Management prospects through development of non-timber forest products

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Abstract. Pressure on the area and the function of forests have been increasingly massive in the industrial age. Timber products and their derivatives, which are limited by harvest periods, become increasingly limited and cause a decline in forest value. Non-timber forest products, known as non-timber forest products (NTFPs), are of concern to stakeholders in the forestry sector. However, the broad type of NTFPs and special characteristics pose challenges in managing NTFPs. This paper summarizes the types of NTFPs based on several references and presents alternatives in the management of NTFPs. The dominant facts in NTFPs management are pressure on the area and function of forest, global economic trend, environmental aspect, the livelihood of people around the forest, and institutional aspects. Thus, the shift in the paradigm of forest management (extensification to intensification, partial to holistic), optimization of forest benefits, collaborative management, preparation of a grand design of forest, and network management are expected to become alternative management of NTFPs in the near future.

1. Introduction

Forest is an ecosystem unit in the form of a stretch of land containing biological natural resources, dominated by trees in the natural environment that cannot be separated from one another (Law No. 41 of 1999 concerning Forestry). The definition of forest products includes several commodities including: 1) vegetable products along with their derivatives such as wood, rattan, bamboo, grasses, medicinal plants, mushrooms, gums, parts or produced by plants [1]; 2) animal products and their derivatives such as wild animals and their captive products, hunting animals, beautiful animals, and parts or products produced by forest animals [2]; 3) ecologically non-biological objects constitute an ecosystem unit with forest-forming biological organs such as water, clean and healthy air and other goods but not including mining goods; 4) services obtained from forests such as tourism services, beauty, and uniqueness services, hunting services and other services [1]; 5) direct production results are obtained from processing raw materials originating from forests which are primary production including logs, sawn timber, plywood, and pulp. From this explanation, non-wood forest products can be interpreted as biological, non-biological objects and derivatives originating from forests and other similar types of land other than wood.

FAO defines non-timber forest products (NTFPs) as goods produced by biological objects other than wood originating from forests and other similar types of land [2], often also called non-timber forest products (NTFPs) as all biological objects including environmental services originating from
forest or forest stands, except wood products. Minister of Forestry Regulation No. 35/2007 explains that non-timber forest products consist of biological objects derived from flora and fauna, including service providers for water, air, and indirect benefits from forests.

1.1. Various kinds of non-wood forest products

In reality, there are several commodities whose form is in the form of wood but are declared as NTFPs, including sandalwood, yellow wood, and agarwood. It is because the commodity in its use does not function as a producer of chemicals such as dyes, fragrances, and active ingredients that affect the biological organs of both humans and animals. NTFP commodities can be collected into several groups, such as the following [3]:

- **Resin groups:** gondorukem, copal loba, copal bua, sticky copal, cat eye resin, rosin resin, resin stone, meat resin, damam pilau, incense, agarwood, kamedangan, shellac, clear, frankincense, mothballs and camphor resin.

- **Essential oil group:** sandalwood oil, eucalyptus oil, syntax oil, aloes oil, kruing oil, trawas oil, turpentine oil, star anise oil, cananga oil, palm oil, palm oil, citronella oil, nutmeg oil, eucalyptus oil, pine oil, clove leaf oil, gold oil, kilemo oil, cinnamon, vanilla, and sandalwood oil.

- **Fatty oils:** tengkawang, hazelnut, jatropha, macadamia, sesame, saga tree, walnut, soka, cashew, nima, moringa, kroton, kapok, nyamplung, picung, ketapang, balam, seminai, nyatoh, katiu, lena, lettuce, lime, flower, kroton, kapok, nyamplung, picung, ketapang, balam, seminai, nyatoh, katiu, lena, suntai, flower sun.

- **Starch:** flour, sago, sugar palm, nipah, various spices (suweg, iles, iles, yam, taro, yams, yams), honey, bamboo shoots, mushrooms, shacks.

- **Fruits:** tamarind, matoa, macadamia, breadfruit, durian, duku, jackfruit, burahol, mango, saga tree, kaling kaling.

- **Tannins:** acacia, bruguiera, rhizopora, areca nut, gambier, tingi, tengar, pilang, segawe, nyiri.

- **Dyes:** soga, clear, angsana, turmeric, honje, saninten skin, strain, secang. Indigo.

- **Gum:** jelutung, patch, hangkang, balam, sundik, red sap, forest rubber, germor.

- **Medicinal plants:** various types of medicinal plants from the forest that contain active ingredients.

- **Ornamental plants:** orchids, palmae, ferns, and various types of beautiful trees.

- **Rattan and bamboo groups:** various types of rattan and bamboo, nibung

- **Animal product groups:** bird nests, natural silk, shells, beeswax, hunting animals, various unprotected animals, and captive animals (crocodiles, deer).

- **Forest service groups:** water, clean air (oxygen), recreation (ecotourism), regulators of natural ecosystems.

- **Other groups (commodities that cannot be included in the above groups):** kupang, palm fiber, genitri, pandanus, germor, elephant grass, purun, oxen, kalapari, salaro wood, wind tree, uyun, wire grass.

Of the above grouping, there were 153 commodities of NTFPs. However, decomposed tengkawang, aloes, orchids, ornamental palms, ornamental plants, bamboo, and rattan consist of dozens of species of producing trees. Even the medicinal plants that have been inventoried include more than 1200 species. Thus, in Indonesia, there are more than 2000 types of NTFP-producing trees that need to be utilized as optimal as possible according to the nature and condition of local forest land.

For optimal utilization of NTFPs, it must be viewed as a multipurpose forest resource (MFR) system involving multiple interests through a holistic approach with a harmonious appreciation of all parties. The direction of the development of the forestry industry is one form of business based on MFR that is sustainable, and it will be able to create solid economic fundamentals and favor the public [4, 5]. Besides, it will open up opportunities for NTFP business development to be considered more because it has a comparative advantage and many alternative types to choose. Moreover, the
technology needed is simple, the required capital is relatively low, and its activities are in direct contact with the communities around the forest.

1.2. Characteristics of NTFPs

Given that the process of utilizing wood requires a relatively long period and requires a relatively higher investment compared to NTFP efforts (e.g., essential oils, medicinal plants, and herbs), more attention must be paid to the development of NTFPs at this time. Some fundamental differences in the characteristics of NTFPs compared to timber forest products are presented in the Table 1.

| Criteria | Wood products | Non-wood products |
|----------|---------------|-------------------|
| Parts used - Animals: skin, horns, animal intact | Stems | Leaves, sap, bark, stems, flowers, seeds, fruit, roots, twigs, extractions combined animal and vegetable, services (commercial and non-commercial) |
| How to harvest discipline | Harvest | Tapping, picking, picking, felling (pengubakan, isolation), picking, pruning Biology, physics, mechanics, chemistry |
| Harvesting Impact Damaging | Physics, mechanical around harvested trees | Slightly damaging the environment |
| Age of trees | 5-100 years | Monthly - more than 100 years |
| Number of harvests per tree age | Once harvest | 1 -100 times |
| Length of harvest | A few minutes/hour | A few minutes to decades |
| Crops yields (types of commodities) | Wood and its processed products | Commodities: resin, fat oil, essential oil, starch, tannin, wood, rubber, protein, medicinal ingredients, fragrances, dyes, tanners, spices and others |
| Production cycle | Production diameter | Productivity and frequency of results |
| Post-harvest Processing | Drying, preservation | withering, drying, soaking, frying |
| | Sawing, paneling | Drying, refining, dissolving, compressing, bio-processing, selection, and grading |
| The Disciplines science | chemistry and biology | Chemistry, biology, and physics |
| Changes in | physical, a little chemical | Chemistry, biology, physics |
| The extent of the business area | Extensive, narrow large capital | small and medium capital |
| Scale enterprises | Large-scale, medium-scale, large-scale entrepreneurs, medium-scale can be authorized by the local community |
| Science and technology Sophisticated equipment | High medium from abroad | Simple, medium Simple can be made at home |
| Marketing of products Used for | National, international construction (buildings and bridges), furniture, crafts | Finishing, polishing, insulators, food, medicine, insecticides, cosmetics, fragrances, sweeteners, spices, flavorings, furniture, craft materials, and other industrial materials |
| Benefits for entrepreneurs | communities, countries | Forest communities, entrepreneurs, countries |
| Public participation | Little and passive, generally as laborers | Many and actively, as owners will feel they own the forest so that they will actively participate in protecting the forest |
| Environmental analysis | Environmental degradation | Slight environmental degradation |

Source: Sumadiwangsa [3]

2. Current condition and the fact of NTPFs

2.1. NTFPs conditions

At this time, chemicals obtained from plant products are preferred over synthetic products. Therefore, the exploration of various types of plants in Indonesia needs to be carried out continuously to obtain
accurate information about plant species that can be used as medicinal ingredients, pesticides, dyes, flavorings, fragrances, sweeteners, adhesives or other useful materials. Some NTFP commodities are reliable export components. Besides, many residents from various rural tribes in the world depend on NTFP commodities to meet basic needs and as a source of livelihood.

Until now, there is still a process of decreasing the potential of producing sources (towards scarcity). Several types of NTFP commodities whose sources of producing plants are scarce include gaharu [6] (included in appendix II at the CITES IX session in Florida). Some whose commodity production has shrunk is such as rasak resin, pilau resin, meat resin, jelutung, camphor, clear, ketiau, balau, sunduk, and biga. The type of commodity needs to be known so that the application of the kinds of science and technology required can hit its needs. The types of science and technology required may range from the aspects of cultivation, post-harvest, processing, and quality control.

The economic involvement of the community around the forest that has owned NTFP businesses needs to be maintained and developed. Analysis, institutions, regulations, limited area, and land ownership, analysis of NTFPs function for the development of the social environment of the people around the forest, and market analysis are vital to take the right steps needed to develop local superior NTFP products. The application of the Indonesian Forestry Socio-Economic Survey Guidelines (PSSEKI) as a software for the socio-economic study of communities around forests and their relationship to NTFPs is urgently needed. This study is needed to find out the forms of potential, problems, and appropriate solutions for the economic empowerment of communities around the forest, in particular, not only generating significant foreign exchange for the country but also embodying the paradigm of the forestry sector.

2.2. Land suitability
The forest area of a province is overgrown with a variety of flora and fauna that are different from other provinces, even the variation of creatures that live in forest areas from one district is different from those living in other districts. This situation is understandable, considering that one plant requires different climatic, land, and environmental conditions from other plants. Likewise, NTFP-producing plants will differ from one forest area to another. With this information, to optimize the land value of a certain forest area, we need to find the most suitable plant species living in the area with optimal production results.

Cendana (Santalum album), for example, naturally now only grows in Nusa Tenggara, especially East Nusa Tenggara. Whereas in 1921, sandalwood grew mostly on the islands of Java, Madura, Timor, Flores, and Bali [7]. If this species will be developed, it is better to look for areas with climate, land conditions (such as fertility types and soil texture) that are similar to sandalwood areas in East Nusa Tenggara.

Eucalyptus (Melaleuca leucadendron) is planted in Ponoroga with seeds from Maluku and Timor. It turns out that this plant now produces an economic value, which is not small for PT. Perhutani Unit II and provides income for communities around the forest [1]. During the royal era in the past, one of the kings of Riau, as well as the Minangkabau, ordered his people to plant sago (Metroxylon sago) as a food reserve plant. Until now, Riau, especially the Riau Islands, is still a significant producer of sago flour, and its exploitation has been carried out sustainably. In the Minangkabau realm, there are still sago plants, namely in Padang Pariaman (95,790 ha) and in Mentawai (56,100 ha), although these plants are not optimally utilized.

In 1969, in the Haur Bentes experimental forest, Dermaga, Bogor planting tests were carried out on several species of Tengkawang trees such as Shorea stenoptera and Shorea pinanga, which after about 32 years of age yielded little harvest [1]. Whereas other tree species planted, namely Shorea seminis, Shorea mecistopterys, Shorea splendida, and Shorea palembanica, did not provide significant yields. As a producer of wood, the trial of planting Tengkawang trees is quite satisfying. However, if it is seen as a producer of Tengkawang seeds, it still becomes a question [8].

Pine trees (Pinus merkusii) and resin (Agathis sp.) have been cultivated by PT. Perhutani planted in several places in Indonesia [1]. Pine, when tapped, produces sap. When pine is distilled, it will produce gondorukem and turpentine oil. Perhutani has cultivated this tree with products other than wood, gondorukem, and turpentine whose value is not small and has opened employment
opportunities, especially for tappers [9]. Type of damar-producing shorea has been planted by the Krui community, Lampung, with the agroforestry system along with fruit-producing plants. The techniques applied by the Krui community need to be spread to other areas so that the communities can build forests from their awareness [10]. Besides, they also actively maintain the forests of their awareness.

Candlenut trees, which produce candlenut seeds, have been planted throughout Indonesia. However, the interesting thing is the yield of hazelnut seeds in Solok, where dozens of candlenut trees (around 80 cm in diameter) are capable of producing seeds around 500-800 kg/tree. With the seed price of IDR 2,000 / kg, each candlenut tree can provide an income of around 1-1.6 million per year. Therefore, to expand the candlenut tree in Solok, the Directorate General of RLPS, the Ministry of Forestry gives the help of seedlings. When the age of the tree is reached, the production of seed decreases and is no longer economical. Then, it needs to be renovated, and trees are cut down to take advantage of high valuable pecan wood. There are still many dual-use trees, a tree that can produce both forestry commodities, namely NTFP commodities and wood commodities. These dual-purpose trees are mainly producing fruit (durian, dukuh, petai, harp, mango, and kemang), producing rubber (jelutung, hangkang, perca, ketiau and balam), producing aris material (resin, copal, pine, and incense) and producing rubber essential oils (kruing, mace, cananga, eucalyptus, pine, and cinnamon). This dual-purpose tree should be developed in certain forest areas such as in production forest areas and buffer zone areas or buffer zones.

When the initial planting of forest land still opens, the local community can use it to plant high-value plants such as patchouli, pepper, kapol, and medicinal plants following the local forest land.

2.3. Local technology
An NTFP commodity produced from a species of plant or animal can only be assessed if its productivity is known, especially if it is measured in units of trees or producing tree species [1]. Besides, productivity can also be used to determine the end of the production period of NTFP-producing trees. Therefore, productivity data for NTFP-producing plants need to be assessed in each producing area. It is due to the quality and quantity of NTFPs, which are determined by the location of the producer tree (climate, soil, and bonita), how to harvest, and local post-harvest processes (local technology) [10, 11].

The productivity of plants producing fruit or seeds, such as tengkawang, candlenut, walnuts, acids, dukuh, durians, and other forest plants, is not yet known precisely. Hence, the results of each tree during its life cycle cannot be specified in what proportion of NTFPs and wood yields. Cat’s eye resin, jelutung, incense, kruing oil, hangkang, and cinnamon bark are still harvested (harvested) with local technology where tapping is done in a tree-unfriendly way. resin and incense trees are tapped with too many notches so that the tree becomes miserable and even falls before the end of production. The jelutung tree is tapped with upward and downward trunks simultaneously so that the tree has no chance for natural self-healing. Besides, the productivity of each producing tree is not yet known because it has not been fully recorded. As anticipation, it is necessary to study tree-friendly tapping methods so that NTFP production (quality and quantity) is optimal and producing trees grow longer (sustainably) according to their natural age.

3. Development prospect
The development of NTFPs should refer to the vision of the development of the forestry subsector that wishes to realize forest resources management for the highest possible prosperity of the people based on ecosystems and biodiversity that ensures increased capacity for community empowerment. NTFPs that produce primary, intermediate, and final products have a particular function, varying in types, and supposedly strong numbers can lift the economic empowerment of people around the forest. This condition [12, 13] can be spurred through integrated leading research that is appropriate and able to have an impact on increasing added value (added value) for people around the forest and can provide multiple benefits (multiplier effects).

Until now, there is still forestry staff who think that forests should only be planted with forestry plants, meaning that plantation and crops are taboo to be planted on forest land. This paradigm needs to be straightened out. Since forest land and the surrounding population cannot distinguish which
forest plants, plantations, or crops, there are some important criteria to consider. Those criteria are: the plants have high-value according to land, the community around the forest understand, and like the plants, the community does not ignore the function of the relevant forest. In the effort to develop NTFPs, it is first necessary to know the economic value, including market opportunities, land suitability, and appropriate technology to be applied.

3.1. Economic value
Unlike wood that is measured in cubic meters (m$^3$), NTFP commodities are generally measured in units of weight (kg) and part in units of content (liters). The price of NTFPs varies greatly, and even one commodity varies in price depending on its quality [14]. For example, the price per kg of agarwood varies from tens of thousands to tens of millions of rupiah. Ideally, forest land is planned to be planted with high-value plants. If land conditions are inadequate, planting low-value plants still needs to be done at least to maintain forest function. Some high-value plants include aloes, sandalwood, masohi, patchouli, ilang-ilang, and kapol, as listed in Table 2.

Table 2. High-value plants that can be developed in forest areas [15].

| No. | Commodity             | US $/kg | IDR/kg (x1,000) |
|-----|-----------------------|---------|-----------------|
| 1.  | Sandalwood            | 430     |                 |
| 2.  | Masohi                | 260     |                 |
| 3.  | Agarwood             | -       | 10-15,000       |
| 4.  | "Kapong" “Sebrang"   | 112     |                 |
| 5.  | Kapol local          | -       | 10-15           |
| 6.  | Cananga odorata      | 68-156  |                 |
| 7.  | Fragrant root        | 57.2    |                 |
| 8.  | Cananga sp           | 39.6    |                 |
| 9.  | Pepper               | 38      |                 |
| 10. | Ginger               | 36.6    |                 |
| 11. | Patchouli            | 34      |                 |
| 12. | Cinnamon             | -       |                 |
| 13. | Nutmeg               | 21      |                 |
| 14. | Lemongrass kitchen   | 18.4-19.8 |              |
| 15. | Lemongrass           | 6.4     |                 |

As shown in Table 2, the price per kg of NTFPs varies greatly, which is 430 US $ (sandalwood), and the cheapest is 6.4 US $ (lemongrass). This price does not reflect the value of forest land. To assess the value of forest land, we need to consider the period of production, post-harvest productivity, and process, including the details costs of each process stage required.

An example of a pine tree in a dual function can be revealed. Pine trees are tapped starting at 11 years old and cut down at 31 years old. The production of sap lasts for 20 years or 6000 days. The production of latex varies from 0.5 - 25.5 g / day, with an average of 10.1 g / day. Thus the pine tree produces 60-600 grams of sap or rounded 60 kg of pine resin. 31-year-old pine diameter ranges from 47.7-68.4 cm with an average diameter of around 56.6 cm. If the tip diameter is 25 cm and the height is 16 m, the volume of wood will be around 0.80 m$^3$. In each plot of land, there are 178 trees in each hectare. In each hectare of pine, 142.4 m$^3$ of pinewood, or 10,680 kg of sap, can be obtained.

If patchouli is overlapped in the pine planting area, then for four years (until the pine covers the land), patchouli leaf production will be obtained. In 1-4 years, leaf production will be obtained as many as 7,000, 8,500, 9,500, and 8,500 or a total of 33,500 kg of dried leaves (Lutony, 1999). If the pine stands can only be planted 80% of the land, then 20100 kg of patchouli leaves can be produced. In the fifth year and more, pine stands can be planted with other high-value plants so that the value of the forested land will increase the added value of additional products from undergrowth products.

Thus results obtained are as follows:
- Pinewood products 142.4 m$^3$ x IDR 217,000/m$^3$ = IDR 30,857,400
- Pine sap 10.680 kg x IDR 1,000/kg = IDR 10,680,000
- Patchouli leaf for 4 years 20,100 kg x IDR 2,000/kg = IDR 40,200,000

With patchouli intercropping (one of the high-value plants), the value of forest land has increased rapidly. Within four years, the forest land income from the production of patchouli leaves is far higher than the yield of wood and pine resin after a 31-year-old tree. Another advantage is that the people living around the forest will get income in the short term. The thing to remember is the suitability between land and plant species. Thus, it is necessary to choose which plants are suitable for planting in certain forest areas.

### 3.2. The commodity of choice according to the land

Planting forest plants (especially production forests) should be planted with dual plants. While we wait for timber products, NTFP commodities can be obtained so that it can provide employment and income for the people living around the forest [1]. Also, as long as the main tree does not cover the forest land, it should be planted with high-value plants (as intercropping plants). Furthermore, the stands can be planted with high-value plants that hold a shade, including ginger, bengkayang varieties pepper, capolaga, and several other types of medicinal plants. Many choices of dual-purpose trees can be planted in certain forest areas, as described below.

#### 3.2.1 Dual-purpose tree species mainly consist of [1]:

i. Fruit-producing trees: durian, duku, kemang, macadamia, cempedak, mango, mangosteen, burahol, tamarind, soursop, srikaya, kawista, matoa, starfruit, lute, guava, menteng, gandaria, kedongdong, longan, burahol, tamarind, sour, soursop, srikaya, kawista, matoa, starfruit, lute, guava, menteng, gandaria, kedongdong, longan, gandis, gandis, tamarind lobbies, rukem, rambutan, sapodilla, bisbul, purut, duwet, calingsing, lychee, kranji, persimmon, bedaru, burundul, dekket, and namman.

ii. Seed-producing trees: tengkawang, candlenut, nutmeg, tree saga, neem, walnuts, genitri, moringa, lerak, picung, duwet, menta, and porch.

iii. Rubber-producing trees: jelutung, hangkang, perca, katiu, red gum, and balam.

iv. Resin-producing trees: resin, copal, pine, and incense.

v. Essential oil-producing trees: kruing, mace, ilang-kenanga, kenanga, masohi, kilemo, eucalyptus, and cinnamon.

#### 3.2.2 Special product. Particular commodities include sandalwood, aloes, rattan, sago, and bamboo.

#### 3.2.3 Intercropping. NTFP-producing plants can be used as intercropping plants or intercropping plants or planted monocultures. Those plants are patchouli, pepper, shredded, kapol, ginger, medicinal plants, fragrant roots, vanilla, lemongrass, jatropha, seeds, breadfruit, gadung, iles-iles, arrowroot, sweet potato, taro, suweng, areca nut, gambier, and ornamental plants.

The design of these plants should be chosen following the land planted. The success of cultivation can be measured, for example, by the criteria of plant growth and productivity and the quality of the product produced.

#### 3.3. Appropriate technology

In general, the characteristics of NTFPs are sporadic spread on forest land and similar land cultivated by communities around the forest. Following these characteristics, the technology needed for NTFP businesses is simple, inexpensive, small-scale technology and can be operated by local communities [1].

Until now, the technology used in the NTFP business is local or traditional technology or also called local wisdom. This technology is obtained as a legacy passed on for generations. This technology is usually simple, less efficient, less effective, environmentally friendly, but sometimes not tree-friendly. Thus the NTFP business is to improve local technology through science and technology with appropriate technology.
If it is sorted out, the technology needed is seed technology, cultivation, harvesting, post-harvest, processing, quality determination/product diversification. The success of an NTFP business starts from seeds because plants will produce high or low productivity and quality products. Experiences prove that the production of resin trees varies greatly from 0-5 kg of resin/tree/year. Likewise, pine trees are from 0-200 g of sap/tree/harvest. Until now, the development of seed quality has not been carried out conscientiously. Likewise, the techniques for planting and maintaining plants have not been carefully developed. Research results for some plants, such as patchouli, pepper, ginger, copal, and several kinds of medicinal plants, from related institutions, can be used. Even advice from plantation or agriculture experts is also needed.

3.3.1 Harvesting tech. Actually, the function of the use of an NTFP commodity is the chemicals contained in it. Each commodity has a specific chemical component and physical, physicochemical characteristics due to the types/varieties of the producing plants, the place of growth, the age of the plant, and the collection and post-harvest techniques. Therefore, the collection of NTFPs can be interpreted as the collection of chemical components found in the growth of producing sources. Depending on the commodity, there are various NTFP collection techniques, such as [1]:

- Felling: rattan, bamboo, sago, sugar palm, sandalwood, and aloes.
- Tapping: pine resin, resin, copal, jelutung, and kemenya.
- Collection: tengkawang, candlenut, resin stone, copal bua, and captive animals.
- Pruning: eucalyptus, eucalyptus, patchouli, and patchouli.
- Picking: cananga flowers, ilang-ilang flowers, copal, bird's nests, orchids, pepper, and medicinal plants.
- Cultivation: various grasses, tubers, medicinal plants, orchids, and fragrant roots.
- Hunting: unprotected birds and animals.

3.3.2 Post-harvest technology and processing. NTFP processing also varies depending on the commodity faced. Sometimes inadequate post-harvest processes will result in lower yields and quality of NTFP products to produce a high yield and quality required post-harvest process and adequate processing according to supporting science and technology. Kinds of post-harvest and NTFP processing can be detailed as follows [1]:

- Withering: various leaves and flowers (withering requires a soft but fast process so that the material becomes dry and resistant to storage but does not change the structure of the intended chemical component)
- Extraction with water: sago flour, palm flour, and tannin (extraction: the process of dissolving and evaporation to produce the intended product)
- Extraction with organic solvents: various fatty oils, various medicinal ingredients
- Drying: various seeds, Babakan, roots, and medicinal plants (drying is a soft process so that the material becomes dry and resistant to storage but does not change the structure of the intended chemical component)
- Distillation: various essential oils, gondorukem as residues
- Pressing: gambier, various fatty oil ingredients
- Evaporation/formulation: palm sugar, fan sugar, tannins, and gambier
- Fermentation: alcohol, vinegar from various sap or starch
- Sorting and grading: resin and copal
- Frying: rattan
- Some types of harvested medicinal plants should be immediately followed by the withering or drying process before being marketed.

3.3.3 NTFPs product diversification technology. Some of the commodities whose production has become mass need further processing in diversification efforts. In this way, the saturation of the commodity market can be avoided. It will increase added value, open up employment opportunities,
and increase the sale value of the commodity. Modification is to change certain properties of materials by chemical, physical or biological processes so that the final properties will be close to the nature of the material to be substituted. The derivation is the process of converting materials into other products that are different from the original nature of the material. Some commodities and advanced processes needed are as follows [1]:

- Sago can be used as dextrin, UF extender adhesive, syrup and paper adhesive
- Gondorukem can be used as arpus soap and ngondorukem maleate
- Turpentine isolates the α pinena component and making borneol
- Resin includes refining and forming and manufacturing of varnish
- Copal, among others, is the purification and formation and manufacture of varnish
- Tengkawang seed oil extraction, oil purification, and lipstick manufacturing
- Kemri seeds, seed stripping, oil extraction, oil purification, and alkyd making
- Frankincense acid extraction, manufacture of cosmetics, and drug manufacturing

4. Forest management

It is necessary to know the problems faced to find out how to overcome them so that the harmony between the stakeholders and the forest becomes sustainable. Also, sustainable forest management can be achieved.

4.1. Problems

Some of the problems [16] encountered in realizing sustainable forest management include:

4.1.1. Aspects of forest resources.

- The forest area continues to decrease as a result of shifting functions (such as transmigration, plantations, industry, etc.) and the unclear legal status of forest designations.
- The potential for diversity and productivity of forest ecosystems is getting lower as a result of the intensity of forest use as a producer of wood that is too high and the malactivity in forest management, especially in typical forest types such as swamp forests in production forests. For example, in the logging of brackish forests, wasted potential of tannins (tanners, dyes, adhesives, and medicinal materials) is found in mangrove bark and sapwood.
- Potentials other than wood in ecosystems in the form of timber forest products and other intangible benefits are still not explored as a result of the lack of awareness of potential stocks and conditions as well as under-optimal utilization of technology.
- Not yet efficient and effective allocation of natural resources in the form of forests, land, and water is associated with the distribution of benefits for each designation.

4.1.2. Economic aspects.

- Plans for economic globalization in international trade (AFTA 2003, APAC 2010, NAFTA, and WTO).
- International forest management requirements as stipulated in the 1992 ITTO targets, 1992 UNCED (Earth Summit) and others.
- The issue of ecolabeling in the trade of forest products.
- An imbalance of supply with the demand of wood and NTFPs, both direct (tangible) and indirect (intangible), both tradable and non-tradable.
- The value of forests as assets (wealth) of the Indonesian nationally that is not yet known accurately, the magnitude of the economic rent of forests that are optimal, and the state of the forest resource balance that always changes.
- The amount of contribution (contribution) from the forest and forestry sector to the gross domestic product (GDP) which continues to decline.
4.1.3. Environmental aspects.

- Issues of deforestation and degradation of the world's tropical forests.
- Issues of global warming (greenhouse effect), acid rain and ozone holes.
- Issues of decreasing biodiversity and its ecosystem, extinction of rare flora and fauna and unique ecosystems.
- The amount of pressure on the land and forest environment due to the need for land and/or forest products for purposes outside of forestry.
- The frequent occurrence of fires and other forest disturbances that affect the success of forest protection measures and forest health.
- Various other biophysical environmental impacts that arise as a result of the intensity of forest use that is too high and the presence of forest management practices.

4.1.4. Social aspects.

- Issues of human rights (HAM) and labor rights.
- Poverty and unemployment
- The high number and rate of population growth, poverty of the population, especially people around the forest, and the amount of unemployment.
- The quality of human resources (HR), especially workspace, which is still low, and the skills/expertise which is incompatible with the available work fields.
- Diverse community perceptions regarding forest benefits and low levels of community participation in management activities.
- Various socio-cultural impacts of the community that arises as a result of misconceptions and mal practices in forest management.

4.1.5. Institutional aspects.

- Cooperation and coordination between stakeholders.
- Distribution of rights and obligations among stakeholders, especially the government, business people and the community.
- Lack of cooperation and coordination between various parties concerned in carrying out their role to support forest management activities.
- The number and quality of labor needed in institutions related to forest management have not yet been fulfilled.
- Unclear formulation of the rights and obligations of each actor in forest management activities, namely the government, entrepreneurs and the community.

4.2. Countermeasures

Future directions for developing forest management can be described as follows:

4.2.1 Forest management.

4.2.1.1 From extensive management to intensive management. In extensive management, the dual function (multipurpose) of forests is implemented in a spatial distribution pattern, i.e. by dividing forest areas into several uses following the main functions desired through forest management activities. In Indonesia, three forest functions have been established, namely production, protection, and preservation.

In intensive forest management, the dual functions of the forest can be implemented in an integrated pattern. In this pattern, every inch of forest land is demanded to provide benefits for the desired basic functions. For this reason, in forest planting activities (if possible), dual-purpose trees should be used, namely tree species capable of producing both wood and NTFPs. Also, the vacant land between the main trees is also planted with economically valuable plants.
4.2.1.2 *From a partial approach to a holistic (ecosystem) approach.* In forest management, it is extensive that each function of forest use is only required for one main type of function, while other functions are seen as limiting. Therefore the dual function of the forest is divided into partial forest units. The total benefit that can be obtained from all managed forest areas is the sum of the benefits obtained from each use function, and the amount is the total benefits that may be generated from the ecosystem.

In contrast, in intensive management, the approach is holistic in that it views the forest as a whole ecosystem so that synergistic principles in the systems approach can be achieved. The total benefits obtained are the maximum total benefits that might be achieved from the ecosystem.

4.2.2 *Efficiency in forest management.* One of the indicators that can be used in measuring the performance of resources management activities is the efficiency that can measure the relative benefits of each business unit resource. In the case of limited resources to produce goods and services, the level of efficiency of the utilization process will be the dominant role in determining the ability of product competitiveness, guaranteeing the sustainability of the availability of resources and the production process.

As a result of the paradox between the increasingly high demand for goods and services that forests can produce and the reduced extent and quality of available forests, the efficiency of forest management will be an inevitable basic demand.

4.2.3 *Harmony in forest management.* The harmony of an activity is an indicator to measure the harmony of relations between various component units that are seen in a system of activities characterized by the proportional distribution of rights, obligations, and responsibilities. It is important to realize that various socio-cultural turmoil arising from forest management problems stems from the unclear distribution of rights, obligations, and responsibilities between related components in forest activities such as the government, entrepreneurs, and the community.

The clarity of the concept in the distribution of rights, obligations, and responsibilities among various related parties that are implemented consistently will be the key to the success of forest management in the future.

5. *Some suggestions*

5.1. *A framework to develop NTFPs*

It is necessary to develop a conception of the NTFP development strategy, which is a synergy between the concept, planning, and the objectives of exploitation as a reference for NTFP management in Indonesia. The development aims to provide appropriate technology in the form of incentives and diversification. It is expected to be able to accommodate all NTFP production problems (inventory, cultivation, productivity, quality, and product diversification) and NTFP economic problems (community empowerment, policies, legislation, and institutions). Then, it will ultimately lead to the implementation of technology, economic development, socio-cultural empowerment, implementation of aspects of preservation, and enhancement of a positive image of NTFP production in Indonesia.

The conception of NTFP strategies is generally directed at collecting data/information, technology packages, and policy input materials that can be used to solve problems that hamper efforts to achieve forestry sector development goals. Specifically, the conception of NTFP strategies is outlined in a framework of thought with the ultimate goal of implementing and increasing the benefits of NTFPs that are efficient and sustainable.

The main framework for developing NTFPs is as follows:

1. Understanding various types of specific local NTFPs that have commercial value
   - Forest resources inventory that has been available (diversity, species, distribution, stock and conditions of natural populations)
   - Local specific commodity
• Planning for product development in the future (local, regional and national) as a result of SDH exploration study activities

2. Increasing the productivity of NTFP resources through appropriate technology

• Producing source cultivation (seed selection, planting, maintenance, collection, post-harvest, processing and quality control)
• Measurement of productivity of producer types (productivity/species)
• The efficiency of utilization/processing through appropriate technology
• Techniques to increase productivity and quality as well as product diversification

3. Improving the quality of various types of NTFPs through the application of appropriate technology

• Harvesting/harvesting technology
• Useful material insulation technology
• Post-harvest product handling technology
• Product standardization and certification (refreshing perception of the quality of NTFP products) according to the market (consumers) desires such as SNI, ISO 9000, ISO guide 25 and Ecolabelling

4. Increasing the benefits of various types of NTFPs and product diversification

• Primary products: fruit, seeds, roots/bulbs, flour, sap, bark, leaves, flowers, buds, resin, honey, natural silk, beeswax, eggs, rattan, bamboo, skin, and animal horns
• Intermediate products: food, drinks, ingredients (medicine, insecticides, and other industrial materials), adhesives, deodorizers, sweeteners and coloring agents, household/decoration tools, musical instruments, play equipment, ornamental tools, religious tools/materials
• Specific diversified products or derivatives such as dextrin, arpus soap, maleate gondorukem, syrup, juice, cinnamon, α-pinena

5. Review the socio-economic, institutional and regulatory aspects of NTFPs

• Assessment of the socio-economic aspects of NTFP products as a medium for community economic empowerment (multiplier effect) and as a business actor who enjoys business results (beneficiary)
• Review the efficiency of laws and regulations regarding business scale restructuring, NTFP tax/levy obligations, institutional patterns including priority participation of local communities
• HHHK socio-diversification

5.2. Productivity prospects

The Ministry of Environment and Forestry [17] set the production of non-timber forest products (NTFPs) or non-timber products in 2020, reaching 718.847.97 tons from the 2019 baseline, which was only 342.819.17 tons. According to the KLHK Director of Environmental Services and Non-Timber Forest Products (HHBK), non-timber products and environmental services are being planned to become the backbone of national forestry development. It is because the production potential of NTFPs is estimated to be far higher than the results of log production. Still, until now, the potential has not been massively exposed. From the book Status of Forests and Forestry Indonesia 2018, data from various libraries and scientific publications mentioned that the foreign exchange value of NTFPs could reach 90% of the forest product value. Where wood, which has been identified to forestry products, only accounts for 10% of the production of forestry products. However, the 90% NTFPs would not have been created if wood (trees) as the formation of the forest ecosystem did not exist. According to KLHK data, the results of NTFP revenue from the Forest Resources Provision (PSDH) in the 2015-2017 period showed relatively similar figures, namely IDR 15.85 billion (in 2015) and IDR 15.41 billion (in 2016). In 2017, the contribution of NTFPs to PSDH was IDR 15.76 billion. NTFP production sources mostly came from industrial plantation forest concession holders and Perhutani Public Corporation, namely in the form of sap and eucalyptus leaves. At the same time, the Forest Management Unit was still very small at 1% of total production. It was noted that NTFP production until August 2018, from the FMU, was 1,436.14 tons from 29,000 trees and 740.01 liters of water. The total NTFP production in 2018 was recorded at 358,800 tons.
To boost the production of NTFPs, KLHK has prepared two schemes. In terms of the licensing scheme, the KLHK has issued two ministerial regulations (Permen). First is LHK Permen Number 54/2016 concerning Procedures for Granting and Extension of Timber Forest Product Collection Permits or Non-Timber Forest Products in State Forests, then Permen Number 66/2016 concerning Procedures for Granting and Extension of Business Permits for Utilizing Non-Timber Forest Products from Natural Forests or Plantation Forests in Production Forests. The LHK Regulation No. 54/2016 regulates that the HHBK Collection License (IPHHBK) is given to individuals to collect for HHBK, for example, rattan, agarwood, resin, etc. with a permit period of 1 (one) year and a maximum volume of 20 tons. Meanwhile, LHK Regulation number 66/2016 regulates that Business License for Utilization of NTFPs (IUPHHBK-HA / HT) is given to SOEs / S / Cooperatives in areas that are not permitted with a permit for a particular area and period to cultivate NTFPs such as pine resin, sago, nipah, and so forth. Second, Permen LHK Number 49/2017 regarding Collaboration on Forest Utilization in Forest Management Units or KPHs to encourage cooperation schemes with investors. KPH can collaborate with the investors to use forests, from SOEs, Cooperatives, Local Communities, and so on. Besides, they can utilize pine resin, rattan utilization, nature tourism services, and others so people should not cut wood, but they can use the spaces between trees to develop the desired NTFPs. In addition to being supported in terms of regulations, to succeed the baseline target of NTFP production in 2020 projected by KLHK to reach around 718,848 tons, there are some strategic steps to be taken. First, KLHK will promote the comprehensive recording of NTFP production, continuous reporting of NTFP production in each business unit while ensuring payment of integrated provisions. Second, KLHK will encourage the establishment of industrial-scale NTFP businesses through planning that can integrate upstream and downstream (clustering of NTFP processing industries). Third, the development of partnerships between the community and the FMU.

5.3. Networking
Production from the sap group is still excellent in increasing NTFP production every year. Until December last year, it was recorded that the gum group (gum rubber, pine resin, resin gum, and so on) succeeded in donating as many as 119,594 tons for NTFP production. Then, it was followed by a group of grains (coffee, cocoa, etc.), managed to donate 82,828 tons. Given the target, forestry business actors convey that the main challenge in boosting NTFP production and environmental services is the marketing network and product standards, particularly on commodities to be exported.

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