Strengthening Indonesian production forest governance

Suryanto¹ and T Sayektiningsih²

¹Natural Resources Conservation Technology of Samboja, East Kalimantan, Indonesia
²Environment and Forestry Research and Development of Makassar Institute, South Celebes, Indonesia

e-mail: suryantoflitce@gmail.com

Abstract. The Indonesian Corruption Eradication Commission indicates some leakages in timber governance as a result of poor forest governance. This study aims to provide some insights in strengthening Indonesian production forest governance by using approaches of effective land-use (ELu), timber production (TP) and Non-tax state revenue (NtSR). Multi-stage analysis are deployed by using main data of forest cover and TP in 2017. Results show that there are 20.84Mha of active forest concessions which is only 11.06Mha administered with ELu, so it is 75.45% of 45.05Mha potential production forests which are un-utilized. There are three-strategic steps proposed, namely: realistic, optimistic and optimistic-realistic. Realistic strategy is proposed to fix TP governance and improve accountability. This step would improve TP by 79.54M m³/year and add NtSR by IDR 2.21trillion/year. Optimistic strategy is proposed to encourage each forest concession implements multi system-sylviculture, so that it would add ELu by 9.48Mha. Optimistic-realistic strategy is implemented by encouraging investment in the 45.05Mha of potential extents of production forest. These all steps would increase ELu to 32.95Mha; TP to 342.54M m³/year and NtSR to IDR 10.41 trillion/year. It would strengthen the National Forestry Planning which initially targeted TP of 376.5M m³/year by2030; however, it is currently stagnant on 44.29M m³/year since the plan was set in 2011.

1. Introduction

One of forest governance goals in forestry is to optimize the function of forest products [1]. To achieve the goal, the Indonesian government has designated an area of 56 Million hectares (Mha) as production forests, covering a 44.5% area of Indonesian Forest based on The Agreed Functional Forest Classification (namely TGHK-Tata Guna Hutan Kesepakatan) and The Land Use Planning (Namely RTRW-Rencana Tata Ruang Wilayah). In addition, there is also 12.81Mha of other production forests that can be converted to develop tree crop plantations, i.e. rubber, coffee, tea and oil-palm [2, 3]. Forest production governance consists of six Concession Licenses. Four of which are for Utilization of Timber Forest Products (namely IUPHHK-Izin Usaha Pemanfaatan Hasil Hutan Kayu), including License of Natural Forest Concessionaires (LNFC, namely IUPHHK Hutan Alam), License Issues to Business of Industrial Plantation (LIBIP, namely IUPHHK Hutan Tanaman), License of Restoration Ecosystem within Natural Forest (namely IUPHHK Restorsi Ekosistem) and License Issues to Business of Community Plantation
Forest within Plantation Forest (namely IUPHHK Hutan Tanaman Rakyat). Two others are in the forms of License for Utilization of Environmental Services (namely IUPJL HP-Izin Usaha Pemanfaatan Jasa Lingkungan di Hutan Produksi) and License for Utilization of Non Timber Forest Products (namely Izin Usaha Pemanfaatan Hasil Hutan Bukan Kayu) [4]. These four IUPHHKs would assure the targeted round wood production of 376.5 Million m$^3$ (Mm$^3$) per year. The target was declared in 2011 through National Forestry Planning 2011-2030 (NFP 2011-2030) with the bases on the projection towards 14.5Mha of planted forest plantation and 24.8Mha of managed LNFC [5].

However, until the first seven years, the national wood production only reached 10-13% of the targeted NFP. It was noted that the National wood production from 2013 to 2017 was 47.81 M m$^3$, 38.61 M m$^3$, 43.87 M m$^3$, 42.25 M m$^3$ and 49.13 M m$^3$ respectively [6, 7, 8, 9, 10]. Thus, this low round wood production failed to meet national demand for raw materials during that period. In fact, the demand for raw materials of 779 timber industries with production capacity above 6,000 m$^3$/year was 84.5 M m$^3$ in 2016, but the realization of round wood production was only 42.25 M m$^3$. Although there was 7.04 M m$^3$ from import and other sources, there was still a lack of raw materials above 35.21 M m$^3$ or less than 58.26% of total production [9, 11].

This condition leads to skepticism about how the industry with a total investment value of IDR 59.69 trillion and employing 323 thousand people [11] can survive in a big challenge of Indonesian production forest governance which is unsustainable [12], deforestation [13], occupation [14], illegal logging [15, 16, 17], forest fire [18], social conflicts [19] and numerous issues related to production forest which degraded and fragmented [20, 21]. The Indonesian Corruption Eradication Commission (ICEC), therefore, criticized the validity of the commercial timber production data during the period of 2003-2014. In fact, according to reported data, timber production was 143.7 M m$^3$, however the number was lower than the actual production from natural forest, which was accounted for 630.1-772.8 M m$^3$, indicated a leakage of 77-81% of total timber production. The leakage was equal to 40.53-52.43 M m$^3$ per annum with total loss projection of IDR 5.24-7.24 trillion/year [22].

Given condition above, two hypothesis are constructed: (1) inefficient and questionable governance of Indonesian production forest, and actually, (2) it could be fixed. This study aims to give some insights in strengthening Indonesian production forest governance by using 3 parameters; namely; effective land-use (Elu), timber production (TP) and Non-tax state revenue (NtSR).

2. Method
Investigation method towards secondary data is applied in this research. Our investigation bases on the fact that management of data on forestry planning and administration of timber forest products is inconsistent, and it is not used effectively as a control instrument [22, 23]. A timber production approach is used during the investigation. For this study 4 species of wood are investigated, those are: Meranti, Mix Forest, Acacia, and Eucalyptus (MMfAE) which are produced in 4 main islands of Indonesia (Sumatra, Kalimantan, Maluku, and Papua - SKMP). The use of MMfAE is in line with a fact that Indonesia’s total wood production during the years of 2016-2017 was derived from MMfAE of SKMP, accounting for 75.6% and 86.25%, respectively [9, 10]. Meanwhile, the area of production forest in SKMP is only 88.99% of total production forest [11].

This investigation was supported by primary data derived from multi-year research carried out in 2009-2013 in several LNFC and LIBIP, including: (1) Kalimantan (PT. IKANI in 2009, PT. BFI in 2009, PT. Sarpatin in 2012, PT. SBK in 2012, PT. SBJ in 2012, PT. SHJ in 2012, PT. ITCIKU in 2013, and PT. ITICHM), (2) Sumatra (PT. AMT in 2009, PT.WCS in 2011, PT. Arara Abadi in 2011). In accordance with data collated, a model is introduced, i.e. Supersilvik. Supersilviks stands for Suryanto Pemodelan Silvikultur (Suryanto’s Model on Silviculture), which is a complex model built using Stella software yet it seems to be comprehensive, it is formulated applying variety of differential equations to project the future
outcomes based on business planning inputs of the present. Therefore, the use of *Supersilvik* is extended, it is not only for LNFC and LIBIP [21, 24] but also for Elu and TP of SKMP. Several formula that are used are:

2.1 Effective Land use

Effective land use (Elu; equation 1) is calculated by subtracting the Total Area Concessionaires (TAC) to the area of Protection Area and Others (PAO), such as rivers, lakes, areas with very steep slopes, high conservation forests, permanent plots, areas for livelihood, offices and warehouses [1, 25, 26]. Furthermore, Annual Elu (Ann Elu; equation 2) is derived by dividing Elu by cutting cycle (d). Elu could be simply determined by the land availability of silvicultural system that is allowed in each concession (Table 1), and this could be used to project actual use of the present and future use.

\[
\text{Elu (Mha)} = \frac{TAC - PAO}{\ldots} \quad (1)
\]

\[
\text{Ann Elu (Mha/year)} = \frac{\text{Elu}}{d} \quad \ldots (2)
\]

**Table 1.** Concessionaires type, main criteria and Silvicultural System allowed and/or recommended

| Concessionaires Type | Main criteria | Silvicultural system allowed and or recommended |
|----------------------|---------------|-----------------------------------------------|
| A. LIBIP \(^a\)      | Minimum-maximum limit of land use | Clear cutting with planting, namely THPB |
|                      | - Land use for main species, maximum limit 70% of TAC | |
| B. LNFC \(^b\)       | Natural forest cover | Indonesian Selective Cutting and Planting, namely TPTI |
|                      | - Primary and secondary forest (Log over area) | Selective Cutting and Line Planting, namely TPTJ |
|                      | - Secondary forest | |
| C. Concessionaires with Multisystem Silvicultural \(^c\) | Land typology | TPTI |
|                      | - Typology A. Medium forest stand potency \(^d\) zone along with steep slope and high stand potency \(^e\) along with topography of 0-40% | TPTJ |
|                      | - Typology B. Very low potency \(^d\) zone along with steep slope; low stand potency \(^e\) zone along with topography of 9-40% and medium stand potency zone along with topography of 0-25% | TTHPB |
|                      | - Typology C. Very low stand potency zone along with topography of 0-25% and low stand potency zone a lot with flat topography | |

Source: \(^a\) [26], \(^b\) [25], \(^c\) [24, 27], Natural forest commercial wood production of \(^d\) <20m, \(^e\) 20-240, \(^f\) 40-60 and \(^g\) >60 m per ha [24]

2.2 Timber Production

In this paper, productivity is a net product of commercial woods allowed to be harvested per year. Wood productivity of protected species and woods with under limit diameter in natural forest are excluded.
Productivity (Prod) of LNFC in between path is approached by limiting felling variables, stand structures, and composition. Forest Stand structure (ss) is divided into 10 diameter classes; and the species composition (sc) is divided into four groups: meranti, mixed forest, other mixed forest, and fancy woods. Diameter (D) is the median of diameter class (cod), including 50 cm up (TPTI in PPF-permanent production forest areas), 60 cm up (TPTI in LPF-limited production forest areas), 40 cm up (TPTJ in PPF areas), and 50 cm up (TPTJ in LPF areas). Moreover, in LIBIP, D is squared and multiplied by height (H), form factor (Ff), Number of Tree (NoT), safety factor (Sf) and exploitation factor (Ef) according to plant species [24]. In addition, timber production (TP) is calculated by multiplying Annual Elu and Productivity (Equation 4). The equations available in the Supersilvik model are determined more detailed bases on the data processing of each single tree. In order to test the reliability of the model, one of TP variables is calculated both manually and by Supersilvik model.

\[
\text{Prod} \left( \frac{m^3}{year} \right) = \left( \frac{1}{4} D^2 \right) \times H \times Ff \times NoT \times Sf \times Ef \quad \ldots \quad (3)
\]

\[
\text{TP} \left( \text{M} m^3 \right) = \text{Ann Elu} \times \text{Prod} \quad \ldots \quad (4)
\]

2.3 Non-tax State Revenue (NtSR)
NtSR is known as Penerimaan Negara Bukan Pajak (PNBP); it is a total non-tax (NonTax) of each wood species produced (TP) and the group of non-tax types (j). Non-tax is derived from reforestation funds (namely DR-Dana Reboisasi) and Provision of Forest Resources (namely PSDH-Provisi Sumber Daya Hutan). Based on national regulation and current dollar rate ($1 = IDR 14,158.8), the mean of non-tax is presented below (Table 2).

\[
\text{NtSTR} \ (IDR) = \sum_{j=1}^{n} TP_j \times \text{NonTax}_j \quad \ldots \quad (5)
\]

Table 2. Reforestation Fund and Forest Resource Provision tariff

| Type of Tax | Meranti       | Mixed Forest | Acacia | Eucalyptus |
|-------------|---------------|--------------|--------|------------|
| DR          | IDR 210,025   | IDR 174,628  | -      | -          |
| PSDH        | IDR 73,000    | IDR 42,667   | IDR 8,400 | IDR 8,400 |

Source : [28, 29]

2.4 Levels of confidence in reported data
R / C ratio is an equation to describe the level confidence in data reported by the government in some statistical data that are investigated. The equation 6 is developed from the basic equation of effectiveness that is grounded in the values and preferences [30], by comparing reported data (R) with calculated data based on equations 1, 2, 3 and 4 (C).

\[
R / C \text{ ratio} = \frac{R}{C} \quad \ldots \quad (6)
\]

Simply put, the value of the R / C ratio is divided into three levels of confidence in the reported data, namely: very low (<0.33 or > 1.67), meaning that it is too far from preference, low / far (0.33-0.67) or 1.33-1.67) and adequate (0.67 < R / C ratio < 1.33).
3. Result and Discussion

3.1 Characteristics of Production Forest of Indonesia

Production forest (PF) is classified into 3 types, namely Permanent Production Forest (PPF), Limited Production Forest (LPF) and Convertible Production Forest (CPF) (Table 3). Availability of production forest in Indonesia is 68.84 Mha. In Papua and Kalimantan, the availability of the production forest is up to 44.80 Mha. The productivity, however, is considerably less than those located in Sumatra. Papua, including Maluku, which only produces 1.68 M m$^3$ wood from 24.83 Mha PF available, compared to Sumatra with the production of 31.11 M m$^3$ wood from 11.92 PF available [3,10]. Surprisingly, those productivity is even lower than it is in Germany which only manages a-11.4 Mha forested area with total production of 121.6 M m$^3$ [31].

The TGHK and the RTRW are the bases for designing and controlling forest land use, in the case of production forest, TGHK and RTRW designs and controls the development of concessionaires and tree crop plantation (TCP) [2]. TCP tends to increase from year to year [32, 33, 34]. Unfortunately, LNFC tends to decrease and LIBIP need to be audited [35].

| Main islands, region & Indonesia | Extent of Production Forest Available (Mha) |
|---------------------------------|-------------------------------------------|
|                                 | PPF | LPF | CPF | PPF & LPF | PPF, LMF & CPF |
| Sumatera                        | 2.83 | 7.36 | 1.72 | 10.20 | 11.92 |
| Kalimantan                      | 10.62 | 10.85 | 3.07 | 21.47 | 24.54 |
| Maluku                          | 1.56 | 1.12 | 1.89 | 2.69 | 4.57 |
| Papua                           | 7.74 | 6.93 | 5.59 | 14.67 | 20.26 |
| **Sub-total SKMP**              | 22.76 | 26.26 | 12.28 | 49.02 | 61.30 |
| Java, Bali & NT                 | 0.88 | 1.84 | 0.08 | 2.72 | 2.79 |
| Sulawesi                        | 3.14 | 1.15 | 0.45 | 4.30 | 4.75 |
| **Sub Total JSBN**              | 4.03 | 2.98 | 0.53 | 7.01 | 7.54 |
| **Total Indonesia**             | 26.79 | 29.25 | 12.81 | 56.04 | 68.84 |

% SKMP: 87.5% 89.0%

Source: [3, 37]; analyzed. Notes: PPF= Permanent production forest; LPF= Limited Production Forest; CPF= Convertible Production Forest, PF= Production Forest

Figure 1 shows that registered LNFC in Indonesia is 575 units with total areas of 61.7 Mha. However, the number of both units and areas decreased significantly in 2017, which were 259 units with total areas of 18.81 Mha. Several LNFC even are closed temporary, leaving 199 active units with total areas of 15.5 Mha. Similar to LNFC, LIBIP also shows the same trend, leaving 156 units in active (6.2 Mha). Total area of active LNFC and LIBIP is 21.65 Mha, which is lower than that of the availability of production forest in Indonesia (68.84 Mha). SKMP, which is registered LNFC, there are 248 units (18.33 Mha) and which is registered LIBIP, there are 275 units (10.70 Mha). However, active and registered LNFC and LIBIP are only 187 units (14.84 Mha) and 155 units (6 Mha), respectively. This fact informs that 40.46 Mha of production forest in SKMP is unmanaged. Interestingly, the area of plantation forest of SKMP is only 2.78 Mha based on spatial analysis [37].
3.2 Estimation of Effective Land Use and Total Log Production

Total timber production in SKMP based on the groups is 43.75 M m$^3$ (Figure 2) [10]. In addition, in accordance with concessionaires, the total timber production of SKMP is 43.18 M m$^3$ (Table 4) [3], which 96.88% of which is from MMfAE. The percentage of MMfAE in SKMP towards the total timber production of Indonesia in 2017 was 86.25%.

Table 4 shows that there are 3 data used to test the reliability of available data. It is related to 4 of 6 major weaknesses identified by The Indonesian Corruption Eradication Commission study [22]. There are (a) management of data on reported timber production that is insufficient for holding companies which are accountable to meet fiscal obligations to the state, b) existing internal controls are inadequate for ensuring the integrity of systems for timber administration and collection of non-tax revenue, (c) external accountability mechanisms are inadequate for preventing state losses from the manipulation of information on timber production and non-tax revenue collection, and (d) ineffective law enforcement in the forestry sector that is resulted in a “shadow economy” for illegally harvested timber.
Table 4. Units and area extent of LNFC / LIBIP in SKMP and Total Woods Production from three of different data sources

| Data Source | Description                  | LNPF Units | LNPF Area (Mha) | LIBIP Units | LIBIP Area (Mha) | TP LNFC (M m³) | TP LIBIP (M m³) |
|-------------|-------------------------------|------------|-----------------|-------------|-----------------|----------------|-----------------|
| MoEF Stat A | Generally                     | 248        | 18.33           | 275         | 10.70           | 5.397          | 37.787          |
|             | Licenses in Active            | 187        | 14.84           | 155         | 6.00            |                |                 |
|             | Licenses in Suspend           | 76         | 5.12            | 44          | 1.82            |                |                 |
| MoEF Stat B | Land cover *                  |            |                 |             |                 | 5.12 **        |                 |

Source: a [3], b [9], c [37]. Notes: * Land cover Calculation 2017 not available yet, approached by 2016. ** Approached by calculation of (6/5 x data) / 65%, assuming Elu 65% of TAC, plant cycle of 6 year, based on forest plantation cover data of 2.78 Mha and assuming that 1 year old plants are illegible in the image hue.

Table 5. The value of the main variables used in estimating the net potential of logging in natural forests and plantation forest

| Natural Forest | Plantation Forest |
|----------------|-------------------|
| Forest Cover & Potency | Species | Acacia | Eucaliptus |
| High | Med | Low | Increment (cm/year) | H/D | Form Factor | Number of Tree (N/ha) |
| cod 40cm | 19 | 17 | 10 | 2.6; 2.8; 3.0 | 0.628 | 0.42 | 1100; 1350 & 1650 |
| cod 50cm | 13 | 8 | 6 | 2.2; 2.4; 2.8 | 0.628 | 0.42 |
| cod 60cm | 7 | 3 | 4 | & 3 | |
| cod 70cm | 5 | 3 | 2 | 2.8 | |
| cod 80cm | 4 | 1 | 1 | |
| cod 90cm up | 2 | 2 | 0 | |
| Class of species | | |
| M | Mf | FW | % growth | Safety Factor | Exploitation Factor |
| 49 | 35 | 5 | 85 | 0.9 | 0.9 |
| 0.46 | 0.42 | 0.32 | 0.9 | 0.9 |
| 0.52 | 0.5 | 0.46 | 0.9 | 0.9 |
| 0.7 | | | 0.9 | |
| Exploitation Factor | 0.7 | | |

Source: data analyzed; approached by primary data collected in 2009, 2012 & 2013

Table 6. Distribution of forest cover in LNFC samples and the net potency based on their forest class

| Land cover                     | % Available | Net Potency / Productivity |
|--------------------------------|-------------|----------------------------|
| High potency of Primary Forest & LoA | 45.36% | 58.69 | 62.02 |
| Medium Potency of LoA           | 17.44% | 42.30 | 32.51 |
| Low Potency of LoA              | 21.47% | 26.80 | 20.90 |
| PAO                            | 15.73% | -     | -     |

Source: data analyzed; approached by primary data in 2009, 2012 & 2013; Note: Loa stands for Log Over Area, is an area where the trees have been cut in the previous cutting cycle; PAO is Protected Area and Others, area which it protected and un-used
Three data that are used consist of the area of LNFC and LIBIP registered in the Ministry of Environment and Forestry Statistics 2017 (MoEF Stat A), the area of active LNFC and LIBIP registered in Directory of Forestry Company 2017 (BPS Stat), and the area of Indonesia’s plantation forest cover based on Land Cover Calculation 2016 (MoEF Stat B). Data related to LNFC are tested with net potency/productivity (Table 6) that is calculated from Table 5. Meanwhile, data related to LIBIP is tested using 102.15 m$^3$/ha that is resulted from primary data of research in 2012 and 2013 as well as other related articles [38, 39, 40].

Table 7. Levels of confidence in the reported data by government, which is approached based on Elu and timber production in 4 LNFC scenarios, 3 LIBIB scenarios and each the most probable estimate (MPE)

| Scenario | Variable Analyzed | Reported (R) | Calculated (C) | R/C Ratio** | Levels of confidence |
|----------|-------------------|--------------|----------------|-------------|---------------------|
|          | TAC   | Elu   | Ann Elu | Prod* | TP      | Prod | TP | TP |               |                     |
| LNFC     |       |       |         |       |         |       |   |    |               |                     |
| A        | 18.33 | 15.45 | 0.44    | 12.23 | 5.397   | 51.06 | 20.82 | 0.26 | Very Low       |
| B        | 18.33 | 11.51 | 0.33    | 16.41 | 5.397   | 60.33 | 18.48 | 0.29 | Very Low       |
| C        | 18.33 | 8.32  | 0.24    | 22.71 | 5.397   | 69.08 | 15.51 | 0.35 | Low            |
| D        | 14.84 | 6.73  | 0.19    | 28.06 | 5.397   | 69.08 | 13.29 | 0.41 | Low            |
| MPE      | 14.84 | 2.73  | 0.08    |       |         |       |    |    |               |                     |
| LIBIB    |       |       |         |       |         |       |    |    |               |                     |
| E        | 10.70 | 6.96  | 1.16    | 32.60 | 37.79   | 102.15| 118.40| 0.32 | Very Low       |
| F        | 6.00  | 3.90  | 0.65    | 58.14 | 37.79   | 102.15| 66.39 | 0.57 | Low            |
| G        | 5.12  | 3.33  | 0.55    | 68.09 | 37.79   | 102.15| 56.69 | 0.67 | Adequate       |
| MPE      | 5.12  | 2.22  | 0.37    |       |         |       |    |    |               |                     |

Note: TAC is Total Concessionaire Area; Scenario A: MoEF stat A with Elu in high, medium and low net potency of area available is used (84.47% of TAC); Scenario B: MoEF stat A with Elu in high & medium net potency of area available is used (62.80% of TAC); Scenario C: MoEF stat A with Elu only in high net potency of area available is used (45.36% of TAC); Scenario D: BPS Stat with Elu only in high net potency of area available is used (45.36% of TAC); Scenario E: MoEF Stat A is used; Scenario F: BPS Stat is used; Scenario G: MoEF Stat B is used. *calculated by dividing TP reported by Ann Elu, especially in LNFC, the net potential bases on their forest class that is presented in table 6 is also counted as an additional variable. ** The parameter chosen to describe the level of confidence in reported data is TP

Based on the 4 scenarios presented in Table 7, the confident level towards the Ministry of Environment and Forestry’s scenarios (scenario A, B) is very low. Those 2 scenarios result very low productivity value (12.23-16.41 m$^3$/ha) and it is less to be able to figure out the structure of natural forest of Indonesia. Scenario which can be forcibly accepted is D with total forest production of 14.84 Mha and Elu 6.73 Mha. Moreover, the best and forcibly accepted scenario is G with TAC projection of 5.12 Mha and Elu 3.33 Mha.

Our analysis supports 4 major weaknesses identified by the ICEC study with the conclusion as it is below:

a. Total Elu of 11.06 Mha (6.73 Mha from LNFC and 3.33 Mha from LIBIP) is lower than the potential availability of production forest in SKMP which is 45.05 Mha. It supports the ICEC study (point a and b), that forest land used extents are smaller than the amount reported.

b. Difference between total production, accounting for 13.29 M m$^3$ from LNFC and 56.69 M m$^3$ from LIBIP, with official statistical data (5.39 M m$^3$ from LNFC and 37.78 M m$^3$ from LIBIP) indicates unreported timber production of 26.81 M m$^3$. This supports point c and d as well as ICEC study. If TP
based on Government reported data is true, it is worst to receive another paradox, that the most probable estimate of Elu on the field is just only 2.73 Mha in LNFC and 2.22 Mha in LIBIB. Therefore, the total of Elu is 5.95 Mha or only 13.21 % of the potential availability of production forest in SKMP.

3.3 Revitalization and Redesign are needed
Those identified weaknesses imply that some improvements are needed. Therefore, three strategies are proposed: (a) realistic strategy to fix TP governance and accountability, (b) optimistic strategy to encourage each forest concession to apply multi-sylvicultural system [24, 27, 41, 42, 43, 44, 45, 46, 47, 48], (c) optimistic realistic strategy to encourage investment in unutilized production forest. Further analysis using database concessionaires produce an optimistic scenario. The success rate in this optimistic scenario is assumed by 80%. Furthermore, 23 different types of land cover by MoEF [37] are simply elaborated by identifying land cover types, well identified from a forested area (primary / secondary dry land forest, etc.) as well as non-forested area (shrubs / underbrush, etc.) for the purpose of developing plantation forest. The optimistic-realistic scenario seems to be precisely called as a great hope. The success rate in this optimistic-realistic scenario is assumed by 70%. The description of the scenario and the results are presented in Tables 8 and 9 and Figure 3 below. Moreover, additional analysis is also presented to explain the projections in units with an area of 100 thousand ha. The results are presented in Table 10 and Figure 4.

Table 8. Land use proposed in each scenario and simulation in unit area 100 thousand ha

| Silvicultural System | Realistic | Optimistic | Great Hope | Unit |
|----------------------|-----------|------------|------------|------|
| TPTI HP              | 2,851,733 | 3,220,557  | 3,305,817  | 7,392|
| TPTI HPT             | 3,879,595 | 4,225,446  | 4,305,395  | 10,056|
| TPTJ HP              | -         | 1,362,767  | 4,910,564  | 14,953|
| TPTJ HPT             | -         | 1,741,457  | 5,068,269  | 14,022|
| THPB Acacia          | 3,406,300 | 8,728,673  | 13,414,373 | 35,329|
| THPB Eucalyptus      | 417,833   | 1,070,700  | 1,645,470  | 4,334 |
| THPB Others          | 75,533    | 193,555    | 297,458    | 783  |
| PAO                  | 10,207,912| 7,179,380  | 12,104,948 | 13,131|
| Potential            | 20,838,906| 27,722,535 | 45,052,294 | 100,000|
| Land Use             | 10,630,994| 20,543,155 | 32,947,346 | 86,869|
Table 9. Total logs production and NtSR based on strategic purposed

| Type of Wood and NtSR | Scenario          | Actual | Realistic A | Realistic B | Optimistic | Great hope |
|----------------------|------------------|--------|-------------|-------------|------------|------------|
|                      |                  |        |             |             |            |            |
| Meranti              |                  | 3.40   | 7.60        | 7.69        | 11.60      | 18.75      |
|                      | 25 years later   | -      | -           | -           | 17.47      | 37.49      |
| Mix Forest           |                  | 1.54   | 4.96        | 4.96        | 7.73       | 12.88      |
|                      | 25 years later   | -      | -           | -           | 7.76       | 10.00      |
| Acacia               |                  | 33.01  | 57.99       | 60.50       | 155.02     | 238.24     |
|                      | 25 years later   | -      | -           | -           | 7.76       | 10.00      |
| Eucalyptus           |                  | 4.05   | 7.11        | 6.39        | 16.38      | 25.18      |
|                      |                  |        |             |             |            |            |
| Total Production (M m3) |                  | 42.00  | 77.66       | 79.54       | 190.73     | 295.05     |
|                      |                  |        |             |             | 215.96     | 342.54     |
| NtSR (IDR trillion)  |                  | 1.61   | 3.77        | 3.82        | 6.40       | 10.32      |
|                      |                  |        |             |             | 6.44       | 10.41      |

Note: Actual based on current statistics. Realistic is processed using two calculation methods, namely Microsoft-excel computer program (A) and the Supersilvik model (B), with the conclusion that the model is quite reliable. A slightly larger value in Realistic B is because some variables in method A are grouped in average numbers, which in method B detects variables per variable. Supersilvik are used in Optimistic and Optimist-Realistic.

Our proposed strategies are:

a. Realistic strategy seems to fix timber production governance and accountability. Governance improvement in LNFC and LIBIP is possible to carry out for initial steps, with stipulating target of round-wood production at 77.66 M m³. This is reasonable since it relates to raw material shortage for industry [9] which does not affect ‘a shocking effect’ for industrial raw material wood processing due to illegal logging and unreported timber [22].

b. Optimistic strategy seems to be able to encourage the implementation of multi-system silvicultural (MSS) by each forest concessionaire. The MoEF as the regulator has the opportunity to reawaken interest in investing with regulations that propel the implementation of MSS [27] in the field and provides better results in terms of timber production [49]. The first step of implementation is through directing to LNFC and LIBIP listed, both active (342 units) and suspended (120 units). Total projecting concession areas by this scheme is 27.77 Mha and Elu is 20.54 Mha, increasing as much as 9.91 from present Elu. MSS implementation is also supporting ecological aspects with increasing the number of trees and forested areas through TPTJ and THPB in low production and unforested areas, creating 25.90% of protected areas [50]. Table 9 shows that this second strategy will yield timber production of 190.73 M m³, and increases 25 years later to 215.96 M m³ from harvested wood in TPTJ. It is argued that 190.73 M m³ is the psychological number if MSS is applied well. Nevertheless, the psychological number can be a target for forest development in the future. Therefore, the key role of government to perform supports could be implemented through capital investment to LNFC and LIBIP. Based on repeated simulation carried out, the result shows that the average of capital requirement per unit within 100 thousand area extent of MSS applied is IDR 175-225 billion, and NPV IDR 1-1.5 trillion (Table 10 and figure 4; analyzed with 60 years of time range of analysis and interest rate of 15% are used).
Table 10. Main indicators to encourage implement of MSS per 100 thousand ha.

| Indicator          | Range of Value | Unit of Value |
|--------------------|----------------|---------------|
| Capital investment | 175 to 225     | Billion IDR   |
| Wood Production    |                |               |
| IPK Logs           | 50 to 200      | thousand m³   |
| Log                | 80 to 120      | thousand m³   |
| KBS/KBK            | 600 to 750     | thousand m³   |
| Labor absorption   | 500 to 750     | Person        |
| Heavy equipment    | 25 to 50       | Unit          |
| Financing          |                |               |
| NPV                | 1000 to 1500   | Billion IDR   |
| IRR                | 80 to 90       | %             |
| BCR                | 1.4 to 1.6     | -             |
| NtSR               | 40 to 60       | Billion IDR   |

Note: IPK Log (abbreviate to Izin Pemanfaatan Kayu) is timber production from utilization permit activities in the framework of forest clearance; KBS (Kayu Bulat Sedang) is medium logs; KBK (Kayu Bulat Kecil) is small logs.

c. Optimistic-realistic strategy to encourage investment in 45.05 Mha of potential extents of production forest, it happens on permanent production forest 23.25 Mha and on limited production forest 21.80 Mha. In other words, this strategy is equal to great hope strategy due to forest land tenure problems [51, 52]. Available analysis is to inform that the National Forestry Planning which is initially targeted TP of 376.5 million m³/year by 2030 is plausible, although the implementation has to wait for the two previous strategies. This 3rd strategy will increase Elu to 32.95 Mha; TP to 342.54 M m³/year and NtSR to IDR 10.41 trillion/year. If the 3 proposed strategies above is applied with the assumption of 5-15 year implementation for each step, the increase in timber production of Indonesia will be as Figure 3.

Figure 3. SKMP Timber Production Projection, times to realize is dependent of Indonesian Government effort for get better

Figure 4. NPV Progress Per Year in 100 Thousand ha Concessionaires
4. Conclusion
This study concludes that timber governance in Indonesia are inefficient and questionable. It starts from unconvincing data about the total area of land use. An extreme example is the three different data of plantation forests, which each of them has a low level in trust when it is used for the bases of estimating land planted and wood production at the field level. Optimistically, weaknesses that have been criticized by many observers can be corrected, depending on the MoeF’s efforts to improve. The most realistic strategic step is to conduct an audit and guidance for each concession holder. Furthermore, encouraging the implement of multisystem-sylvicultur for each concessionaire is logically able to improve each performance. Hence, those efforts still require two conditions: seriousness and honesty.

Acknowledgement
The authors gratefully acknowledge many forest concessions for providing the opportunity to conduct the study in its concession area. Thanks to many experts, i.e. Prof. Andri Indrawan, Prof. Ellias, Prof Nina Mindawati, Dr. Putera Parthama dan Mr. Gadang Pamungkas, especially in providing support until the first author receives an official acknowledgment from Directorate General of Sustainable Forest Management, MoEF.

References
[1] Republic of Indonesia 2007 Peraturan Pemerintah Republik Indonesia Nomor 6 Tahun 2007 Tentang Tata Hutang Dan Penyusunan Rencana Pengelolaan Hutan, Serta Pemanfaatan Hutan (Pub. L. No. Lembaran Negara Republik Indonesia Tahun 2007 Nomor 22)
[2] Kartodihardjo H & Supriono A 2000 The Impact of Sectoral Development on Natural Forest Conversion and Degradation: The Case of Timber and Tree Crop Plantations in Indonesia. (Group, 26(26)) https://doi.org/10.17528/cifor/000628
[3] MoEF 2018 Statistik Kementerian Lingkungan Hidup Dan Kehutanan Tahun 2017 (Pusat Data dan Informasi. Sekretariat Jenderal Kementerian Lingkungan Hidup dan Kehutanan / Ministry of Environment and Forestry-MoEF).
[4] Ministry of Forestry 2009 Peraturan Menteri Kehutanan tentang Sistem Silvikultur Dalam Areal Izin Usaha Pemanfaatan Hasil Hutan Kayu Pada Hutan Produksi (Pub. L. No. Berita Negara Republik Indonesia Nomor 24 Tahun 2009)
[5] Ministry of Forestry 2011 Peraturan Menteri Kehutanan Republik Indonesia Nomor P.49/Menhut-II/2011 Tentang Rencana Kehutanan Tingkat Nasional (RKTN) Tahun 2011-2030 (Pub. L. No. Berita Negara Republik Indonesia Nomor 381 Tahun 2011)
[6] BPS – Statistics Indonesia 2014 Statistics Of Forestry Production 2013 (Subdirectorate of Forestry Statistics, ed.) https://doi.org/BPS Catalogue: 5601005
[7] BPS – Statistics Indonesia 2015 Statistics Of Forestry Production 2014 (Subdirectorate of Forestry Statistics, ed.) https://doi.org/BPS Catalogue: 5601005
[8] BPS – Statistics Indonesia 2016 Statistics Of Forestry Production 2015 (Subdirectorate of Forestry Statistics, ed.) https://doi.org/Catalog: 5601005
[9] BPS – Statistics Indonesia 2017 Statistics Of Forestry Production 2016 (Subdirectorate of Forestry Statistics, ed.) https://doi.org/Catalogue: 5601005
[10] BPS – Statistics Indonesia 2018 Statistics Of Forestry Production 2017 (Subdirectorate of Forestry Statistics, ed.) https://doi.org/Catalogue: 5601005
[11] MoEF 2017. Statistik Kementerian Lingkungan Hidup Dan Kehutanan Tahun 2016 (Pusat Data dan Informasi, Ed.). Kementerian Lingkungan Hidup dan Kehutanan - Ministry of Environment and Forestry (MoEF), Republic of Indonesia.
[12] Tsujino R, Yumoto T, Kitamura S, Djamaluddin I & Darnaedi D 2016 History of forest loss and
degradation in Indonesia. *Land Use Policy* 57 P 335–347
[13] Margono B A, Potapov P V, Turubanova S, Stolle F & Hansen M C 2014 Primary forest cover loss in Indonesia over 2000–2012. *Nature Climate Change*, 4 (June) p 1–6
[14] Maladi Y 2013 Kajian hukum kritis alih fungsi lahan hutan berorientasi kapitalis. *Dinamika Hukum*, 13 p109–123.
[15] Linkie M, Sloan S, Kasia R, Kiswayadi D & Azmi W 2014 Breaking the vicious circle of illegal logging in Indonesia *Conservation Biology* 28(4) p 1023-1033. [https://doi.org/10.1111/cobi.12255]
[16] Maryudi A 2016 Choosing timber legality verification as a policy instrument to combat illegal logging in Indonesia. *Forest Policy and Economics* 68, p 99–104. [https://doi.org/10.1016/j.forpol.2015.10.010]
[17] Schmitz M 2016 Strengthening the rule of law in Indonesia: the EU and the combat against illegal logging. *Asia Europe Journal*, 14(1) p 79–93. [https://doi.org/10.1007/s10308-015-0436-8]
[18] Herawati H & Santoso H 2011 Tropical forest susceptibility to and risk of fire under changing climate: A review of fire nature, policy and institutions in Indonesia. *Forest Policy and Economics*, Vol. 13 pp. 227–233 [https://doi.org/10.1016/j.forpol.2011.02.006]
[19] Szulecka J, Obidzinski K & Dermawan A 2016 Corporate-society engagement in plantation forestry in Indonesia: Evolving approaches and their implications. *Forest Policy and Economics*, 62, p 19–29 [https://doi.org/10.1016/j.forpol.2015.10.016]
[20] Suryanto, Nurrochmat D R, Prijono H, Budiman A & Suyana A 2010 *Multisistem Silvikultur, Menjadikan Pemanfaatan Kawasan Hutan Produksi Menjadi Lebih Baik* pp. 1–8 Retrieved from [https://www.scribd.com/document/328475511/Policy-Brief-No-4]
[21] Suryanto & Wahyuni T 2016 *Proc. Int Conf. of Indonesia Forestry Researchers III-2015* ed Siregar C A, Pratiwi, Mindawati N, Pari G, Turjaman M, Tata H T, … Balfas J (Bogor) pp. 553–563. Retrieved from [http://www.forda-mof.org/content/publikasi/post/618]
[22] ICEC 2015 *Mencegah Kerugian Negara Di Sektor Kehutanan Sebuah Kajian Tentang Sistem Penerimaan Negara Bukan Pajak Dan Penatausahaan Kayu* (Indonesian Corruption Eradication Commission-ICEC) Retrieved from [https://acch.kpk.go.id/images/tema/lifbang/pengkajian/pdf/Laporan-PNBP-Kehutanan-KPK-report-web.pdf]
[23] Koalisi Anti Mafia Hutan 2015 *Kesenjangan Persediaan Kayu Legal Dan Implikasinya Terhadap Peningkatan Kapasitas Industri Kehutanan Di Indonesia: Sebuah Kajian Peta Jalan Revitalisasi Industri Kehutanan, Fase 1 Kehutanan, Fase 1*. Retrieved May 20, 2019 from [https://www.eyesontheforest.or.id]
[24] Suryanto, Susilo A, Onrizal, Andriansyah M & Muslim T 2018 Implementation Of Multi-System Silviculture To Improve Performance Of Production Forest Management: A Case Study Of PT. Sarpatim, Central Kalimantan. *Indonesian Journal of Forestry Research*, 5 No. 1 p 1–19. [https://doi.org/10.20886/ijfr]
[25] Ministry of Environment and Forestry 2015 *Peraturan Menteri Lingkungan Hidup Dan Kehutanan Republik Indonesia Nomor : P. 12/Menhk-II/2015 tentang Pembangunan Hutan Tanaman Industri* (Pub. L. No. Berita Negara Republik Indonesia Nomor 472 Tahun 2015)
[26] Ministry of Forestry 2009 *Peraturan Direktur Jenderal Bina Produksi Kehutanan Tentang Pedoman Pelaksanaan Sistem Silvikultur Tebang Pilih Tanam Indonesia (TPTI)* (Pub. L. No. P.9/VI-BPHA/2009)
[27] Ministry of Forestry 2014 *Peraturan Menteri Kehutanan tentang Perubahan Atas Peraturan Menteri Kehutanan Nomor P.11/Menhut-II/2009 tentang Sistem Silvikultur Dalam Areal Itu*
Usaha Pemanfaatan Hasil Hutan Kayu Pada Hutan (Pub. L. No. P.65/Menhut-II/2014 2014)

Ministry of Environment and Forestry 2017 Peraturan Menteri Lingkungan Hidup Dan
Kehutanan Republik Indonesia Nomor: P. 64/Menhk-II/SETJEN/KUM.1/12/2017 tentang
Penetapan Harga Patokan Hasil Hutan dan Ganti rugi Tegakan (Pub. L. No. Berita Negara
Republik Indonesia Tahun 2017 Nomor 1889).

Republic of Indonesia 2017 Peraturan Pemerintah Republik Indonesia Nomor 12 Tahun 2014
Tentang Jenis Dan Tarif Atas Jenis Penerimaan Negara Bukan Pajak Yang Berlaku Pada
Kementerian Kehutanan (Pub. L. No. Lembaran Negara Republik Indonesia Tahun 2014 Nomor 36).

Cameron K 2015 Organizational effectiveness. Wiley Encyclopedia of Management, 1-4.
https://doi.org/10.1002/9781118785317.weom110202

Servicebüro Forstwirtschaft. (2019). Forestry in Germany, Looking Ahead but based on Tradition. Retrieved June 25, 2019, from Webpage website: https://www.forstwirtschaft-in-
deutschland.de/index.php?id=8&L=1

Abood S A, Lee J S H, Burivalova Z, Garcia-Ulloa J & Koh L P 2015 Relative Contributions of the
Logging, Fiber, Oil Palm, and Mining Industries to Forest Loss in Indonesia. Conservation
Letters, 8 (1) p 58–67 https://doi.org/10.1111/conl.12103

Gatto M, Wollni M & Qaim M 2015 Oil palm boom and land-use dynamics in Indonesia: The role
of policies and socioeconomic factors. Land Use Policy 46 p 292–303. https://doi.org/10.1016/j.landusepol.2015.03.001

Wicke B, Sikkema R, Dornburg V & Faaij A 2011 Exploring land use changes and the role of
palmoil production in Indonesia and Malaysia. Land Use Policy, 28(1) p 193–206. https://doi.org/10.1016/j.landusepol.2010.06.001

Gaveau D L A, Sheil D, Husnayaen, Salim M. A, Arjasakusuma S, Ancrenaz M, … Meijaard E
2016 Rapid conversions and avoided deforestation: examining four decades of industrial
plantation expansion in Borneo. Scientific Reports, 6 (October 2015), 32017. https://doi.org/10.1038/srep32017

BPS – Statistics Indonesia 2017 Direktori Perusahaan Kehutanan 2017 (Sub-Directorate of Forestry
Statistics, ed.). https://doi.org/Catalog: 1305070

MoEF 2017 Rekalkulasi Penutupan Lahan Indonesia Tahun 2016 Ed; Wibawa M & Limbu E S
(Direktorat Inventarisasi dan Pemantauan Sumber Daya Hutan. Direktorat Jenderal Planologi
Kehutanan dan Tata Lingkungan. Kementerian Lingkungan Hidup dan Kehutanan / Ministry of
Environment and Forestry (MoEF). Jakarta)

Aswandi A 2017 Model Simulasi Penjarangan Hutan Tanaman Ekaliptus. Jurnal Penelitian Hutan
Dan Konversi Alam, 4 (2), 195–209. https://doi.org/10.20886/jphka.2007.4.2.195-209

Ikhwan M, Sadjati E & Insusanty E 2018 Pendugaan Potensi Tegakan Ekaliptus (Eucalyptus Pellita
F. Meull) Menggunakan Metode Tree Sampling Dan Circular Plot. Wahana Forestra: Jurnal
Kehutanan, 12 (2), p 41–48. https://doi.org/10.31849/forestra.v12i2.220

Krisnawati H, Kallio M & Kanninen M 2011 Acacia mangium Willd. Ekologi, Silvikultur dan
Produktivitas. Retrieved from http://www.cifor.org/publications/pdf_files/Books/
BKrisnawati1106

Indrawan A 2008 Prosiding Lokakarya Nasional Penerapan Multisistem Silvikultur pada
Pengusahaan Hutan Produksi dalam rangka Peningkatan Produktivitas dan Pemantapan
Kawasan Hutan Ed Indrawan A, Istomo C, Wilbowo, Kasno & Nurhayati A D pp. 1–12 Retrieved
from http://repository.ipb.ac.id/handle/123456789/24319

Buongiorno J & Zhu S 2014 Assessing the impact of planted forests on the global forest economy.
New Zealand Journal of Forestry Science, 44 (Suppl 1), S2. https://doi.org/10.1186/1179-5395-
[43] Jo H, Lee H, Suh Y, Kim J & Park Y 2015 A dynamic feasibility analysis of public investment projects: An integrated approach using system dynamics and agent-based modeling. International Journal of Project Management, 33(8), 1863–1876.

[44] Jürgens C, Kollert W & Lebedys A 2014 Assessment of industrial roundwood production from planted forests. FAO Planted Forests and Trees Working Paper, FP/48/E(48), 40. Retrieved from http://www.fao.org/forestry/plantedforests/67508@170537/en/

[45] Kastner, T., Erb, K. H., & Nonhebel, S. (2011). International wood trade and forest change: A global analysis. Global Environmental Change, 21(3), 947–956.

[46] Lebedys A & Li Y 2014 Contribution of the Forestry Sector to National Economies, 1990-2011. FAO Report, 168. Retrieved from http://www.fao.org/publications/card/en/c/0e077344-03b5-4d0b-9953-4606c27e1884/

[47] LORC 1999 Choosing a Silviculture System (pp. 1–6). pp. 1–6. Retrieved from www.communitiescommittee.org/pdfs/mgmt_plans/slvcltr.pdf

[48] Madureira L, Nunes L C, Borges J G & Falcão A O 2011 Assessing forest management strategies using a contingent valuation approach and advanced visualisation techniques: A Portuguese case study. Journal of Forest Economics, 17(4), 399–414. https://doi.org/10.1016/j.jfe.2011.04.001

[49] Baskent E Z, Keles S & Yolasigmaz H A 2008 Comparing multipurpose forest management with timber management, incorporating timber, carbon and oxygen values: A case study. Scandinavian Journal of Forest Research, 23(2) p 105–120. https://doi.org/10.1080/02827580701803536

[50] Kusmana C 2011 Forest resources and forestry in Indonesia. Forest Science and Technology, 7(4), p155-160.

[51] Harun M K & Dwiprabowo H 2014 Model Resolusi Konflik Lahan Di Kesatuan Pemangkuan Hutan Produksi Model Banjarn. Jurnal Penelitian Sosial Dan Ekonomi Kehutanan 11 (4).

[52] Riggs R A, Sayer J, Margules C, Boedihartono A K, Langston J D & Sutanto H 2016 Forest tenure and conflict in Indonesia: Contested rights in Rempek Village, Lombok. Land Use Policy, 57, 241–249. https://doi.org/10.1016/j.landusepol.2016.06.002