The Use of Marketing Monitoring Web System Application to Estimate Cempaka Wood Product Consumption Level in North Sulawesi, Indonesia

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Abstract. Cempaka or *Magnolia* spp. is categorised into primary local wood mostly used by the people in North Sulawesi. Efforts to cultivate cempaka and supply of raw materials continue to be carried out. However, there is no measurement of consumption of cempaka wood at the industrial and household levels. This will threaten the existence of cempaka or cempaka cultivation is not attractive to the Minahasa community. The objective of this study was to obtain the information of consumption ratio of cempaka wood in North Sulawesi in household scale. This study was carried out for approximately eight months in Minahasa, South Minahasa, and North Minahasa. There are 13 industries of cempaka wood in household scale, and 99 respondents are gathered successfully. The study findings indicated that cempaka wood products identified were not only wooden houses construction but also furniture. Average consumption of cempaka wood products in North Sulawesi reached 0.17 m³/capita/annual. If the total population of North Sulawesi reached 2.5 million, the total consumption of cempaka timber was estimated to reach 435,000 m³ annually. With enormous demands for cempaka wood in North Sulawesi compared to its inefficient availability, it is recommended to promote more intensive cempaka plantation development in the region.

1. Introduction
Sustainable wood consumption is a global concern to reduce pressure on forest sustainability. Wood products that have been used for a long time are sometimes still intact but are not in accordance with the latest fashion. This makes people sometimes change their shape into new products or even add some additional materials so that they look like composite wood. This consumption pattern causes the demand for new wood to decline [1]. The decline in demand can be interpreted from a small consumption figure. A small consumption value will threaten the timber industry and the incomes of community forest cultivators or wood suppliers. Thus, the economic value of forested land will decrease [2], so that people will choose to convert forested areas to gardens or other uses.

Research related to the level of wood consumption is very important in preparing plans for the supply of raw materials and plans to produce wood products. The level of wood consumption can be calculated at 3 (three) levels of use, namely the national, industrial, and household levels. The level of wood consumption can be estimated by using an estimating model of wood consumption based on the level of use, although adjustments need to be made to the research location [3]. Adjustments mainly on the independent variables used in the model. The level of wood consumption at the national level uses the...
independent variable GDP (Gross Domestic Product) [4]. While at the industrial level, the independent variables used are the type of raw materials used and also the number of families who order wood products [5], [6]. Household wood consumption rate using house size [7]. The level of consumption of wood can also be known from the database of estimation of consumption levels. The database is composed of the results of empirical research. The empirical research in question is to estimate the volume of the product from the weight of the product. The results of the volume estimation are then calculated for consumption. Consumption is a function of the volume of wood divided by the number of family members and divided by the length of use [8].

Wood products are made from wood that is known to be durable and in accordance with the wishes of the community, such as cempaka. Cempaka (Magnolia spp.) is a popular wood type in North Sulawesi. It mainly functions as raw materials for furniture, cupboards, doors, boats, panels, sports equipment, musical instrument for Kolintang, and plywood [21]. Cempaka wood contains close historical values to the culture of North Sulawesi people because it has long been consumed as main material of Minahasa traditional houses constructions. The demands for cempaka woods are growing annually. This is because requests for Minahasa traditional houses and other products are increasing, particularly raising household needs. On the other hand, high demands are imbalanced with cempaka woods’ availabilities in the fields [22].

Cempaka is cultivated by the surrounding community as a supplier of wood raw materials and the cempaka wood processing industry requires certainty of the level of demand for wood products. This effort will continue if wood consumption continues to increase. Unfortunately, wood consumption figures cannot be obtained easily. Moreover, the consumption of wood by type. Estimating the consumption of cempaka wood using the GDP variable, the type of raw materials or the size of the house may not directly explain the level of consumption. For this reason, this study adopted the TEINIT (Timber product inventory on information technology) method [10] in providing consumption figures for wood products with cempaka wood as raw material.

2. Materials and Method
2.1. Research Location
Study was conducted in Minahasa and South Minahasa Regencies, North Sulawesi Province, Indonesia (Figure 1). It is divided into two stages which are i) wooden products inventory in industrial sectors and ii) interviews regarding wooden products in household areas. Both Minahasa and South Minahasa are located in North Sulawesi Province. The population total of South Minahasa Regency reaches 210,110 individuals [23], while Minahasa has 342,110 individuals [24]. The population in these two areas reaches 552,805 individuals. Population density in South Minahasa reaches 144.66 individuals/km² [23], and Minahasa reaches 300 individuals/km² [24].

2.2. Sample Analysis
This study began from surveying the weight of fine solid wooden goods in industries or craftsmen. Estimating the weight of these products is done in 10 furniture industries and wood retailers. Each product is weighed and photographed as well as questioned about the wood species? and the dry condition of the raw material. The data of wooden goods and roof is recorded and stored in database. After that, we use the database as interview resources with respondents. The number of respondents are 99 families scattered throughout Regencies and Manado City, North Minahasa, South Minahasa, and Tomohon City. Generally, wooden goods are depicted on the following picture.

Figure 2 illustrates the classification of wooden product. For furniture such as chairs, tables, bedstead and cupboards are differentiated according to the wooden raw material type used such as solid and composite timbers as explained by [25]. Measured wooden products are later recorded in a web-based database system. This data on wood products is then verified for use at the household level. We conducted research in 9 (nine) villages. The total sample households (respondents) interviewed were 99 households. Respondents were differentiated based on professions such as pensionary, government employees, entrepreneurs and other professional groups such as farmers (Table 1).
**Figure 1.** Research location in North Sulawesi

**Figure 2.** Classification of Wooden Product in Households
Table 1. Characteristics of respondents

| Area                  | Occupation | Total |
|-----------------------|------------|-------|
|                       | Pensionary | Farmer | Government Officer | Entrepreneur |     |
| Kembes                | 2          | 5      | 1                   | 2             | 10  |
| Mapanget, Dimembe     | 1          |        |                     |               | 1   |
| Matungkas, Dimembe    | 3          | 2      |                     | 1             | 6   |
| Rumoong               |            |        |                     | 1             | 1   |
| Rumoong Atas          | 7          | 15     | 5                   | 12            | 39  |
| Talawaan, Dimembe     | 3          | 2      | 2                   | 5             | 12  |
| Tombuluan             | 2          | 8      | 3                   | 6             | 19  |
| Cempaka, Dimembe      | 2          | 3      | 1                   | 2             | 6   |
| Wusa                  | 2          | 2      |                     | 1             | 5   |
| **Total**             | **19**     | **35** | **15**              | **30**        | **99** |

Based on Table 1, it can be seen that the number of respondents in Rumoong Atas village is more than other locations. In Rumoong Atas village, there are more respondents who work as farmers and entrepreneurs than retirees or government officials. The opposite was found in Mapanget village. In that village, only one respondent can be interviewed and works as a Government Official. Meanwhile, in Wusa village, there were no respondents who worked as Government Officials.

From the description above, it describes the diversity of the respondents' professions. However, this does not mean that in the village of Wusa there is no Government Official or that in the village of Mapanget there are no entrepreneurs. This is because the sampling is done intentionally and is not random or stratified.

2.3. Data Analysis

Data analysis is customized to TEINIT method informed by [26]. Based on this method, development particularly on product category is carried out by adding category of wooden bricks (Lata and Totara) house buildings. Lata and Totara resemble Gazebo. Data Analysis stages in study included the following steps:

2.3.1. Determining product volume

To find put product volume uses similarities [27].

\[
V_{obj} = \left( \frac{\text{object weight}}{\text{specific density} \times \text{density of } H_2O \times M_{COD}/100} \right)
\]  

(1)

To employ similarities (1), we assume specific density of all logs is 0.7 [28],[29]. Specific gravity is the weight of each unit's volume [19],[29]. Whereas, density of H_2O is 1000 kg/m^3 and M_{COD} is 12% - 17% [19],[29]. In this study, we use M_{COD} for 12%. Similarities (1) are modified by assuming that 90% of tree volume is functioned for solid wooden products [19].

\[
V_{obj,s} = \left( \frac{\text{object weight (kg)}}{0.8 \times 1000 \times 12/100} \right) \times 0.9
\]  

(2)

\[
V_{obj,s} = \left( \frac{1000}{96} \right) \times 0.9
\]  

(3)
Hereby, if an object’s weight is known, its volume ($V_{obj}$) of solid wood can be found directly.

2.3.2. Determining product volume
Consumption is calculated based on wooden product which are used

$$k_p = \left( \frac{V_p}{\text{number of family members}} \right) \frac{1}{\text{time of use}}$$  \hspace{1cm} (4)

$k_p$: konsumsi consumption of the p-th product, the unit is m$^3$ per capita per year
$v_p$: product volume p

As for calculating the average consumption of wood products are:

$$\bar{k} = \frac{\sum_{p=1}^{N} k_p}{N}$$  \hspace{1cm} (5)

$\bar{k}$: average consumption (m$^3$ per capita per year)
$N$: total data

3. Results and Discussion

3.1. Results
3.1.1. Characteristic of Wooden Products in Local Industries

The cempaka wood processing industry makes cempaka wood products based on orders from consumers, both in Minahasa and outside the Minahasa area. The purchases are from households and social buildings such as churches, schools, and several parts of traditional houses. With this condition, industries do not have wooden property supplies, even for display. Local industries usually fabricate doors, windows, chairs, tables, cupboards, and bedsteads with Cempaka woods. Doors are classified into two sizes which are single door and double doors. Door sizes are decided by the width measured in cm. Single doors have a width <100cm, and double doors are 100 – 150 cm. Furthermore, they consist of 2 parts which are structure and door panel. For the door panel double leaf, it needs 0.53 m$^3$ of wood for double doors, and 0.3 m$^3$ for single doors.

| Door Category | Length (cm) | Width (cm) | Thick (cm) | Weight (kg) | Volum (m$^3$) |
|---------------|-------------|------------|------------|-------------|---------------|
| Double        | 208         | 109        | 4          | 15          | 0.4           |
| Frame         | 206         | 129        | 5          | 15.9        | 0.2           |
| Door          | 211         | 90         | 3          | 14.5        | 0.2           |
| Single        | 229         | 60         | 3          | 9           | 0.11          |
| Door          | 208         | 109        | 4          | 9           | 0.11          |

Table 2 points out that the weight of a set of double doors is 15 kg and 9 kg for single doors. If Cempaka wood density is 0.676 [31], it requires 0.11 – 0.4 m$^3$/set of timber. Doors are made with thickness of 3 – 4 cm and length 200 cm. Additionally, cempaka is used to produce windows. Window’s size is 180 x 50 cm. This size shows that windows’ sizes used is massive. Probably, they are for churches, mosques, schools, and houses. Local residents need spacious areas for air circulation. To construct windows needs 0.2 m$^3$ timber.

| Window Category | Length (cm) | Width (cm) | Thick (cm) | Weight (kg) | Volume (m$^3$) |
|-----------------|-------------|------------|------------|-------------|----------------|
| Window          | 157         | 45         | 4          | 5.2         | 0.1            |
| Frame           | 128         | 82         | 4          | 4.2         | 0.1            |
| Total           | 17.3        |            |            |             | 0.2            |

Table 3. Cempaka wood needs for window
This result signifies that to craft 4 doors consisting of 2 main doors and 2 bedroom doors, and 6 windows which are 2 front windows, 2 bedroom windows, and 2 lounge windows requires 2.1 m$^3$ wood.

| Furniture | Length (cm) | Width (cm) | Thick (cm) | Weight (kg) | Volum (m$^3$) |
|-----------|-------------|------------|------------|-------------|---------------|
| Dresser   | 150         | 60         | 92         | 29.64       | 0.365         |
| Table     | 97          | 60         | 90         | 9.32        | 0.115         |
| Table     | 80          | 60         | 57         | 13.24       | 0.163         |
| Table     | 120         | 120        | 3          | 15.18       | 0.187         |
| Wardrobe  | 162         | 50         | 120        | 53.28       | 0.657         |
| Wardrobe  | 176         | 51         | 120        | 52.75       | 0.650         |
| Bed       | 200         | 160        | 3          | 36.44       | 0.449         |
| Bed       | 200         | 160        | 4          | 27.16       | 0.335         |
| Chair     | 95          | 40         | 5          | 5.16        | 0.064         |
| Chair     | 95          | 40         | 5          | 6.36        | 0.078         |
| Chair     | 75          | 20         | 3.5        | 4.8         | 0.059         |
| Chair     | 48          | 28.5       | 4          | 3.6         | 0.044         |
| Chair     | 120         | 50         | 66         | 19.36       | 0.239         |

In addition, the people of Minahasa practice cempaka wood for furniture. It includes tables, dressers, bed, wardrobes, and chairs. Massive needs for wood are for wardrobe approximately 0.6 m$^3$. Meanwhile, chairs depend on different proportions. To manufacture wooden products, craftsmen usually purchase Cempaka with diameter of 60 cm. From the tree, 15 pieces of planks with the length of 3 m, width of 30 cm, and thickness of 3.5 cm or 11 bricks with the volume 2.5 m x 0.2 m x 0.2 m.

### 3.1.2. Consumption of Wood Products in the Households

Minahasa people use cempaka woods for long-term and for varieties of products such as house frames, doors, windows, tables, chairs, wardrobes, and bedsteads. The average duration is 20 years.

| Wood Products | Weight (kg) | Time of Use (yr) | Volume (m$^3$) |
|---------------|-------------|------------------|----------------|
| House Frame   | 36          | 59               | 0.45           |
| Door          | 23          | 25               | 0.28           |
| Window        | 18          | 28               | 0.22           |
| Chair         | 6           | 37               | 0.08           |
| Wardrobe      | 52          | 23               | 0.64           |
| Table         | 25          | 27               | 0.31           |
| Bed           | 36          | 24               | 0.45           |

Table 5 indicates that wardrobes are heavier compared to other items that more timbers are necessary. However, according to direct communication with traditional houses’ craftsmen from Cempaka wood, wooden houses with volume 7 m x 8.5 m and height of 5 m need 10 m$^3$, whereas for 6 m x 6 m require 8 m$^3$.

Table 6 illustrates that larger needs for planks are for floors and walls. This necessity can reach 156 pieces of planks (36 for floors and 120 for walls) or equal to 5 m$^3$. Nevertheless, manufacturers usually use materials from Nyatoh (*Palaquium* spp.) for flooring. This portion is to build a house with volume 7.5 x 8 m but not windows and doors. Generally, the average usage of wooden items by Minahasa people last for 38 years with consumption rapidity of 0.17 m$^3$/person/yr. People tend to replace house construction part rather than adding some furniture such as chairs, wardrobes, and bedsteads.
Table 6. Wood needs for stilt houses

| Part      | Length (cm) | Weight (cm) | Thick (cm) | Number of stems | Volume (m³) |
|-----------|-------------|-------------|------------|----------------|-------------|
| Trestle   | 900         | 20          | 10         | 3              | 0.54        |
|           | 750         | 20          | 10         | 3              | 0.45        |
|           | 300         | 15          | 10         | 13             | 0.585       |
|           | 100         | 5           | 10         | 9              | 0.045       |
| Floor     | 300         | 30          | 3          | 24             | 0.648       |
|           | 400         | 30          | 4          | 36             | 1.728       |
| Wall      | 300         | 30          | 3          | 120            | 3.24        |
| Pillar    | 400         | 20          | 15         | 20             | 2.4         |
| Total     |             |             |            |                | 9.636       |

Figure 3. Consumption rate based on household items

Consumption rate of household wooden items vary. Houses are cempaka wood products that last for 60 years with consumption rate 0.1 m³/person/yr. Meanwhile, chairs, tables, beds, and windows survive for roughly 20 – 30 years with similar consumption rate around 0.01 – 0.2 m³/person/yr with 20 years duration. What is more, wardrobes seem to recently employ Cempaka because their usage rate reaches 0.32 m³/person/year with the duration of 20 years.

Table 7 points out that entrepreneurs have higher purchasing rate compared to other occupations. This is probably because they possess greater capability acquiring Cempaka woods. Data from cempaka woods’ craftsmen explains that the price of cut Cempaka woods reach 2.5M IDR/m³. On the one hand, pensioners and government officers have the least rate of utilization 0.01 – 0.05 m³/person/yr. Perhaps, those government workers prefer to employ different raw materials to construct houses or furniture because it is believed that steel houses last longer. Moreover, Teak furniture or Tectona grandis is more artistic and durable compared to cempaka produced locally.

Table 7. Consumption rate by occupation

| Profession         | Time of Use (year) | Consumption rate (m³/person/year) |
|--------------------|--------------------|----------------------------------|
| Pensionary         | 42                 | 0.04                             |
| Farmer             | 32                 | 0.14                             |
| Government Officer | 32                 | 0.05                             |
| Entrepreneur       | 32                 | 0.38                             |
| Total              | 34                 | 0.17                             |
3.1.3. Inputting data consumption of Cempaka wood products into web-based database

Web-based database is dynamic database. Dynamics means data are accessible anytime and anywhere. Web-based database employed is created by Abdulah, Suhendang, Purnomo and Matangaran published in the form of dissertation by Bogor Agriculture University Graduate School[30]. This database is an electronic catalogue such as product pictures, categories and subcategories, and weights. It has been continuously upgraded mainly regarding the display of household wooden products consumption index, and the input of respondents’ data and usage data. Web database operated is https://lutfyabdulah.info. Data uploaded is names, addresses, ages, and occupations of respondents and the number of their families. It is input in users’ webpage. In the meantime, data of products, unit totals, use durations and raw material type (solid/composite) is input in product webpage. Web database will perform data analysis and summarise the index automatically.

Further, web database https://lutfyabdulah.info is created to observe the utilisation percentage of wooden products in households across Indonesia. Therefore, the consumption index of wooden products in households in national scale can be found.

3.2. Discussion

The measurement of consumption percentage per capita is converted into database measuring public’s interest rates to choose wooden goods or the efforts to store carbon at home without realizing it. Timber is classified into carbon neutral material because it reduces carbon emission contained in enormous way [32]. Information on wood consumption per capita can be the base in achieving goals of continuous development. Constant growth ensures that the needs of future generation can be fulfilled without sacrificing current demands [33]. Sacrifice meant in this study is the wood volume required in the future can be delivered, similarly today. In addition, forest ecosystem condition functioning as log producers and other forestry uses is not interrupted in the present and future. Apart from this, community as wood and wooden goods suppliers can cultivate better ligneous merchandises.

In accordance with the definition of continuous development above, there are 3 regards which must be noticed that the necessities of wooden products, forest ecosystem sustainability, and public’s livelihood in forestry department involve raw materials and wooden items suppliers. Knowledge of timber consumption attained in this research relates to products necessitated, products’ volumes, and the duration of wooden products usages. Utilizing these items is affected by the wood’s durability rate. Hence, consumption rapidity tends to be lower compare to groceries and clothes [34]. Increasing requests in timber usages must be concomitant with the raise of population and gross domestic product (GDP) of a country [35]. It does not necessarily escalate carbon emission impact but can be controlled with planting swiftness to ensure log supplies in the future [36, 35].

Efforts in declining emission due to household consumption by elevating the use of ligneous equipment is called carbon offset. Households’ emission can be reduced for 51% if the consumptions are improved [36] Wood practices in decreasing household emission will affect wood industry sectors’ emission. Study finding in Bogor indicates using woods at home will reduce emission of 17 ton CO₂ [34]. However, this is less than emission from steel or plastic [7, 37]. If parts of buildings are replaced with steel or plastic, the amount of carbon will escalate more compare to using timbers. An instance, the largest consumption level of houses is on the construction of roof [26], if substituted with steel, the emission will increase two to three times when using logs. [38] adds that emission reduction on material issue can be found on material preference, and it is easily accomplished by depleting the use of bricks, iron, concrete, calcium, cement and other materials with high carbon emission.

Determinations in increasing wood consumption per capita will result in deforestation and environmental damage [39]. This saying is opposed by [40] who explains that advancing uses in timbers per capita decelerates forest conversion. This might be possible if this efforts are more beneficial than other businesses. Each price growth of 10% will enforce forest replanting 0.08% wide. Conversely, if there is a decrease of 10% in the price, the forest width will also decline for 0.09%.

The use of wooden equipment can elevate forest productivities. The speed of this productivities will increase around 7% with the growth rate reaching 0.2% [41]. Nonetheless, stands’ damage will be new
obstacle [42]. As a result, the best strategy is to produce wooden goods with fine quality, durability, and highly aesthetic value. This is implementable by selecting appropriate raw material according to types and volumes. To guarantee the sustainability of raw material and wooden products, one must ensure the resources of Cempaka woods which are planted with applicable Silviculture techniques, the process of wood processing assuring the durable excellent quality and showing the exquisiteness of wood texture, influential marketing pattern on value increase [43], logging under annual cut quotas, and aggregating logging efficiency and forest output [42].

Study finding signifies that Cempaka wood is majorly utilized by the people for construction and household furniture. Consumption rate is 0.17 m$^3$/person/yr. The greatest use is for wardrobe, meanwhile for houses, chairs, and tables, it appears to be less due to long-term endurance. Perhaps, this is caused by wood density which reaches 0.676. If the current population total is 552,085 people with growth promptness of 0.1%, the demands for timber material are calculated with similarities:

$$V = [552.085 \times (1 + 0.001)^t] \times 0.17 \tag{6}$$

This similarities is positive exponential. Addition in consumption rapidity will unceasingly enforce Cempaka wood requests to grow. However, if there is a reduction in consumption rate, the demands will also decline. Hence, wood usages must be observed dynamically.

Attempts in advancing consumption rate can be applied by warranting stable timber prices, long-lasting wood production according to biophysical carrying capacity, clarified forest right and acknowledged by the right timber administration institution, forestry management, outstanding harvesting and wood processing infrastructure [44]. Application of these strategies is expected to be able to suppress poverty rate [45]. Therefore, elevating wood consumption must be regarded as integrated management system. Harvesting sustainable wood and according to ecological support, suitable prices, inovative technological application, acknowledgement of land rights and public infrastructures which are accessible by all societies mainly arround forests. We think that improving wood consumption proportions starts from national revenue expansion [46,47] and is followed by application of strategies above. Outstanding wood quality encourage higher worth, as a result, the improvement of GDP will simplify the wood purchasing process within society [48]. Study finding discovering that entrepreuner gorups have the highest consumption level describes that income is the most significant factor in promoting wood usage percentage.

To date, Cempaka practice pattern bases on consumers demand not because of raw material amount. Demand is a function of financial convenience. Study field result finds that average worth of 1 m$^3$ of processed Cempaka wood in industries can reach up to IDR 2,5 million. Observed from long-term uses which can extent to 100 years, product economic value of 1 m$^3$ annually is IDR 25,000. This amount shows that if Cempaka wood consumption is increased, the opportunity of adding the worth annually is IDR 25,000.

Economic value will rise if Cempaka products are exported because it increases revenue [4]. Undoubtedly, export will be implemented if huge production and local requirements are fulfilled. Apart from raw material obtainability, goods’ qualities must be ensured to be utilized long-term [50].

Nonetheless, nation’s acts with insufficient national revenue condition (for instance Indonesia) will endlessly extract wood and later cope with severe environmental damage issues [51], meanwhile the country employ inherited wooden products such as composite woods manufactured by country with high GDP rate. This circumstance causes developed countries to generate emission 100 – 1000 times more compare to developing regions [51] because of shifting massive amount of carbon from forest and store it in the form of low ligneous equipment. In addition, consuming composite timbers can bourgeon emission of 8% in comparison to solid ones [12]. Meaning, utilizing solid logging can be an indicator of public’s prosperity.

Finding of this study uncovers that cempaka wood consumption ratio per capita for construction and furniture in North Sulawesi is 0.17 m$^3$ per capita. This number approaches that of the United States of
America which is 1.26 m$^3$ per capita [52] calculates log uses in the USA towards all derivative goods such as construction, furniture, and papers. On the other hand, practicing one type of wood such as Cempaka is greater than that of in Bogor that is only 0.06 m$^3$ per capita/annually [26]. This condition might be triggered because the people of North Sulawesi are located near to the raw material resources and their prices are affordable, and the culture that holds high obligation.

Web database http://lutfyabdulah.info is a web-based database able to present consumption levels in different regions in Indonesia. An instance, usage rates in regencies and Bogor City from 40 respondents are 0.014 m$^3$ per capita annually [52]. It is far below the use amount of Cempaka in Minahasa which is 0.17 m$^3$ per capita annually. Further, Minahasa might acquire larger usage level if considering all wooden merchandises without distinguishing varieties. This is due to usage duration, unit total, and various product weights. Furthermore, Minahasa culture attachment to kindlings such as constructing houses and furniture is inevitable. Other reason is natural wood potential and plants in Minahasa are superior. however, this figure needs to be validated by expanding the sample size. This is the limitation of this research. The sample size should be representative of profession, income level, social status as well as interest in using wood products. This shows that the inventory of consumption levels at the household level is very complicated. Validation of consumption figures needs to be done so as to obtain a small level of estimation error.

The development of web database in observing wood consumption rate is also improved by United Nations Economic Commission for Europe (UNECEF) in https://unece.org/forests/data-and-statistics. Still, UNECE reports national consumption percentage. Consumption data includes uses of wooden raw material, sawn wood from softwood and hardwood, wood-based panels, papers, paperboards and pulps, and wood energy [53]. Thus, data reported by UNECE is more complete than that of Indonesian via http://lutfyabdulah.info. UNECE predicts that the level of wood consumption is positively correlated with the level of income. The higher the GDP, the higher the level of wood consumption. UNECE sees that the income level parameter is one of the important parameters in using wood.

4. Conclusion
Cempaka is local wood in North Sulawesi used in construction and furniture since many years ago, one of which is very important for building traditional houses. To build this category of buildings 8 – 10 m$^3$ timbers are required. Cempaka wood consumption per capita in North Sulawesi is 0.17 m$^3$. Communities with high financial capacity tend to obtain high consumption rate. The employment of web database http://lutfyabdulah.info simplifies wood utilization surveillance that will be guideline in determining the fare of household wood volume in nationally.

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