Methodological Options & Provisional Reference Emission Level of Central Sulawesi

UN-REDD Program Technical Report

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UN-REDD
PROGRAMME

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ACCRONYMS

AFOLU	: Agriculture, forestry, and other land use
BAU	: Business as usual
CO2	: Carbon dioxide
CDM	: Clean Development Mechanism
COP	: Conference on Parties
GDP	: Gross Domestic Product
GHG	: Green House Gas
GPG	: Good Practice Guidance
GOFC-GOLD	: Global Observation of Forest and land Cover Dynamics
IPCC	: Intergovermental Panel on Climate Change
LULUCF	: Land use, land use Change, and Forestry
MRV	: Measurement, reporting, and verification
REDD+	: Reducing emission from deforestation and forest degradation, and the role of conservation of forest carbon stocks, sustainable management of forest and enhancement carbon stocks
RL	: Reference Level
REL	: Reference Emission Level
SBI	: Subsidiary Body for Implementation
SBSTA	: Subsidiary Body for Scientific and Technical Advice
UNFCCC	: United Nation Framework Convention on Climate Change

1. INTRODUCTION

1.1. Background

Forest Reference Emission Level (REL) and/or forest Reference Levels (RLs) are benchmarks for assessing country's performance in implementing REDD+[1] 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.

Credible and rigorous RELs/RLs calculation is critical to the success of REDD+ implementation. RELs/RLs that are verifiable will increase the quality of REDD+ projects and will in turn prevent deviated incentives ("hot air") and avoid potential leakages. They are required to follow IPCC Guidelines and Good and Practice Guidance for LULUCF, serving as the world's most unequivocal documents for greenhouse gas inventories. Conservativeness is very important in estimating RELs/RLs because it allows to obtain scientific robustness even with large uncertainties in the data. [2] The Durban Decision (2011)[3] provides clearer modalites of forest RELs/RLs. Developing country Parties are invited to submit information and rationale on the development of their forest RELs/RELs including details of national circumstances. RELs/RLs are developed using a step-wise approach to enable a country to improve them by incorporating better data, improved methodologies and when necessary, additional pools. The decision also provides guidance for Parties for developing and submitting RELs/RLs.

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 circumstances where necessary. RELs/RLs will be derived from the average of the historical emission

[1] REDD+ (Reducing Emissions from Deforestation and Degradation plus three other activities: conservation, sustainable forest management and enhancement of carbon stocks).
[2] GOFC-GOLD, "How to Provide Credible REDD Estimates Starting froM REDD Estimates", available at: http://www.cifor.org/publications/pdf_files/cop/session%202/1-Moyo-2-1-5-Guidance-EU.pdf
[3] Decision on REDD+: Safeguards and Reference Levels, accessed from: http://unfccc.int/files/meetings/durban_nov_2011/decisions/application/pdf/cop17_safeguards.pdf

within certain period of time calculated with a conservative approach multiplied by the Adjustment Factor.

Initiative to implement REDD+ requires the development of a baseline scenario 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 baseline scenario will be used as a reference to determine whether the proposed REDD+ project activity is additional. Additional means the proposed project scenario is not the baseline scenario.

There are at least three general approaches in defining REL, namely:

1. REL - calculated based on historical emission,
2. REL – calculated based on adjusted historical emission and
3. REL – calculated with forward-looking scenarios that may or may not consider historical emission. However, to be in line with UNFCCC decision, the approach that considers historical emission is preferred.

Below is a figure that depicts baseline scenario or REL, which is the likely continuation of historical emission, adjusted historical emission or projected emission in certain area be it at national or sub-national level. REDD+ intervention will change the trend into a lower level of emission. The difference between REL and the actual emission in the measuring and reporting year is the emission reduction credit that a country can claim to be entitled to financial incentives.

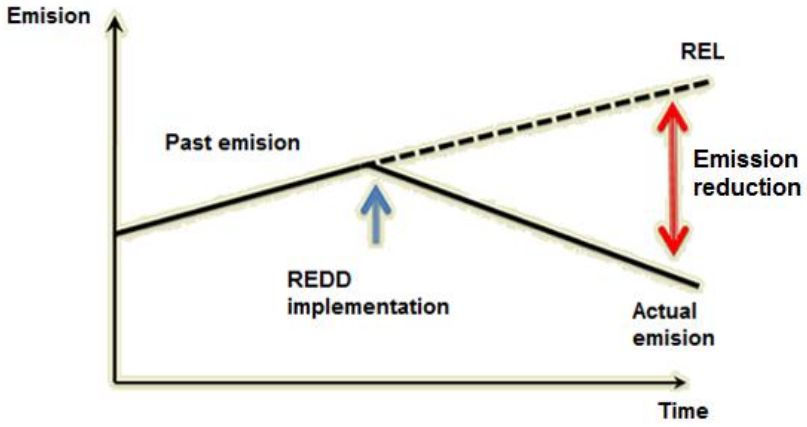


Figure 1. Reference Emission Level

The UN-REDD Programme embarks on an initiative to construct provisional REL options as part of REDD+ readiness phase in Central Sulawesi Province. The UN-REDD Programme assists the

government of Indonesia and particularly local government of Central Sulawesi to develop a methodological approach to set up a workable and verifiable REL against which future efforts to reduce deforestation and forest degradation will be measured. To develop REL, the following activities are envisaged[4]:

- Review of methodologies for establishing REL at sub-national level
- Development of methodological options to establish REL at sub-national scale
- Compilation of data to support development of REL
- Assessment of a provisional REL in a pilot province
- Scientific peer review of provisional REL
- Stakeholder consultations on REL methodological approach and provincial provisional REL
- Scientific peer review of REL methodological approach and provincial provisional REL

The assignment focuses on REL instead of REL and RL. The recommendation will serve as a basis for future work on REL and RL in Central Sulawesi Province.

1.2. Objectives

The objective of the assignment is to develop recommendations for the establishment of provisional REL for stakeholders and decision makers by providing strong analysis of different methodological options of REL development based on testing in Central Sulawesi. The strengths and weaknesses of each methodological option will be assessed based on the availability of data to support REL construction in accurate and transparent manner, the capacity of relavant authorities in the province to perform REL calculation, its scientific robustness and the suitability to the province's specific condition.

2. OVERVIEW CENTRAL SULAWESI READNES ON REDD PROGRAM

2.1. General Overview of Central Sulawesi Province

Central Sulawesi is one of province in Sulawesi Island. Administratively, Central Sulawesi Province has a total land area 68.033 km2 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 walacea. 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

[4] UN-REDD Programme Project Document page 19

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 terajadinya 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 Goverment have been submitted by the President at the G20 meeting in Pittsburg September 2009, Indomesia 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 enchancement carbon activity.

2.2. Current Situation of Central Sulawesi on REDD Implementation

Due to support REDD program in Central Sulawesi, UNREDD was seen by local goverment 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

1) 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,

2) 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. METHODOLOGICAL OPTIONS

3.1. General Overview and Data needs

IPCC suggest the calculation of carbon emission by multiplying activity data and emission factor. Activity data is defined as area of changes between each pair wise of land cover type and is expressed in area of land use change. It requires data on land use and land cover change. The area of forest covers change is a result of map of stratified forest covers overlaid with management practices. Stratification of forest types into homogeneous sub-categories will reduce the uncertainty of carbon emission estimate.

Land use systems are defined as land cover and land use, which embraces several concepts: land cover (vegetation and man-made features on Earth's surfaces), land use (management/cultivation systems implemented on the land cover) and the life cycle of a system, which includes a sequence of vegetation changes within a land use system. Activity data

is derived from changes in land use systems inferred from land cover change analysis using data from different years. [5]

Land/forest cover classes are determined using imagery from remote sensing technology. To understand the land use dynamics in a landscape within a period of time, the image analysis uses the time-series of Landsat image in combination with other thematic maps such as forest concessions, administrative boundaries and roads and rivers.

Calculating REL needs activity data from certain period of time, 5, 10 or 20 years depending on the level of accuracy that needs to be achieved. Annual quantification of activity data is ideal to achive REDD+ objective. There have been some proposals on the REL calculation methodologies developed by experts . Generally, there are three approaches in defining REL[6].

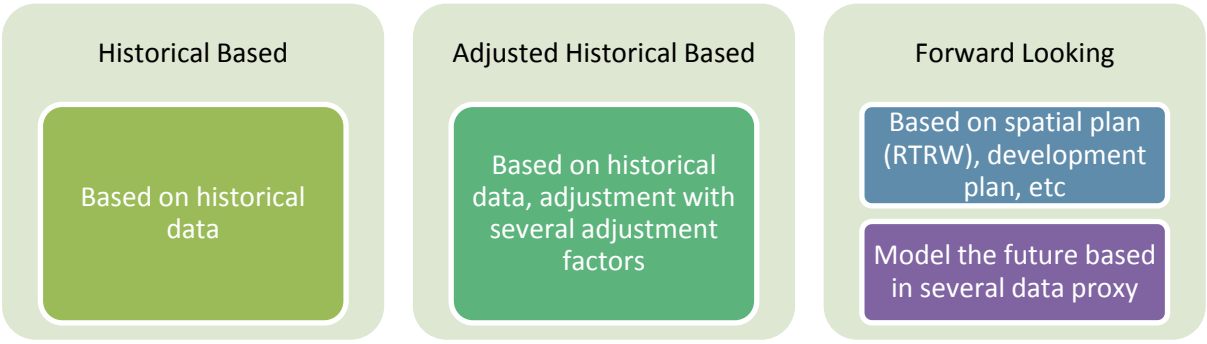


Figure 2. Various calculation methods in REL

3.2. General Overview and Data needs

a. Historical Emissions

This method focuses on historical data of land cover change in certain area, national or subnational., in this case in Central Sulawesi Province. Mollicone, et al (2007) and Santilli, et al (2005) propose to use mean rate of extrapolation of past emission in calculating REL. Country or province with low deforestation rate may apply REL that is higher than its historical emission. While country or province with high deforestation rate, such as Indonesia may simply use its historical emission as REL. There are two examples that can best illustrate the use of this method. The first one is Brazil's Amazon Fund back in 2009. Brazil developed a subnational REL for gross deforestation in the Amazon region. The REL is simple and straightforward using Brazil

[5] ALLREDDI Brief 01, ICRAF, Bogor.
[6] As presented by Rizaldi Boer. 2010. CCROM, IPB, Bogor.

national statistics. Meanwhile, the second case, Guyana is a country with high forest intact which has low deforestation rate. Guyana has considerably good historical data and therefore it can calculate more detailed and accurate REL which includes 4 carbon pools and differentiated emission factors.[7]

b. Adjusted Historical Emissions

Assumption: future emission can be estimated using historical emission and adjusted with specific national/sub-national circumstances factors such as population density, GDP, agriculture land demand, etc). Amano, et al, 2008

c. Forward-Looking (parametric, non-paremetric, may or may not consider historical emission)

This approach is basically a modeling of future emissions taking into account factors that drive and constraint emissions from land use. The advocates of this method include Petrova, et al (2007) that proposes the use of Land-Use and Cover Change such as IDRISI's GEOMOD, which can simulate change between two land categories[8]. Boer (2009) also suggests the importance of forward-looking method for Indonesia use threshold, Boer, 2009, based on level of Carbon stock at risk in the future, Strassburg, et al, 2009.

Land-use change models can also be characterised as dealing with either transformation or allocation. Transformation models start from the current land use and simulate the possible conversion into another land-use type, e.g. based on a transformation probability or the status of surrounding locations. Allocation models, on the other hand, allocate a certain type of land use to a location based on its characteristics. Koomen, et al, 2007.

In this assignment, Forward-Looking method is further sub-categorized into: [a] Forward-Looking Non-Parametric, and [b] Forward-Looking Parametric. Forward looking non parametric use scenario on projected future emisison based on related spatial data dan development plan. Meanwhile, forward looking parametric using explicit spatially model on projected the future emisison based on various data proxy. Data proxy identifed through deforestation and forest degradation which already

[7] These two examples are summarized by Meridian Institute (2011)
[8] Pontius, R and Chen, H. 2006

Furthermore, based on inputs from national and local stakeholders through a series of focus group discussions and stakeholder consultations, the most appropriate and preferred method will be selected to construct provisional REL of Central Sulawesi. Below is the flowchart of REL method options (Figure 3).

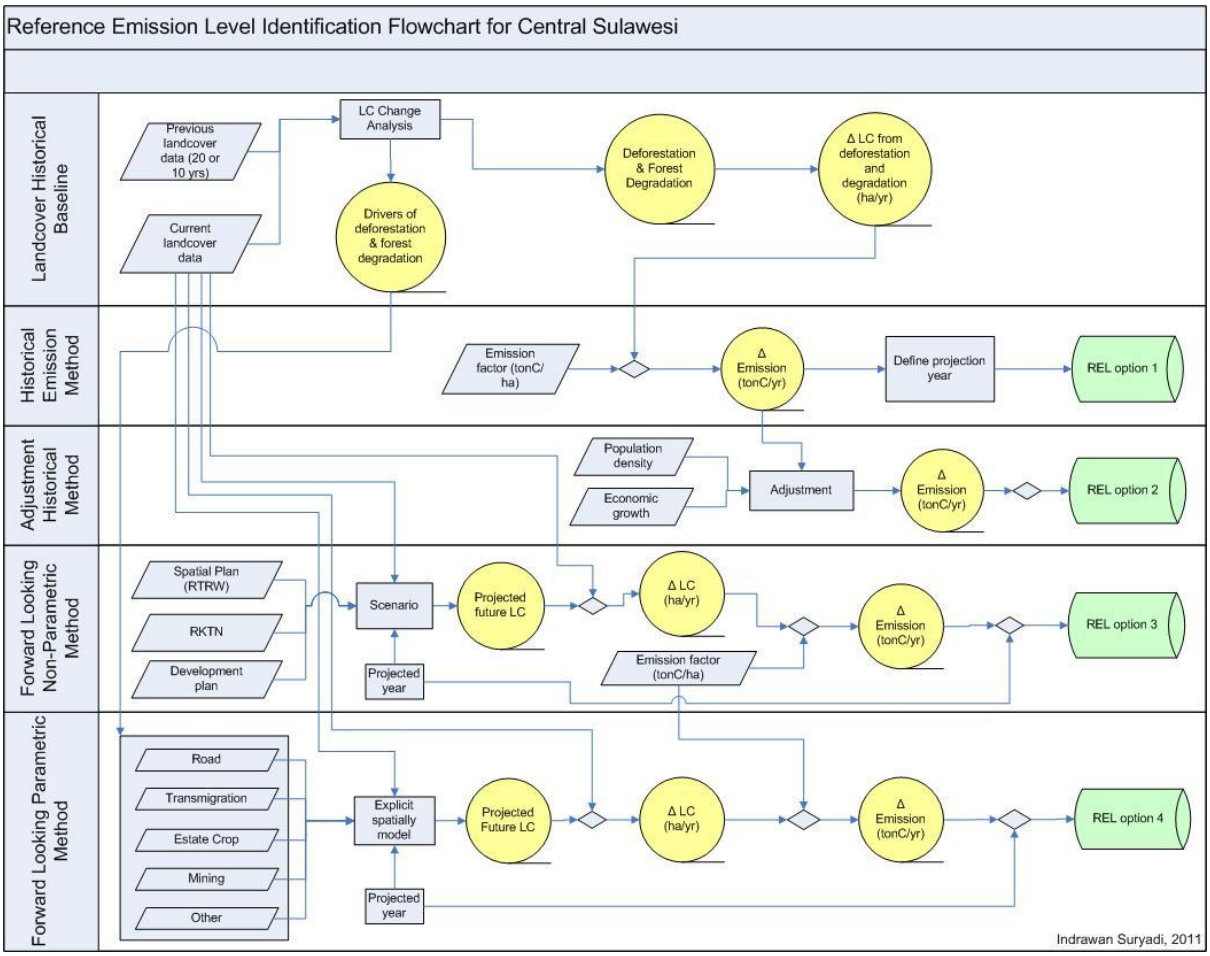


Figure 3. REL Methodological Options Identification Flowchart for Central Sulawesi

In general there are two step in defining REL: [a] Analyze the landcover change in order to get landcover historical baseline, and [b] project the emission. Landcover change analysis will be made based on historical landcover data. The output of these step are identify the deforestation and forest degradation area, as well as define the drivers. Both data will be use as primary input on project the future emission using various methods.

Historical emission method is the simplest one. This method project the future emission based on its historical data. Historical emission calculates based on landcover change and emission factor data. Hence, after define the projection year, the REL using this method may derived. Meanwhile, adjustment historical emission method adjust the historical emission using several

adjustment factor such as popultion density, economic growth, etc in order to derived the REL.

Forward looking non parametric method using scenario on project the future emission. The scenario will refer to existing spatial plan, and development plan. Through combining these data and current landcover data, future landcover on certain year may projected as a base to proximate future emission.

Forward looking parametric method project future emission based on various data proxy which identified as deforestation and forest degradation drivers. The proxy data could be road, estate crop, mining, transmigration, etc. This method use explicit spatially model to generate future LC.

Since REL deals with both technical and political aspect, it takes a negotiation process that involves multi-stakeholders to define REL in a transparent, simple and consistent manner. The key considerations in selecting REL method are data availability, complexity, cost, national/sub-national strategic plan and circumstances.

3.3. Data Needs

In general, all method has similar base data requirement; landcover historical data. And then each method, refer to its deep level of analysis, will be required varians of data for their further analysis as describe on figure 4 below.

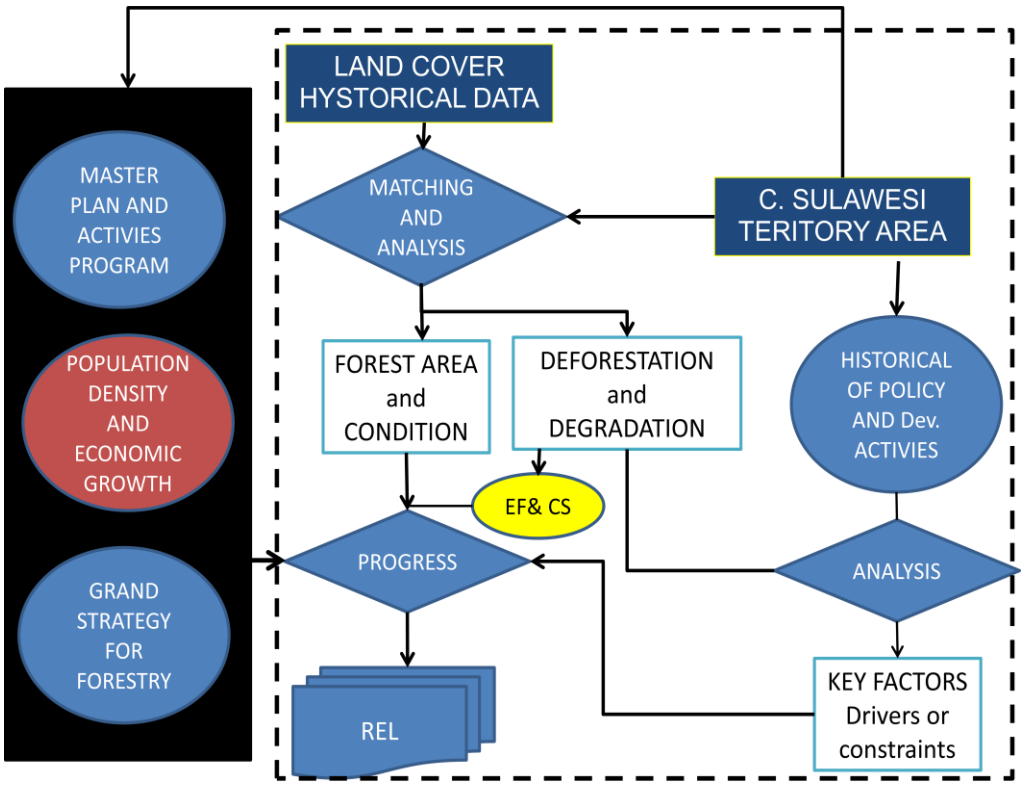


Figure 4. Conceptual of analysis and methods

Above figure shows that:

a) All of methods require time series data of land cover and emission factors for each land use and history of activities and policy development

b) Adjusted Historical requires contribution data such as emissions production and population growth

c) Forward looking non-parametric requires three additional basic data data; on the development plan mid term regional plan (RPJMD), spatial and forestry strategic plan (RKTN).

d) Forward looking parametric need more detailed data to proxymate future landcover change based on accessibility, plan, etc.

From above description, list of data required are put on table below:

Table 1. List of data sources and institution in charge

Component	Data Source	Institution in charge
a. Administration	RPJM and RTRW	Bappeda and Law Bureau
b. Landcover	Landsat	BPKH – Baplan
c. Policy	Laporan RPJM	Bappeda
d. Emission factor	Research paper	Universities and research institution
e. Demography	Central Sulawesi in Number	Statistical Bureau
f. Economic development	Laporan RPJM	Bappeda
g. Land base activity	Forest concession, forest plantation, mining, estate crop	BPKH, Bapped, Agriculture Service, Forestry Service
h. Development Plan	RPJM,RTRW, Renstra Kehutanan	Bappeda, Forestry Service, Ministry of Forestry

3.4. Data Analysis

As described in Figure 4 data were analyzed to obtain input data in the calculation of REL as in Figure 3, either alone or integrate with other data, as follows:

a. Data on the administrative territory of the Legal Bureau and Profinsi Bappeda Province Map of the area need to determine the spatial form of Central Sulawesi province and territory of each county and city.

b. Administration boundary data overlaid by forest cover which obtained from BPKH. Landcover data need to identify in order to get:

   1) Forest cover distribution in each county and city

   2) Forest cover change which tend to deforestation and forest degradation.

b. RPJM description analysis need to identify: economic growth, development, policy, and land-based economic activity.

c. Demographic data and population was analyzed in order to get: distribution of the population of each administrative region, and density of population in agriculture.

d. Spatial data analysis including mid term development plan need to identify: land allocation requirement, development plan of land-based activities, and national and sub national policy

e. Forestry Strategic Develoopment Plan need to identify: forestry sector-based performance improvement, efforts on forest conservation and rehabilitation issue, forest related policy, etc.

f. Forest inventory data (from the Ministry of Forestry, University, and Research Institutions) are needed to identify the emission factor.

3.5. Synthetic Data

Since Central Sulawesi has been choosed 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,

and 2009 as well as emission factor was taken from BAPLAN used as an input. Hence this paper only focused the historical emission caused by deforestation and forest degradation.

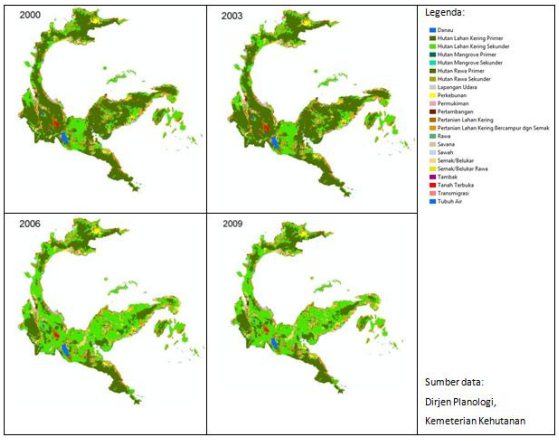


Figure 4. Landcover of Central Sulawesi since 2000 until 2009

Table 2. Emission Factor for Baplan land cover class

Land cover	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)

a. 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.

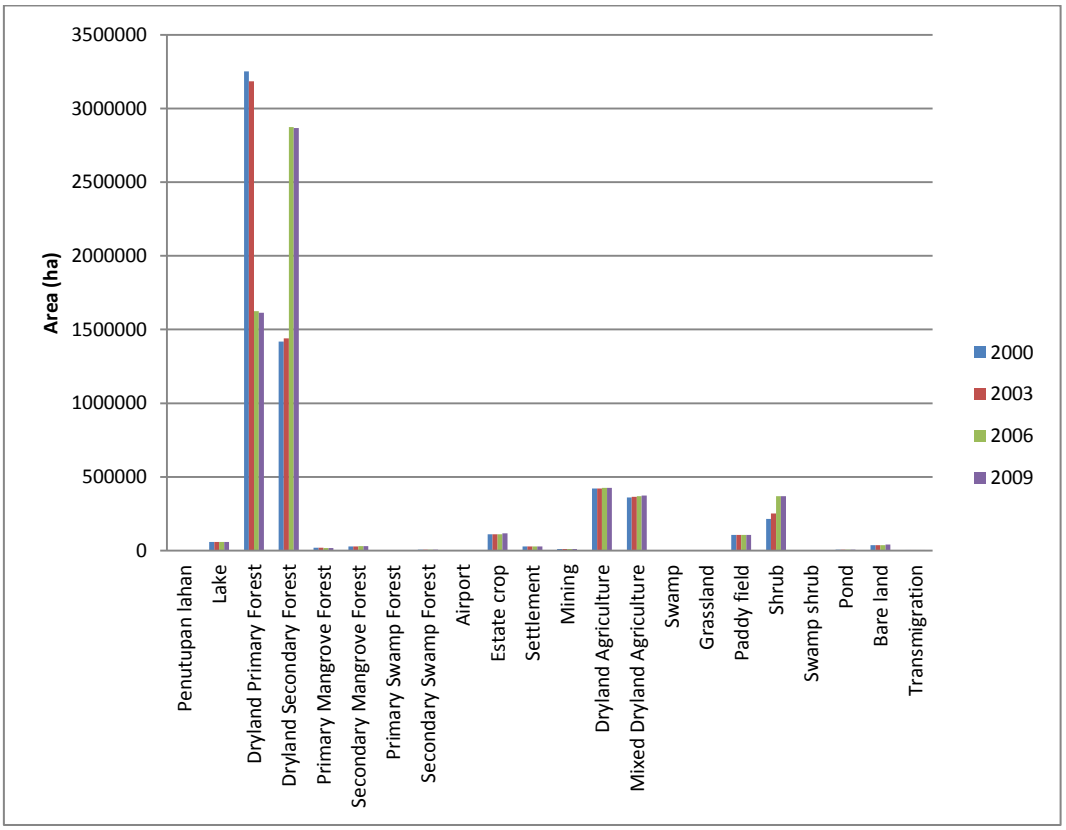


Figure 5. Landcover change in Central Sulawesi during 2000 until 2009

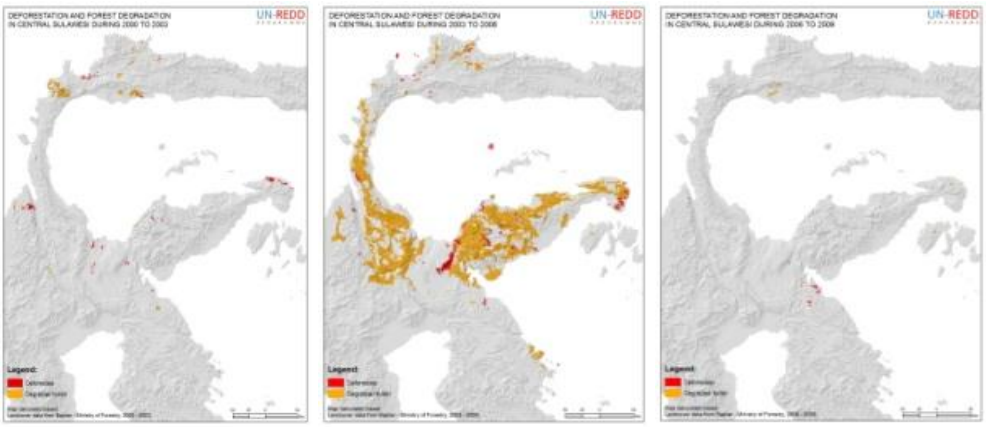
Table 3. Landcover Transition Method during 2000 until 2009

Landcover		Year 2009																				
		DN	HLKP	HLKS	HMP	HMS	HRP	HRS	LU	PK	PM	PT	PLK	PLKC	RW	SV	SW	BLK	BLKR	TBK	LT	TRN
Year 2000	DN	58,800																				
	HLKP		1,614,407	1,621,042						4,707			784	2,158			44	7,416			74	
	HLKS			1,247,196						463			4,321	14,988			314	147,565			2,907	
	HMP				17,813	2,344																
	HMS					27,465													22			
	HRP						325															
	HRS							7,717							75							
	LU								147													
	PK									110,237												
	PM										28,337											
	PT											11,269										
	PLK									135			420,509	0			653	164			359	
	PLKC									849				356,807				2,030			38	
	RW														235							
	SV															2,379						
	SW																106,047					
	BLK									114	22	182		106				213,364			418	
	BLKR																		917			
	TBK																			###		
	LT																				36,642	
	TRN																					4,992

Analyzed based on data from: BAPLAN

b. Deforestation and Degradation Identification

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



[a] [b] [c]

Figure 5. Deforestation and forest degradation during:
[a] 2000-2003, [b] 2003-2006, and [c] 2006-2009

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.

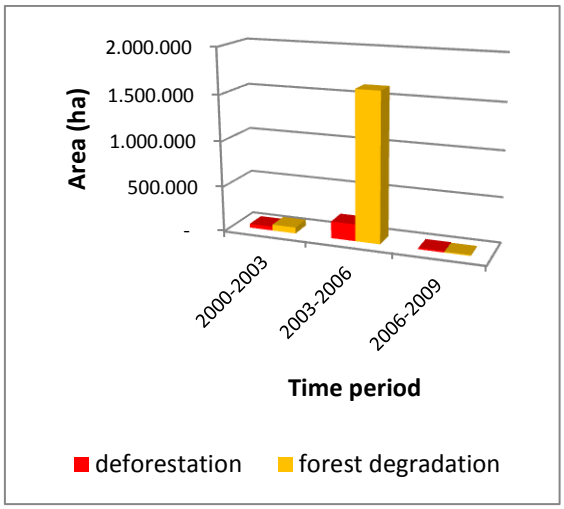


Figure 6. Deforestation and forest degradation at three different periods in Central Sulawesi

Below are map indicated land use changes which attend to deforestation and forest degradation from 2000 until 2009.

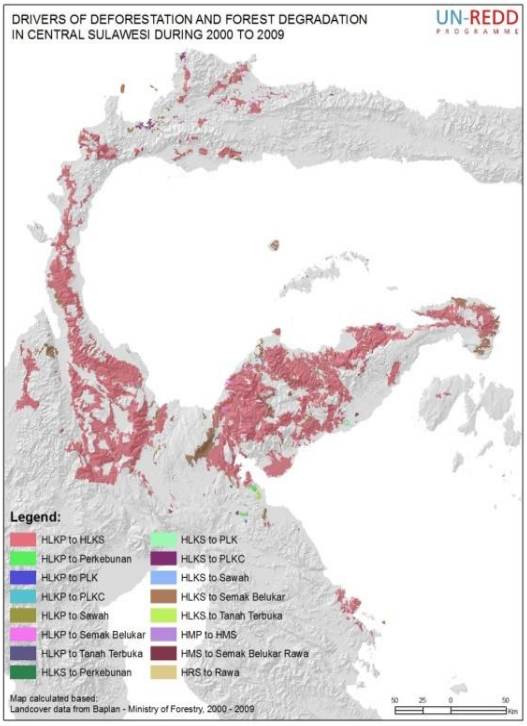


Figure 7. Map of land use change which attend to deforestation and forest degradation since 2000 until 2009

Biggest land cover change which attends to deforestation since 2000 until 2009 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)

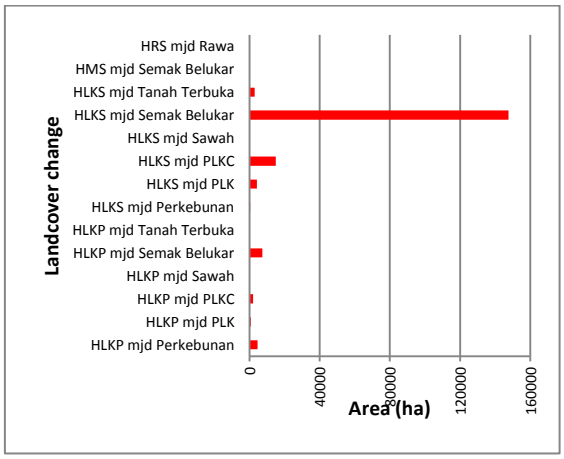


Figure 8. Landcover change which attend to deforestation since 2000 until 2009

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.

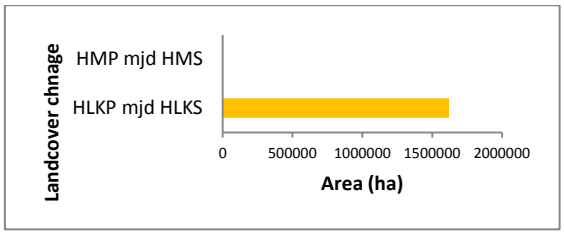


Figure 9. Landover change which attend to forest degradation since 2000 until 2009

There are some interesting phenomenm of landcover change during 2003 until 2006 in Central Sulawesi. During this period, there are huge forest degradation happen in Central Sulawesi.

c. Initial Historical Emission from Deforestation and Forest Degradation

Based on above deforestation and forest degradation data and emission factor data, below are the initial historical emission which caused from deforestation and forest degradation in Central Sulawesi.

Table 3. Emission Caused from Deforestation and Forest Degradation since 2000 until 2009

Periode	Total emission (tonC)	Annual emission in average (tonC)
2000-2003	8,512,430	2,837,476
2003-2006	59,719,937	19,906,645
2006-2009	2,551,198	850,399
Total 2000-2009	70,783,565	7,864,840

Total initial historical emission from deforestation and forest degradation is 70.783.565 tonC, which the biggest caused during 2003-2006 (59.719.937 tonC).

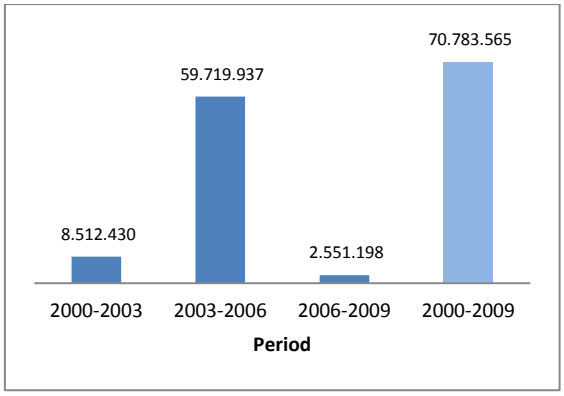


Figure 10. Emission caused from deforestation and forest degradation from 2000 until 2009

4. REL METHODOLOGICAL COMPARATION

Pre-conditions, advantages, and disadvantages, as well as various other consideran aspects of REL methods has been discussed through multistakeholder consultation. Focus group discussions have been carried out at national level and some feedback has been adopted in this paper. Future discussion and consultation of the parties planned to be conducted at the provincial level, to further scientific review which will be conducted by some experts towards final recommendation.

4.1. Historical Based Method

Advantage of historical based method:

- Compared with other methods, historical based is the simplest method.
- Only requires historical data of land cover within 20 or 10 years.
- Requires lower cost compare with other methods.
- Requires only standar Geographic Information System and Remote Sensing tool in conducting the analysis/calculations.
- Since this is the simplest one, the method easy to be understood by local government.

Disadvantage of historical based method:

- This method does not consider government policies related to land use allocations in the future.
- This method does not consider the relationship and the impact of various factors affecting the trigger land cover changes.

4.2. Adjusted Historical Based Method

The advantage of adjusted historical based method are:

- Is a simple method, future emission calculated based on historical data which adjusted by an adjustment factor.
- Accommodate the current state which represented by several adjustment factors (population density, economic growth, etc.) in order to adjust the projected future emissions.
- Requires only two sets of data: [1] the history of land cover, and [2] The adjustment factor.
- Only require standar Geographics Information Syatem and Remote Sensing tool in conducting its analysis.

The disadvantage of adjusted historical based are:

This method does not consider current/future government policies that affect to the land cover change.

4.3. Forward Looking Method

The advantages of using non-parametric forward looking method are:

- The scenarios are based on local spatial plans to make this method relatively easy weeks to discuss with local governments, especially in terms of its emissions reduction strategy.
- This method is easily understood by the local government for emissions projections are based on spatial data and the relevant regional development plans.
- Because this method uses the local spatial data, then this method by some parties considered sufficient to represent the interests of economic development and growth for the region.
- This method only requires GIS and remote sensing tools in the standard analysis.

The disadvantage of using non-parametric forward looking:

This method does not consider the relationship and the impact caused by matters beyond local spatial plans.

The advantage of looking forward parametric methods:

- This method is considered by some parties is comprehensive enough to use a variety of proxy data in projecting future emissions.

- Spatially explicit model will better enable periodic updates to the results obtained based on the data update.

The disadvantage of parametric looking forward methods:

- Relative complex analysis, hence requires relatively high technical skills to be possessed by the region.
- Require diverse proxy data as input source.
- The use of models as a tool and variety of data which are needs, made this method relative costly than others.
- The method need explicit spatial model tool instead of standar Geographic Information System and remote sensing tool.

Following chart presents a comparison of the relative initial sample calculation on REL of Central Sulawesi using several methods.

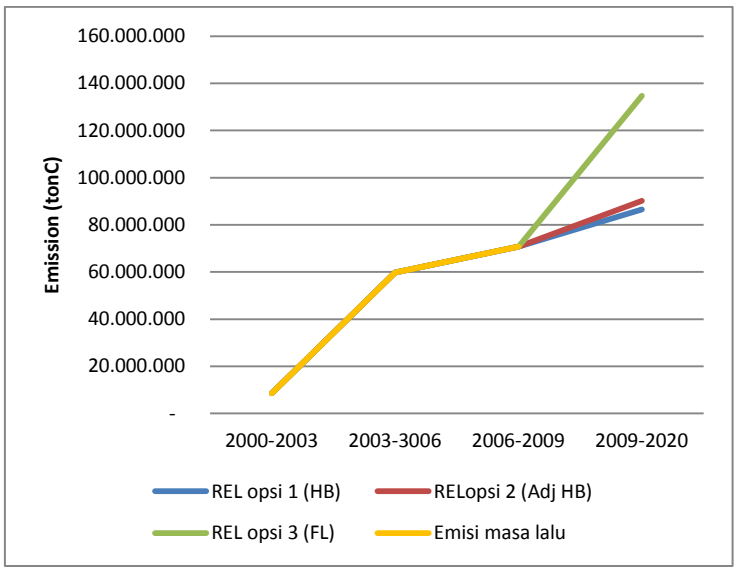


Figure 14. REL initial comparison sample calculation with several methods

The considerans which are used to define the method are complexity, data needs, human resource capacity needs, whether consider local development plan, level of easy to understand by local stakeholder, and cost needs, which described on matrix below.

Tabel 4. Comparison on REL Calculation Method based on various Consideran

Considerans	Historical	Adjusted	Foeward	Forward

	Based	Historical Based	Looking Non-parametric	Looking Parametric
Complexity	Simple	Simple	Moderate	Complex
Data Need	Less	Moderate	Moderate	More
Cost	Low	Low	Moderate	Hight
Analysis Tools	Moderate	Moderate	Moderate	Higth
Difficulty to understand by local Goverment	Easy	Moderate	Easy	Difficult
Continuity with local spatial and economic development plan	Low	low	Hight	Moderate
Towards emission reduction strategy development	Moderate	Moderate	Easy	Difficult

Historical Based is simplest method, meanwhile Forward Looking Parametrik is the complex one. Forward looking parametrik need more various data than others, meanwhile the Historical based need less than others. Since its need more data and tools, Forward Looking parametrik is relatively costly then others, meanwhile the Historical Based is relatively low cost. Historical Based dan Metode Forward Looking non Parametrik more easy to understand by local goverment. Forward Looking non Parametrik consider local development / economic plan than others. Since Forward looking non-parametrik using spatial plan and development strategy as main considerans, it will relatively easier then to develop reduction emission strategy. Figure below describe the min max relative method comparison for each consideran.

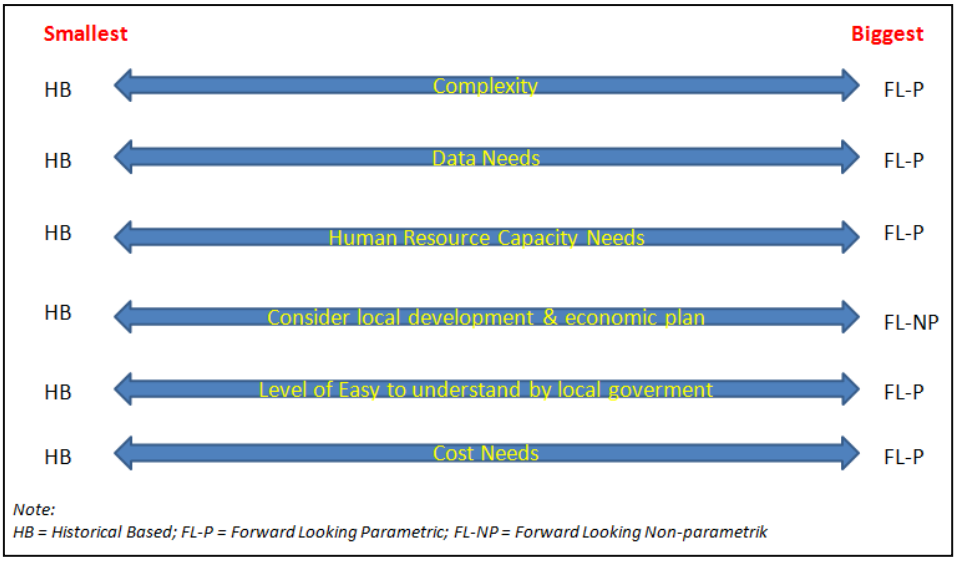


Figure 15. Min max comparison of REL method per each considerans

Since main objective of this method evaluation are define the REL calculation which efficient but fair enough for local goverment in order of economic and development plan perspectives, hence towards the application, level of applicable and capability needs to be considered. Diagram vent below describe the relative comparison each on both aspects.

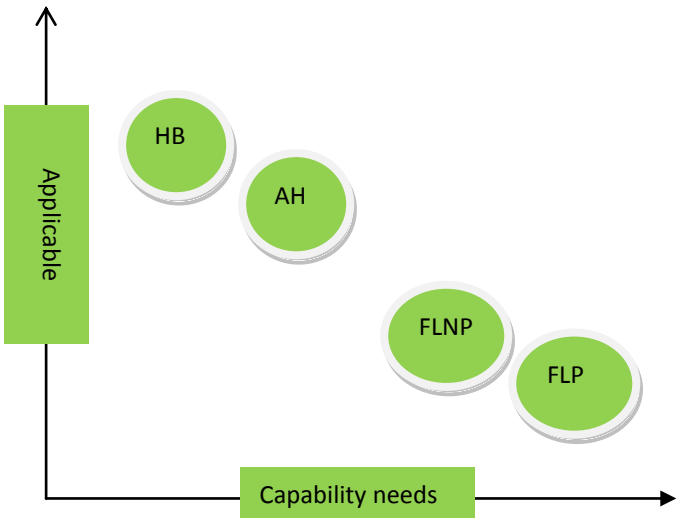


Figure 16. Min max comparison of REL method per each considerans

5. Provisional REL for Central Sulawesi using various Method Option

Various potential methods already identifed that potentially can be used for REL calculation imetn Central Sulawesi. Various method options on REL calculation grouped into: [a] historical based method, [b] adjusted based historical method, and [c] looking forward method. Initial REL was calculated to test each method based on current available data. Provisional REL of Central Sulawesi was calculated using several option of method. Activity data taken from landcover map of Baplan year 2000 until 2009, meanwhile emission factor using default national value which released by Baplan on 2011. In future, REL of Central Sulawesi may updated after emission factor data updated which will be taken from redesign NFI field survey ativities.

5.1. Provisional REL using Historical Based Method

Historical method based (HB) emission projections based on historical data that has occurred in a region. Emissions data is synthesized from the activity data in the form of land cover change data and emission factors. Below are the initial result of REL using historical based method.

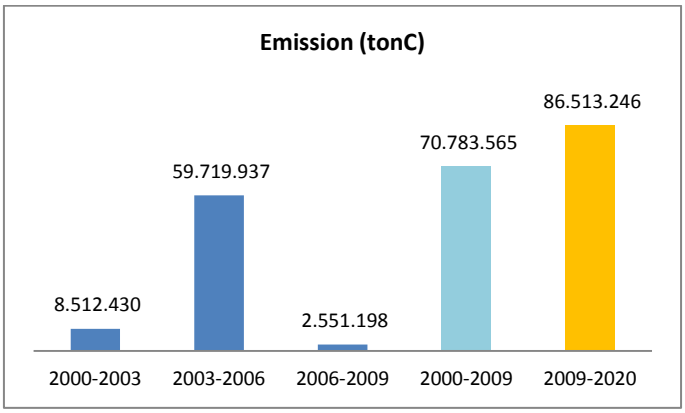


Figure 11. REL calculation examples using historical based methods

Since goverment of Indonesia commited to reduced the emission on 2020. This period then used as projection year on calculation of initial REL.

5.2. Provisional REL using Adjusted Historical Method

Adjusted historical method based (AHB) to adjust the past history of emissions by a factor of adjustment (adjustment factors), such as population density, economic growth, and others. Below are initial result of REL using adjusted historical method.

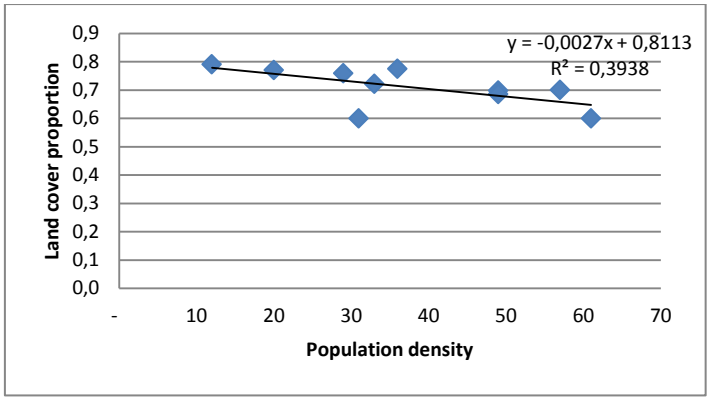


Figure 11. Examples of identification of the relationship with the proportion of the population density of forest cover

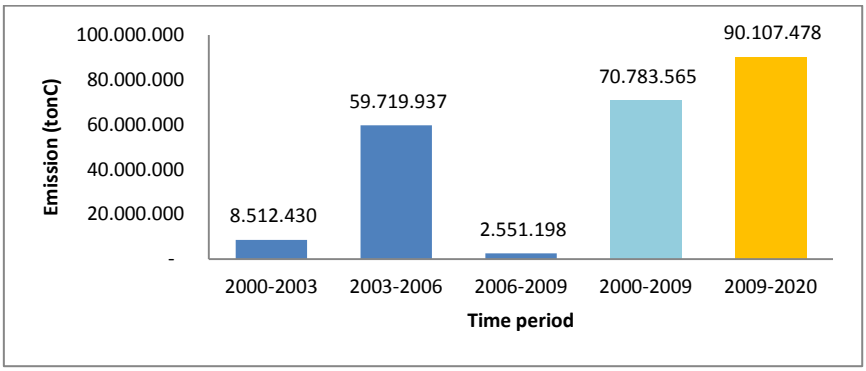


Figure. 12. Example of calculation of REL with adjusted historical based

5.3. Provisional REL using Forward Looking

Looking forward methods may divided into: [a] non-parametric and [b] parametric. Looking forward method of non-parametric (FL-NP) predict the changes based on the scenario which calculated using spatial plans data on related area. While looking forward parametric method (FL-P) to predict future emissions based on some proxy data (identified from deforestation and forest degradation deriver analysis) using explicit spatially modeling. Below are the initial result of REL using forward looking non parametric.

6. CONCLUSION AND RECOMMENDATIONS

1. Since REL dealt with both technical and political aspects; data availability, complexity, cost, national/sub-national strategic plan and circumstances need to be used as a consideran to be negotiated in transparent, simple, and consistent manner.

2. Historical method determine the REL based on historical emission in the past. Adjusted historical method use historical emission and some adjustment factor (such as population density, economic growth, etc.) to develop REL. Looking forward non-parametric method determine REL through scenario based on spatial plan and local development planning documents. Meanwhile looking forward parametric methods using multiple data triggers on land cover change which are inputted into spatially explicit model.

3. Historical based method is the simplest method, while the Forward Looking Parametric method is the most complex method compared with others. Forward looking parametric has highest data demand from various types.

4. Since it requires a high amount variation of data and model tools, Forward Looking parametric has high cost requirements than other method. Historical Based and Non Parametric Looking Forward are the most easy to understood by local government.

5. Looking Forward non parametric is a method that has a sustainable local economic development plan for use and spatial planning documents as the basis for its consideration. Since forward looking methods using non-parametric spatial development plans and local area, then this method gives relatively easy for parties involved in designing emission reduction strategies.

6. It is important to emphasize that REDD should fill the gaps between the climate change mitigation and economic development on related area. Hence REL should be develop effectively, but fair enough for local goverment from economic development perspective by consider the spatial plan or policy strategies in Central Sulawesi.

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