

ACCELERATING INDONESIAN TROPICAL FRUITS DEVELOPMENT THROUGH SEED PRODUCTION AND DISTRIBUTION PROGRAM

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ABSTRACT

Indonesia has great potential as a major producer of tropical fruits in the region. The strengths are in genetic resources, sufficient land and labor, different harvest season among regions, and good market potential. The high population number and increasing of public awareness to consume more fruit has enhanced the demand of tropical fruits with annual increases. Until now tropical fruit supply is not sufficient for both the domestic and export markets. The main problems are caused by scattered production areas among the islands and the limited number of large-scale professionally managed fruit orchards. To overcome this problem it is necessary to develop and establish large production areas of commercial scale fruit plantations. To achieve this purpose large number of fruits seedlings are needed as planting materials. In order to accelerate the development of tropical fruits, the Indonesian government has launched a seed production distribution program throughout Indonesia. Fruit seedlings are produced in collaboration with seed growers under the supervision of the Ministry of Agriculture and seed certification institutions. The seedlings are distributed to prospective farmer groups and communities based on wide area development. Before planting the seedlings, the farmer groups were given advise and training on cultivation technology by the local government and private sector. Until 2019 about 1,000,000 seedlings consisting of mango, mangosteen, durian, papaya, banana, salacca, and breadfruit have been produced and distributed to suitable areas. The number of seedlings distributed is equivalent to 2,899 hectares of new areas. With the assumption that 50% of the seedlings will be successful, it is anticipated that in the next five years the production area will increase to about 1,450 ha and contribute to domestic and export markets.

Keywords: seedlings, production, distribution, tropical fruits, development

1. INTRODUCTION

Indonesia has great potential as a producer of tropical fruits. The strengths lies in the diversity of genetic resources, sufficient land labor for extension area, different harvest season between regions, and good market potential. There are approximately 392 fruit species found in Indonesia and only a few have been cultivated. Most of them are still growing wild in the forest (Soedjito & Uji, 1987). Another study reported that there are 266 species of indigenous fruits encountered in Indonesia and 62 species of them are cultivated. Four genera of indigenous fruits are recommended for development in Indonesia, *i.e.* *Durio*, *Mangifera*, *Garcinia*, and *Nephelium*. Duku (*Lansium domesticum*), salak (*Salacca zalacca*), and matoa (*Pometia pinnata*) have good

prospects to be developed in Indonesia (Uji, 2007).

Tropical fruit trees generally fruit once a year with a different harvest season based on the agroecological zone (AEZ). Indonesia has an area along 5,000,000 km from 95° to 141° East with varying AEZ. This condition gives the advantage for fruit production and availability throughout the year, including their availability for international market. Field observations on durian show that the average durian harvest period is around 8 months each year. In some places, such as in North Sumatra and Riau province, the local durian fruits all time. These scenarios show- that durian can be produced throughout the year (Santoso, 2012).

Another strength on the fruit business in Indonesia is the adequacy of labor resources. The number of workers in February 2018 was 133,940,000 people with a participation rate about 69.20 percent (BPS, 2018). Among these workers as many as 38,875,389 people (30%) work in the agricultural sector (Sustanti & Waryanto, 2018). The Ministry of Agriculture has been supporting the initiative to increase the interest of young people in agriculture business through the "millennial farmers program". This is in accordance with the government policy in 2019 which was named the year of human resources. The goal is to build competent farmers in the future by targeting one million millennial farmers from all over Indonesia. Another program to be developed is the competency certification program in the field of expertise in the agricultural sector through professional training (Humas Kementan, 2019).

The demand for high quality tropical fruits is increasing year by year. About 90% of Indonesian fruits production is consumed domestically and 10% exported to other countries. This situation indicates high potential for both domestic and export markets. One of the biggest opportunities is the export of tropical fruits to Singapore with a capacity about 1,000 mton per day. So far, Indonesian fruit exports to Singapore is still around 6%. Papaya, banana, and avocado have great opportunity to be exported to Singapore. The objectives of Indonesian tropical fruits development are to increase quality, quantity, and continuity to fulfill domestic demand and to increase export volume.

2. PRESENT SITUATION OF FRUIT CULTIVATION IN INDONESIA

Tropical fruits are grown in the entire Indonesian islands. The availability of sufficient land provides a great opportunity in the development of fruit commodities. There are approximately 12,016,778 hectares (32.36%) unused land in Indonesia and part of them are suitable for planting tropical fruits. Most of the land available are in Sumatera and Kalimantan islands. In 2018, the total planting area for tropical and subtropical fruit accounted was about 704,860 ha, with total production 19,643,616 mton. The largest harvested area is mango (201,080 ha), followed by banana (89,615 ha), durian (63,533 ha), citrus (51,811 ha), and pineapple (20,785). The highest production commodity is banana (7,162,678 mton), followed by mango (203,789 mton), citrus (2,165,184 mton), and pineapple (1,795,982 mton) (Sustanti & Waryanto, 2018).

The most commonly consumed tropical fruits in Indonesia are banana (about 9,907 kg/capita/year), papaya (5,319 kg/capita/year), citrus (3,494 kg/capita/year), and salak (2,346 kg/capita/year). Demand for tropical fruits is increasing rapidly both for domestic and export market. The demand for tropical fruits by consumers in urban areas is very large due to lifestyle changes related to awareness in good health practices, including reducing carbohydrate consumption. According to the export data, pineapple, banana, and mangosteen are the most popular exported tropical fruits with export volume 210,045 mton, 18,177 mton, and 9,167 mton respectively. Fruit industry experts estimate about 80% of tropical fruits are consumed fresh rather than processed

or canned, with the exception for pineapple, citrus, and mango (Sustanti & Waryanto, 2018).

Generally, all Indonesian regions are suitable for tropical fruits plantation. But there are some exceptions for certain fruits such as mango which are more suitable in the dry lowlands. About 75% of Indonesian mango are produced in Java island with the largest area in East Java. The largest banana production comes from West Java and East Java, which covers about 45% of total banana production areas. Lampung contributes to 20% of banana production and the remaining 35% are grown all over Indonesia. Mangosteen is generally found more in Java, West Sumatera, North and South Sumatera. Durians are evenly scattered throughout Indonesia, with the largest production area, approximately 27%, in East Java.

3. PROBLEM IN DEVELOPMENT OF TROPICAL FRUITS

The major problem in the supply of tropical fruits is irregular flowering and poor fruit retention, while alternate bearings and small fruit sizes reduce grower returns in some districts. Trees take three to five years to come into production, and will not produce substantial crops until six or eight years. The problem with Indonesian fruit exports is quantity, quality and continuity. Indonesian exports are still dependent on the fruit season. One strategy to become an exporter of tropical fruit in the world is to develop tropical fruits such as durian, mangosteen, banana, salaca, and mango throughout Indonesia for year-long production of fruits. Development of large or industrial-scale fruit commodity is needed to make crop management, business process, application of technology, and marketing easier.

The president of the Republic of Indonesia declared 2018 as the year of "national horticulture seed production". This is in accordance with the efforts to accelerate the achievement of food self-sufficiency and to realize Indonesia as a global food source by 2045. For Indonesia to become the largest exporter in Southeast Asia in 2025 and in the world in 2045, the targets such as improving quality, quantity, and sustainability of tropical fruits have to be met. This program is part of the agenda of the 'Orange Revolution', a national program for tropical fruits production. This activities are to support the Indonesian Ministry of Agriculture program. In 2017, 971,000 tropical fruit seedlings were produced, consisting of mango, mangosteen, durian, banana, salacca, papaya, and breadfruit to distribute to farmers and growers (Mansyah *et al.*, 2017).

One of the problems in large scale fruit crop development is the limited supply of plant materials (seedlings) to be distributed, due to: 1) Limited number of parent trees as a source of seedlings; 2) Slow growth of seedlings; 3) Limited propagation techniques; and 4) Seed availability is dependent on seasonality of fruits (Mansyah *et al.*, 2017).

4. ACCELERATION PROGRAM OF TROPICAL FRUITS DEVELOPMENT

The first step in tropical fruits development areas is to provide quality seedlings for increased fruit production. The seedlings are produced vegetatively by government institutions, in collaboration with seed growers, suppliers, and the seed certification institution. The seedlings distributed to prospective farmers and locations are based on regional development. Before distribution, the prospective farmers were assisted in using modern agricultural techniques to improve productivity by the private sector.

The seedling production process consists of vegetative or clonal propagation for woody fruit plants and generative propagation for apomixis plant such as mangosteen. Propagation of

banana is done through *in vitro* culture. Papaya propagation was also done through seeds. The seedlings produced could be divided into two classes: stock seedlings and extension seedlings. The stock seedlings are used as sources of planting materials for the next propagation while the extension seedlings are distributed to users. The production process of woody tropical fruits including preparation of rootstocks and scion, grafting, and certification or labeling.

4.1. Production of durian and mango seedlings

The seedlings of woody fruit plants such as durian and mango are produced by grafting between the rootstock and the scion of recommended varieties. Recommended durian varieties are 'Pelangi', 'Matahari', 'Sitokong', 'Kromo', 'Salisun', 'Tembago', and 'Sijapang'. Stock plant varieties for mango are 'Madu', 'Wajik', 'Agung', and 'Lalijiwo' while the grafted varieties are 'Garifta', 'Agrigardina45', 'Arumanis', and 'Gadung21'. (Rebin, 2017)

The scions are maintained as duplicate parent trees and are established in foundation blocks. The next step is growing the seedlings in multiplication block of scion as a source of scions for extension seedlings production. Each stage of seedlings production, start from rootstock preparation, scion selection, grafting, and labeling is tightly controlled to produce true to type seedlings. Labeling is done when the plants are ready to be distributed to consumers, about 5-6 months after grafting, with a minimum height of 50 cm. Labeling process is done in collaboration with the seed certification institution.

4.2. Banana seedling production

Plant materials for mother plants (stock seeds) production are suckers in order to prevent off-type plants in *in vitro* culture propagation. The method used is conventionally by optimizing the number of shoots by peeling all the midribs and stop the growth of the apical meristem. Extension seedlings are propagated by mass propagation through *in vitro* culture. To ensure the seedlings produced are free from viruses, indexing from banana bunchy top virus (BBTV) is much recommended. BBTV virus detection or BBTV indexing is done by polymerase chain reaction (PCR) method using the leaves from suckers of prospective plants.

Extension banana seedlings are the seedlings that are directly distributed to farmers and are propagated through tissue culture. If tissue culture facilities are not available the propagation is done by modification of conventional propagation technology (conventionally optimized). The principle of this method is to remove the growing point (apical meristem) to stimulate axillary growth, and remove all the midribs to reduce the obstacle of the axillary buds growing. Labeling is carried out in collaboration with the seed certification institution.

4.3. Mangosteen seedlings propagation

Mangosteen is an apomictic plant and propagation from seeds can be considered as a clonal propagation of the parent trees. Mangosteen extension seed production in large numbers has several obstacles, including limited number of selected parent trees, the only one harvest season in a year, and slow growth of seedlings. There are several ways to accelerate mangosteen seedling growth. The use of mycorrhizal fungi is intended to overcome the slow growth of mangosteen which is caused by poor root system. Mangosteen, known as, the plant without root hairs that leads to poor uptake of water and nutrients. Arbuscular mycorrhizal fungi (AMF) is one of the obligate symbiotic fungi which is known to have beneficial effects for plant growth. The mycorrhiza acts symbiotically with plant roots to enhance nutrient uptake, stimulate growth,

and improve plant resistance to drought and soil pathogens (Muas *et al.*, 2002), and enriching mangosteen seedlings environment using carbon dioxide (Jawal *et al.*, 2002). Tissue culture propagation need to be improved to increase the percentage of successfully seedling growth.

4.4. Papaya Seed Production

Source seed production procedures are carried out through strict isolation and controlled pollination. As many as 300-1000 papaya mother trees are planted in one stretch. Male plants and other varieties are removed from mother trees populations. Hermaphrodite mother plants which are stable and healthy with high production are selected from the middle of the orchard for selfing. It is important to avoid pollen from other flowers when the flowers are open. Paper wraps protect flowers from excessive moisture which can disturb fruit formation. At the age of 4-5 months after pollination the papaya fruit can be harvested (Budiyanti, 2017).

5. COLLABORATION OF SEEDLINGS PRODUCTION WITH SEED GROWERS AND PRIVATE SECTOR

In order to accelerate the development of tropical fruits, it is imperative that the Indonesian government provide and distribute the seedlings to all the different regions. In the implementation of seed production, Indonesian Tropical Fruits Research Institute (ITFRI) and Directorate General Horticulture (DGH) as executing agency, must collaborate with seed growers and the private sector. In this collaboration ITFRI contribute in providing mother plants and scions, while the Seed growers contribute in providing nursery space and labor.

Seedlings are produced through intensive supervision based on standard operating procedures. One week before grafting, the number and variety to be produced are reported to the local seed certification institution. This cooperation provides benefits to both government and seed growers. Government provides benefits in terms of accelerating process of seed production, accelerating the development of new varieties, and overcome the limitations of land and labor for large-scale seed production. This collaboration reflected good synergy between government and the communities in the development of tropical fruits. The benefits received by seed growers include opportunities for new jobs, increasing knowledge in tropical fruit seedlings production, and increasing family income.

6. SEEDLINGS DISTRIBUTION

The seedlings produced are distributed free of charge to the communities. The stock seedlings (mother plants) are distributed to government and non-government institutions that play a role in production of extension seedlings (Agency of Implementation Agricultural Technology and seed growers). Extension seedlings are distributed directly to users (farmers group and communities). Distribution activities start with selection of interested farmers and potential regions for fruit development. Some seedlings are also distributed to farmer groups that are under supervision of the private sector as satellite farms. Before seedlings distribution the technical guidance of fruit crop cultivation are given to prospective farmers. Monitoring and evaluation are needed to ensure the seedlings are planted and maintained properly.

Within three years from 2017 to 2019, about 1,001,180 of tropical seedlings of avocado, mango, mangosteen, durian, banana, papaya, salak, and breadfruit were produced and distributed. About 31,000 of them were stock seedlings (Table 1.). Mango, durian, and banana were the

most commodities with the number of seedling production. The new total area development is predicted to reach 2,899 ha. Assuming an estimated success rate of 50%, it is anticipated that in the next 4-5 years the harvest area will increase by about 1.450 ha and will give significant impact in increasing Indonesian fruit exports. This fruit crop development program will continue until 2024. In 2020 the DGH plans to develop 4,807 ha of mango, mangosteen, durian, and banana commodities.

Table 1. Tropical fruits seedlings production and distribution from 2017 to 2019

| Commodity | Seedling Production | | Total seedlings production (ITFRI) 2019 | Seedling production (BPTP) 2017 | Seedling production (DGH) 2018 | Total seedlings | Estimated new planting area (ha) |
|------------|---------------------|--------------------|---|---------------------------------|---------------------------------|-----------------|----------------------------------|
| | Stock Seedling | Extension seedling | | | | | |
| Avocado | 0 | 6,500 | 6,500 | | 82,950 | 89,450 | 450 |
| Mango | 2,500 | 145,500 | 160,000 | 120,000 | 0 | 180,000 | 60 |
| Mangosteen | 2,500 | 26,500 | 29,000 | 4,500 | 0 | 33,500 | 335 |
| Durian | 25,000 | 46,890 | 76,890 | 60,000 | 0 | 136,890 | 1368 |
| Banana | 1,000 | 13,000 | 19,000 | 8,000 | 168,649 | 195,649 | 178 |
| Papaya | | 83,000 | 83,000 | 150,000 | 0 | 233,000 | 155 |
| Salacca | | 25,000 | 25,000 | 20,000 | 103,491 | 147,491 | 73 |
| Breadfruit | | 19,000 | 19,000 | 40,000 | 0 | 59,000 | 280 |
| Total | 31,000 | 364,890 | 395,890 | 402,500 | 355,090 | 1,001,180 | 2,899 |

*Agricultural statistics 2018

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