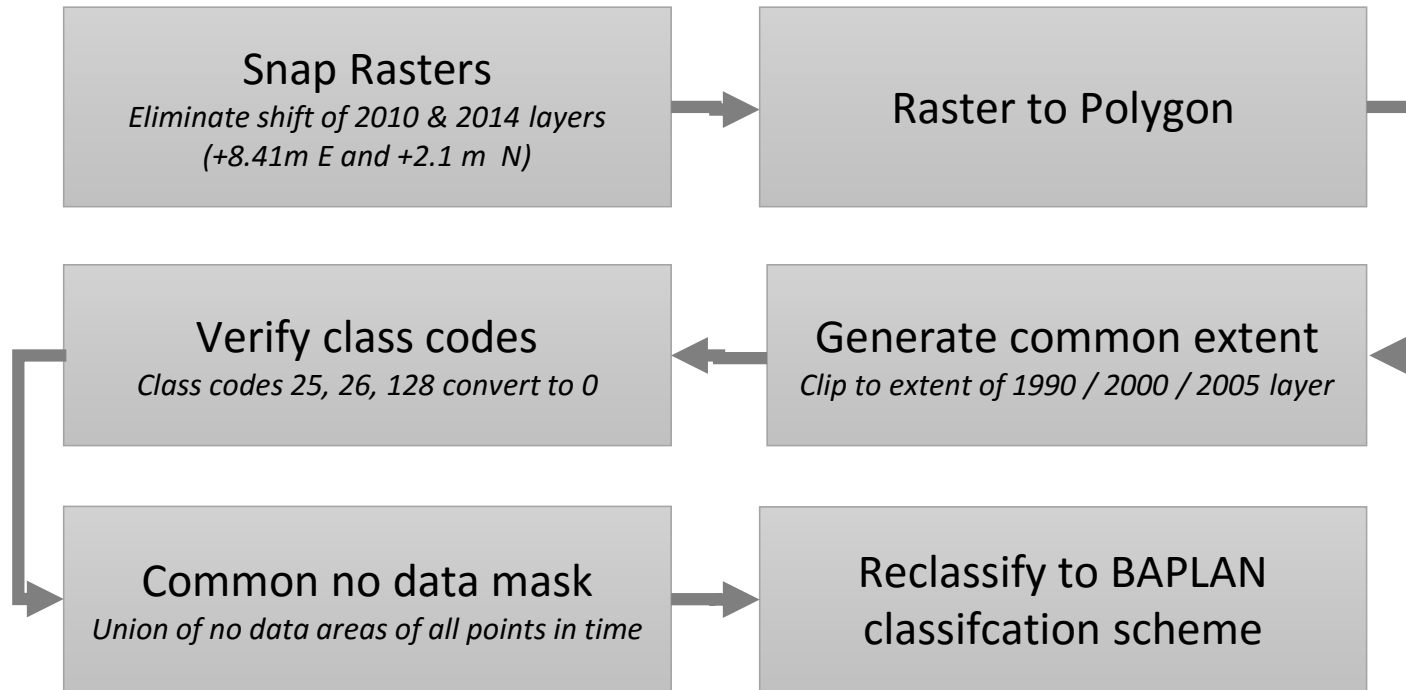
Land cover data produced by ICRAF and available through the LAMA-I project

- Based on Landsat satellite imagery
- Five points in time 1990 – 2000 – 2005 – 2010 – 2014
- 30 m spatial resolution
- Custom ICRAF class hierarchy



Workflow of the work package





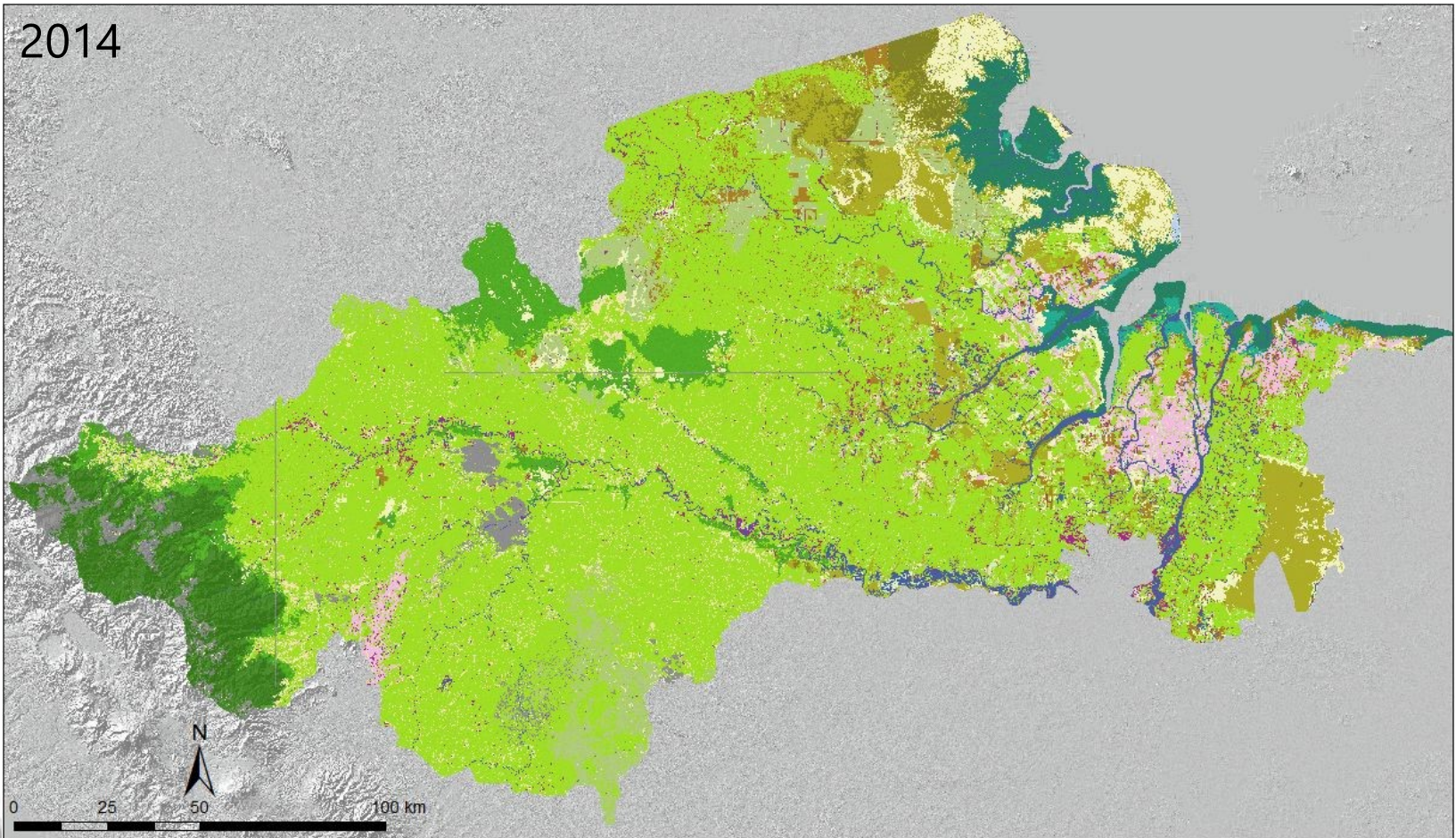
Translation key for classification scheme

| ICRAF Code | ICRAF Classification Scheme | Translation | BAPLAN Classification scheme | Indonesian name | Baplan Code |
|------------|-----------------------------------|-------------|--|--|-------------|
| 1 | Undisturbed forest | ↔ | Primary dry land forest | Hutan lahan kering primer | 2001 |
| 2 | Logged over forest (High density) | ↔ | Secondary/ logged over dry land forest | Hutan lahan kering sekunder/ bekas tebangan | 2002 |
| 3 | Logged over forest (Low density) | ↔ | | | |
| 4 | Undisturbed swamp forest | ↔ | Primary swamp forest | Hutan rawa primer | 2005 |
| 6 | Undisturbed peat swamp forest | ↔ | | | |
| 5 | Logged over swamp forest | ↔ | Secondary/ logged over swamp forest | Hutan rawa sekunder/ bekas tebangan | 20051 |
| 7 | Logged over peat swamp forest | ↔ | | | |
| 8 | Undisturbed mangrove forest | ↔ | Primary mangrove forest | Hutan mangrove primer | 2004 |
| 9 | Logged over mangrove forest | ↔ | Secondary/ logged over mangrove forest | Hutan mangrove sekunder/ bekas tebangan | 2007 |
| 10 | Mixed garden | ↔ | Mixed dryland agriculture/mixed garden | Pertanian lahan kering campur semak / kebun campur | 20092 |
| 12 | Coffee agroforest | | | | |
| 11 | Rubber agroforest | | | | |
| 14 | Oil palm monoculture | ↔ | Tree crop plantation | Perkebunan/ Kebun | 2010 |
| 15 | Rubber monoculture | | | | |
| 16 | Coconut monoculture | ↔ | | | |
| 13 | Acacia plantation | ↔ | Plantation forest | Hutan tanaman | 2006 |
| 19 | Shrub | ↔ | Scrub | Semak belukar | 2007 |
| 17 | Rice field | ↔ | Rice fields | Sawah/ persawahan | 20093 |
| 18 | Annual crops | ↔ | Dry land agriculture | Pertanian lahan kering | 20091 |
| 20 | Grass | ↔ | Grass | Rumput | 3000 |
| 21 | Cleared land | ↔ | Open land | Tanah terbuka | 2014 |
| 22 | Settlement/Built-up area | ↔ | Settlement/ developed land | Pemukiman/ lahan terbangun | 2012 |
| 24 | Waterbody | ↔ | Water body | Tubuh air | 5001 |
| 23 | Fish pond | ↔ | Embankment | Tambak | 20094 |

- Local emission factors calculated from field inventory and LiDAR data (see WP 3)
- EFs consolidated for BAPLAN classification scheme
- Carbon emission calculations based on Stock-difference approach

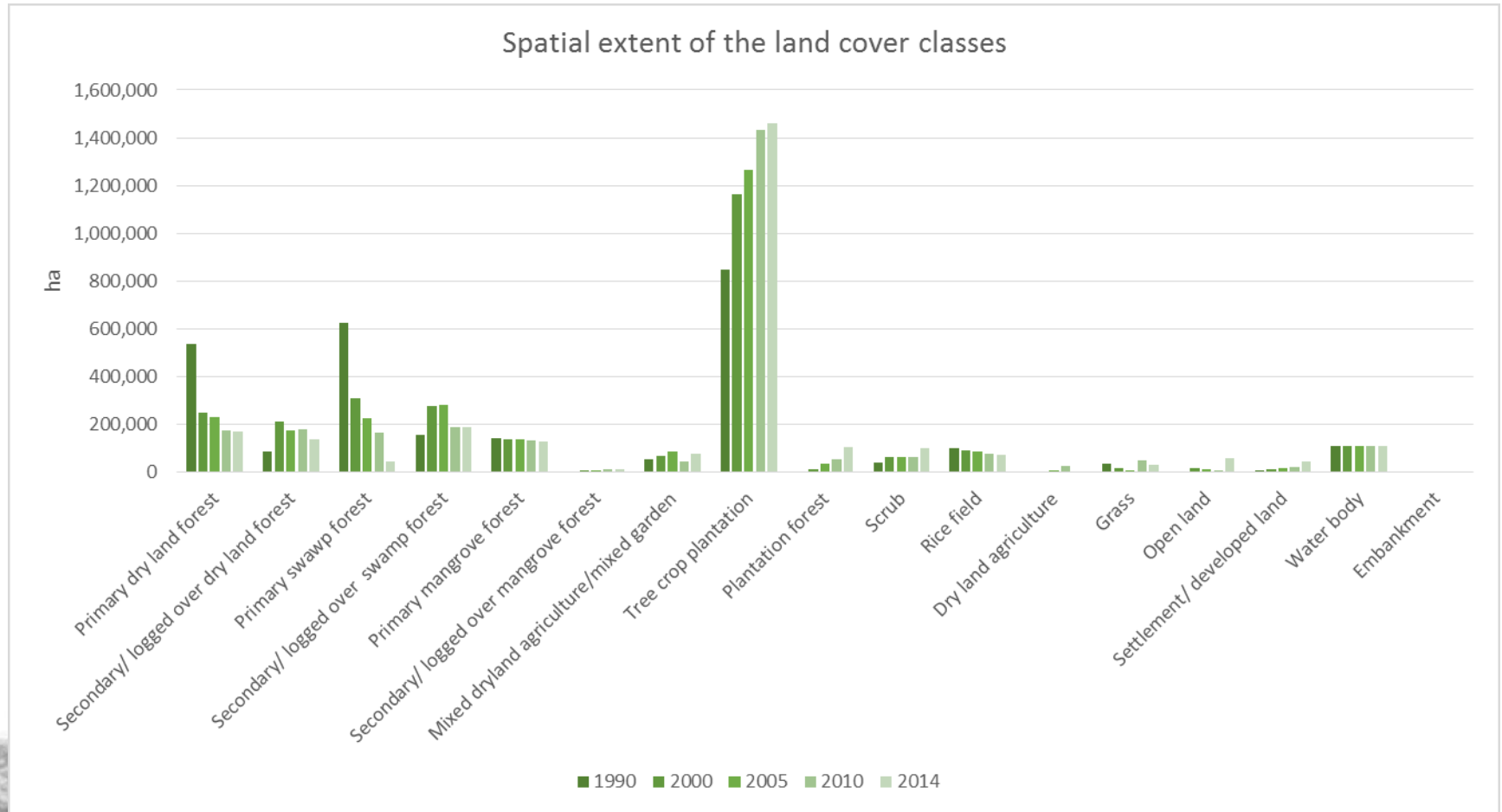
| Land cover class | Map code | AGB [t ha-1] | Carbon [t ha-1] |
|--|----------|--------------|-----------------|
| Primary dry land forest | 1 | 545 | 273 |
| Secondary/ logged over dry land forest | 2 | 256 | 128 |
| Primary swawp forest | 3 | 226 | 113 |
| Secondary/ logged over swamp forest | 4 | 74 | 37 |
| Primary mangrove forest | 5 | 198 | 99 |
| Secondary/ logged over mangrove forest | 6 | 44 | 22 |
| Mixed dryland agriculture/mixed garden | 7 | 105 | 53 |
| Tree crop plantation | 8 | 32 | 16 |
| Plantation forest | 9 | 40 | 20 |
| Scrub | 10 | 25 | 13 |
| Rice field | 11 | 10 | 5 |
| Dry land agriculture | 12 | 31 | 16 |
| Grass | 13 | 6,2 | 3 |
| Open land | 14 | 0 | 0 |
| Settlement/ developed land | 15 | 0 | 0 |
| Water body | 16 | 0 | 0 |
| Embankment | 17 | 0 | 0 |

Results: Land cover maps



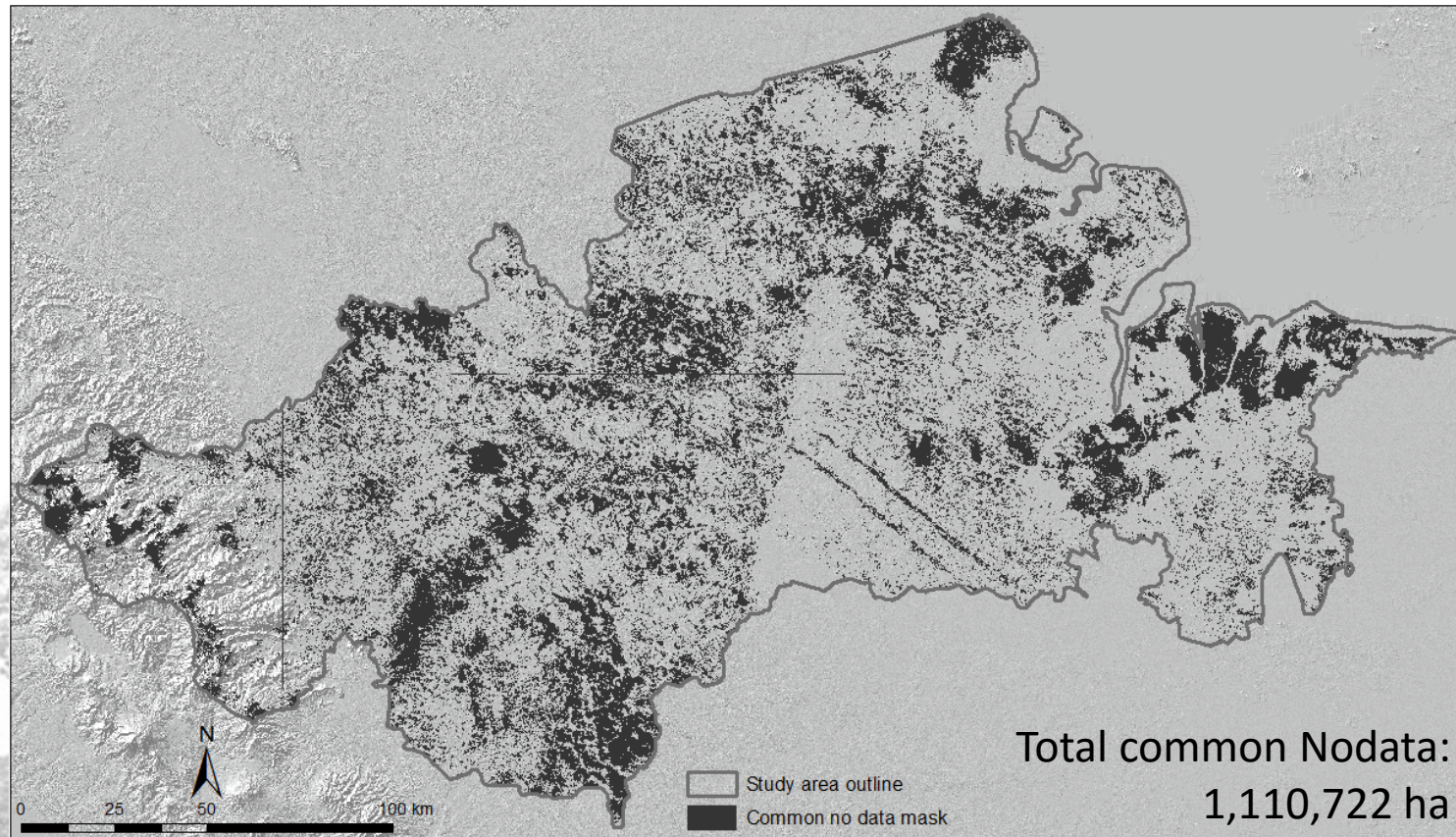
| | | | |
|--|--|----------------------------|------------|
| Primary dry land forest | Secondary/ logged over mangrove forest | Rice field | Water body |
| Secondary/ logged over dry land forest | Mixed dryland agriculture/mixed garden | Dry land agriculture | Embankment |
| Primary swamp forest | Tree crop plantation | Grass | No data |
| Secondary/ logged over swamp forest | Plantation forest | Open land | |
| Primary mangrove forest | Scrub | Settlement/ developed land | |

Results: Land cover statistics

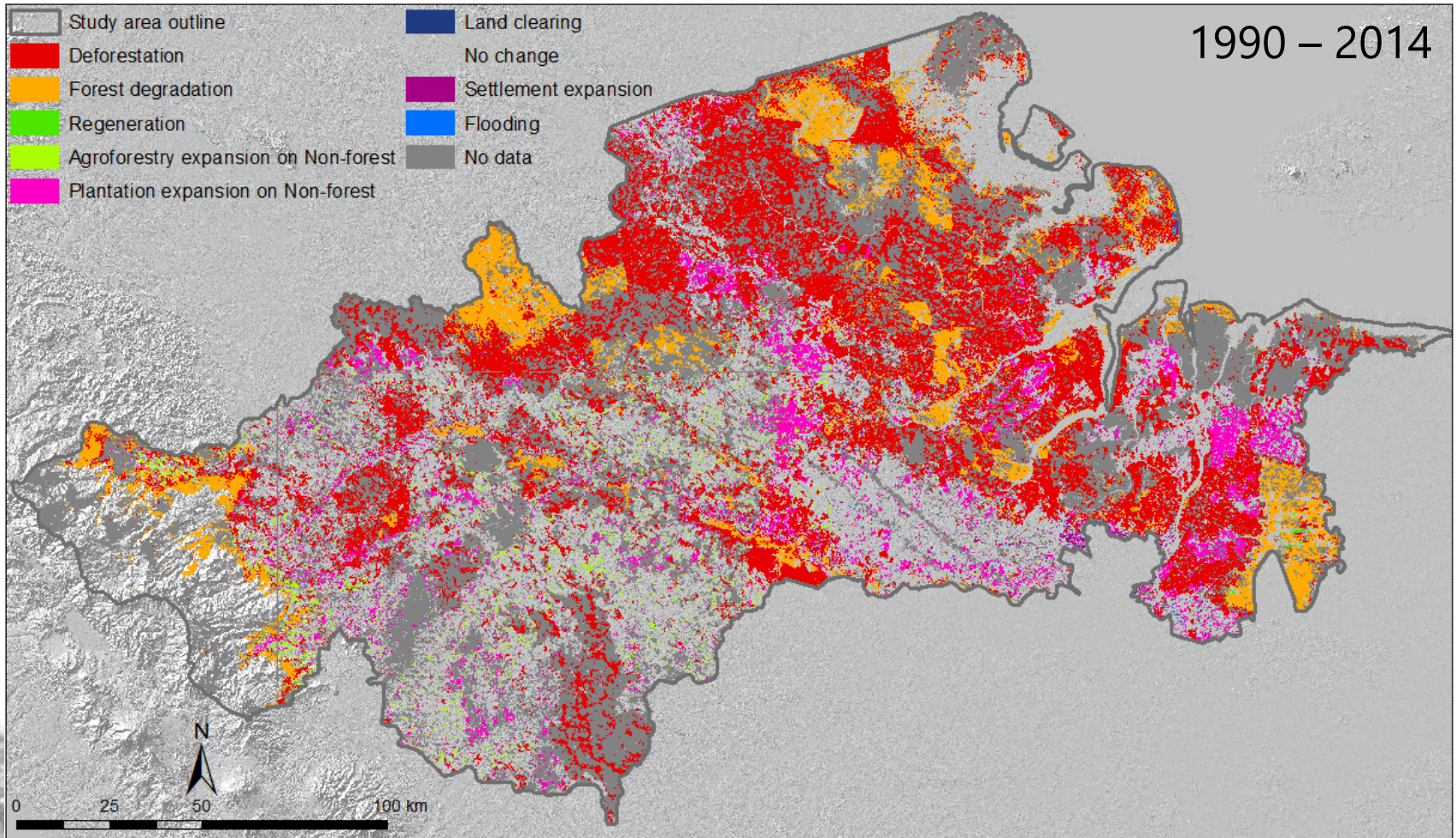


Results: Land cover change

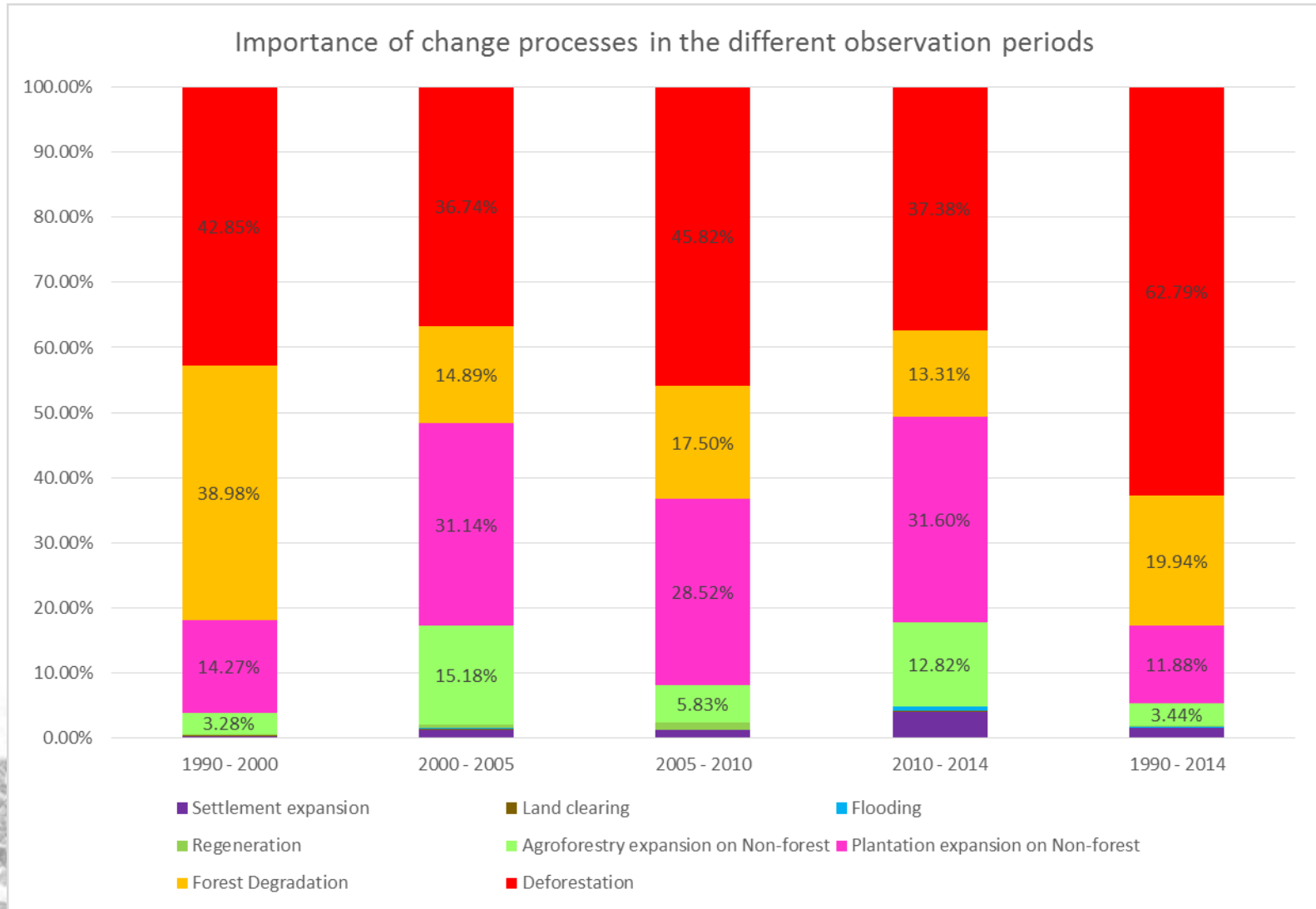
Multitemporal land cover change assessment requires the consolidation of No data areas of all points in time, in order to make the results for different observation periods comparable



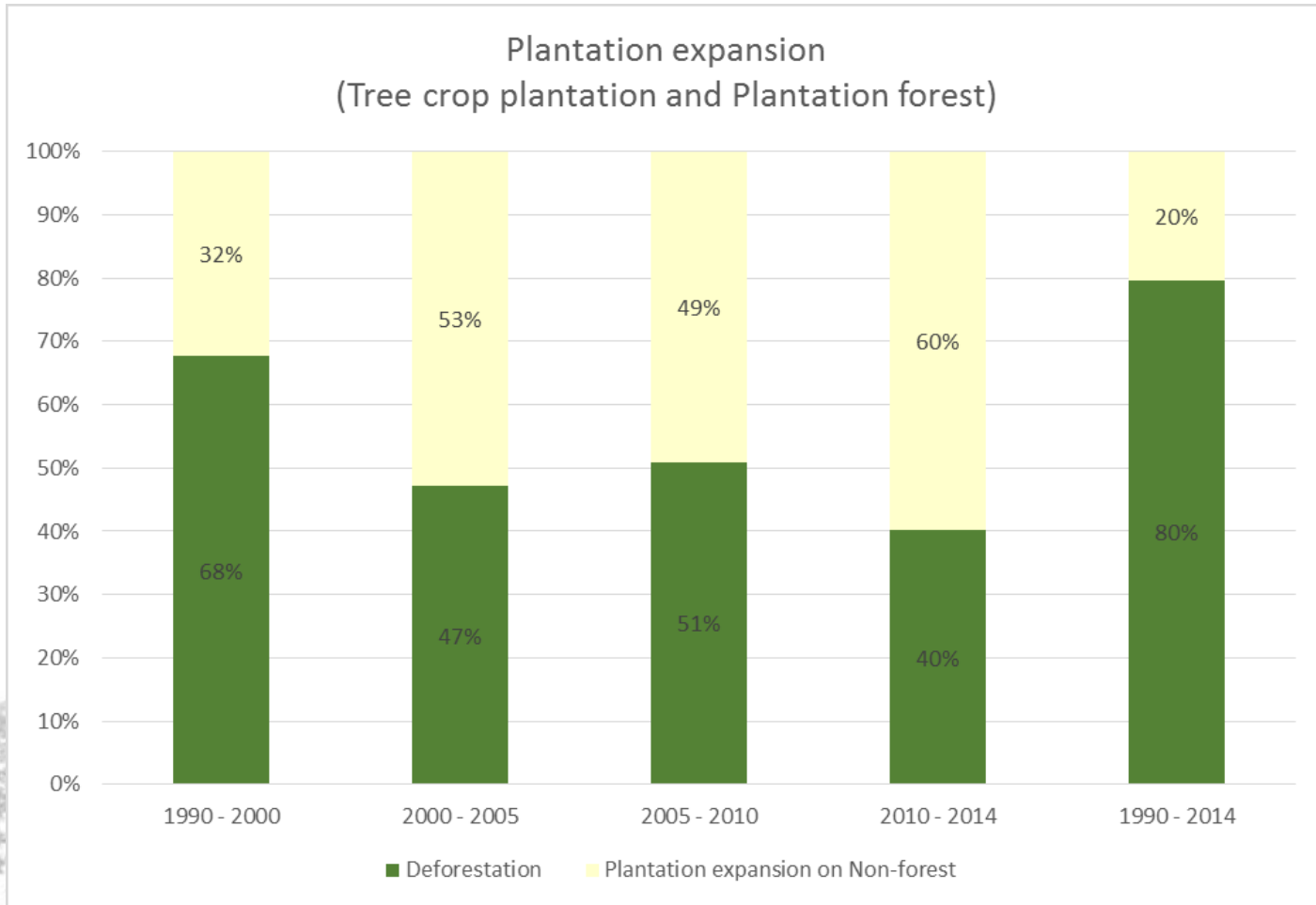
Results: Land cover change maps



Results: Land cover change processes

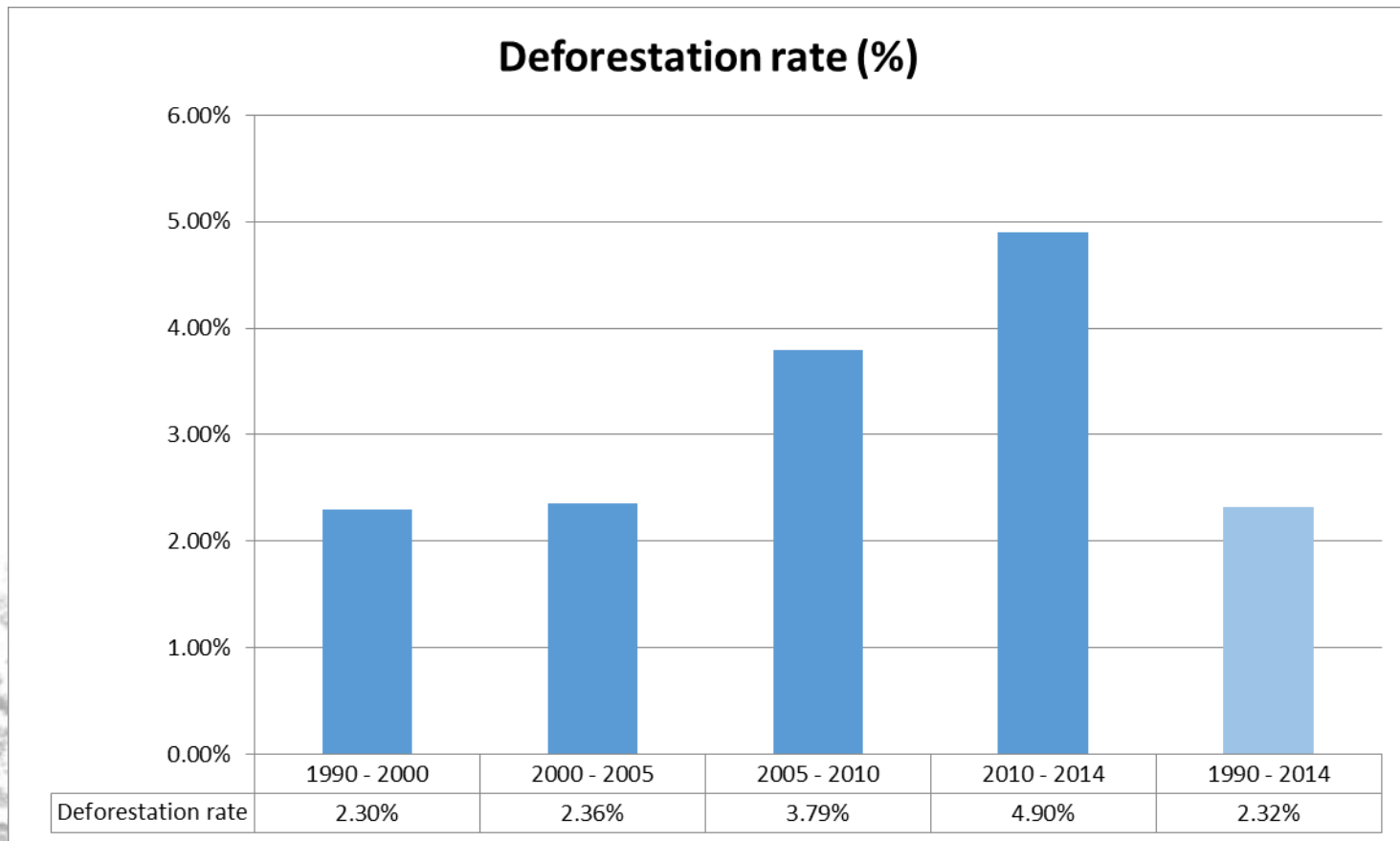


Results: Land cover conversion into plantations

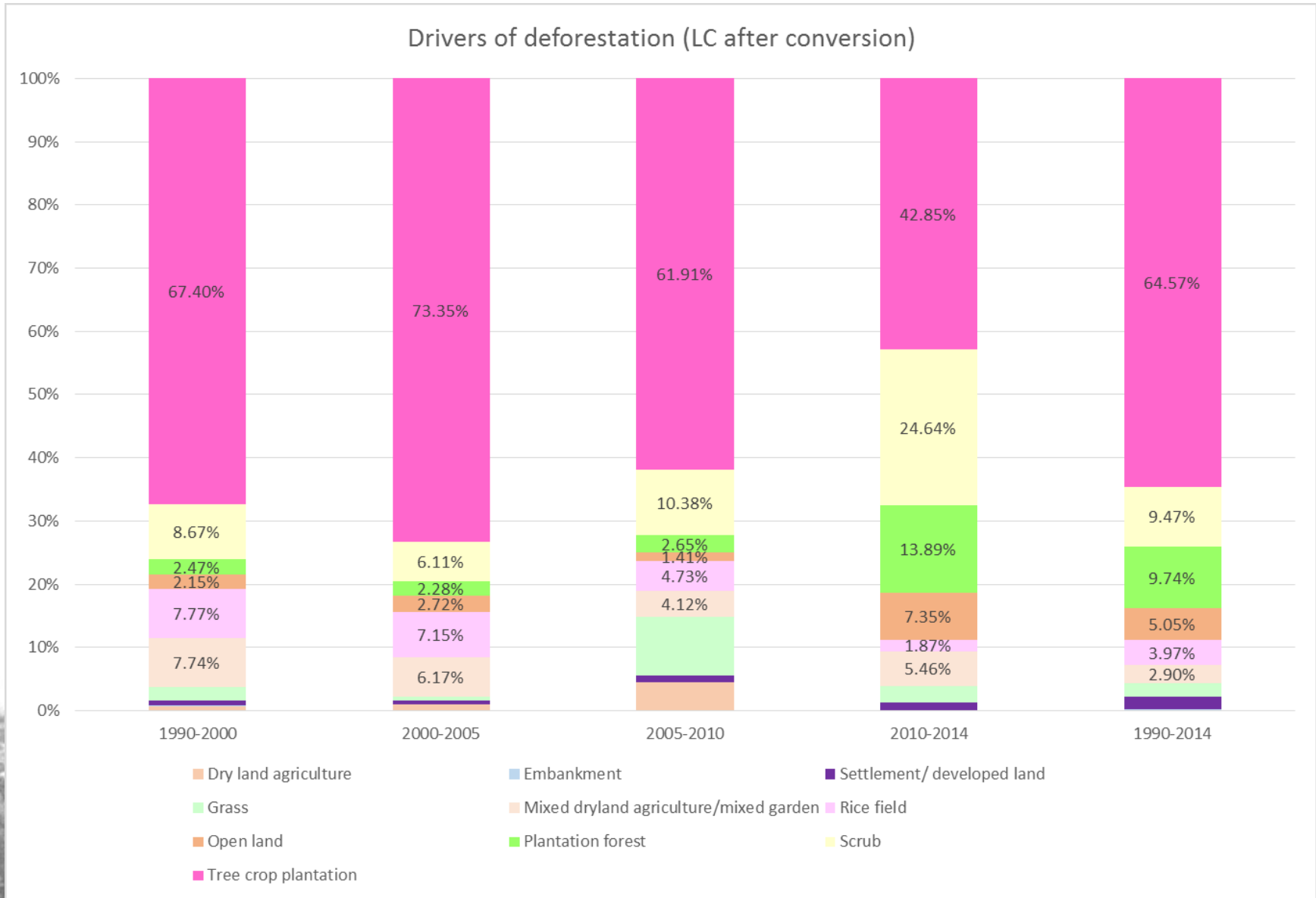


Results: Net forest loss and deforestation rate

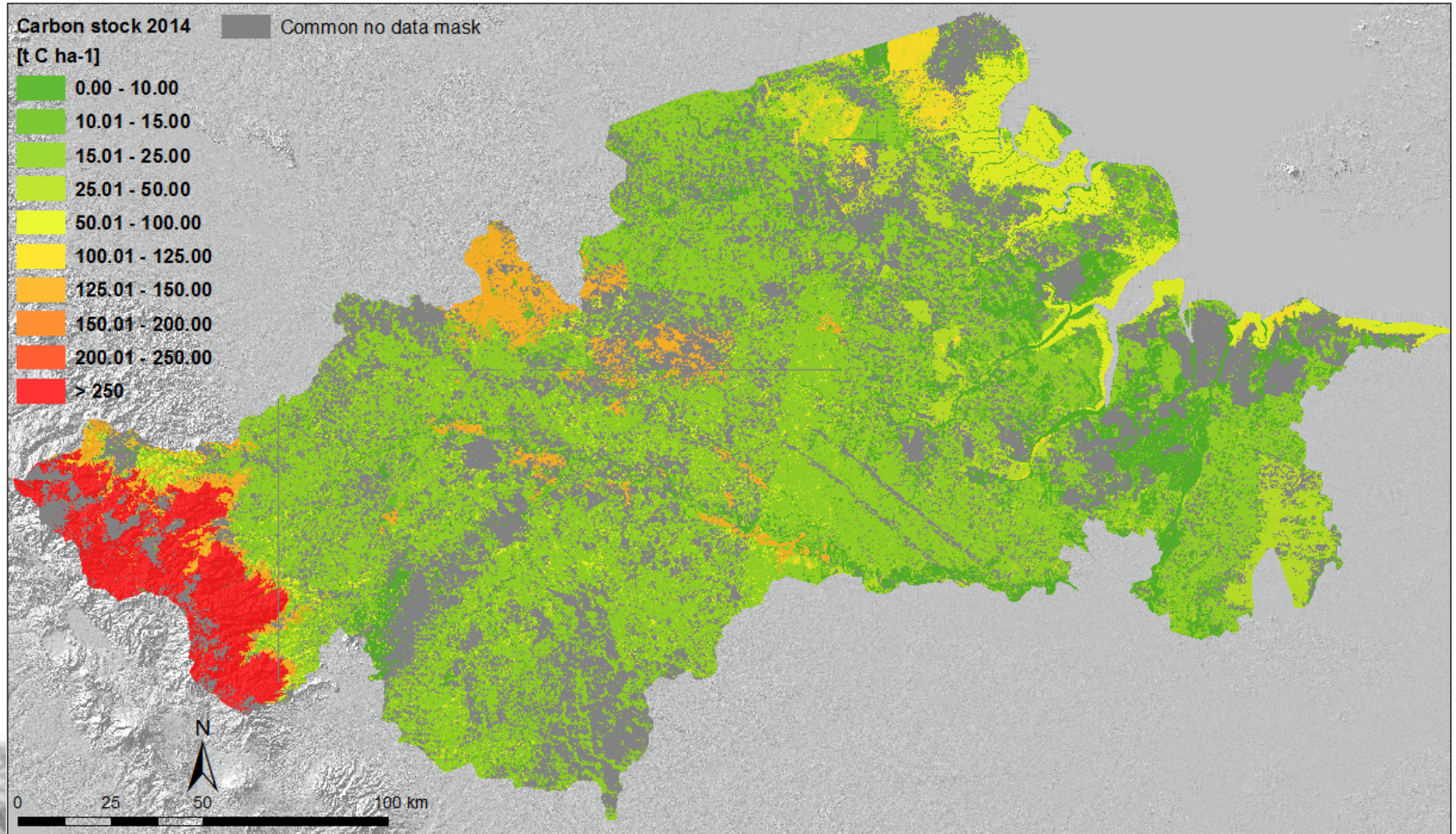
| Net forest loss | 1990 - 2000 | 2000 - 2005 | 2005 - 2010 | 2010 - 2014 | 1990 - 2014 |
|-----------------|-------------|-------------|-------------|-------------|-------------|
| ha | -357,080 | -140,784 | -199,873 | -167,549 | -865,286 |
| % | -23.01% | -11.78% | -18.96% | -19.61% | -55.75% |



Results: Drivers of deforestation



Results: Carbon stock maps



Results: Carbon stock change

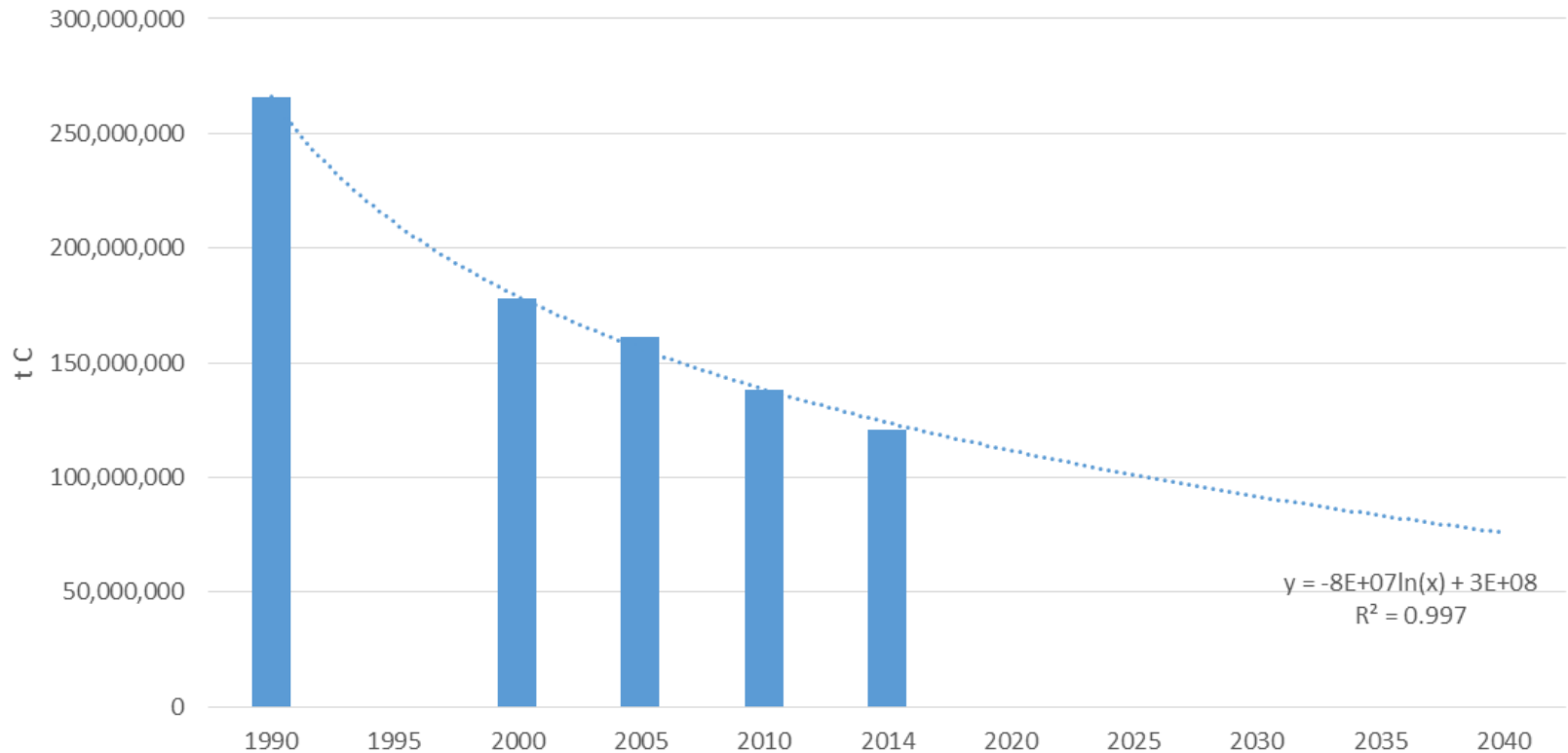
| Land Cover | Code | Carbon stock [ha] | | | | |
|--|------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | | 1990 | 2000 | 2005 | 2010 | 2014 |
| Primary dry land forest | 1 | 146,045,443 | 67,917,009 | 62,369,356 | 48,103,114 | 46,666,832 |
| Secondary/ logged over dry land forest | 2 | 11,036,091 | 27,077,322 | 22,240,581 | 22,808,287 | 17,472,038 |
| Primary swamp forest | 3 | 70,740,679 | 34,807,018 | 25,451,289 | 18,917,166 | 5,334,226 |
| Secondary/ logged over swamp forest | 4 | 5,772,165 | 10,341,828 | 10,376,160 | 6,936,543 | 7,020,166 |
| Primary mangrove forest | 5 | 14,384,304 | 13,863,889 | 13,774,807 | 13,199,862 | 12,724,300 |
| Secondary/ logged over mangrove forest | 6 | 57,139 | 146,393 | 149,191 | 251,250 | 298,729 |
| Mixed dryland agriculture/mixed garden | 7 | 2,836,328 | 3,500,771 | 4,527,736 | 2,419,276 | 3,989,247 |
| Tree crop plantation | 8 | 13,568,373 | 18,596,684 | 20,287,692 | 22,922,794 | 23,379,703 |
| Plantation forest | 9 | 0 | 266,013 | 684,860 | 1,134,070 | 2,153,637 |
| Scrub | 10 | 487,970 | 793,847 | 826,416 | 812,553 | 1,292,438 |
| Rice field | 11 | 495,594 | 452,011 | 434,506 | 385,418 | 361,552 |
| Dry land agriculture | 12 | 37,867 | 94,195 | 121,899 | 401,856 | 18,396 |
| Grass | 13 | 118,051 | 50,248 | 28,818 | 156,854 | 93,917 |
| Open land | 14 | 0 | 0 | 0 | 0 | 0 |
| Settlement/ developed land | 15 | 0 | 0 | 0 | 0 | 0 |
| Water body | 16 | 0 | 0 | 0 | 0 | 0 |
| Embankment | 17 | 0 | 0 | 0 | 0 | 0 |
| Sum | | 265,580,004 | 177,907,228 | 161,273,311 | 138,449,043 | 120,805,181 |

Total carbon loss 1990 - 2014:
Average annual loss:

144,774,823 t C (55%)
6,032,284 t C yr-1

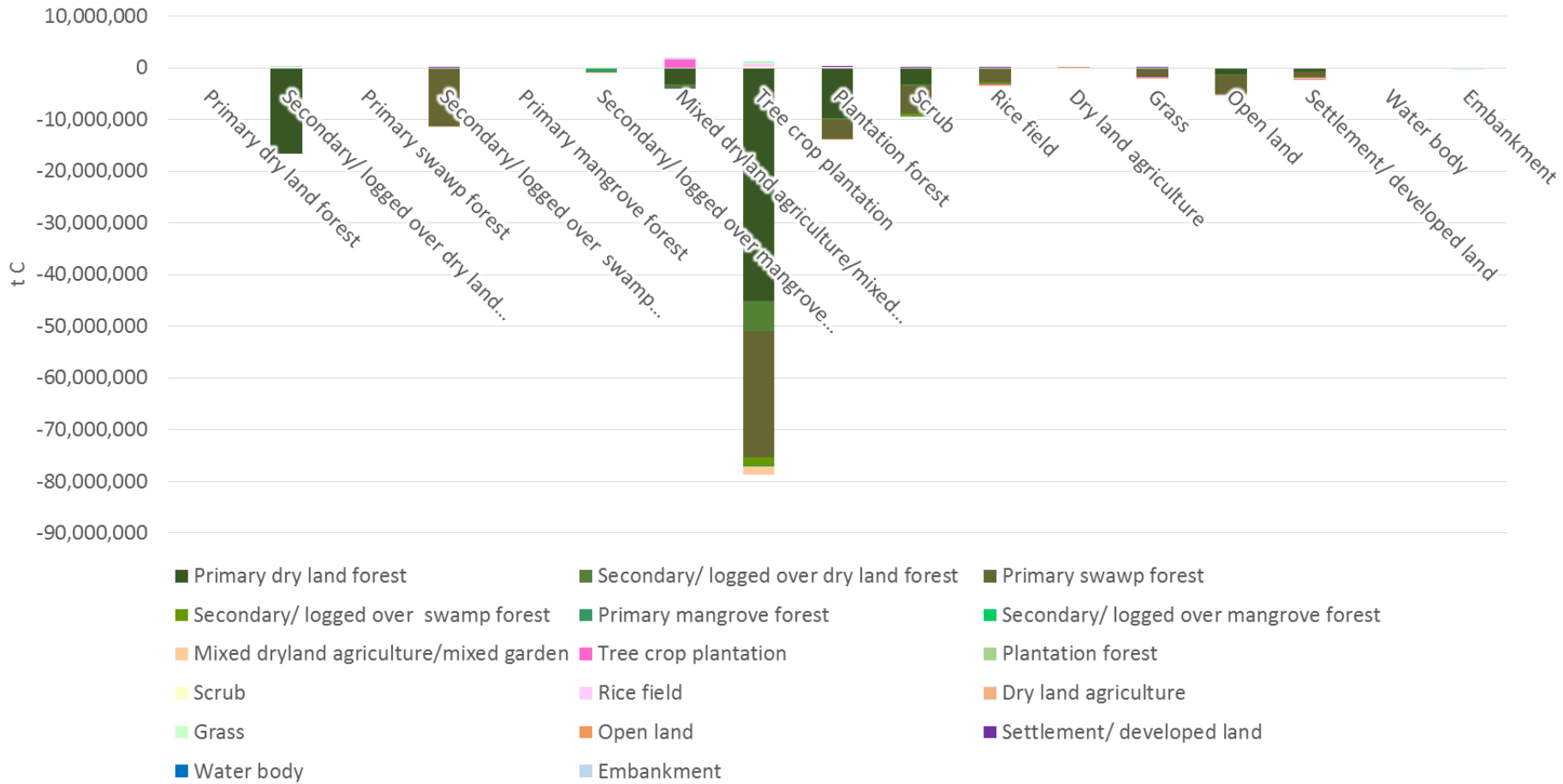
Carbon stock baseline

Carbon stock t C



Results: Drivers of carbon emissions

Drivers of carbon emissions 1990 - 2014



- Net forest loss amounts to -865,286 ha or -55.75% in the observation period 1990 – 2014
- Average deforestation rate 2.32 %
- Deforestation is most dominant change process, but is decreasing (63% average 1990-2014, 38 % 2010-2014)
- Conversion to tree crop plantation is most dominant driver of deforestation (65%), followed by conversion to plantation forest (10%)
- 55 % of carbon stock has been lost in the observation period 1990-2014, amounting to approx 145 Mio t C, or 6 Mio t C yr⁻¹
- Expansion of tree crop plantations is most dominant driver of carbon emissions, with the majority of emissions coming from conversion of primary dryland and primary swamp forest (1990-2014)