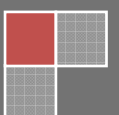


# Provisional Reference Emission Level of Central Sulawesi

Draft

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## 1. Introduction

Forest Reference Emission Level (REL) and/or forest Reference Levels (RLs) are benchmarks for assessing country's performance in implementing REDD+<sup>1</sup> activities. REL is the amount of gross emissions from a geographical area estimated within a reference time period, while RL is the amount of net/gross emission and removals from a geographical area estimated within a reference time period. Reference Emission Level is the level of emission that is used to demonstrate emission reduction from avoided deforestation and forest degradation while Reference Level is the level of carbon stocks that is used to demonstrate emission reduction from conservation, sustainable forest management and enhancement of carbon stock. Both RELs and RLs are expressed in tonnes of carbon dioxide equivalent.

Since Central Sulawesi choosed as pilot on REDD readiness activities under UN-REDD Indonesia programme, Initiative to implement REDD+ in Central Sulawesi requires the development of a reference emissin level that reasonably represents the changes in carbon stocks in pools and GHG emissions by sources and removals by sinks that would have occured without REDD+ intervention. The reference will be used as a reference to determine whether the proposed REDD+ project activity is additional. On this report, provisional Reference Emission Level of Central Sulawesi calculated using selected method which recommended by stakeholders from government and others at national and sub-national level through series of technical consultations.

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<sup>1</sup> REDD+ (Reducing Emissions from Deforestation and Degradation plus three other activities: conservation, sustainable forest management and enhancement of carbon stocks).

## **2. General Overview of Central Sulawesi Province on REDD Implementation**

Central Sulawesi is one of province in Sulawesi Island. Administratively, Central Sulawesi Province has a total land area 68.033km<sup>2</sup> in the form characterized by hills ecosystem. With a narrow slope with unstable soil conditions are generally suitable geological characteristics. On the other hand, the province has a wealth of natural resources such as forests with a wealth of high biodiversity and is part of the Wallacea. Also in the region of Central Sulawesi is also rich in mineral mining materials. Various efforts have been made by the Central and Local Government or in conjunction with the Central Government to build this area, these efforts include the placement of the population through the transmigration program in a few places that are projected as a center of production, forestry, mineral management and development of good agricultural food and plantations and the construction of basic infrastructure.

Development activities mentioned above can not be prevented from terjadinya ecosystem changes that could potentially degrade the quality of the environment. To mengperkecil negative impact that would arise, the government implemented a national policy on environmental management through Pokiok Environmental Law and Environmental Impact Assessment (EIA) and is currently carried out a strategic environmental assessment (KLHS) in order to construct a development policy. Since commitments of Indonesia Government have been submitted by the President at the G20 meeting in Pittsburg September 2009, Indonesia proposed to reduce emissions by 26% from BAU in 2020 with their own business and can be increased to 41% with international support. National policy should respond and take measures by all parties to support these commitments, including local government and its local people in Central Sulawesi. One of activities to respond the COP 13 Bali is decreased the emissions, especially carbon, known as REDD, or emission reduction from deforestation and forest degradation. This conception was later developed into a component to include REDD+; Sustainable Forest Management (SFM), conservation and enhancement carbon activity.

Due to support REDD program in Central Sulawesi, UNREDD was seen by local government as an opportunity to support Central Sulawesi region as REDD pilot project. Series of discussions and studies has been conducted including Inception Workshop of UN-REDD participated by local government in March 2010. From this discussion along with input from the stakeholders by the UN-REDD national workshop decided that the Central Sulawesi Province was selected as a

Demonstration Activity REDD +, which in turn determined by the Secretary General of the Ministry of Forestry Letter Number: 5.786/II-KLN/2010 dated July 26, 2010.

On October 13, 2010 Launching of the UN-REDD Programme by the Governor of Central Sulawesi. Since then, various activities are being implemented with the involvement of various stakeholders in order to prepare the province of Central Sulawesi welcome the implementation of REDD + mechanism, and supported by UN-REDD National. The most serious thing in preparation for proficiency level is the emergence of a view and a different understanding and appreciation of one another about climate change and REDD + program. Realizing the urgency of the matter, the local government of Central Sulawesi develop REDD+ Working Group of Central Sulawesi on February 18, 2011 legalized by Governor of Central Sulawesi Number: 522/84/DISHUTDA-G.ST/2011.

There are several preparations that have been implemented together with the Working Group Sulteng REDD UN-REDD to memoersiapkan Central Sulawesi towards the implementation of REDD program:

**a. Capacity Building**

- Knowledge and preseption strenghtening related with climate change and REDD issue through workshops, focus group discussions, seminars ranging from internsonal levels - local and Feld visit,
- Technical strengteing related with technology implementation to support REDD; Remote sensing training, field surveys training, etc.

**b. Institutional Strenghtening Starting with REDD working group**

Related to MRV, the infrastructure is an important part of participating countries on REDD program. An important part of the MRV is not only the technical measurement, reporting and validation but it is the value of Banch Mark of emission, known as emission Reference Level (REL) and the Reference Level (RL).

### 3. Emission History of Central Sulawesi

Since Central Sulawesi has been chosen as provincial level REDD demonstration activities area, which defining REL as part of the step approaches, identify the historical emission of Central Sulawesi then become the prerequisites. Past emission was calculated based on activity data and emission factor. Represent those data, various time series of land cover; yr 2000, 2003, 2006, 2009, 2011 as well as emission factor was taken from BAPLAN used as an input. Scooping of this paper is focusing on historical emission caused by deforestation and forest degradation.

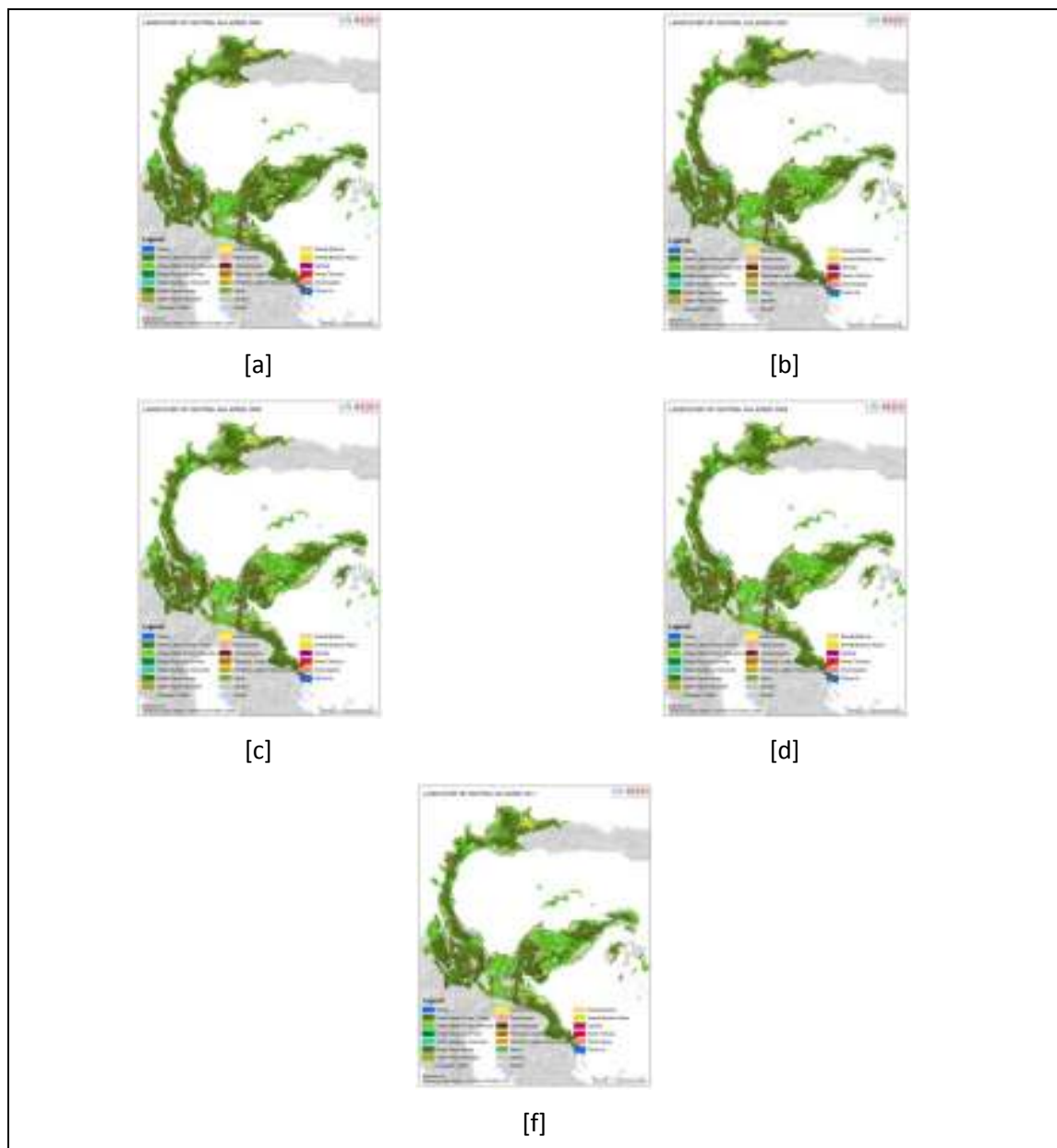


Figure 1. Landcover of Central Sulawesi since 2000 until 2011

Table 1. Emission Factor for Baplan land cover class

| Landcover                 | stok_tCha   | Source          |
|---------------------------|-------------|-----------------|
| Dryland Primary Forest    | 195.4       | NFI             |
| Dryland Secondary Forest  | 169.7       | NFI             |
| Primary Mangrove          | 170         | NFI             |
| Primary swamp forest      | 196         | NFI             |
| Secondary Mangrove Forest | 120         | NFI             |
| Secondary Swamp Forest    | 155         | NFI             |
| Forest Plantation         | 100         | NFI             |
| Shrub                     | 15          | Wasrin, 2000    |
| Shrub Swamp               | 15          |                 |
| Estate Crop               | 63          |                 |
| Settlement                | 1           |                 |
| Grassland                 | 4.5         |                 |
| Dryland Agriculture       | 8           |                 |
| Mixed Dryland Agriculture | 10          |                 |
| Paddy field               | 5           |                 |
| Transmigration            | 10          |                 |
| Cacao plantation          | 8,4 Mg C/ha | Gravenhos et al |

*Table source: Baplan MoF (2011) and Tadulako University (2010)*

### 3.1. Landcover Change Analysis

Landcover change analysis was done for Central Sulawesi compared time series data from 2000 until 2009. Matrix below describe the landcover change transition during this period. Red shadow indicate deforestation, meanwhile the yellow one indicated the forest degradation which are caused during this period.

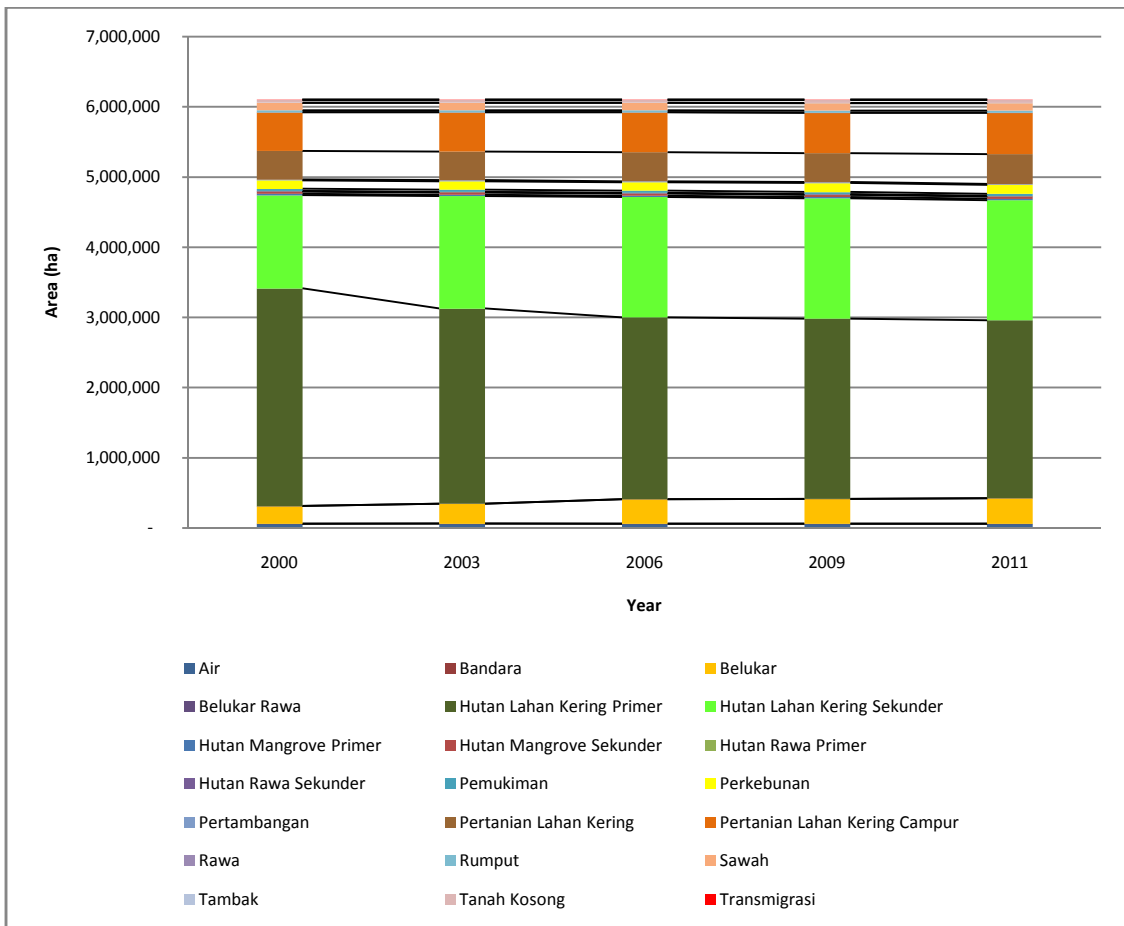


Figure 2. Landcover change in Central Sulawesi during 2000 until 2011

Table 2. Landcover Transition Method during 2000 until 2011

|             |                               | 2009   |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |         |        |       |              |              | Grand Total |        |           |         |       |           |
|-------------|-------------------------------|--------|---------|---------|--------------|---------------------------|-----------------------------|-----------------------|-------------------------|-------------------|---------------------|-----------|------------|--------------|------------------------|-------------------------------|---------|--------|-------|--------------|--------------|-------------|--------|-----------|---------|-------|-----------|
|             |                               | Air    | Bandara | Belukar | Belukar Rawa | Hutan Lahan Kering Primer | Hutan Lahan Kering Sekunder | Hutan Mangrove Primer | Hutan Mangrove Sekunder | Hutan Rawa Primer | Hutan Rawa Sekunder | Pemukiman | Perkebunan | Pertambangan | Pertanian Lahan Kering | Pertanian Lahan Kering Campur | Rawa    | Rumput | Sawah | Transmigrasi | Tanah Kosong |             |        |           |         |       |           |
| 2000        | Air                           | 15,323 |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |         |        |       |              |              |             | 15,323 |           |         |       |           |
|             | Bandara                       |        | 102     |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |         |        |       |              |              |             |        | 102       |         |       |           |
|             | Belukar                       |        |         | 240,332 |              |                           | 11                          |                       |                         |                   |                     |           |            | 116          | 182                    | 233                           | 315     |        |       |              |              |             | 419    | 241,397   |         |       |           |
|             | Belukar Rawa                  |        |         |         | 333          |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |         |        |       |              |              |             |        |           | 333     |       |           |
|             | Hutan Lahan Kering Primer     |        |         |         |              | 2,327,282                 | 549,222                     |                       |                         |                   |                     |           |            | 4,791        |                        | 531                           | 3,131   |        |       |              | 146          |             | 489    | 3,489,084 |         |       |           |
|             | Hutan Lahan Kering Sekunder   |        |         |         |              |                           | 352                         | 4,933,043             |                         |                   |                     |           |            |              |                        |                               | 24,038  |        |       |              | 171          |             | 3,288  | 5,333,225 |         |       |           |
|             | Hutan Mangrove Primer         |        |         |         |              |                           |                             |                       | 13,432                  | 4,752             |                     |           |            |              |                        |                               |         |        |       |              |              |             |        |           | 18,184  |       |           |
|             | Hutan Mangrove Sekunder       |        |         |         |              |                           |                             |                       |                         |                   | 31,388              |           |            |              |                        |                               |         |        |       |              |              |             |        |           | 31,388  |       |           |
|             | Hutan Rawa Primer             |        |         |         |              |                           |                             |                       |                         |                   |                     | 353       |            |              |                        |                               |         |        |       |              |              |             |        |           | 353     |       |           |
|             | Hutan Rawa Sekunder           |        |         |         |              |                           |                             |                       |                         |                   |                     |           | 7,737      |              |                        |                               |         |        |       |              |              |             |        |           | 7,737   |       |           |
|             | Pemukiman                     |        |         |         |              |                           |                             |                       |                         |                   |                     |           | 23,327     |              |                        |                               |         |        |       |              |              |             |        |           | 23,327  |       |           |
|             | Perkebunan                    |        |         |         |              |                           |                             |                       |                         |                   |                     |           |            | 128,415      |                        |                               |         |        |       |              |              |             |        |           | 128,415 |       |           |
|             | Pertambangan                  |        |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              | 41,274                 |                               |         |        |       |              |              |             |        |           | 41,274  |       |           |
|             | Pertanian Lahan Kering        |        |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        | 493,852                       |         |        |       |              |              |             |        |           | 493,852 |       |           |
|             | Pertanian Lahan Kering Campur |        |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               | 544,852 |        |       |              | 216          |             | 18     |           | 546,216 |       |           |
|             | Rawa                          |        |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |         | 517    |       |              |              |             |        |           | 517     |       |           |
|             | Sawah                         |        |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |         |        |       |              |              | 18,839      |        |           | 18,839  |       |           |
|             | Transmigrasi                  |        |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |         |        |       |              |              | 182,286     |        |           | 182,286 |       |           |
|             | Tanah Kosong                  |        |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |         |        |       |              |              |             | 4,281  |           | 4,281   |       |           |
|             | Total                         |        |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |         |        |       |              |              |             |        |           | 56,307  |       |           |
| Grand Total |                               | 15,323 | 102     | 240,332 | 333          | 2,327,282                 | 6,212,281                   | 13,432                | 51,822                  | 352               | 7,737               | 23,327    | 128,415    | 41,274       | 10,483                 | 497,948                       | 544,852 | 171    |       |              | 18,839       | 493,762     | 4,281  | 48,382    | 4,332   | 2,025 | 6,465,467 |

Analyzed based on data from: Ditjen Planologi Ministry of Forestry



### 3.2. Deforestation and Degradation in Central Sulawesi

Deforestation and forest degradation was identified at four sequential years; 2000 to 2003, 2003 to 2006, 2006 to 2009, and 2009 to 2011.

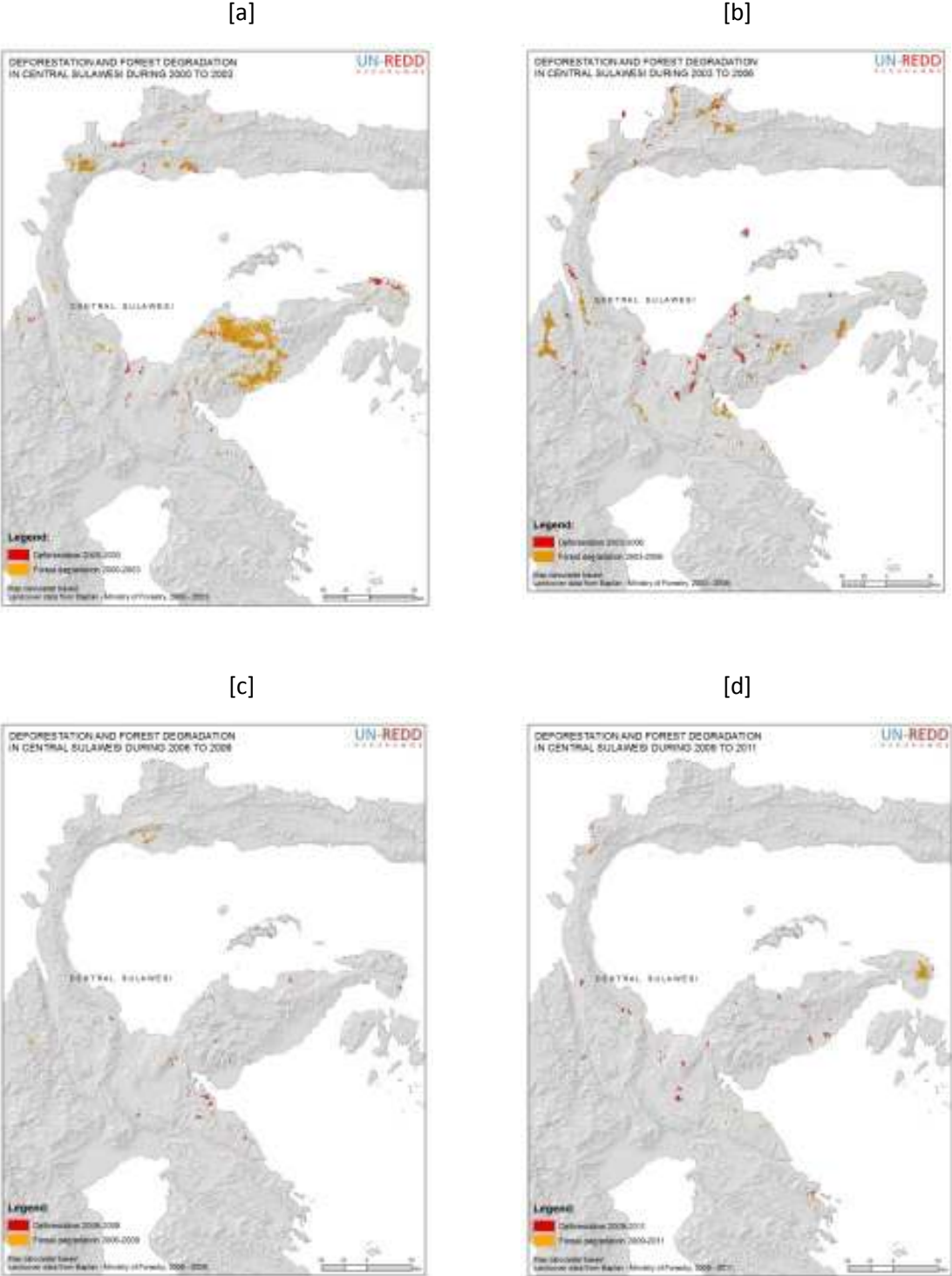
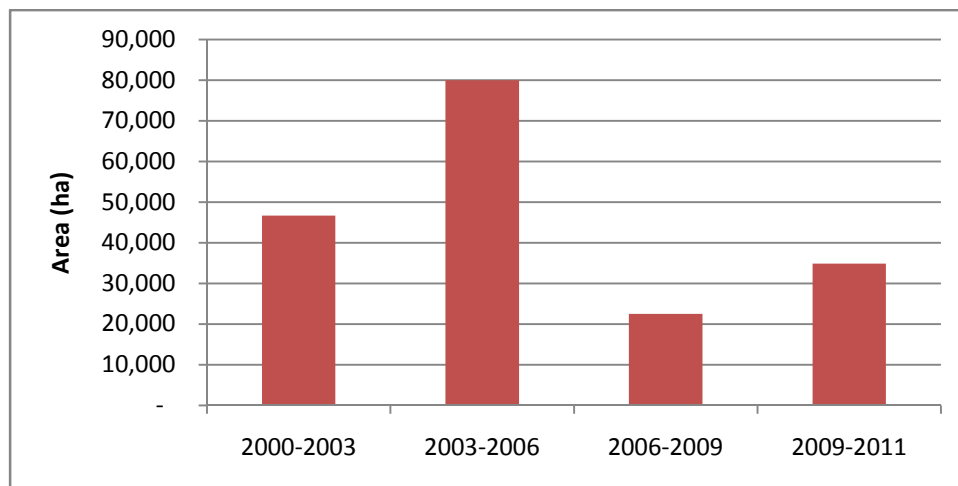
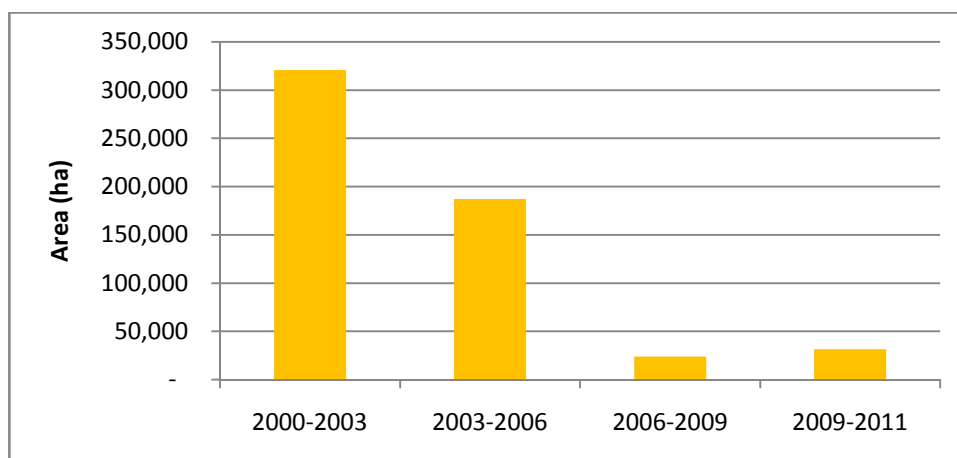


Figure 3. Deforestation and forest degradation during: [a] 2000-2003, [b] 2003-2006, [c] 2006-2009, and [d] 2009-2011

Based on the analysis which presented on above series of deforestation and forest degradation maps, period 2003 to 2006 has highest deforestation and forest degradation rate during last decade in Central Sulawesi.



*Figure 4. Deforestation at four different periods in Central Sulawesi*



*Figure 5. Forest degradation at four different periods in Central Sulawesi*

Biggest land cover change which attends to deforestation since 2000 until 2011 is conversion from Dry land Secondary Forest to Shrub, Dry land Agriculture, and Shrub Mixed Dry land Agriculture. Transmigration, mining, estate crop, and infrastructure development identified as factors which drive this forest conversion to shrub land cover type (RPJP report). Meanwhile, conversion from Dry land Primary Forest became Dry land Secondary Forest is the biggest land cover change which attend to forest degradation during this period. There

are some interesting phenomenon of landcover change during 2003 until 2006 in Central Sulawesi. During this period, there are huge forest degradation happen in Central Sulawesi. Summary of deforestation and forest degradation in Central Sulawesi shown on table below.

Table 3. Deforestation and Forest Degradation of Central Sulawesi during 2000 until 2011

|                        | Deforestation |        | Forest degradation |         |
|------------------------|---------------|--------|--------------------|---------|
|                        | ha            | ha/th  | ha                 | ha/th   |
| <b>2000-2003</b>       | 46,704        | 15,568 | 320,826            | 106,942 |
| <b>2003-2006</b>       | 80,031        | 26,677 | 187,242            | 62,414  |
| <b>2006-2009</b>       | 22,487        | 7,496  | 23,884             | 7,961   |
| <b>2009-2011</b>       | 34,919        | 17,460 | 31,521             | 10,507  |
| <b>Total 2000-2011</b> | 184,141       | 16,740 | 563,473            | 51,225  |

Calculated from Landcover data of Central Sulawesi, BAPLAN 2000-2011

### 3.3. Historic Emission

Based on extrapolation between above land cover change matrix and carbon density data, below are the emission factor matrix (in ton CO<sub>2</sub>-eq/year) of Central Sulawesi during 2000 until 2011.

Table 4. Emission Factor Matrix of Central Sulawesi during 2000 until 2011

|                            | 2011 |         |           |            |                        |                        |                    |                      |                 |                  |             |             |             |                      |                            |       |        | Total  |         |         |             |              |            |           |
|----------------------------|------|---------|-----------|------------|------------------------|------------------------|--------------------|----------------------|-----------------|------------------|-------------|-------------|-------------|----------------------|----------------------------|-------|--------|--------|---------|---------|-------------|--------------|------------|-----------|
|                            | Air  | Bandara | Bekas     | Bekas Rasi | Hutan Lahan Kering Pri | Hutan Lahan Kering Sek | Hutan Mangrove Pri | Hutan Mangrove Sekur | Hutan Raus Prim | Hutan Raus Sekur | Pertamban d | Pertamban g | Pertamban s | Pertamban Lahan Kari | Pertamban Lahan Kering Cui | Rasa  | Pomput |        | Sawah   | Tembak  | Tanah Karan | Transmigrasi |            |           |
| Air                        | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Bandara                    | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Bekas                      | -    | -       | -         | -          | -                      | (1,029)                | -                  | -                    | -               | -                | -           | (1,023)     | 990         | 1,020                | 1,552                      | -     | -      | -      | -       | 2,690   | -           | -            | 2,726      |           |
| Bekas Raus                 | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | 89      | -       | -           | -            | 89         |           |
| Hutan Lahan Kering Primer  | -    | -       | 542,052   | -          | -                      | 4,644,277              | -                  | -                    | -               | -                | -           | 207,757     | 1,790       | 119,012              | 425,741                    | -     | -      | 2,023  | -       | 35,433  | -           | -            | 5,494,856  |           |
| Hutan Lahan Kering Sekund  | -    | -       | 5,388,227 | -          | (5,411)                | -                      | -                  | -                    | -               | -                | 3,049       | 24,903      | 23,404      | 909,421              | 1,857,674                  | -     | -      | 41,234 | -       | 192,731 | -           | -            | 4,907      | 6,346,450 |
| Hutan Mangrove Primer      | -    | -       | 3         | -          | -                      | -                      | -                  | 29,195               | -               | 0                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | 29,195     |           |
| Hutan Mangrove Sekundar    | -    | -       | -         | 754        | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | 340     | -           | -            | 1,094      |           |
| Hutan Raus Primer          | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Hutan Raus Sekundar        | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | 3,899  | -      | -       | -       | -           | -            | 3,899      |           |
| Pemukimn                   | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Pertamban                  | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Pertamban s                | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Pertamban Lahan Kering     | 1    | -       | (213)     | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | 211    | -       | 210     | -           | -            | 41         |           |
| Pertamban Lahan Kering Cui | -    | -       | (2,146)   | -          | -                      | (10,027)               | -                  | -                    | -               | 59               | (15,083)    | -           | -           | -                    | -                          | -     | -      | 345    | -       | 926     | -           | -            | (35,624)   |           |
| Rasa                       | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Pomput                     | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Sawah                      | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | (195)                      | (195) | -      | -      | -       | -       | -           | -            | (222)      |           |
| Tembak                     | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Tanah Karan                | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | (332)       | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | (332)      |           |
| Transmigrasi               | -    | -       | -         | -          | -                      | -                      | -                  | -                    | -               | -                | -           | -           | -           | -                    | -                          | -     | -      | -      | -       | -       | -           | -            | -          |           |
| Total                      | 1    | -       | 5,164,854 | 754        | (5,411)                | 4,635,251              | -                  | 29,195               | -               | 3,109            | 214,697     | 25,104      | 1,029,617   | 2,204,850            | 3,099                      | -     | 44,722 | 340    | 220,593 | 1,407   | -           | -            | 14,346,701 |           |

Below are the summary of above matrix.

Table 5. Historic emission of Central Sulawesi during 2000 until 2011.

|               | Total (ton CO <sub>2</sub> -eq/year) |
|---------------|--------------------------------------|
| Emission      | 14,392,090                           |
| Sequestration | 45,382                               |
| Net Emission  | 14,346,708                           |

Initial emission during 2000 until 2011 are 14,392,090 ton CO<sub>2</sub>-eq/year, meanwhile the initial sequestration are 45,382 ton CO<sub>2</sub>-eq/year. Hence, net historic emission during 2000 until 2011 in Central Sulawesi are 14,346,708 ton CO<sub>2</sub>-eq/year.

## **4. Provisional REL for Central Sulawesi**

On previous report, review on various potential methods already identified which potentially can be used for REL calculation in Central Sulawesi. Refer various technical discussion from stakeholders particularly from government at national and sub-national level, historical based and adjusted historical based both recommended to be applied. Historical based recommended by national government due to its applicability reason considering availability data and less of complexity. Meanwhile adjusted historical recommended by government at sub-national level since its can be adjusted using their sub-national circumstances.

In line with above recommendations, provisional REL of Central Sulawesi calculated using both methodology. Hence in future, this document may used as an input or reference to government at national and sub-national level when defining the REL on legal matter.

Provisional REL calculated using current available data. Activity data taken from landcover map of Baplan year 2000 until 2011, meanwhile emission factor using default national value which released by Baplan on 2011.

### **4.1. Provisional REL using Historical Based Method**

Historical Based (HB) method project the future emission based on historic emission which occurred in a region. Historic emissions synthesized from the activity data in the form of land cover change data and carbon density. Since government of Indonesia committed to reduced the emission on 2020. This period (2020) then used as projection year on calculation of initial REL.

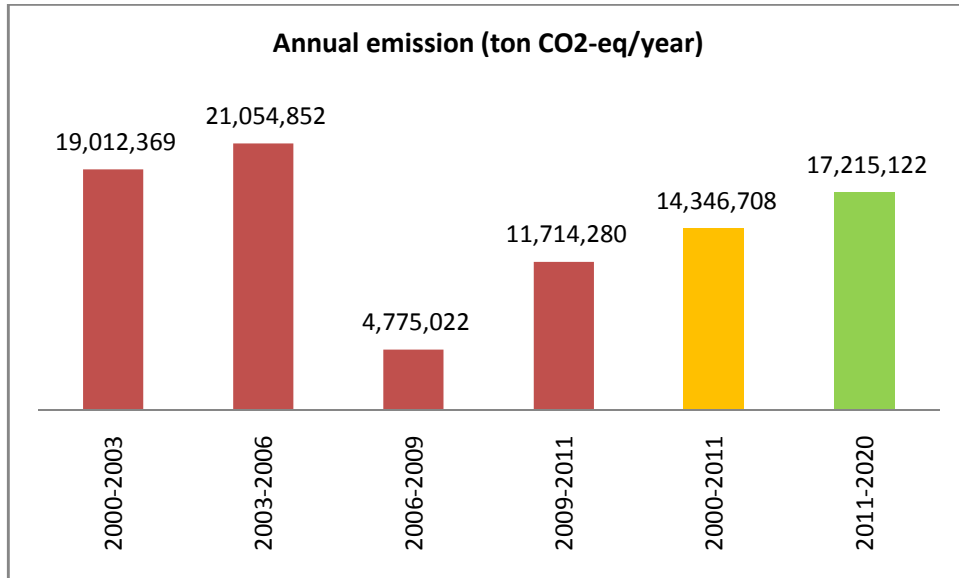


Figure 6. Projected annual emission based on historical data

Based on historic emission, using historical based method, the projected annual emission between 2000 until 2020 are 17,215,122 ton CO2-eq/year. Below are the provisional REL using historical based method.

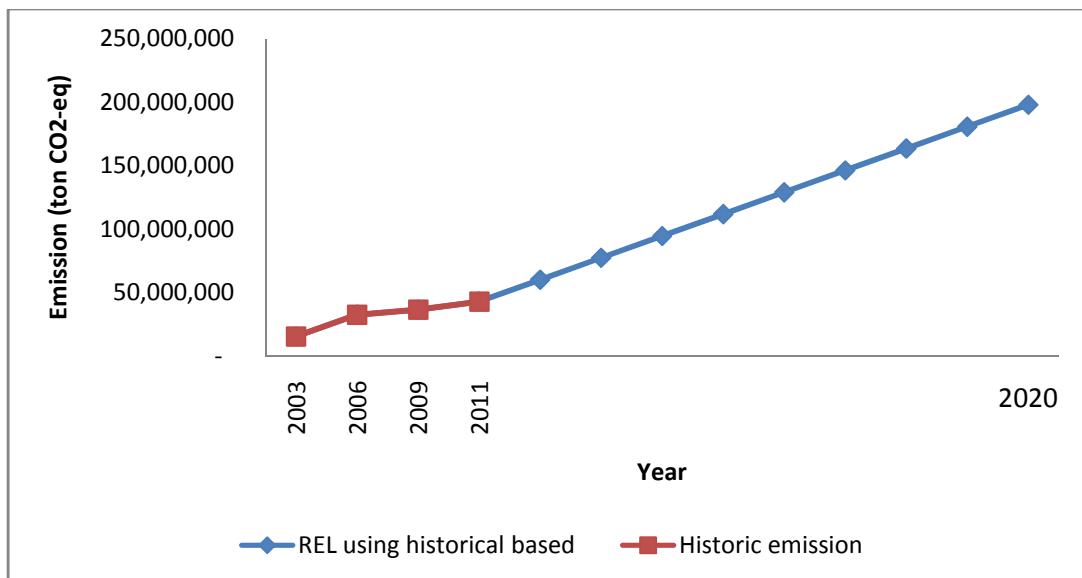


Figure 7. Provisional REL calculated using historical based method

## 4.2. Provisional REL using Adjusted Historical Method

Adjusted Historical Based (AHB) method project the future emission based on historic emission which adjust using some adjustment factors related on their national or sub-national circumstances, such as population, forest cover proportion, etc.

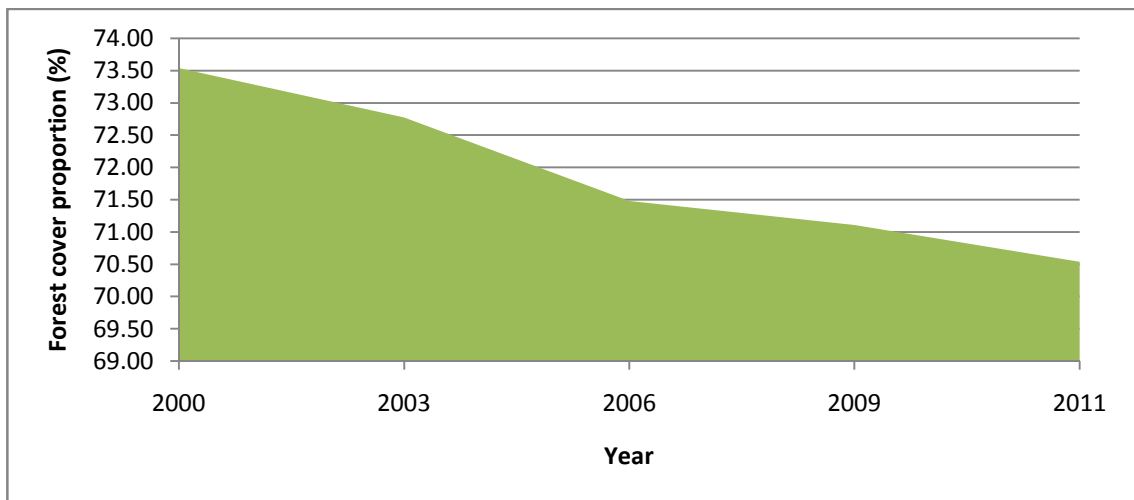


Figure 8. Forest cover proportion during 2000 until 2011

In this adjustment method, comparison between population and forest cover proportion data on 2000, 2009, and 2011 linear formula has generated to predict future forest proportion.

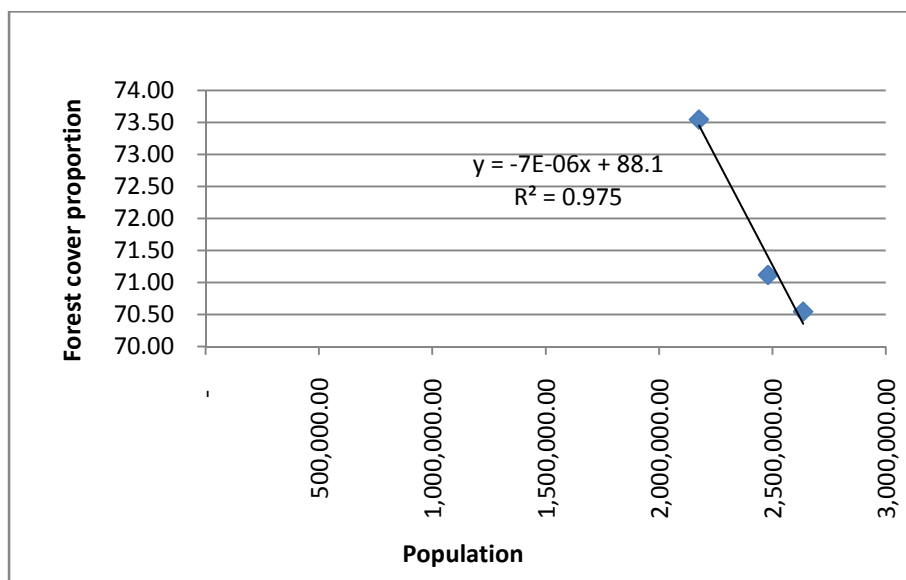


Figure 9. Examples of identification of the relationship with the proportion of the population density of forest cover

It predicted that forest cover proportion in 2020 will be decreased become 66.15%. Projected annual emission after adjusted using above value are 15,239,420 ton CO<sub>2</sub>-eq.

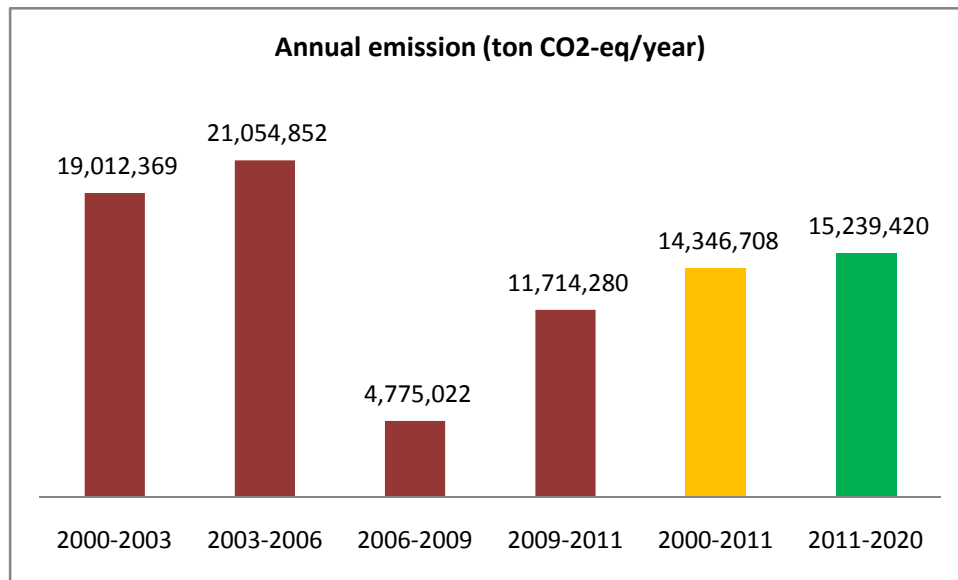


Figure. 10. Projected annual emission using adjusted historical method

Below are the provisional REL using historical based comparing with the adjusted historical based.

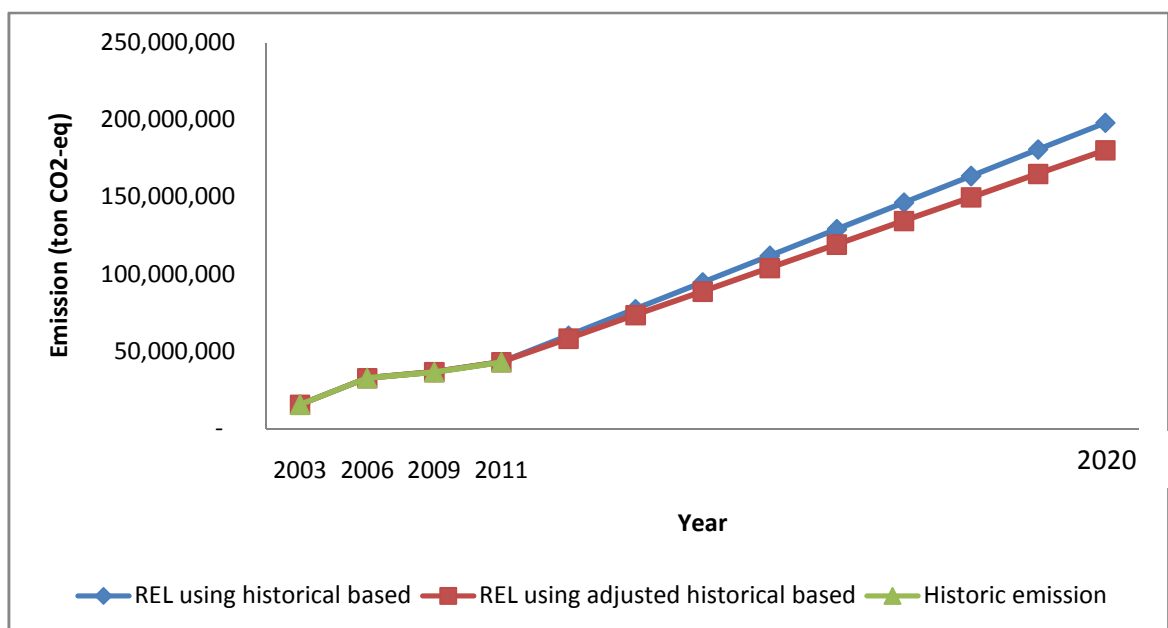


Figure 11. Provisional REL using historical based and adjusted historical based method



## 5. Conclusion and Recommendation

1. Forest RELs/RLs are business-as-usual (BAU) baselines which should be consistent with emissions as contained in each country's greenhouse gas inventories. It implies that RELs/RLs should be based on and highly consider historical emissions. RELs/RLs may be adjusted for specific national and sub-national circumstances where necessary. RELs/RLs will be derived from the average of the historical emission within certain period of time calculated with a conservative approach multiplied by the adjustment factor.
2. Historical based recommended by national government due to its applicability reason considering availability data and less of complexity. Meanwhile adjusted historical recommended by government at sub-national level since it can be adjusted using their sub-national circumstances.
3. Deforestation of Central Sulawesi during 2000 until 2011 are 184,141 ha with annual average 16,740 ha/yr
4. Forest degradation of Central Sulawesi during 2000 until 2011 are 563,473 ha with annual average are 51,225 ha/yr
5. Initial emission during 2000 until 2011 are 14,392,090 ton CO<sub>2</sub>-eq/year, meanwhile the initial sequestration are 45,382 ton CO<sub>2</sub>-eq/year. Hence, net historic emission during 2000 until 2011 in Central Sulawesi are 14,346,708 ton CO<sub>2</sub>-eq/year.
6. Provisional REL of Central Sulawesi which projected since 2011 until 2020 using Historical Based method are 17,215,122 ton CO<sub>2</sub>-eq/year. Meanwhile the provisional REL of Central Sulawesi which adjusted using ratio of forest land proportion and population density are 15,239,420 ton CO<sub>2</sub>-eq.
7. Since provisional REL calculated using current best available data, in future, REL of Central Sulawesi recommended to be updated after emission factor data updated which taken from redesign NFI field survey activities.

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## APPENDIX

**Appendix 1. Landcover Matrix of Central Sulawesi during 2000 until 2011 (ha)**

|                               | 2011   |         |         |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |      |        |       |        |              |              |        |             |
|-------------------------------|--------|---------|---------|--------------|---------------------------|-----------------------------|-----------------------|-------------------------|-------------------|---------------------|-----------|------------|--------------|------------------------|-------------------------------|------|--------|-------|--------|--------------|--------------|--------|-------------|
|                               | Air    | Bandara | Belukar | Belukar Rawa | Hutan Lahan Kering Primer | Hutan Lahan Kering Sekunder | Hutan Mangrove Primer | Hutan Mangrove Sekunder | Hutan Rawa Primer | Hutan Rawa Sekunder | Pemukiman | Perkebunan | Pertambangan | Pertanian Lahan Kering | Pertanian Lahan Kering Campur | Rawa | Rumput | Sawah | Tambak | Tanah Kosong | Transmigrasi | NoData | Grand Total |
|                               | 59,958 | -       | -       | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -      | -     | -      | -            | -            | -      | 59,958      |
| Bandara                       | -      | 147     | -       | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -      | -     | -      | -            | -            | -      | 147         |
| Belukar                       | -      | -       | 248,674 | -            | 20                        | -                           | -                     | -                       | -                 | -                   | -         | 114        | 182          | 441                    | 932                           | -    | -      | -     | -      | 418          | -            | -      | 250,781     |
| Belukar Rawa                  | -      | -       | -       | 893          | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -      | 26    | -      | -            | -            | -      | 920         |
| Hutan Lahan Kering Primer     | -      | -       | 9,347   | -            | 542,133                   | -                           | -                     | -                       | -                 | -                   | -         | 4,707      | 27           | 1,905                  | 6,889                         | -    | -      | 44    | -      | 544          | -            | -      | 3,100,004   |
| Hutan Lahan Kering Sekunder   | -      | -       | 102,941 | -            | 1,167,711                 | -                           | -                     | -                       | -                 | -                   | 54        | 678        | 414          | 16,882                 | 34,897                        | -    | -      | 751   | -      | 3,230        | 36           | -      | 1,328,225   |
| Hutan Mangrove Primer         | -      | -       | 0       | -            | -                         | -                           | 19,426                | 1,752                   | -                 | 0                   | -         | -          | -            | -                      | -                             | -    | -      | -     | -      | -            | -            | -      | 21,178      |
| Hutan Mangrove Sekunder       | -      | -       | -       | 22           | -                         | -                           | -                     | 32,292                  | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -      | -     | 8      | -            | -            | -      | 32,322      |
| Hutan Rawa Primer             | -      | -       | -       | -            | -                         | -                           | -                     | -                       | 325               | -                   | -         | -          | -            | -                      | -                             | -    | -      | -     | -      | -            | -            | -      | 325         |
| Hutan Rawa Sekunder           | -      | -       | -       | -            | -                         | -                           | -                     | -                       | 7,717             | -                   | -         | -          | -            | -                      | -                             | -    | -      | -     | -      | -            | -            | -      | 7,793       |
| Pemukiman                     | -      | -       | -       | -            | -                         | -                           | -                     | -                       | -                 | -                   | 29,267    | -          | -            | -                      | -                             | -    | -      | -     | -      | -            | -            | -      | 29,267      |
| Perkebunan                    | -      | -       | -       | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | 120,315    | -            | -                      | -                             | -    | -      | -     | -      | -            | -            | -      | 120,315     |
| Pertambangan                  | -      | -       | -       | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | 11,271     | -            | -                      | -                             | -    | -      | -     | -      | -            | -            | -      | 11,271      |
| Pertanian Lahan Kering        | 1      | -       | 164     | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | 409,064                | -                             | -    | 211    | -     | 82     | -            | -            | -      | 409,522     |
| Pertanian Lahan Kering Campur | -      | -       | 1,888   | -            | 339                       | -                           | -                     | -                       | -                 | 20                  | 849       | -          | -            | -                      | 544,865                       | -    | 219    | -     | 38     | -            | -            | -      | 548,217     |
| Rawa                          | -      | -       | -       | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -      | -     | -      | -            | -            | 547    | 547         |

2000



Appendix 2. Annual Emission Matrix of Central Sulawesi during 2000 until 2011 (ton CO2-eq/yr)

|                               | 2011 |         |           |              |                           |                             |                       |                         |                   |                     |           |            |              |                        |                               |      | Total |        |       |         |              |              |           |
|-------------------------------|------|---------|-----------|--------------|---------------------------|-----------------------------|-----------------------|-------------------------|-------------------|---------------------|-----------|------------|--------------|------------------------|-------------------------------|------|-------|--------|-------|---------|--------------|--------------|-----------|
|                               | Air  | Bandara | Belukar   | Belukar Rawa | Hutan Lahan Kering Primer | Hutan Lahan Kering Sekunder | Hutan Mangrove Primer | Hutan Mangrove Sekunder | Hutan Rawa Primer | Hutan Rawa Sekunder | Pemukiman | Perkebunan | Pertambangan | Pertanian Lahan Kering | Pertanian Lahan Kering Campur | Rawa |       | Rumput | Sawah | Tambak  | Tanah Kosong | Transmigrasi |           |
| <b>2000</b>                   | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | -         |
| Air                           | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | -         |
| Bandara                       | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | -         |
| Belukar                       | -    | -       | -         | -            | (1,029)                   | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | 2,090   | -            | -            | 2,726     |
| Belukar Rawa                  | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | 88        |
| Hutan Lahan Kering Primer     | -    | -       | 562,052   | -            | 4,644,277                 | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | 35,433  | -            | -            | 5,998,886 |
| Hutan Lahan Kering Sekunder   | -    | -       | 5,308,327 | -            | (5,411)                   | -                           | -                     | -                       | -                 | 3,049               | 24,103    | 23,404     | -            | -                      | -                             | -    | -     | -      | -     | 182,731 | -            | 1,907        | 8,346,950 |
| Hutan Mangrove Primer         | -    | -       | 3         | -            | -                         | -                           | 29,195                | -                       | 0                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | 29,199    |
| Hutan Mangrove Sekunder       | -    | -       | -         | 754          | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | 340   | -       | -            | -            | 1,094     |
| Hutan Rawa Primer             | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | -         |
| Hutan Rawa Sekunder           | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | 3,899 | -      | -     | -       | -            | -            | 3,899     |
| Pemukiman                     | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | -         |
| Perkebunan                    | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | -         |
| Pertambangan                  | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | -         |
| Pertanian Lahan Kering        | 1    | -       | (383)     | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | 211    | -     | 218     | -            | -            | 48        |
| Pertanian Lahan Kering Campur | -    | -       | (3,146)   | -            | (18,027)                  | -                           | -                     | -                       | 59                | (15,003)            | -         | -          | -            | -                      | -                             | -    | -     | 365    | -     | 126     | -            | -            | (35,626)  |
| Rawa                          | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | -         |
| Rumput                        | -    | -       | -         | -            | -                         | -                           | -                     | -                       | -                 | -                   | -         | -          | -            | -                      | -                             | -    | -     | -      | -     | -       | -            | -            | -         |

