3. SEEDLING SUPPLY SITUATION IN THE STUDY AREA

3.1 Prevailing and Proposed Fruit Varieties

Field investigations have been made in order to get information on fruit varieties, as shown in Tables A-3-1 to A-3-4, prevailing in four Provinces and selected by each Provincial Agricultural Services Office. In principle, variety selection is made by referring to the MOA's recommendation, but there exist some non-recommended varieties due mainly to lack of mother plants.

3.2 Variety Characteristics of Target Fruits

Characteristics of cultivars are also inquired to evaluate the selection of varieties for candidate orchard development areas in each Province as shown in Table A-3-5.

3.3 Mother Plants in Central Seed Farm

In each Province, the BBI has registered and maintained mother plants as supply sources of scions for the BBU and private nurseries.

(1) North Sumatra

All of mother plants are too young and available number of trees is limited in the BBI of North Sumatra as shown in Table A-3-6. Under such situation, the BBI's capacity is not enough to cover the BBU's scion requirements.

(2) West Java

Mother plants of duku, mangosteen and salak are not available in the BBI of West Java as shown in Table A-3-6. All mother plants of avocado and mango as well as some of durian are still young, most of which have been kept by budding. The propagation new material supply capacity of mother plants is therefore far below the needs of BBU and private nurseries.

(3) East Java

Mother plants of avocado, banana, duku, durian and salak are not available in BBI of East Java as shown in Table A-3-6, while mother plants of mango have been only kept by budding method, furthermore, they are old in age and relatively many in number.

(4) South Sulawesi

Mother plants of mango, mangosteen and rambutan have been kept by budding and grafting in the BBI of South Sulawesi as shown in Table A-3-7. Their age and number vary according to variety. The supplying capacity of mother plants is insufficient to cover the needs of BBU and private nurseries in avocado and mangosteen and some varieties of mango and rambutan. There are no plants of marquisa in the BBI.

3.4 Scion In Main Seed Farm

Mother plants of mangosteen, marquisa and salak are not available in BBUs of North Sumatra as shown in Table A-3-8.

In West Java, aged mother plants of durian and mango have been maintained in BBUs as shown in Table A-3-8. Furthermore, a large number of them have been kept by grafting method. Mother plants of avocado, duku, mangosteen and salak are not available in BBUs.

In East Java, mother plants of avocado, banana, duku and salak are not available in BBUs of East Java as shown in Table A-3-8, and they are mature in age and relatively many in number. All mother plants of durian are matured, but a few number of them have been kept by grafting method.

In South Sulawesi, mother plants of avocado, mango, mangosteen and rambutan have been maintained by both methods of budding and grafting in BBUs as shown in Table A-3-8. The age and number are quite different among BBU's locations and fruit varieties. Mother plants of marquisa are not available in BBUs.

3.5 Conditions of Fruit Nurseries

In each Province, the present condition of fruit nurseries is investigated to get information of their knowledge and skill concerned with propagation of labeled class of fruit seedlings.

(1) North Sumatra

Although North Sumatra is one of advanced fruit growing areas in the country, private fruit nurseries have not been independent in their business activities. As a result, production and supply of fruit seedlings depend largely on BBI/BBU. Most of farmers have lack of sense to purchase quality guaranteed fruit seedlings and instead they used to grow plants from seeds of which origin is unknown. NO MOA's recommended varieties of target fruits are available and minor public investment had been made in orchard development in North Sumatra. This situation caused nurseries to have less intention to practice vegetative propagation methods which are not so difficult for them.

(2) West Java

Several private nurseries, small to large scale, have been established in West Java. Some of them have also durian mother plants using as their own propagation material sources. One private nursery propagates mangosteen seedlings by grafting method.

(3) East Java

In East Java, there exist several large scale private nurseries. They propagate "Giant Cavendish" of banana by tissue culture method, duku and durian by grafting method, mango by grafting and budding method, and salak using suckers.

(4) South Sulawesi

Similar to North Sumatra, a limited number of small scale private nurseries play a supplemental role in producing fruit seedlings.

3.6 Seedling Control and Certification Activities

Activities of the respective BPSP/TPH in the four Provinces are summarized in Table A-3-8. In principle, staff of BPSP/TPH are obliged to check seed and seedlings of both annual and perennial crops. In comparison with the increasing work quantity for the quality control, the available manpower capacity is insufficient, resulting in that no attention is paid to quality control of minor fruits like avocado, duku and mangosteen.

4. SEEDLING SUPPLY ISSUES

For production of fruits with acceptance among markets and consumers, it is prerequisite to

plant seedlings uniformly propagated from mother plants of specific varieties authorized by the MOA and certified by BPSB about the variety and origin. Although this concept becomes common consensus among those who have involved in horticulture development in the country, its realization is still in the very beginning stage especially in production and supply of fruit seedling with high quality. Among others, the main constraint is insufficient propagation capability and supply capacity of quality fruit seedlings by public agencies and private nurseries.

4.1 Predominant Constraints in North Sumatra

Among the five target fruits, marquisa and rambutan growing areas in North Sumatra concentrate in Karo and Langkat Districts both of which are selected by the Provincial Agricultural Services Office as the candidate areas with high orchard development potential for the Study. In these two Districts, orchard development under the HHDUA/P2AH Project is under implementation, and the MOA's recommended varieties of Malino for marquisa and Binjai for rambutan are being planted in newly established orchard of 500 ha each. As for marquisa, the BBI has been propagating vines from seeds of mother plants of local varieties including Berastagi, but vegetative propagation by means of cutting has yet been practiced. Though rambutan seedling propagation of the MOA's recommended variety of Binjai are currently under practice in both public and private nurseries by the grafting and budding method, the BBI's mother plants are young in age of tree and limited in number.

In case of durian, vegetative propagation of mother plants of the MOA's recommended varieties is practice by grafting and budding methods in the both BBI and BBU, but the present supply capacity of private nurseries seems to be low compared with the prospected demand for the future durian orchard development plan. With regard to Mangosteen, local variety of mother plant is used for vegetative propagation by grafting method in the BBI, but its varietical characteristics are far from market preference. As salak is quite new face in North Sumatra, no suitable variety has been identified and no mother plants have been collected by the BBI.

In comparison with the facility and equipment standard guideline of the MOA as shown in Tables A-4-1 and A-4-2, there still remain enlarging, upgrading and supplementing necessities in two BBIs located at Kuta Gadung and Sipirok as well as another two BBUs placed at Siguci and Buluh Pancur. As for the present nursery condition, no FB and SMB are available for specific fruits in the respective BBI and BBUs.

4.2 Predominant Constraints in West Java

A wide range of the MOA's recommended varieties of durian and mango are available in the BBI and BBU, while mother plants of avocado are maintained only by the BBI and no mother plants of duku, mangosteen and salak are available in the both BBI and BBU. Propagated scions of avocado, durian and mango by budding method can be supplied with enough quantity to meet the requirements in and other Provinces. However, there is no propagation field and supply source of quality guaranteed seedling of duku, mangosteen and salak.

No laboratory and warehouses are available in the BBI located at Pasir Banteng, and two BBUs placed at Kasugengan and Cimangkok are under arrangement for construction of facilities and procurement of equipment. As for the present nursery condition, no FB and SMB have been established for specific fruits in each of the BBI and BBUs.

4.3 Predominant Constraints in East Java

In East Java, the private sector plays an important role in propagating fruit seedlings, especially banana and salak, while the BBI concentrates into vegetative propagation of mango with several varieties recommended by the MOA. With respect to durian, the BBU has mother plants of three varieties of which age of tree is 44 to 60 years old and from which scions are

propagated by grafting method. Under such situation, the problem issue is to mismatch farmers' intention to selection of banana variety with processing and fresh market demand. For farmers' demanding variety, suckers rhizomes are generally used, while tissue culture method is putting into practice for different variety from farmers' preference. Duku and mangosteen are not propagated either commercially or non-commercially because no mother plants have been identified by the BBI in East Java.

The existing BBI located at Poh Jentrek are facilitated with building and equipment to almost full extent of the standard level in quantity, but all are required to be innovated and modernized. There are four BBUs each located in Warujinggo, Patrang, Laden and Jampirogo of which facilities and equipment are in the same condition as the BBI with requirements of renovation and improvement. As for the present nursery condition of the respective BBI and BBUs, no independent FB and SMB have been constructed for specific fruits.

4.4 Predominant Constraints in South Sulawesi

In both of the BBI and BBU, vegetative propagation of mango and durian by budding and grafting is carried out with a large supply capacity of scions. The BBI has recently commenced to propagate avocado scion by budding method, but its mother plant is non-recommended variety of the MOA. As for Marquisa, no action for vegetative propagation has been taken in the BBI and BBU, while mother plant of local variety mangosteen is identified but not utilized as propagation material source in the BBI.

The present status of facilities and equipment available in the BBI located in Bonto-Bonto and four BBUs placed in Latuppa, Batu Karopa, Lajonga and Sudiang do not satisfy the standard guideline. As for the present nursery condition, there are no independent FB and SMB for specific fruits in each of the BBI and BBUs.

5. QUALITY SEEDLING PRODUCTION PLAN

As described in the above, all of prevailing constraints are not specific issues but common in the four Provinces, it is essential to formulate a basic quality seedling development plan which needs to be applied to the four Provinces with special remarks to overcome limited issues in each Province.

5.1 Selection of Varieties for Target Fruits

Selection of varieties are to be made citing the recommended varieties of the MOA as listed up in Table A-5-1. The selected varieties of the respective target fruits for each of the four Provinces are shown in Table A-5-2.

5.2 Seedling Requirements

Basic factors to provide seedling requirements are planting distance and plant density. The former is one of key factors that influence successful fruit growing. If the distance is to narrow, the fruit trees will grow poorly, produce small quantity of fruits, and suffer from various diseases and pests causing low quality of fruits. On the other hand, if the spacing is too wide, it will waste valuable land of orchard and reduce fruit production of the orchard below the expected level. Although the latter is closely related to the planting distance, this factor directly provides seedling requirements of the respective target fruits in developing orchard. Therefore, the optimum density needs to be set up for each target fruit paying special attention to the following characteristics of tree form :

- spreading growth habit specified to avocado, duku, mango, mangosteen and rambutan;
- upright growth habit specified to durian; and
- less spreading growth habit specified to banana, marquisa and salak.

Under this Study, seedling requirements of the respective target fruits are determined as shown in Table A-5-3 by referring to the planting distance and plant density of fruit trees both of which are put into practice in the implementation of ongoing IHDUA/P2AH Project. Considering the above features and based on the result of evaluation on bitter experiences obtained through the past horticulture development projects under which planting materials consisting of fruit seedlings and fertilizers were simply distributed to farmers, the DGFCH concluded to apply uniformly these two basic factors to all the public investment projects.

Even in the minimum requirement case, 100 quality guaranteed seedlings should be planted every 1 ha of orchard to be newly established. According to the orchard development schedule, the total seedling requirement for the first year is 5,000 plants covering a pilot area of 50 ha, followed by 20,000 plants for the second year and 25,000 plants for the third year. In addition, 20% of planted seedlings need to be supplied in the next year for the supplemental planting purpose to recover plant mortality. Thus, the total requirement is 60,000 seedlings for establishment of 500-ha orchard where avocado, duku, durian, mango, mangosteen or rambutan is planted with the spacing of 10 x 10 m or the plant density of 100 plant/ha. As for target fruits with more dense spacing, it increases to 300,000 seedlings for marquisa, 500,000 seedling for banana and 1,000,000 seedlings for salak. To ensure the production of such a large number of target fruit seedlings meeting quality specifications and supply of these seedlings at the appointed time and places, it is indispensable to tackle various constraints in the technical and non-technical fields that are left unsolved in each of the four Provinces.

5.3 Propagation Method

Propagation aims to produce quality guaranteed seedlings of target fruits. The propagation of fruit trees can be accomplished by a various methods including seeding, cutting, grafting, budding, air-layering and suckering as well as modern technique like tissue culture. There are two major techniques consisting of sexual and asexual propagation. Fruit trees reproduced by the sexual propagation methods mean rhizomes, runners or suckers. Advantages of this method are :

- Seedlings are long lived, hardly, bear more heavily and easier to propagate;
- Hybrids are first raised from seed;
- Chance to get seedlings of very superior quality can be expected; and
- Rootstock is usually propagated by seeds due to the hardy and well developed root systems.

Disadvantages are :

- Progency is not always uniform in growth, quality of fruit and yield.
- This method is not safe for the presaturation of exact replica of the mother plant;
- It takes longer time for the first bearing than grafted materials; and
- Larger fruit trees hence uneconomical to handle.

Asexual propagation through the use of vegetative organs of the fruit tree involves no change in the genetic make-up of the offspring and the fruit trees are bearing all the characteristics of the mother plant. This method has more advantages than sexual method as follows :

- Uniformity of fruit quality can be guaranteed. Picking of fruits becomes easy owing to the restricted growth and early maturity;

- Fruit trees come to the early fruiting stage;
- Grafting and budding of rootstock make seedlings resistant to vigorous growth and free from pests and diseases;
- Rootstock regulates fruit tree size and fruit quality; and
- Composite fruit trees with different types of fruit trees can be raised on a common stock.

In due consideration to the above advantages and disadvantages as well as the plant characteristics of target fruits, asexual propagation or vegetative propagation method is applied to avocado, duku, durian, mango, mangosteen and rambutan. In case of banana, tissue culture method is applied. While, salak is propagated by using suckers.

5.4 Institutional Strengthening Plan

It is also indispensable to strengthen the capability of public and private sectors both involved in fruit seedling production and quality control. The capability strengthening plans consist of six components as outlined below.

(1) Strengthening of Research and Development Activities for Introduction and Breeding of New High Quality Fruit Varieties

a) Objective

This Program aims to upgrade the institutional and technical capacities of the research and development organizations responsible for introduction and development of new varieties as the basic material to support fruit production development through fruit quality improvement.

b) Component

- The target institution is the National Research Institute for Fruits in Solok in West Sumatra Province. The capacity of this institute needs to be upgraded for developing new seedling propagation techniques including tissue culture, cutting, root suckers, copping, grafting, air-layering and budding, and supplying the true clone of the target fruits. For this, new varieties will be introduced from the neighboring countries with similar agro-ecological condition like Thailand and Malaysia to accelerate propagation of varieties with higher market demand.
- In this program, the investigations on phytogenes will be carried out to prepare an inventory of the mother plants of recommended variety in cooperation with the institutions concerned. The results of these investigations will be used in establishing in future a fruit seedling production system.

(2) Strengthening of New Technology Adaptability Trial Operation System

a) Objective

This Program is designed for the purpose of strengthening the existing new technology assessment system for tropical fruits. At present, new technology adaptability tests are carried out only at the Institute for Agricultural Technology Assessment (BPTP) in Sukarami, West Sumatra.

b) Component

- The BPTPs which assume the implementation of new technology adaptability tests are to be established in every province. Consequently, the study for establishment of BPTPs in each of the four provinces will be firstly conducted with a view to establishing in future a nationwide technology adaptability trial operation system for the recommended varieties.

- In this program, the standard manuals on farm management and post-harvest handling of each target fruit will be prepared by the relevant Assessment Institute for Agricultural Technology taking into consideration the agro-ecological conditions, especially weather conditions and elevation of the respective localities. These manuals should be designed to be used by the extension workers in charge of technical guidance to the farmers.

(3) Rationalization of Fruit Seedling Inspection System

a) Objective

The main objective is to rationalize the actual seedling inspection system including examination and certification of mother plants, scions, rootstocks, and seedlings of the target fruits in order to guarantee the variety and quality of their seedlings.

b) Component

- This program is designed to improve mainly BPSB of MOA and enable the private nursuries to produce fruit seedlings for ordered development. Its components consist of strengthening of the inspection system, staff capability upgrading and improvement of examination facilities in branch stations of BPSB. In the Study Area, the stations are located at Medan in North Sumatra, Bandung in West Java, Wonocolo in East Java, and Maros in South Sulawesi.
- Among others, the seedling inspection system for identification of the mother plants and their varieties will be consolidated through capability building of the staff and installation of the inspection facilities for their physical, chemical and botanical examinations.

(4) Strengthening of Plant Quarantine System

a) Objective

This Program aims to continue and extend the ongoing strengthening efforts of the plant quarantine system in Indonesia to support export promotion of Indonesian tropical fruits.

b) Component

- The main activity is to provide a comprehensive package of measures for preventing infestation of fruits by insects and pests, as well as for staff training.
- The target institution to be strengthened is the Center for Agricultural Quarantine of MOA. Its capacity and facilities need to be improved in the field of disinfestation technology and applied research.
- The issues to be urgently solved for export promotion (e.g. in Singapore, Malaysia, Hong Kong, China, Japan and etc) are determination of admissible maximal limits of chemical residues on fresh fruits and identification of the insects and pests causing their infestations.
- In this program, the insect nad pest control system is to be established in the future by installing fumigation facilities in the export-oriented fruit producing centers or shipping ports.

(5) Improvement of High Quality Seedling Propagation and Distribution System

a) Objective

The objective is to set up large scale foundation blocks to maintain the mother plants of target fruits as well as multiplication blocks of scions to maintain and multiply the recommended varieties and species as material supply sources to private nurseries.

b) Component

- The main activity is to rehabilitate and renew the facilities and equipment of the Provincial Horticulture BBI and BBU for effective and smooth distribution of seedlings, and to improve the knowledge and skills of the staff involved. In this program, a database on the existing mother plants system will be established in each Province.
- The five BBI targeted in this program are located in Karo and Tapanuli Selatan (both in North Sumatra), Sumedang (West Java), Pasuruan (East Java), and Gowa (South Sulawesi), while the number of targeted BBU amounts to twelve in total: 2 in North Sumatra, 2 in West Java, 4 in East Java, and 4 in South Sulawesi. The rehabilitation and/or construction works will be carried out focusing on the Foundation Block in BBI and the Scion Multiplication Block in BBI and/or BBU.
- As for avocado, duku and mangosteem, their seedling production system is not yet established. For this, it is needed for each BBI concerned to reproduce them by taking up scions from the mother plants of recommended varieties. The pressing need for implementation of this program is to transplant and maintain the certified mother plants in BBI's farms. In parallel, it is important to carry out the adaptability tests of the proposed varieties in the respective BPTP's, in cooperation with the Seed Certification and Control Services (BPSBs). These tests will be conductive to the seed certification and control to the done by BPSBs.

(6) Institutional and Technical Capability Building of Private Nurseries

a) Objective

This Program is designed to organize private seed growers into cooperatives and to upgrade the propagation capacity of quality fruit seedlings in private nurseries.

b) Component

- This program includes the provision of a systematic training program and establishment of a coordination system with BBI and BPSB for private nurseries in order to strengthen the private seedling growers, organizations, and their capacities. For the purpose of rationalizing the seedling certification and control system, the training courses by target fruit will be given to the interested nurserymen.
- To enable the private nurseries to upgrade their propagation capacity of quality fruit seedlings and improve their facilities, a supporting measure would be taken by the authority concerned. This measure will not include direct financial assistance from the authority, but pricing support in procurement of seedlings so that the private nurseries can keep a certain investment fund for improving their facilities and equipment.

Table A-3-1 Prevailing and Selected Fruit in North Sumatra

(1) Prevailing Varieties

No.	Target Fruits	Districts	Varieties
1.	Durian	Dairi	Sibatal, Si Kempes, Tanah Jawa, Sunan, Sitokong
		Tapanuli Utara	Sibatal, Si Kempes, Tanah Jawa, Sunan, Sitokong
		Tapanuli Tengah	Sibatal, Si Kempes, Tanah Jawa, Sunan, Sitokong
2.	Mangosteen	Tapanuli Utara	Local
		Tapanuli Selatan	Local
3.	Marquisa	Karo	Local
4.	Rambutan	Langkat	Binjai, Rapiah, Terang Bulan, Si Nona (for root stock)
5.	Salak	Tapanuli Selatan	Local

(2) Varieties Selected by the Provincial Authority

No.	Target Fruits	Districts	Varieties
1.	Durian	Dairi	Kani, Otong, Si Jantung, Si Tembaga
		Tapanuli Utara	Kani, Otong, Si Jantung, Si Tembaga
		Tapanuli Tengah	Kani, Otong, Si Jantung, Si Tembaga
2.	Mangosteen	Tapanuli Utara	Local
		Tapanuli Selatan	Local
3.	Marquisa	Karo	Asam Berastagi
4.	Rambutan	Langkat	Brahrang
5.	Salak	Tapanuli Selatan	Padang Sidempuan

Source : Provincial Agricultural Services, North Sumatra

Table A-3-2 Prevailing and Selected Fruit in West Java

(1) Prevailing Varieties

No.	Target Fruits	Districts	Varieties
1.	Avocado	Bandung	Local, Ijo Panjang
2.	Duku	Ciamis	Local
3.	Durian	Bogor	Sitokong, Kani, Perwira, Bokor, Siriwig, Sunan, Sukun, Petruk, Raja Mabah, Sawah Mas, Aspar, Gajah, Sibakul
4.	Mango	Sumedang	Gedong, Indramayu, Arumanis, Manalagi, Madu, Golek 31, Opyong, Cengkir, Golek
5.	Mangosteen	Purwakarta	Local
6.	Salak	Tasikmalaya	Local, Pondoh

(2) Varieties Selected by the Provincial Authority

No.	Target Fruits	Districts	Varieties
1.	Avocado	Bandung	Ijo Bundar
2.	Duku	Ciamis	Palembang
3.	Durian	Bogor	Otong, Matahari, Hepi
4.	Mango	Sumedang	Manalagi 69, Arumanis 143, Gedong Gincu
5.	Mangosteen	Purwakarta	Local
6.	Salak	Tasikmalaya	Nglumut

Source : Provincial Agricultural Services, West Java

Table A-3-3 Prevailing and Selected Fruit in East Java

(1) Prevailing Varieties

No.	Target Fruits	Districts	Varieties
1.	Avocado	Lumajang	Ijo Bundar, Local
2.	Banana	Jombang Lumajang	Local, Raja Bulu, Ambon Lumut Local, Ambon Lumut
3.	Duku	Tulung Agung	Local
4.	Durian	Jombang Trenggalek	Local, Sitokong, Sitebal Local
5.	Mango	Pasuruan	Madu, Gadung 21, Golek 31, Local, Manalagi, Arumanis, Gadung, Lalijiwo, Golek
6.	Salak	Malang	Local

(2) Varieties Selected by the Provincial Authority

No.	Target Fruits	Districts	Varieties
1.	Avocado	Lumajang	Ijo Panjang
2.	Banana	Jombang Lumajang	Cavendish, Ambon Kuning Raja Bulu, Cavendish, Ambon Kuning, Agung
3.	Duku	Tulung Agung	Palembang
4.	Durian	Jombang Trenggalek	Otong Otong
5.	Mango	Pasuruan	Arumanis 143, Manalagi 69
6.	Salak	Malang	Suwaru, and/or Pondoh (if the growers perfer it.)

Source : Provincial Agricultural Services, East Java

Table A-3-4 Prevailing and Selected Fruit in South Sulawesi

(1) Prevailing Varieties

No.	Target Fruits	Districts	Varieties
1.	Avocado	Gowa	Local
		Soppeng	Local
2.	Mango	Sidenreng Rappang	Lanabu, Local, Sukku, Arumanis 143, Golek, Golek 31, Manalagi
		Majene	Lanabu, Local, Sukku, Gadung, Lalijiwo, Dodol, Madu
		Bone	Lanabu, Local, Sukku, Madu 225, Madu
		Maros	Lanabu, Local, Sukku, Lalijiwo, Golek 31
		Wajo	Lanabu, Local, Sukku, Kanre Jawa, Madu, Manalagi
3.	Mangosteen	Tana Toraja	Local
		Polewali Mamasa	Local
4.	Marquisa	Gowa	Local
		Tana Toraja	Local
5.	Rambutan	Mamuju	Local, Lengkeng, Rapiah
		Enrekang	Local, Semarang, Garuda
		Pinrang	Local, Lengkeng, Garuda
		Barru	Local, Gula-gula, Aceh

(2) Varieties Selected by the Provincial Authority

No.	Target Fruits	Districts	Varieties
1.	Avocado	Gowa	Mentega
		Soppeng	Mentega
2.	Mango	Sidenreng Rappang	Arumanis
		Majene	Arumanis
		Bone	Arumanis
		Maros	Arumanis
		Wajo	Arumanis
3.	Mangosteen	Tana Toraja	Local
		Polewali Mamasa	Local
4.	Marquisa	Gowa	Malino
		Tana Toraja	Malino
5.	Rambutan	Mamuju	Binjai, Lebak Bulus, Aceh
		Enrekang	Binjai
		Pinrang	Binjai, Lebak Bulus
		Barru	Binjai, Lebak Bulus

Source : Provincial Agricultural Services, South Sulawesi

Table A-3-5 Characteristics of Target Fruits by Variety (1/5)

Characteristics	Avocado		Banana					Duku			
	Ijo panjang	Ijo bundar	Ambon Putih	Ambon Hijau	Badak	Rajasereh	Nangka	Wollangi	Pontianak	Rasuan	Palembang
1. Plant											
(1) Height (m)	5 - 8	6 - 8	3.2	2.43	1.24	1.71	2.44	10 - 20	20	20	9
(2) Crown											
1) Diameter (m)	7	10	3.99	4.69	2.06	2.94	3.68	3 - 4	15	10	5
2) Shape	oval	widely									
3) Branch	- many branch - horizontal tend to upward	- many branch - horizontal						umbrella-shape	conical		
2. Flower											
(1) Shape											
(2) Color	green-yellowish	green-yellowish						white	yellowish white	white	yellow
3. Fruit											
(1) Shape	pear	oblong						oval	oval	oval	oval
(2) Weight	300 - 500 (g)	300 - 400 (g)	13.9 (kg)	16.7 (kg)	11.1 (kg)	8.4 (kg)	14.2 (kg)	13.6 - 14.2 (g)	13 - 35 (g)	20.38 - 33.62 (g)	17.48 - 30.22 (g)
(3) Yield	40 - 80 (kg/tree/year)	20 - 60 (kg/tree/year)						about 200 (kg/tree/year)	200 - 800 (kg/tree/year)	250 - 500 (kg/tree/year)	80 - 150 (kg/tree/year)
(4) Size	6.5 - 10 x 11.5 - 18(cm)	7.5 x 9 (cm)									
(5) Rind											
1) Color	reddish dark green	dark green	light yellow	yellow		yellow with black spot	green-yellowish	yellow	yellow	yellow	creamy yellow
2) Thorn or hair	- slippery green and has yellow spot	- slippery surface and has yellow spot									
3) Thickness	1.5 (mm)	1 (mm)	thin	thin	medium thick	thin					
(6) Flesh											
1) Color	yellow	greenish yellow	slightly reddish white yellow	reddish yellow	reddish yellow	reddish white	reddish yellow	discolored	discolored	discolored	discolored
2) Taste	- delicious,tasty - slightly soft	- delicious, tasty - slightly dry	sweet	sweet	subacid	sweet	sweet	sweet	sweet	juicy sweet	sweet
3) Texture											
4) Aromatic			fragrant	fragrant	slightly fragrant	fragrant	slightly fragrant	fine			
(7) Seed											
1) Number								-	0 - 1	0 - 1	1 - 2
2) Size, Shape	4 x 5.5cm	4 x 5.5cm						-	-	3.5 - 4.0 (cm)	2.5 - 3.6 (cm)
4. Resistance											
(1) Disease			low resistant to panama disease	low resistant to panama disease	sensitive to leaf spot	slightly sensitive to panama disease	slightly resistant to leaf spot, panama disease	resistant to flour frost	resistant to flour frost	resistant to flour frost	resistant to flour frost
(2) Pest			slightly resistant to stem borer	slightly resistant to stem borer	slightly resistant to stem borer	sensitive to stem borer, leaf borer	slightly resistant to stem borer	resistant to fruit fly	rather resistant to fruit fly	resistant to fruit fly	resistant to fruit fly
(3) Other				- low resistant to wind - slightly resistant to leaf spot	resistant to wind						
5. Others											

Source: Penuntun Budidaya Hortikulture, Dinas Pertanian Tanaman Pangan Propinsi Bengkulu, 1994

Table A-3-5 Characteristics of Target Fruits by Variety (2/5)

Characteristics	Durian (1/2)												
	Sunan	Sukun	Petruk	Sitokong	Mas	Otong	Kani	Sihijau	Sijapang	Sidodol	Lalong Ka Lunak	Tembaga	Sawengading
1. Plant													
(1) Height (m)	10	15	18	20	15	5 - 8	5 - 8	25	25	20	20 - 25	15	20 - 25
(2) Crown													
1) Diameter (m)	10	6	10	8	6	2 - 4	2 - 4	12	20	10	10	6 - 7	8 - 12
2) Shape	umbrella - shape	soared	conical	soared	raher soared	umbrella - shaped	conical - soared	conical	conical	conical	blun pyramidal	soared	blunt pyramidal
3) Branch	horizontal and branch up tend to downward	horizontal and branch up tend to upward	tend to upward	horizontal	tend to upward	horizontal and branch up tend to upward	rather tend to upward	horizontal and branch up tend to upward	horizontal and branch up tend to upward	horizontal and branch up tend to upward	-	tend to upward	horizontal and branch up curved to upward
2. Flower													
(1) Shape	rounded in stem	rounded in stem	rounded in stem	rounded in stem	rounded in stem	rounded in stem	rounded in stem	rounded in stem	rounded in stem	rounded in stem	rounded in stem	rounded in stem	rounded in stem
(2) Color	white	white	white	white	white	yellowish white	yellowish white	white	white	white	red	yellowish	yellowish white
3. Fruit													
(1) Shape	egg - shaped upside down	oval	egg - shaped upside down	oval	oval	longish	round	oval	oval	round	oval	oval	oval
(2) Weight	1.25 - 2.50 (kg)	1.50 - 3.00 (kg)	1.50 - 2.50 (kg)	2.00 - 2.50 (kg)	1.50 - 2.00 (kg)	1.00 - 1.50 (kg)	1.00 - 1.50 (kg)	2.00 - 2.50 (kg)	1.50 - 2.50 (kg)	1.50 - 2.50 (kg)	1.60 - 2.10 (kg)	2.00 (kg)	2.00 - 2.50 (kg)
(3) Yield	200 - 800 (fruit/tree/year)	100 - 300 (fruit/tree/year)	10 - 150 (fruit/tree/year)	50 - 200 (fruit/tree/year)	50 - 200 (fruit/tree/year)	20 - 50 *) (fruit/tree/year)	15 - 50 *) (fruit/tree/year)	300 - 400 *) (fruit/tree/year)	300 - 600 *) (fruit/tree/year)	100 - 200 **) (fruit/tree/year)	150 - 250 (fruit/tree/year)	100 - 300 (fruit/tree/year)	100 - 160 (fruit/tree/year)
(4) Size													
(5) Rind													
1) Color	brownish green	yellowish	yellowish green	yellowish green	reddish yellow	yellowish green	brownish yellow	green	greenish yellow	yellowish green	brownish yellow	yellowish green	yellowish green
2) Thorn or hair	conical, small, rare	conical, small, dense	-	conical, dense	conical, dense	conical, small, rather dense	conical, sharp, rather dense	conical, dense rather sharp	conical, rather rare	conical, dense, rare	conical, rather big and rare	big and rare	conical, big, rare
3) Thickness	thin	medium thick	thin	medium thick	medium thick	medium thick	medium thick	1.20 (cm)	0.50 - 1.00 (cm)	1.10 (cm)	medium thick	thick	6.0 - 11.5 (mm)
(6) Flesh													
1) Color	pure white	yellowish white	yellow	yellow	bright yellow	yellow	yellowish	bright yellow	ivory yellow	bright yellow	yellow	silver yellow	yellow
2) Taste	sweet	sweet	very sweet	sweet	very sweet	very sweety	sweet	tasty sweet	tasty sweet	tasty sweet	sweet	sweet	sweet
3) Texture	very fine	fine	very fibrous	fine fibrous	fine	very fine	fine	fine	fine	fine	rather fibrous	fine	fine
4) Aromatic	strong fragrant	fragrant	medium fragrant	strong fragrant	medium fragrant	medium fragrant	medium fragrant	fragrant	fragrant	fragrant	medium fragrant	fragrant	medium fragrant
(7) Seed													
1) Number	1 - 2	0 - 1	5 - 10	5 - 20	20 - 30	5 - 10	5 - 12	18 - 30	8 - 15	15 - 20	16 - 18	8	10 - 12
2) Size, Shape	small oval	small oval	small oval	small oval	medium oval	medium oval	small oval	small oval	small oval	small oval	oval	small oval	egg - shaped
4. Resistance													
(1) Disease	resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	susceptible to root rotten	susceptible to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	-	resistant to root rotten
(2) Pest	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	medium resistant to fruit borer	susceptible to fruit borer	susceptible to fruit borer	rather susceptible to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	-	resistant to fruit borer
(3) Other													
5. Others	quality better than other high yielding	quality better than overseas durian	quality same with overseas durian	quality better than overseas durian	quality same with overseas durian	plants able to bear fruits several time in one year	plants able to bear fruits several time in one year	quality better than import durian	quality better than import durian	quality better than import durian	-	-	-

Source: Penuntun Budidaya Hortikulture, Dinas Pertanian Tanaman Pangan Propinsi Bengkulu, 1994

Note: *) seven years after transplanting **) more than 100 years

Table A-3-5 Characteristics of Target Fruits by Variety (3/5)

Durian (2/2)

Characteristics	Tamalatea Durian Hijau (Local name)	Bokor	Sirwig	Perwira	Mansau	Raja Mabah	Sawah Mas	Bakul	Aspar	Kalapet	Bantai Mas	Matahari	Hepe
1. Plant													
(1) Height (m)	20	>16	20	20	25	35	25	20 - 30	35	30	16 - 30	20	30
(2) Crown													
1) Diameter (m)	8 - 12	5	5 - 10	5 - 10	20	20	20	10	20	20	10 - 12	16	18
2) Shape	blunt pyramidal	soared	conical	leafy	umbrella shaped	umbrella - shaped	umbrella - shaped	soared	umbrella - shaped	umbrella - shaped	umbrella - shaped	conical	conical
3) Branch	tend to upward	tend to upward	horizontal	upward	horizontal branch tip curved downward	horizontal branch tip curved upward	horizontal branch up curved upward	horizontal branch tip curved upward	horizontal branch tip curved upward	horizontal branch up curved upward	horizontal	tend to upward	horizontal branch up curved upward
2. Flower													
(1) Shape	rounded in stem	big rounded	rounded	rounded	big rounded in stem	rounded in stem	rounded in stem	oval	rounded in stem	rounded in stem	oval	rounded in stem	rounded in stem
(2) Color	yellowish white	yellowish	white	yellowish white	red	white	white	yellowish white	white	white	yellowish white	white	white
3. Fruit													
(1) Shape	oval	oval	egg - shaped	round	oval	rectangle oval	oval	rounded	oval	oval	oval	oval	oval
(2) Weight	1 - 2 (kg)	3,9 (kg)	1,5 - 2,0 (kg)	2 - 3 (kg)	0,9 - 1,5 (kg)	2,5 - 5,0 (kg)	2,5 - 4,0 (kg)	3 - 4 (kg)	6 - 8 (kg)	2 - 3,5 (kg)	3 - 6 (kg)	2 - 3,5 (kg)	1,5 - 2 (kg)
(3) Yield	150 - 200 (fruit/tree/year)	50 - 200 (fruit/tree/year)	100 (fruit/tree/year)	100 - 300 (fruit/tree/year)	200 - 350 (fruit/tree/year)	150 - 200 (fruit/tree/year)	150 - 250 (fruit/tree/year)	300 - 500 (fruit/tree/year)	150 - 250 (fruit/tree/year)	150 - 200 (fruit/tree/year)	400 - 900 (fruit/tree/year)	50 - 200 (fruit/tree/year)	150 - 250 (fruit/tree/year)
(4) Size													
(5) Rind													
1) Color	green	yellowish green	yellowish green	green	yellow	green	green	brownish green	brownish green	yellowish green	yellowish green	brownish green	yellowish green
2) Thorn or hair	conical	big, rare	big, rare	conical, big, dense	small conical, sharp, dense	conical, rare	conical, rare	short cone, sharp	short cone, sharp	cobe, rare	long cone, sharp	big, rare, sharp, bent	conical, small, dense
3) Thickness	5 - 9 (mm)	medium thick	thick	thin	0,9 cm	1,0 - 1,3 cm	1,0 - 1,3 (cm)	1 - 1,5 (cm)	1 - 1,5 (cm)	1 - 1,3 (cm)	1,5 - 2 (cm)	5 - 10 (mm)	8 - 10 (mm)
(6) Flesh													
1) Color	yellow white	light yellow	milk white	yellow	dark red	ivory yellow	yellow	white	ivory yellow	ivory yellow	yellow	bright yellow	yellowish white
2) Taste	tasty sweet	sweet	sweet	sweet	sweet	tasty sweet	tasty sweet	sweet	tasty sweet	tasty sweet	sweet	sweet	sweet
3) Texture	fine, rather fibrous	fine	fine	-	fine	fine	fine	fine rather fibrous	fine	fine	fine	fine fibrous	fine fibrous
4) Aromatic	medium fragrant	fragrant	strong fragrant	strong fragrant	no odour	fragrant	fragrant	strong fragrant	fragrant	fragrant	strong fragrant	medium fragrant	fragrant
(7) Seed													
1) Number	10 - 15	10 - 20	10 - 15	15 - 20	14 - 16	10 - 15	12 - 14	24	14 - 20	10	10 - 20	5 - 10	2 - 3
2) Size, Shape	oval	small oval	egg - shaped	egg - shaped	oval, small	oval	oval	oval	oval	small	rather oval, small	oval	medium oval
4. Resistance													
(1) Disease	resistant to root rotten	resistant to root rotten	slightly resistant to root rotten	slightly resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten	resistant to root rotten
(2) Pest	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer	resistant to fruit borer
(3) Other													
5. Others	-	quality nearly same with other high yielding	quality nearly same with other high yielding	quality nearly same with other high yielding	good quality	good quality	good quality	-	good quality	good quality	-	-	-

Source: Penuntun Budidaya Hortikulture, Dinas Pertanian Tanaman Pangan Propinsi Bengkulu, 1994

Table A-3-5 Characteristics of Target Fruits by Variety (4/5)

Characteristics	Mango					Mangosteen	Marquisa
	Arummanis 143	Golek 31	Manalagi 69	Gedong Gincu	Sukku	Kaligesing	Malino Sembang (local name)
1. Plant							
(1) Height (m)	up to 9.2	up to 8.7	up to 7.5	9 - 15	20	10 - 15	unlimited
(2) Crown							
1) Diameter (m)	12	13.5	12.5		22	3 - 4	unlimited
2) Shape	blunt pyramidal	umbrella-shaped	rounded	blunt pyramidal	blunt pyramidal	soared	trellis
3) Branch	leafy	rarely leaf	leafy	leafy		- branching rarely begin height 4m. - horizontal	creeping on soil surface
2. Flower							
(1) Shape	sharp pyramidal	sharp pyramidal	pyramidal	blunt pyramidal	sharp pyramidal	round and come off	attractive
(2) Color	yellow	yellow	yellow	red	yellow	red	shining purple
3. Fruit							
(1) Shape	oval, small beak, acture on fruit apex	longish, without beak acute on fruit apex	oval with beak, and round on fruit apex	round on fruit basal and apex, small sinusidal	oval, acute on fruit basal and apex	round	round - oval
(2) Weight	450 (g/fruit)	502 (g/fruit)	560 (g/fruit)	200 - 240 (g/fruit)	250 (g/fruit)	100 - 125 (g)	40.9 - 45 (g)
(3) Yield	54.7 (kg/tree/year)	52.3 (kg/tree/year)	36.5 (kg/tree/year)	100 - 150 (kg/tree/year)	1,000 - 1,500 (fruit/tree/year)	4.5 - 6.5 (kwintal/tree)	300 - 500 (3 years old, fruit/plan/year)
(4) Size	15.1 x 7.8 x 5.5 (cm)	16.7 x 7.9 x 6.2 (cm)	16 x 8.2 x 7.3 (cm)	10 x 8 x 6 (cm)	-		
(5) Rind							
1) Color	purplish red on basal and the others is blueish green	yellow on basal	yellow on basal	purpleish on basal and dark green on apex	green	purple-dark red	greenish purple
2) Thorn or hair							
3) Thickness	thick	thick	thick	thick			- thin (3 - 5 mm) - slippery and shining
(6) Flesh							
1) Color	yellow	yellow	yellow	yellow		white	gold yellow
2) Taste	sweet	sweet	sweet	sweet		sweet-acid	slightly sweet acid
3) Texture	refined fibrous	refined fibrous	refined fibrous	refined fibrous		juicy	
4) Aromatic	fragrant	fragrant	fragrant	fragrant			fragrant
(7) Seed						1 - 2	
1) Number							
2) Size, Shape	13.8 x 4.3 x 1.9 (cm), small oval	14.5 x 4.2 x 2.8 (cm), oval	14 x 4.6 x 2.2 (cm), small oval	- length: 5 - 6 (cm) - width: 3 - thick: 2 - 3 , big	6.5 x 4.0 x 1.1 (cm), small		
4. Resistance							
(1) Disease						resistant to root rotten	resistant to root rotten
(2) Pest						resistant to fruit borer	resistant to fruit caterpillar
(3) Other							
5. Others							- area: high land with altitude 700 - 1,650 m above sea level - propagation by cutting (stem or seed) - suitable in latosol (soil)

Source: Penuntun Budidaya Hortikulture, Dinas Pertanian Tanaman Pangan Propinsi Bengkulu, 1994

Table A-3-5 Characteristics of Target Fruits by Variety (5/5)

Characteristics	Rambutan									Salak				
	Rapiah	Lebakbulus	Binjai	Antalagi	Sibongkok	Sibatuk Ganal	Garuda	Brahrang	Nona	Pondoh	Swaru	Nglumut	Enrekang	Gula Pasir
1. Plant														
(1) Height (m)	6.5 - 7.5	5 - 10	6 - 7	7 - 9	6 - 8	7.5 - 9.0	5 - 9	6 - 8	4 - 6	4 - 7	3 - 6	3 - 6	4.0 - 4.5	4.0 - 5.5
(2) Crown														
(1) Diameter (m)	5 - 7	6 - 8	6 - 8	8 - 10	5 - 7	7.5 - 10.0	7.0 - 9.5	-	6 - 8	3.5 - 6.0	2.5 - 5.0	2 - 4	3.8 - 4.5	5.0 - 6.5
(2) Shape	umbrella-shaped	umbrella-shaped	umbrella-shaped	umbrella-shaped	umbrella-shaped	umbrella-shaped	umbrella-shaped	umbrella-shaped	umbrella-shaped	lanceolate line-shaped, sharp on the apex and spiky	lanceolate line-shaped, sharp on the apex and spiky	lanceolate line-shaped, sharp on the apex and fine spiky	-	-
(3) Branch	horizontal	horizontal	horizontal	horizontal	horizontal	horizontal	horizontal	horizontal	tend to upward					
2. Flower														
(1) Shape	-	small rounded in stem, short stem	small rounded in stem, very short stem	small rounded in stem, short stem	small rounded in stem, short stem	small rounded in stem, short stem	small rounded in stem, short stem	small rounded in stem, short stem	-					
(2) Color	yellowish	-	yellowish	yellowish	brownish	yellowish	yellowish	yellow	yellowish					
3. Fruit														
(1) Shape	round	round	rather oval	oval, slightly flat	oval	round	rather oval	egg-shaped	round	- triangle - egg-shaped upside down	- egg-shaped upside down - sharp on the apex	- triangle - egg-shaped upside down - sharp on the apex	- triangle - egg-shaped upside down - sharp on the base	round to oval
(2) Weight	18.9 (g)	25.5 (g)	33.8 (g)	42 (g)	50.67 (g)	41.1 (g)	68.15 (g)	40 - 50 (g)	20 - 22.5 (g)	30 - 100 (g)	70 - 120 (g)	70 (g)	56.30 (g)	45 - 75 (g)
(3) Yield	18 - 30 (kg/tree)	50 - 100 (kg/tree)	40 - 68 (kg/tree)	160 - 210 (kg/tree)	175 - 225 (kg/tree)	240 - 280 (kg/tree)	200 - 270 (kg/tree)	100 - 135 (kg/tree)	50 - 150 (kg/tree)	1 - 4 (kg/plant)	-	1 - 4.5 (kg/plant)	-	-
(4) Size										2.5 - 7.5 (cm)	6.0 - 8.0 (cm)	2.5 - 8.0 (cm)	73.50 - 80.75 (cm)	4.0 - 7.5 (cm)
(5) Rind														
(1) Color	yellowish green	red	dark red	greenish yellow	brown dark red	red	red	dark red	yellow	brown	brown	brown	brown	brown
(2) Thorn or hair	short hair, rarely and rough	long hair, rarely and smooth	long hair, rarely and rough	hair rather short	slightly smooth hair	long hair	long hair	-	short hair	scaly	scaly	scaly	scaly	scaly
(3) Thickness										0.8 - 1.5 (cm)	0.5 - 2.0 (cm)	-	-	0.1 - 1.0 (cm)
(6) Flesh														
(1) Color	white	white	white	white	white	white	white	white	white	chalk white	brownish yellow	yellowish white	chalk white	chalk white
(2) Taste	sweet	sweet	sweet	sweet	sweet	sweet	sweet	sweet	orange sweet	sweet, tasty crispy	sweet, juicy crispy	sweet	sweet tasty crispy	sweet
(3) Texture	-	juicy	dry	dry	dry	juicy	-	rather dry	-	hard	soft	-	hard	- crispy - juicy - peel
(4) Aromatic														
(7) Seed										1 - 3	1 - 3	2 - 3	2 - 3	1 - 3
(1) Number														
(2) Size, Shape	- round, have plate - 1 (g)	- oval - 2 (g)	- oval - 2.6 (g)	oval	- oval - slightly bend on apex	-	oval	oval	oval					
4. Resistance														
(1) Disease														
(2) Pest														
(3) Other														
5. Others										vegetative propagation	vegetative propagation	-	-	generative and vegetative propagation

Source: Penuntun Budidaya Hortikulture, Dinas Pertanian Tanaman Pangan Propinsi Bengkulu, 1994

Table A-3-6 Mother Plants Registered in BBIs (1/2)

(1) North Sumatra

Location	No.	Target Fruit Variety	Age of Tree	No. of Tree	About no. of Scion	Propagation Method	Root Stock Variety	Remarks
Kuta Gadung (High Land)	1.	Marquisa						
		1) Local	4	1,000	200,000	Seedling	-	-
Sipirok (Low Land)	1.	Durian						
		1) Otong	3	10	-	Grafting	Local	-
	2.	Mangosteen						
		1) Local	3	45	-	Grafting	Local	-
	3.	Rambutan						
		1) Binjai	3	20	-	Grafting, Budding	Local	-

(2) West Java

Location	No.	Target Fruit Variety	Age of Tree	No. of Tree	About no. of Scion	Propagation Method	Root Stock Variety	Remarks
Pasir Banteng	1.	Avocado						
		1) Ijo Bundar	9	93	25,000	Grafting	Local	-
		2) Ijo Panjang	9	80	20,000	Grafting	Local	-
	2.	Durian						
		1) Sunan	9	33	60,000	Budding	Local	-
		2) Sukun	6	15	25,000	Budding	Local	-
		3) Kani	9	39	125,000	Budding	Local	-
		4) Hepi	4	24	80,000	Budding	Local	-
		5) Otong	8	61	240,000	Budding	Local	-
		6) Petruk	8	29	100,000	Budding	Local	-
		7) Sitokong	8	79	300,000	Budding	Local	-
		8) Bokor	13	1	3,000	Budding	Local	-
		9) Raja Mabah	15	6	18,000	Budding	Local	-
		10) Sawah Mas	15	5	15,000	Budding	Local	-
		11) Aspar	15	5	15,000	Budding	Local	-
		12) Gajah	13	1	3,000	Budding	Local	-
		13) IM	13	5	12,500	Budding	Local	-
		14) Sibakul	10	10	30,000	Budding	Local	-
		15) Perwira	10	1	3,000	Budding	Local	-
		16) Local	10	37	100,000	Budding	Local	-
	3.	Mango						
		1) Arumanis	5	60	100,000	Budding	Local	-
		2) Madu	4	19	35,000	Budding	Local	-
		3) Golek 31	4	13	20,000	Budding	Local	-
		4) Opyong	4	2	2,000	Budding	Local	-
		5) Gedong Gincu	4	4	6,000	Budding	Local	-

Table A-3-6 Mother Plants Registered in BBIs (2/2)

(3) East Java

Location	No.	Target Fruit Variety	Age of Tree	No. of Tree	About no. of Scion	Propagation Method	Root Stock Variety	Remarks
Poh Jentrek	1.	Mango						
		1) Arumanis	75	41	10,000	Budding	Madu	-
		2) Golek	75	12	5,000	Budding	Madu	-
		3) Manalagi	56	2	1,000	Budding	Madu	-
		4) Madu	46	45	10,000	Budding	Madu	-

(4) South Sulawesi

Location	No.	Fruit Variety	Age of Tree	No. of Tree	About No. of Scion	Propagation Method	Root Stock Variety	Remarks
Bonto-Bonto, Bonto Marano, Gowa	1.	Avocado						
		1) Mentega	57	4	1,000	Budding	Local	-
	2.	Mango						
		1) Arumanis	60	31	31,000	Budding	Madu	-
		2) Arumanis 143	5	26	13,000	Grafting	Madu	-
		3) Golek	60	51	51,000	Budding	Madu	-
		4) Golek 31	3	15	3,000	Grafting	Madu	-
		5) Manalagi	60	29	29,000	Budding	Madu	-
		6) Manalagi 69	5	14	6,000	Grafting	Madu	-
		7) Gadung	60	7	7,000	Budding	Madu	-
		8) Lalijiwo	60	3	1,500	Budding	Madu	for Root Stock
		9) Dodol	60	2	1,000	Budding	Madu	for Root Stock
		10) Madu	60	3	1,500	Budding	Madu	for Root Stock
		11) Madu 225	5	21	10,500	Budding	Madu	for Root Stock
	3.	Mangosteen						
		1) Local	2	37	-	-	Local	-
	4.	Rambutan						
		1) Aceh	57	19	19,000	Budding	Sinyouyo	-
			3	21	10,500	Budding	Sinyouyo	-
		2) Lebak Bulus	57	8	8,000	Budding	Sinyouyo	-
		3) Lengkeng	57	8	8,000	Budding	Sinyouyo	-
			3	49	-	Budding	Sinyouyo	-
		4) Semarang	57	2	2,000	Budding	Sinyouyo	-
		5) Rapiah	57	1	1,000	Budding	Sinyouyo	-
		6) Gula-gula	57	3	2,000	Budding	Sinyouyo	for Root Stock
		7) Garuda	2	5	-	Grafting	Sinyouyo	
		8) Binjai	1	3	-	Grafting	Sinyouyo	

Table A-3-7 Mother Plants as Source of Scion in BBUs (1/2)

(1) North Sumatra

Location	No.	Target Fruit Variety	Age of Tree	No. of Tree	About No. of Scion	Propagation Method	Root Stock Variety	Remarks
Siguci, Deliserdang	1.	Durian						
		1) Sitokong	5	3	300	Budding	Local	-
		2) Kani	5	71	21,300	Budding	Local	-
		3) Otong	5	15	4,500	Budding	Local	-
	2.	Rambutan						
		1) Brahrang	3	60	1,500	Budding	Local	-
Buluh Pancur, Karo	1.	Durian						
		1) Local	15 - 20	15	25,000	Budding	Local	-
	2.	Rambutan						
		1) Local	10	20	15,000	Grafting, Budding	Local	-

(2) West Java

Location	No.	Target Fruit Variety	Age of Tree	No. of Tree	About no. of Scion	Propagation Method	Root Stock Variety	Remarks
Kasugengan	1.	Mango						
		1) Arumanis	39	30	75,000	Grafting	Local	-
		2) Arumanis 143	33	60	90,000	Grafting	Local	-
		3) Cengkir	33	80	160,000	-	Local	-
		4) Gedong Gincu	33	23	51,750	-	Local	-
		5) Golek	33	12	27,000	-	Local	-
		6) Manalagi	33	30	37,500	-	Local	
		7) Lalijiwo	39	20	60,000	-	Local	
		8) Kweni	33	5	25,000	-	Local	
Cimangkok	1.	Durian						
		1) Petruk	13	13	6,500	-	Local	-
		2) Bokor	13	2	1,000	-	Local	-
		3) Sunan	13	3	1,500	-	Local	-
		4) Hepi	13	2	1,000	-	Local	-
		5) Kani	13	2	1,000	-	Local	-
		6) Mas	13	4	2,000	-	Local	-
		7) Bakul	13	1	500	-	Local	-
		8) Local	13	71	35,500	-	Local	-

(3) East Java

Location	No.	Target Fruit Variety	Age of Tree	No. of Tree	About no. of Scion	Propagation Method	Root Stock Variety	Remarks
Lebo, Sidoarjo	1.	Mango						
		1) Gadung	28	50	150,000	Grafting	Local	-
Jiwan, Madiun	1.	Mango						
		1) Gadung	28	201	603,000	Grafting	Local	-
		2) Arumanis	25	150	450,000	Grafting	Local	-
		3) Manalagi	25	150	450,000	Grafting	Local	-
Warujinggo, Probolinggo	1.	Mango						
		1) Madu	39	150	375,000	Grafting	Local	-
		2) Gadung	39	5	12,500	Grafting	Local	-
		3) Manalagi	39	3	7,500	Grafting	Local	-
		4) Lalijiwo	39	5	12,500	Grafting	Local	-
		5) Golek	39	2	5,000	Grafting	Local	-
Patrang, Jember	1.	Durian	-	-	-	-	-	-
		1) Sitokong	60	1	5,000	Grafting	Local	-
		2) Sitebal	56	6	30,000	Grafting	Local	-
		3) Situmbo	45	1	5,000	Grafting	Local	-

Table A-3-7 Mother Plants as Source of Scion in BBUs (2/2)

(4) South Sulawesi

Location	No.	Target Fruit Variety	Age of Tree	No. of Tree	About No. of Scion	Propagation Method	Root Stock Variety	Remarks
Latuppa, Luwu District	1.	Mango						
		1) Golek	7	4	2,000	Budding	Local	-
		2) Arumanis	5	2	400	Budding	Local	-
	2.	Mangosteen						
		1)	71	4	4,000	Grafting	Local	-
		2)	12	5	2,500	Grafting	Local	-
	3.	Rambutan						
		1) Lebak Bulus	71	6	6,000	Budding	Local	-
			11	4	2,000	Budding	Local	-
			8	11	5,500	Budding	Local	-
		2) Binjai	71	1	1,000	Budding	Local	-
			11	2	1,000	Budding	Local	-
			6	3	1,500	Budding	Local	-
		3) Macan	71	2	-	Budding	Local	for Root Stock
		4) Garuda	11	1	500	Budding	Local	-
		5) Madu	71	1	-	Budding	Local	for Root Stock
Batu Karopa, Bulukumba District	1.	Mango						
		1) Arumanis 143	4	4	-	Budding	Local	-
			4	1	-	Budding	Local	-
		2) Golek 31	1	2	-	Budding	Local	-
		3) Madu	27	2	2,000	Budding	Local	for Root Stock
			17	4	1,500	Budding	Local	for Root Stock
		4) Kanre Jawa	12	1	-	Budding	Local	for Root Stock
	2.	Rambutan						
		1) Binjai	1	2	-	Budding	Local	-
Lajonga, Sidrap District	1.	Mango						
		1) Arumanis	20 - 50	44	22,000	Budding	Local	-
		2) Manalagi	15	4	1,600	Budding	Local	-
		3) Golek	15	2	800	Budding	Local	-
		4) Madu	50	5	5,000	Budding	Local	for Root Stock
Sudiang, Ujung Pandang	1.	Avocado						
		1) Mentega	12	1	500	Grafting	Local	-
	2.	Mango						
		1) Manalagi	40 - 50	23	23,000	Budding	Madu	-
		2) Arumanis	40 - 50	24	24,000	Budding	Madu	-
		3) Golek	40 - 50	18	18,000	Budding	Madu	-
		4) Brazil	4	3	300	Budding	Madu	-
		5) Gadung	40 - 50	5	5,000	Budding	Madu	-
		6) Gedong Gincu	40 - 50	3	3,000	Budding	Madu	-
		7) Manalagi Probolinggo	5	4	800	Budding	Madu	-
		8) Arumanis 143	1	12	-	Budding	Madu	-
		9) Golek 131	1	2	-	Grafting	Local	-
		10) Manalagi 69	1	1	-	Grafting	Local	-
		11) Kanre Jawa	55	5	5,500	Grafting	Local	for Root Stock
		12) Lali Jiwo	5	1	-	Grafting	Local	for Root Stock
	3.	Mangosteen						
		1) Kaligesing	1	2	-	Grafting	Local	-
	4.	Rambutan						
		1) Binjai	1	5	-	Grafting	Sinyonyo	-

Table A-3-8 Activities of BPSB/TPH (1/4)

North Sumatra

No.	No. of Staff	Working Area District	No. of Fruit Seed Grower	No.	Target Fruit	Variety: Released	Variety: Determination	Age of Tree	No. of Tree	About No. of Scion	Used Root Stock	Planted location	No. of Seedling	Control of Labeling
1.	4	Tapanuli Selatan	4	1.	Durian	-	Tembaga	15	100	70,000	Local	Dairi	71,000	17,600
							Sijantung	25	125	80,000	Local	Dairi, Langkat		
						Otong	Otong	8	25	17,500	Local	Tapanuli Selatan		
2.	1	Dairi	2	2.	Mangosteen	-	Local	25	60	36,000	Local	Tapanuli Selatan Langkat	-	-
3.	2	Langkat	6	3.	Marquisa	-	Local; Karo	4	75	-	Local Local	Karo	70,000	16,000
4.	1	Tanah Karo	3	4.	Rambutan	Brahrang	Brahrang	25	105	70,000	Local	Langkat, Tapanuli Tengah	115,000	18,450
						Binjai	Binjai	30	85	60,000	Local	Tapanuli Selatan Tapanuli Tengah		
5.	1	Tapanuli Tengah	1	5.	Salak	-	Local; Sidempuan	40	25	-	Local	Tapanuli Selatan	12,500	2,000
6.	1	Tapanuli Utara	-											

Source : JICA Study Team

Table A-3-8 Activities of BPSB/TPH (2/4)

West Java

No.	No. of Staff	Working Area District	No. of Fruit Seed Grower	No.	Target Fruit	Variety: Released	Variety: Determination	Age of Tree	No. of Tree	About No. of Scion	Used Root Stock	Planted location	No. of Seedling	Control of Labeling
1.	115	116	45	1.	Avocado	-	Ijo Panjang	18	10	50,000	Local	Bandung	-	-
							Ijo Bundar	18	10	50,000	Local	Garut		
							Mentega	18	5	50,000	Local	Sumedang		
				2.	Duku	-	Local	40	30	300,000	Local	Cianjur, Majalengka	-	-
				3.	Durian	Sitokong	Sitokong	27	50	125,000	Local	Sukabumi	188,448	25,000
						Petruk	Petruk	28	25	625,000	Local	Cianjur, Majalengka		
						Perwira	Perwira	28	50	125,000	Local	Garut, Sumedang		
						Bokor	Bokor	28	20	100,000	Local	Subang, Ciamis		
						Siriwig	Siriwig	27	5	12,500	Local	-		
						Kani	Kani	14	10	25,000	Local	-		
						Otong	Otong	14	50	125,000	Local	-		
				4.	Mango	Gedong Gincu	Gedong Gincu	20	500	250,000	Local	Majalengka, Indramayu, Cirebon	93,319	9,500
						Arumanis	Arumanis	14	300	300,000	Local	Sukabumi, Sumedang		
				5.	Mangosteen	-	Local	30	50	250,000	Local	Purwakarta, Majalengka, Subang, Sukabumi	8,092	800
				6.	Salak	-	Pondoh	8	4,000	20,000	-	Tasik Malaya	-	-
							Manonjaya	8	500	20,000	-	Tasik Malaya		
							Benteng	8	500	20,000	-	Ciamis		
							Bangkok	8	500	20,000	-	Sumedang		

Source : JICA Study Team

Table A-3-8 Activities of BPSB/TPH (3/4)

East Java

No.	No. of Staff	Working Area District	No. of Fruit Seed Grower	No.	Target Fruit	Variety		Age of Tree	No. of Tree	About No. of Scion	Used Root Stock	Planted location	No. of Seedling	Control of Labeling
						Released	Determination							
1.	1	Gowa	1	1.	Avocado	-	-	-	-	-	-	-	-	-
2.	1	Takalar	2											
3.	1	Jeneponto	9	2.	Mango	Golek	Golek	25	443	443,000	Local	Bulukumba, Bantaeng, Jeneponto, Wajo, Gowa	37,500	37,500
4.	1	Bantaeng	1											
5.	1	Bulukumba	8			Arumanis	Arumanis	20	1,021	1,020,000	Local	Bulukumba, Bantaeng, Jeneponto, Wajo	1,036,000	1,036,000
6.	1	Selayar	2											
7.	1	Sinjai	3			Arumanis 143	Arumanis 143	6	14	4,200	Local	Bulukumba, Gowa		
8.	1	Wajo	-			Manalagi	Manalagi	25	165	165,000	Local	Bulukumba, Jeneponto, Wajo, Gowa	94,500	94,500
9.	1	Soppeng	-											
10.	4	Sidrap	-			Madu	Madu	18	37	37,000	Local	Bulukumba, Bantaeng, Jeneponto, Wajo		
11.	4	Luwu	1											
12.	1	Tator	-											
13.	1	Enrekang	-											
14.	3	Pinrang	-	3.	Mangosteen	-	-	-	-	-	-	-		
15.	1	Polmas	-											
16.	1	Majene	-	4.	Marquisa	-	-	-	-	-	-	-	80,000	80,000
17.	1	Mamuju	-											
18.	1	Barru	-	5.	Rambutan	Rapiah	Rapiah	18	157	105,000	Local	Bulukumba, Sinjai, Wajo	12,000	12,000
19.	1	Pangkep	-											
20.	2	Maros	3			Binjai	Binjai	8	44	30,800	Local	Bulukumba, Sinjai, Gowa	9,600	9,600
21.	1	Ujung Pandang	1											
						Aceh	Aceh	10	65	42,000	Local	Sinjai, Wajo		
						Lengkeng	Lengkeng	12	52	35,000	Local	Sinjai, Wajo	18,000	18,000
						Lebak Bulus	Lebak Bulus	12	334	230,000	Local	Wajo, Luwu, Gowa	120,385	120,385
						Garuda	Garuda	10	41	28,000	Local	Luwu		

Source : JICA Study Team

Table A-3-8 Activities of BPSB/TPH (4/4)

South Sulawesi

No.	No. of Staff	Working Area District	No. of Fruit Seed Grower	No.	Target Fruit	Variety		Age of Tree	No. of Tree	About No. of Scion	Used Root Stock	Planted location	No. of Seedling	Control of Labeling
						Released	Determination							
1.	125	20	10	1.	Avocado	Ijo Panjang	-	27	7	400	Local	Malang	-	-
				2.	Banana	Cavendish	-	1	80	800	-	-	198,687	59,000
						Ambon Kuning		1,5	45	450	-	Mojokerto	50,000	5,600
						Raja Bulu		1,5	50	300	-	-	14,000	4,000
				3.	Duku	Local	-	35	24	36,000	Local	Tulung Agung	-	-
				4.	Durian	Local	-	60	5	25,000	Local	Jember	-	-
				5.	Mango	Arumanis 143	-	1	546	21,840	Madu	-	-	-
						Manalagi 69		1	520	10,400	Madu	Pasuruan	219	150
						Golek 31		1	337	6,540	Madu	-	300	250
						Gadung		18	322	322,000	Madu	-	100,376	50,000
						Arumanis		13	138	13,000	Madu	-	31,300	15,000
						Lalijiwo		13	7	7,000	Madu	Pamekasan	255	200
				6.	Salak	Local	-	-	-	-		-	-	-

Source : JICA Study Team

Table A-4-1 List of Standard Facilities and Equipment for BBI

No.	Description	Specification	Quantity
1.	**Buildings**		
	a. Seed storage + cold storage	150 m2 + 50 m2	1 unit
	b. Tractor and equipment	150 m2	1 unit
	warehouse	20 m2	1 unit
	c. Production input warehouse	100 m2	1 unit
	d. Work loods	200 m2	1 unit
	e. Office	20 m2	1 unit
	f. Laboratory	600 m2	1 unit
	g. Donnitory	100 m2	1 unit
	h. Class room/Library	150 m2	1 unit
	i. Auditorium	type C/70 m2	1 unit
	j. Management Housing	type D/50 m2 each	5 unit
	k. Executive housing	type E/36 m2	10 unit
	l. Dept. head housing	type E/36 m2	1 unit
	m. Mess	10 m2	1 unit
	n. Guard house	72 m2	1 unit
	o. Car garage	30 m2	1 unit
	p. Compost room	30 m2	1 unit
	q. Livestock stall	30 m2	1 unit
	r. Fertilizer warehouse	60 m2	1 unit
	s. Green house	100 m2 each	2 unit
	t. Shadow houses	60 m2	1 unit
	u. Electrical relay station	100 m2	1 unit
	v. drying floor	30 m2	1 unit
2.	**Production equipment**		
	a. Wheel type orchard tractor	25 HP	1 unit
	b. Track type orchard tractor	25 HP	1 unit
	c. Hand tractors	7 - 8 HP	2 units
	d. Power weeders	2.5 - 5 HP	2 units
	e. Hand sprayers (semi-automatic)	10 liters	2 units
	f. Hand sprayers (automatic)	10 liters	5 units
	g. Mist Blowers (Knapsack Power Sprayer)	10 liters	3 units
	h. Foggers		2 sets
	i. Cow/Buffaloes		2 pairs
	j. Carts		2 units
	k. Mattock		50 units
	l. Plows		3 units
	m. Spades		30 units
	n. Crowbars		5 units
	o. Grafting knives		20 units
	p. Razor		20 units
	q. Scissors		20 units
	r. Saws		5 units
	s. Grass knives/small hoes with short handle		40 units
	t. Pails/diarrheas/watering cans		10 units
	u. Scales		
	- Capacity of 100 kg		1 unit
	- Capacity of 25 kg		1 unit
	- Capacity of 5 kg		1 unit
	v. Roll meters		4 units
	w. Climatology instruments		1 unit
	x. Sprinkler		1 unit
3.	**Laboratory Equipment**		
	a. Laboratory tables		2 units
	b. Microscopes		
	- Binocular		2 units
	- Three dimension (stereo)		1 units
	c. Germinators		5 units
	d. Bunser burner		1 unit
	e. Autoclave		1 set
	f. Seed storage rack		2 units
	g. Analysis scales		1 unit
	h. Mirror cupboards		2 units
	i. Loopes		5 units
	j. Petridishes		85 units
	k. Calibrated beakers		15 units
	l. Erlenmeyers		2 units
	m. Refrigerator		1 unit
	n. Cuffs		10 units
	o. Moisture tester		2 units
	p. Counters (talisman)		5 units

Table A-4-2 List of Standard Facilities and Equipment for BBU

No.	Description	Specification	Quantity
1.	**Buildings**		
	a. Seed warehouse	100 m2	1 unit
	b. Equipment warehouse	75 m2	1 unit
	c. Compost warehouse	20 m2	1 unit
	d. Production input warehouse	20 m2	1 unit
	e. Work loods	100 m2	1 unit
	f. Office	50 m2	1 unit
	g. Leader house	type C = 70 m2	1 unit
	h. Staff house	type D = 50 m2	3 unit
	I. Shade house	60 m2	1 unit
	j. livestock pen	15 m2	1 unit
	k. Drying floor	50 m2	1 unit
2.	**Production Equipment**		
	a. Mini Tractor		1 unit
	b. Power weeder 2 - 3 HP		1 unit
	c. Power Sprayer		1 unit
	d. Hand sprayer		3 units
	e. Push cart		1 unit
	f. Hoe		20 units
	g. Shuffle		10 units
	h. Fork		10 units
	I. Plough		2 units
	j. Crowbar		5 units
	k. Budding knife		10 units
	l. Cutting knife		5 units
	m. Cutting scissors		5 units
	n. Saw		3 units
	o. Sickle		15 units
	p. Pail		2 units
	q. weight scales 100 kg		1 unit
	r. Roll meter		2 units
	s. rainfal measure		1 unit
	t. Buffalo/Cow		2 pairs
3.	Laboratory		
	a. Laboratory table		1 unit
	b. Germinator		2 units
	c. Moisture Tester		1 unit

Table A-5-1 Recommended Mother Plant Varieties for the Target Fruit Productions

No.	Crops	Varieties	Origin / Location	Recommended Year
1.	Avocado	1) Ijo Panjang	Tlekung, Batu Malang, East Jawa	1987
		2) Ijo Bundar	Tlekung, Batu Malang, East Jawa	1987
2.	Banana	1) Barangan Merah	Desa Selamat, Sibiru-biru, Deli, North Sumatra	1997
		* Lately, the recommended varieties of banana were reviewed by MOA and they include Ambong kuning, Ambong jepang (Giant Cavendish), Ambung lumut, Barangan, Raja besar, Badak, Kepok kuning, Nangka, Susu, and Faduk agung.		
3.	Duku (Lanzon)	1) Palembang	Batu Ampar, O. Komering Ilir, South Surawesi	1995
		2) Rasuan	Rasuan, O. Komering Ulu, South Surawesi	1995
		3) Pontianak	Punggur, West Kalimantan	1995
4.	Durian	1) Sunan	Gondol Boyolali, Central Jawa	1984
		2) Sukun	Gempolan Karanganyar, Central Jawa	1984
		3) Petruk	Randusari Jepara, Central Jawa	1984
		4) Sitokong	Ragunan Ps. Minggu, Jakarta	1984
		5) Mas	Rancamaya, Bogor, East Jawa	1984
		6) Otong	Introduksi Thailand	1987
		7) Kani	Introduksi Thailand	1987
		8) Sawerigading	Wara Utara, Luwu, South Surawesi	1992
		9) Lalong	Wara, Luwu, South Surawesi	1992
		10) Tamalatea	Wara Utara, Luwu, South Surawesi	1992
		11) Tembaga	Kab. Kampar, Riau	1992
		12) Sijapang	Karang Intan, South Kalimentan	1992
		13) Sidodol	Karang Intan, South Kalimentan	1992
		14) Sihijau	Karang Intan, South Kalimentan	1992
		15) Perwira	Sinapel Majalengka, West Jawa	1993
		16) Bokor	Sukahati, Majalengka, West Jawa	1993
		17) Siriwig	Rajagaluh, Majalengka, West Jawa	1993
		18) Kakapet	Kayu Tanam, West Kalimentan	1995
		19) Mansau	Nanga Pinoh, West Kalimentan	1995
		20) Raja Mabah	Mabah, West Kalimentan	1995
		21) Sawah Mas	Mabah, West Kalimentan	1995
		22) Aspar	Pelanan Mabah, West Kalimentan	1995
		23) Matahari	Cimahpar, Bogor, West Jawa	1995
		24) Hepi	Jonggol, Bogor, West Jawa	1995
		25) Bakul	Ujan Mas, Pinang Belarik, South Sumatra	1995
		26) Bantal	Kikim, Tj. Beringin, M. Enim, South Sumatra	1995
5.	Mango	1) Arumanis 143	Probolinggo, East Jawa	1984
		2) Manalagi 69	Pasuruan East Jawa	1984
		3) Golek 31	Probolinggo, East Jawa	1984
		4) Gedong Gincu	Majalengka, West Jawa	1995
		5) Sukku	Masemba, Enrekang, South Sulawesi	1995
		6) Lanabbu	Liorong, Mattrobulu, Pinrang, South Sulawesi	1995
6.	Mangosteen	1) Kaligesing	Kakigesing, Purworejo, Central Jawa	1995
7.	Marquisa	1) Malino	Malino, Tinggi Moncong, Gowa, South Sulawesi	1994
8.	Rambutan	1) Binjai	Pasar Minggu, Jakarta	1985
		2) Rapiah	Pasar Minggu, Jakarta	1985
		3) Lebak Bulus	Pasar Minggu, Jakarta	1985
		4) Nona	Kampar, Riau	1992
		5) Antalagi	Sungai Andai, South Kalimentan	1992
		6) Garuda	Sungai Andai, South Kalimentan	1992
		7) Sibatuk Ganal	Sungai Andai, South Kalimentan	1992
		8) Sibongkok	Sungai Lulut, South Kalimentan	1992
9.	Salak	1) Enrekang	Kalimbua-Bontangan, Baraka, Masemba Solanta, Enrekang, South Sulawesi	1992
		2) Nglumut	Kab. Magelang, Central Jawa	1992
		3) Pondoh	Lokal Sleman, D.I. Yogyakarta	1987
		4) Suwaru	Lakal Suwaru, Malang, East Jawa	1992
		5) Bali	Kab. Karang Asem, Bali	1994
		6) Gula Pasir	Kab. Karang Asem, Bali	1994

Source : Directorate of Seed Production, 1995-1997.

Table A-5-2 Fruit Variety Selection for Orchard Development

Fruit	North Sumatra	West Java	East Java	South Sulawesi
1. Avocado	-	Ijo Bundar	Ijo Panjang	Ijo Bundar, Ijo Panjang
2. Banana	-	-	Cavendish	-
3. Duku	-	Palembang	Palembang	-
4. Durian	Kani, Otong	Otong, Hepi Matahari	Otong	-
5. Mango	-	Arumanis 143, Manalage 69	Arumanis 143, Manalage 69	Arumanis 143
6. Mangosteen	Kaligesing	Kaligesing	-	Kaligesing
7. Marquisa	Asam Brastagi	-	-	Malino
8. Rambutan	Binjai	-	-	Binjai
9. Salak	Padang Sidempuang	Ngtumut	Suwaru, Pondoh	-

Source : JICA Study Team

Table A-5-3 Annual Requirements of Fruit Seedlings

Unit : per 500 ha

Fruit	Plant Density (tree/ha)	1st Year New (10%) (tree)	2nd Year New (40%) (tree)	2nd Year Supple. (20%) (tree)	3rd Year New (50%) (tree)	3rd Year Supple. (20%) (tree)	4th Year Supple. (20%) (tree)	Total (tree)
Avacado	100	5,000	20,000	1,000	25,000	4,000	5,000	60,000
Banana	1,000	50,000	200,000	10,000	250,000	40,000	50,000	600,000
Duku	100	5,000	20,000	1,000	25,000	4,000	5,000	60,000
Durian	100	5,000	20,000	1,000	25,000	4,000	5,000	60,000
Mango	100	5,000	20,000	1,000	25,000	4,000	5,000	60,000
Mangosteen	100	5,000	20,000	1,000	25,000	4,000	5,000	60,000
Marquisa	500	25,000	100,000	5,000	125,000	20,000	25,000	300,000
Rambutan	100	5,000	20,000	1,000	25,000	4,000	5,000	60,000
Salak	2,000	100,000	400,000	20,000	500,000	80,000	100,000	1,200,000

Note : Supplemental Plantings require 20% of total trees planted in previous year.

Source : JICA Study Team

Appendix B

Farm Management

APPENDIX B
FARM MANAGEMENT

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APPENDIX B
FARM MANAGEMENT

1. INTRODUCTION

Fruits in general contain considerable quantities of 6 to 30% carbohydrate, less than 2% protein, less than 1% fat, 28 to 130 kilocalorie value as well as important vitamins and minerals resource to meet the nutritional requirement for human being. It can be processed into a variety of fruit products; i.e., dried fruit, fruit in syrup, jam, marmalade, jelly, juice, wine, and so on. All of these are supplied to the people as all year round products of the fruit processing industry.

Fruit trees may be used for creating green belts round cities and industrial centers, for developing windbreaks and for reclaiming gully-ridden land. Fruit trees are healthy builders that can reduce winds, improve the composition of the air and beautify recreation centers. Almost all the fruit trees are honey plants.

The fruit trees in Indonesia are generally grown substantially under the home yard, in both humid and dry tropical climates. About 12 kinds of fruit dominate over production, but without exception the yield level is low and the quality is poor. This surely causes difficulty in marketing fruits. The poor local market facilities, low grade infrastructures and time consuming transportation are major constraints for orchard development and fruit marketing.

In some areas such fruit commodities as citrus, banana, mango, durian, rambutan and salak have been grown and well managed. These fruits have stable local marketing channels and are also exported to Southeast Asia, Middle East and European countries. Banana accounting for over 33% of the total fruit production is the most important fruit in the country. In 1996, the total fruit production was 11,468,000 tons for harvested area of 667,000 ha. The average yield was 17.21 ton/ha.

2. AGRO-ECOLOGICAL REQUIREMENTS OF TARGET FRUITS

Fruit trees require specific agro-ecological conditions favourable for their growth and longevity. Such required conditions can be categorized into the following four factors:

- Edaphic factor (soil and water resources);
- Climatic factor (rainfall, light, temperature, humidity, wind and evaporation);
- Physiographic factor (topography and altitude); and
- Biotic factor

2.1 Edaphic Factor

Soil and water resources are the major edaphic factors. Soil is an important factor for growth of the plants. It provides stability, nutrients, water and oxygen for root growth. Soil productivity to support plant growth is indicated by its fertility and physical conditions. Soil fertility is defined as the nutrient supply capacity of the soil, namely the availability and contents of plant nutrients. Soil capacity of absorbing and supplying the nutrient is determined by soil reaction or soil pH. The very acid soil (below pH 4) and very alkaline soil (above pH 100 will disturb and damage growth of roots. Most favorable value for all fruit trees is about pH 6 so that all nutrients are easily absorbed. Soil reaction below pH 5 needs to be improved by applying lime. The maintenance of soil fertility is concerned with adjusting the current supply of available nutrient to optimum levels for economic crop production. The nutrients consumed may be supplemented by fertilizers and manure.

Physical conditions of the soil related to soil structure and texture have a direct effect on water holding capacity and aeration of the soil, both of which influence root growth as well as soil microorganisms enabling fruit trees to absorb available nutrients in organic matter. The physical conditions of soil largely depend on the amount of organic matter. The soil types in Indonesia and those characteristics are summarized in Table B-2-1.

The rain is the most well known source of water for plant growth. If the rain falls all year round, water will be always available. Only the excessive water, which soaked the roots, will be harmful. This water has to be removed by making drainage facilities. If the rainfall is very limited, the water has to be supplied through utilization of water resources such as river, lake and groundwater or provision of irrigation facilities.

2.2 Climatic Factor

Fruit commodities grown commercially are determined firstly by climatic factors. Those are water, light, heat, humidity, wind velocity and evaporation. Water is an essential constituent of living plants; leaf and young shoot, root and fruit contain 50 to 70%, 60 to 85% and more than 85% of water, respectively. Water is the solvent and transportation medium for all plants; it becomes a compound with carbon dioxide in the formation of sugar in photosynthesis; it becomes a compound with starch in the formation of sugar in respiration and maintains turgor in all living cells.

Light is necessary for photosynthesis, growth and development of plants. In the photosynthetic process light energy is necessary for the union of carbon dioxide and water in the formation of carbohydrates. The light energy comes from the sun. The greater the amount of energy is available with other conditions favorable, the greater will be the rate of photosynthesis. In other words, with other factors in abundant supply, increases in light intensity make for increases in the rate of photosynthesis.

The entire visible spectrum is necessary for plant growth. The light intensity is estimated with the number of hours of bright sunlight, regulate the formation and ripening of fruit. Fruit trees in general need a lot of light and must be grown in sunny climate. Exception is found for salak and duku, both of which require permanent shade. Avocado, banana, durian, lanzon, mangosteen, marquisa, rambutan and salak need 40-80% of sunlight, while mango needs 50-80% of sunlight.

Heat plays an important role in the growth of fruit trees. All of the fundamental processes of the fruit tree; i.e., photosynthesis, respiration, water absorption and transpiration, cell division, cell enlargement, and cell differentiation, are regulated by heat. The optimum temperature will create the optimum condition for taking place the whole fundamental living processes. The heat requirement of each fruit tree is different. Mango needs much heat. The fruit trees, which always be in optimum temperature, will produce heavy fruits and long physiological life.

Air contains a number of mix gases and other particles such as ash and so on. Two gases needed by the fruit trees are:

- Carbon dioxide which is used in photosynthesis in the formation of sugar; and
- Oxygen which is used by leaves and roots in the respiration process.

Carbon dioxide and oxygen contents are relatively constant in air, but not in the soil. In heavy or poor aeration soil the fruit tree roots need favorable water and air contents to guarantee the roots with favorable oxygen supply. If not absorbing the minerals, the adventitious root growth will be disturbed. Fruit tree root system is very susceptible to the lack of soil oxygen content.

Wind is also an important factor in fruit growing. Good growth and fruiting will take place if the wind blows slow and continuously. With strong and dry wind, flowers and fruits will be

dropped, and bees will not feel up to fly around. Once the flower nectar and stigma get dry, there is no more possibility for their flower pollination and fruit setting.

Wind velocity of 16 to 24 km/hr will cause reduction of pollination and insects activity. Wind velocity of 24 to 32 km/hr will have an effect on mechanical damage to plants. To fight strong winds, provision of shelter belts and windbreaks is required.

The fruit tree roots absorb water from the soil. Some part of this water, through transpiration process of the fruit tree, escapes to the atmosphere as vapor through the leaves and stem. This process is called "transpiration" which mainly during the daytime. Some part of water on the leaves and stem escapes as vapor to the atmosphere during the day. This process is called "vaporation". The combination of two processes is called "vapotranspiration".

The ecological requirement of the Indonesian fruit trees is determined by Dr. G.J.A. Terra using Schmidt Fergusson method. While, to determined wet and dry months for the fruit tree ecology requirement, Mohr method is used; wet month for more than 100 mm and dry moth for less than 60 mm of rainfall.

Schmidt and Fergusson used an equation between the number of dry month average in 30 years and the number of wet moth average in 30 years. The equation is:

$$Q = \frac{\text{number of dry month average}}{\text{number of wet month average}} \times 100\%$$

Where, Q = quotient

From this equation they determined the type of the climate as below.

0	≤	Q	<	0.143	A : very wet
0.143	≤	Q	<	0.333	B : wet
0.333	≤	Q	<	0.600	C : rather wet
0.600	≤	Q	<	1.000	D : moderate
1.000	≤	Q	<	1.670	E : rather dry
1.670	≤	Q	<	3.000	F : dry
3.000	≤	Q	<	7.000	G : very dry
7.000	≤	Q			H : extremely dry

Later, Terra determined or grouped the above eight equation to six climate types for the fruit trees as below.

A_1	climate type:	if a year found 12 wet months and 0 dry month
A_2	climate type:	if a year found less than 12 wet months and 0 dry month
B_1	climate type:	if a year found less than 11 wet months and 1 dry month until 9 to 10 wet months and 2 dry months
B_2	climate type:	if a year found less than 9 wet months and 2 dry month until 7 to 8 wet months and 4 dry months
C	climate type:	if a year found less than 7 wet months and 4 dry month until 5 to 6 wet months and 6 dry months
D	climate type:	if a year found less than 5 wet months and 6 dry month until 2 to 4 wet months and 8 dry months

According to terra's classification, water table is determined as below.

a: less than 50 cm
b: between 50 and 150 cm
c: between 150 and 200 cm

d: more than 200 cm

With the above method, Terra determined the ecological requirements by soil type based on climate and elevation. The ecological requirements of the nine target fruits are shown in Table B-2-2. In Indonesia, Terra found a distribution of nine target fruits over various centers as shown in Table B-2-3 and special fruit growing centers in Indonesia are listed up in Table B-2-4.

2.3 Physiographic Factor

Physiographic factor covers topography and altitude of an area.

Topography
It is considered that the best slopes are those having an inclination of 3 to 5, or at any rate not more than 8 to 10 degrees. In undulating land where the slope is below 125, the fruit tree should be planted in the contour system. In case of the steeper slope of is below more than 30%, the terrace should be constructed on the land. It will need labor and more expensive budget, but it will not be environmental friendly.

Altitude.
The altitude influences both temperature and moisture conditions, and also the absorption of radiant energy. According to the Agency for Meteorology and Geophysics (BRAAK), Jakarta, the average temperature at 1 m above sea level is 26.3°C. With increasing elevation above sea level, the temperature for each 100 m will decline about 0.61°C. According to BRAAK, the average temperature (T) in Java can be obtained with the formula of:

$$T = 26°C - 0.61\ H$$

Where, T = the average temperature; and
H = 100 m above sea level.

The atmospheric strata also become less dense with increasing elevation above sea level. The rarefaction of the atmosphere with increasing elevations also serves to increase transpiration rates of tree plants. Radiant energy is less absorbed at high, altitudes compared with low altitudes.

As each elevation has certain climates, the farmer should know about which elevation is suitable for the growth of fruit trees. The elevation below 700 m above sea level belongs to the lowland area, and the upper side is recognized as highland area.

2.4 Biotic Factor

An association of habitats may be helpful, neutral or harmful. There might be symbiotic and parasitic relationship among them. The parasitic one may limit plants growth, present a constant hazard to farming operations and constitute a potential threat to reduce crop yields, if not complete crop failure. Among others harmful biotic factors are fungi, bacteria, virus, mycoplasma, insect, mites and nematodes. Others causing damages are rats, birds, snails, weeds and parasitic plants.

On the other hand, helpful biotic factors are earthworms and pollinator insects. The pollinator insects should be protected during the pest control operation period by selecting pest control timing before or after the blooming season.

3. FARM MANAGEMENT OF THE TARGET FRUITS

Farm management is very dependent on land and micro-climate conditions. These elements are known as limiting factors of farm management. If the land and micro-climate are suitable for fruit growing, the orchard needs only a better management such as proper land preparation, good quality fruit seedlings, appropriate and economical amount of fertilizer, pest and disease control, and so on. However, if the land and micro climate conditions are limitedly suitable, the special attention and care are needed in farm management. If the land is located in the critical upland areas, it usually has very low productivity and is susceptible to erosion. Such land needs to be analyzed carefully in terms of soil fertility compared with nutrient and fertilizer requirements of specific fruits to be developed.

Other than these factors, farmers should play an important role in implementing successfully orchard development in upland areas. The farmers need to improve their knowledge by transforming their traditional way of thinking to a modern, business-minded and market-oriented attitude. They have to be aware that such farm management requires certain agronomic techniques such as watering, pruning, fertilizing, tree shading, and so on.

3.1 Fruit Growing

3.1.1 Avocado

Avocado is considered one of the most nutritious and wholesome fruits. In 1920 to 1930, Indonesia introduced 20 varieties from Central America and United States of America. This introduction of avocado was intended to improve health of people, especially in highland areas. Now avocado trees are grown in the farmers household backyards all over the country.

(1) Adaptability

Avocado grows well even in a hot climate but with well-distributed rainfall. Its soil requirements can hardly be pointed out, but it will not grow on poorly drained area. It is adapted to the elevation ranging from sea level up to 2,800 m above sea level.

In Indonesia, avocado trees grow in areas under wet climate all the year up to 1 to 6 dry months climate. Soil water is the most important factor to grow and develop up to avocado table is well. Avocado plant will grow well if the soil water table is about 2 m depth below the growth of the surface. If the soil water table is deeper, the avocado plant hardly grow.

(2) Race and Variety

Avocado consists of three races; Mexican, Guatemalan and West Indian. Each race has a number of varieties. The characteristics of the race are summarized below.

Mexican race
This race is originated from Mexico, Equador, and Peru highland, each of which has an elevation of 2,400 to 2,800 m above sea level and semi tropical climate. Fat content ranges from 12 to 25 %. Varieties of this race are Puebla, Ganter, Mexicola and Duku.

Guatemalan race
This is originated from Mexico and Central American highland, which have the altitude of 800 to 2,400 m above sea level and subtropical climate. The fat content is around 10 %. The varieties of the race are Dickinson, Taft, Benik, Winslowson and Ryan.

West Indian race
This is originated from Central and South American lowland where the elevation is lower than 800 m above sea level and tropical climate dominates. The variety is very susceptible to the

low temperature. Fat content is 4 to 7%. The varieties of the race are Wilson, Waldin and Butler.

In 1987 the MOA recommended two varieties, long green avocado (alpukat ijo panjang) and round green avocado (alpukat ijo bundar). The former has pyriform shape of 300 to 500 g in weight with yellow color and thick flesh. One tree produces avocado fruits of 40 to 80 kg each year. The latter is of 300 to 400 g in weight with thick, greenish yellow, flesh and dried delicious taste. One tree produces 20 to 60 kg fruits each year. Avocado flower has an interesting characteristic called dichomigamic. The pistils and the stamens mature in different times, and self-pollinating will never happen in the flower. Exceptions happen only in the long green variety. The pistils will be only in function if pollinated through cross-pollination from flower of other type. So the avocado flower may be called dichogamy protogynous flower. Due to the characteristics of flower sex organs, avocado flower can be grouped into two types; i.e., A flower type and B flower type.

A flower type: Flower opens first at 08:00 to 09:00 in the morning. At this time the pistils are maturing, but the stamens are still unmaturing. At the mid day, the flowers are still fresh, however it is closed again as at the beginning. In the afternoon of the next day the flower opens again for the second time. At this second opening, the stamen matures, while the pistils already wilted.

B flowers type: Flower opens firstly in the afternoon or after mid day. At this time the pistils are maturing, but the stamens are still unmaturing. At the sunset the flowers are still fresh, however it is closed again as at the beginning. In the next or third day, the flower opens again for the second time. At this second opening, the stamens are maturing, while the pistils already wilted.

So Avocado growing will be only succeeded if varieties of the both flower types grow together.

(3) Cultural requirement

Avocado can be grown by using budded or grafted plantlets. The best time of planting is at the start of the wet season. The roots of Avocado are extremely sensitive to high salt concentration. The young avocado tree needs enough water. Watering is needed when there is no rain falls. The land should be prepared with good cultivation method.

Planting distance for avocado trees depends on the climate variety, soil fertility and topography; the usual plant density is 100 tree/ha.

Plant growth and development need enough soil nutrients. Fertilization program should be practiced well and continuously. As avocado fertile root system is very poor, inextensive fertilization should be done often and in small quantity treatments. The annual fertilization is split into four times a year as below.

Table B3.1 Annual Fertilization for Avocado

(Unit kg/tree)

Age of Tree	Urea	TSP	KCl
Non bearing tree (1 to 4 year)	0.21 to 0.5	0.5 to 1.0	0.2 to 0.4
Bearing tree (more than 5 years)	2.2 to 3.5	3.2	4.2

Pest and disease are the most important issue in growing avocado. Among the pests, stem borer is very danger, and the diseases are Antracnosa, cancer, root rot and nematode. To prevent the plant from infestation of the fungus, the dried and died twigs are pruned and burnt.

(4) Harvesting

Flowering time starts at the end of dry season in August and September each year. After six months, the fruit can be harvested. Harvesting could be done by climbing the tree, or using ladder or bamboo pole with a small knife and pouch at the end pole.

3.1.2 Banana

Banana is the most widely and commonly grown fruit in the country. The fruit is available in the market throughout the year. Banana has many uses, the ripe fruit is eaten as a dessert. The cooking varieties are cooked for many kinds of cakes, fried or roasted. The other banana products are figs, powder, chips and flour, flakes, and puree. The market for banana has wide potentials, both domestic and overseas.

(1) Variety

Giant Cavendish variety belongs to high-yielding and early bearing variety. The fruit is large, attractive, good keeping quality and very much liked by foreign consumers. The plants are susceptible to Fusarium wilt which is common disease in the country.

(2) Adaptability

Banana native to the warm and moist regions of Southeast Asia requires a monthly rainfall equivalent to 200 mm and no sustained temperature below 15.6°C nor above 35°C for optimum growth. The growth is impaired when precipitation falls below 100 mm.

Region with long dry seasons may be developed into good banana producing areas if irrigation facilities are available and economically feasible. Banana are sensitive to strong winds. Wind velocities of 96 km cause serious blow downs. Deep and friable loams with good drainage and aeration are the best soils for banana. It seem not to be highly sensitive to soil reaction. Flat terrains are generally preferred to rolling lands or hilly areas.

(3) Cultural Requirement

Land preparation depends upon the previous use of the land. This will provide the banana plants with soil of proper tilt. Planting distance depends greatly on the variety, soil fertility, and so on. Dessert bananas are usually spaced by 3.0 x 3.0 m or planting density is 1,000 plant/ha. The size of the hole is 50 x 50 x 50 cm, to each of which 40 kg of farm yard manure are given. The best planting season is the wet season.

Banana is a fast growing plant that yields a heavy crop within a short period. It needs large quantities of readily available nutrients for optimum production. The yearly fertilizing per tree is as below.

Table B3.2 Annual Fertilization for Banana

Age	Manure Once a year (kg/tree)	Urea Every 3 months (g/tree)	TSP Every 6 months (g/tree)	KCl Every 6 months (g/tree)
0	40	50	50	50
1	_	250	100	150
2	_	350	100	250

Desuckering is done every four months. So one plant has a follower and suckers. Irrigation is necessary in areas with long dry season. Some other treatments required are:

- Propping to protect bearing plants from falling over;
- Removal of the male bud; and
- Bagging of bunches.

There are four important insects which attack banana plant in the country; Banana weevil (Cosmopolites sordidus Germer), Banana scab moth (Nacoleia octasema Meyr), Banana rust thrips (Scirtothrips signipennis) and Banana aphid (Pentalonia nigronervosa). The first two are native insects.

There are many diseases that attack banana. The most important one is Vascular Wilt, Panama Disease or Fusarium Wilt (Fusarium oxysporrum f. cubense), and the other is Moko Disease or Bacterial Wilt (Pseudomonas solanacearum E.F. Sm). Both of the diseases already exist in the country. The other are leaf diseases; i.e., Sigatoga or Cercospore Leaf Spot (Mycosphaerella musicola Leach), Black Leaf Streak (Mycosphaerella fijiensis), and Leaf Speckle (Mycosphaerella musae (Speg.) Syd) as damaging as Cercospora Leaf Spot. Fruit diseases from fungal origin cause various fruit blemishes; i.e., Black Pit (Piricularia grisea Sacc), Fruit Spot and Black Tip (Deightoniella torulosa M.B. Ellis), Balck Finger (Botryosphaeria ribis Gross and Dug.), Cigar End (Verticillium theobromae Mason and Hughes).

(4) Harvesting

Banana for local market is used to be cut when the fruits are full, plump, round and light green in color. If shipped at a distance, banana must be harvested while somewhat angular in appearance. In harvesting, two men are needed, a cutter and a helper. The two are assisted by a group of a carriers who will continually carry the bunches to fixed station. All the harvest are brought to a trading shed by the helpers where the bunches are dehanded, classified and displayed to prospective buyers.

3.1.3 Duku

Duku is another popular tropical fruit in the country, but still home garden plant.

(1) Adaptability

Duku is humid tropical plant and grows well in the lowland area up to 650 m above sea level. It will thrive in different kinds of soil, which have effective depth, moist and rich in organic matter. Duku also prefers to grow in the shade area.

Regarding the climate, duku can grow well in the area where the rain falls all the year and the soil water depth has no limitation. Soil drainage should be good. In the area with 7 to less than 12 wet months and 1 to 4 dry months, duku still can grow as long as soil water depth surrounding 2 m below the surface.

(2) Variety

In 1995, the MOA recommended three varieties of duku. These are Palembang duku (variety originated from Batuampar, Ogan Komering Ilir, South Sumatera); Rasuan duku (variety originated from Rasuan, Ogan Komering Ulu, South Sumatera); and Pontianak duku (variety originated from Punggur, West Kalimantan).

(3) Cultural requirement

After land preparation, 20 kg of organic manure is put into each planting hole (0.6 x 0.6 x 0.6 m). Planting distance is 10 x 10 m or planting density is 100 plant/ha. Grafted plant of recommended variety is used. Planting is done at the beginning of wet season. The young tree needs shade.

To have the healthy growth and well fruiting, fertilizers should be applied to the tree. There is no recommended fertilization dosage for duku in the country. Under the Study, it is planned to apply 3 kg/tree of the compound fertilizers of NPK 15:15:15 plus KCl with ratio 2:1. In the dry season, duku tree should be watering with 150 lit/tree/day.

There are not so many pests and diseases that attack duku trees. Among others the pests are:

- Fruit borer (Curculio sp);
- Fruit fly (Dacus sp); and
- Squirril eating duku fruits.

Among the disease, Dye back, because of Gloeosporium, attacks twig and branch of the tree. To prevent the plant from the infestation of the fungus, the dried and died twigs need to be pruned and burnt.

(4) Harvesting

Duku fruits are harvested by climbing when mature. It is in full size and has yellow color. Only mature bunches are harvested. Generally duku fruit will be mature after five months flowering.

3.1.4 Durian

Durian is one of the most famous fruits and highly valued in the tropics. The fruit has a unique exquisite flavor and tonic value. The predominating flavor compounds in fruit pulp are hydrogen sulphide, ethyl hydro-disulphide and several diakyl poly sulphides. Its taste is sweet, aromatic and persistent, and with a touch of garlic. Because of those reason and the big size of the fruit, durian is also called as King of Fruit.

The aril is usually eaten fresh or used for flavoring ice cream, candy, pastry and dessert as well as preserved durian paste (a mixed of the aril with gelatinous rice and sugar or lempog). The aril may be allowed to ferment and eaten as side dish (tempoyak).

(1) Variety

Since 1984 up to 1995, the MOA recommended 26 varieties of durian. Among those varieties, there were two varieties native to Thailand; i.e., Montong and Chanee. Both varieties already had been adapted and naturalized with their Indonesian name, Otong and Kani.

To extend the fruit season and to have high percentage of fruit set, it is better to grow durian more than two varieties in a field.

(2) Adaptability

Durian is classified as a fruit with highly humidity and high temperature requirement. It thrives best in the areas of annual precipitation more than 2,000 mm and optimum temperature ranging from 27 to 32℃. In the country durian grows well up to the altitude of 700 m above sea level, where the rainfall is distributed all the year, up to 9 to 10 wet months and 2 dry months with the soil water table of more than 2 m. It grows best at a deep, loose and fertile soil. Loamy or sandy loamy soil types are the suitable one for growing durians.

(3) Cultural Requirement

Generally, propagation of durian is done by means of grafting, budding and air layering. The grafting method has become more popular in the country, because it may produce faster and certainly seedlings in 6 to 8 months. If fail, the root stock still can be used for budding. Seedlings of cultivated varieties may be used for rootstock.

Durian is highly cross-pollination plant and a cross compatible flower. Therefore, at least two varieties or more need to be planted on alternating row of each varieties or mix planting among the varieties in the field. Plant density is 100 tree/ha. Planting holes of 60 x 60 x 60 cm should be prepared and provided with 40 kg of farmyard manure. The trees are planted at the beginning of wet season. Staking the trees with bamboo sticks and watering are made. If no rain the young plant is watered with 3 to 4 lit/day.

The young plant needs shade. Weeds should be kept down at all times. The plant, in most cases and under local conditions, does not need pruning. When its vegetative growth is much and prevents sunlight penetration in the crown, some of the smaller branches have to be pruned and then painting of the wounds with bordeaux-oil paint is done.

Several pests and diseases affect the production of durian. Among others, the insect and pest are termites, flower and fruit boring, caterpillars, stem boring grub, aphids, soft scale, and woolly aphids. It is said that stem-boring grub becomes a serious pest problem in the country. Among the diseases, some of them already attacked durian plantation in Thailand are die back, twig blight, Antracnosa, powdery mildew, pink disease, nematodes hypocotyl brown, leaf blight caused by Rhizotocnia sp., root rot disease caused by Phytopthora sp., patch cancer by Phytopthora palmivora in Malaysia, and rot by Phythium completens (in Singapore). To prevent the plant from the infestation of the fungus, the dried and dead twigs need to be pruned and burnt. As there is no certain fertilizer application standard in the country, the following dosage is applied. This amount is split into three times.

Table B3.3 Annual Fertilization for Durian

Age of Plant (year)	Manure (kg/tree)	Urea : TSP : KCl (1: 2 : 2) (g/tree)
1	40 kg	80 g/year (3 times a year)
2	8 kg	255 g/year (3 times a year)
3	–	540 g/year (3 times a year)
4	–	600 g/year (3 times a year)
5	–	920 g/year (3 times a year)
More than 6	–	1,000 g/year (3 times a year)

(4) Harvesting

After five years, grafted or budded durian will start flowering. Depend on the variety, the fruit will be harvested after 3 to 5 months from flowering. The fruit is considered mature when it falls naturally to the ground. The variety may be classified as the early matured variety after 90 to 100 days pollinated, medium mature variety after 105 to 115 days pollinated and the late mature variety after 120 to 130 days pollinated.

The first year harvesting is still low; 2 to 10 fruits at the age of 5 to 6 years. At 10 years old the plant will produce 45 to 80 fruits. At 20 years old the harvested fruits will be 100 to 120 pieces. The harvesting fruits will be influenced by many factors, especially climate and the characteristic of the variety. If the fruit will be sold to market in the distance, the fruits should be harvested during the period of hanging on the tree, about 100 days after flowering. Durian tree will produce fruits economically until 40 to 50 years old and after that the yield will decrease.

3.1.5 Mango

Mango is a well-known fruit in the country. It has a valuable nutritional supplement; such as vitamin A which is contained nearly as much as butter, vitamin C varies but generally low and sugar content is around 10 to 12% up to 16 to 18% per fruit. Ripe fruit is eaten for dessert or made for juice, frozen puree or others. Firm and ripe mango may be made as frozen slices or cubes. The green one can be made as chutney, sweet or spiced preserves, pickle and many other delicacies.

(1) Variety

The MOA recommended six mango varieties including four varieties from Java; i.e., Arumanis 143, Manalagi 69, Golek 31 and Gedong Gincu, and two varieties from South Sulawesi; i.e., Masemba and Lanabbu.

(2) Adaptability

Mango belongs to the dry lowland crop and grows well from sea level to 500 m above sea level and in areas having a definite alternation of wet and dry seasons. Mango can grow at temperature from 4 to 43.3℃, but the ideal growth takes place at 23.9 to 26.7℃. A distinct dry season that induces a rest period and extends through the blooming and fruit development stages is essential for high production of quality fruits. If rainfall is well distributed throughout a year, vegetative growth becomes uninterrupted and the mango trees never bear flowers nor fruits; uninterrupted vegetative growth is at the expense of flowering. In choosing areas for a mango orchard or plantation, regions with distinct wet and dry season are considered ideal.

Mango can be grown on a wide range of soil types from light to heavy. However, rich and deep alluvial loam soils with good drainage have always given the best yields. Mango has been grown successfully on soil with a pH range of 5.5 to 7.5.

(3) Cultural Requirement

Land preparation is done during dry season and the field is staked at a distance of 10 x 10 m. Less plowing and harrowing may be done if the land had already been under cultivation. Grafted or budded trees are utilized. Cover crop not only prevents soil erosion but also suppresses the growth of weeds. Further, it will increase organic matters.

Planting hole of 1 x 1 x 1 m is quiet enough and 20 kg of farmyard manure are added to each hole. The best time for planting is the beginning of wet season. If the rains are irregular or wet season is short, some supplementary irrigation will be needed during the initial years. Although the long dry season is ideal for mango area, it is critical period for young and newly-established trees. That is why the young trees should be watered as frequently as needed during the first dry season. Weeds must be kept in check, especially near the stem.

Mango trees respond well to fertilization. Young non-fruit bearing trees are induced to grow rapidly by heavy application of nitrogenous fertilizers, while bearing trees are given more phosphate and potash. The general fertilization for mango in the young stage as below.

Table B3.4 Annual Fertilization for Mango in Young Stage

Age of Plant (year)	Manure (kg/tree)	Urea (g/tree)	TSP (g/tree)	KCL (g/tree)
1	20	200	50	200
2	30	250	100	250
3	40	300	150	300
4	50	400	150	300
5	70	600	300	800
More than 6	+ 45%	+ 45%	+ 45%	+ 45%

If too much vegetative growth and poor fruits set occur, the amount of phosphorus and potash application are raised. If shoot growth is insufficient, the proportion of nitrogen is increased. Pruning to form the tree shape is conducted at one, two and three year old plant. The 1-year-old plant is pruned at 50 to 60 cm from the surface has only one single trunk with three-well placed primary branches. Pruning of each three branches 30-cm from the trunk at two years old has three-well placed secondary branches. The similar pruning will be conducted at three years old plant. Later pruning is conducted only to remove the disease, unproductive, died and dense growth of branches.

There are many pests and diseases that attack mango plants, causing the growth hampered, the plant organs damaged or the plant totally destroyed. The most common pest of mango is the mango hopper (Ideocerus clypealis) which is ver serious during young shoots and blooming season. Fruit fly (Dacus dorsalis) is also the important pest of mango but it is serious only if the fruits are allowed to remain on the trees beyond the green-mature stage. Fruit for export can be rendered free of Fruit fly eggs, maggots or larvae by fumigation using EDB (Ethylene dibromide) at 16 g/m3 for 2 hours at room temperature. Besides Fruit fly, there are some insects that attack mango fruit; i.e., mango fruit borer (Noorda albizonalis), fruit-piercing moths (Othreis fullonia) and giant mango mealy bug (Drosicha stebbingi).

There are many other borers and insects; i.e., mango stem borers (Batocera rufomaculata and Rhytidodera stimulans), mango bark eating caterpillar (Inderbela quadrinonata), mango shoot borer (Clumatia transvera), scale insects, mango psyllids, black fly, mango weevils, leaf cutting weevil, mango shoot gall maker, mango leaf gall makers, termites, and so on which should be taking care their development and infestation. A number of diseases attack almost every part of the plant organs, trunk, branch, twig, leaf, petiole, flower and fruit at all stages of their development from plants in the nursery to the fruits in storage or transit. No organ plants are immune.

The most common diseases of mango in the country are Antracnosa (Colletotrichum gloeosporioides), which attacks young leaves, flowers and fruits. To prevent the plants from the infestation of fungus, countermeasures are:

- Not to cultivate mango in wet areas;
- To manage the orchard with proper cultural requirements;
- To carry out aeration in the nursery;
- To prune and burn the died twigs after harvesting;
- To spray the plants before flowering, during bloom and fruit development stage with fungicides such as Difolatan 4F, Antracol, Benlate, and Dithane M 45; and
- To treat the fruits with hot water dipping of 55°C for 5 minutes before shipping.

Damping off (Rhizoctonia solani) attacks the plants during in the bed of the nursery. Powdery mildew (Erysiphe cichoracearum), Bark disease (Botryodiplodia theobromae), Red-rust (Cephaleuros virescens), Pink disease (Upasia salmonicolor) and root rot (Rigidoporus microporus) should be taken care of their development and infestation.

(4) Harvesting

Grafted or budded trees start bearing after five years. The yield will increase with age and may rise to 300 to 500 fruits in the 10th year and 1,000 to 1,500 fruits at full maturity. The yield of mango trees depend on variety, vigor, age and climate. Mango trees are irregular bearers and production varies from year to year. A heavy cropping year is often followed by one or more years of light harvests. A well managed mango orchards gives as much as 6.2 ton/ha per season.

There are no certain criteria for harvesting from physical, chemical and morphology of fruit condition. The general practice is that picking of fruits starts at the stage where they just begin to change their color. When one or two ripe fruits have dropped from the tree, the rest of fruits can be considered sufficiently mature to permit the whole cop to be harvested at once.

It may be preferable, therefore, that fruit for local markets should be picked when they become soft on the tree. While for distance marketing, they should be picked when still green and firm but only after attaining their full size and maturity. The picking is done by hand. The pickers climb up the tree with cloth bag on their shoulders, pluck individual fruits by hand and put them in bags.

Mango season in the country is from July to November every year. The fruit will be harvested after 75 to 107 days from flowering for Golek, 75 to 85 days for Arumanis and 93 to 107 days for Gedong Gincu. Mango tree could be harvested economically until the age of 40 years.

3.1.6 Mangosteen

Mangosteen is considered the most delicious fruit in the tropics. That is the reason why mangosteen is well known as Queen of Fruit.

(1) Varieties

Mangosteen is originated in Indonesia. Distinct varieties are unknown, although it has been grown for centuries in Southeast Asia. The seed is being an apomictically propagated organ. It is possible that evolutionary process of the mangosteen has stopped and consequently the absence of distinct varieties has happened. The difference in size of fruits, seed and taste of pulp can be attributed to environmental causes. In 1995, the MOA recommended a clone of mangosteen originated from Kaligesing, Central Java that is called Kaligesing variety mangosteen.

(2) Adaptability

Mangosteen belongs to the plants of Asian rainforest zone, and needs humid and equatorial climate with no dry season or only a short one. It will thrive in different kinds of soils which have moisty and rich in organic matter. They also prefer to grow in the shade area.

In the country, mangosteen grows in places up to 800 m above sea level with a wide adaptability to moist deep soil types with good drainage and high organic matter content. Regarding climate, mangosteen can grow well in the area where the rain falls all the year. In the area having less than 7 up to 5 to 6 wet months and 4 up to 6 dry months, mangosteen still can grow as long as soil water depth is about 2 m below the surface of the land.

(3) Cultural requirement

Since mangosteen seed is of apomictic origin, planting from seed will produce tree identical to the parent tree. The problem is to take 8 to 12 years until the first harvest. By grafting method, seedlings will produce the first harvest after 5 years. A major constraint in growing mangosteen

is its very slow growth. Such slow growth is mainly attributed to poor growth of its root system which essentially consists of only the tap root and usually devoid any laterals.

Planting should be done at the beginning of the wet season to assure the humidity necessary to stimulate new root formation. Planting distance is 10 x 10 m or density is 100 plant/ha. For the soil conservation, it is not necessary to plow the soil. After a good clean up (1.2 to 1.5 m in diameter around the planting hole of 0.6 x 0.6 x 0.6 m), the grafted plant is placed at the same depth as it was in its previous container. It is also important to place the soil mixed with 20 kg organic manure carefully around the roots and then watering well. At transplanting, the long and delicate taproot can be adversely damaged with little hope of recuperation. Whatever method of transplanting, it is imperative to save the damage to the tap root an attempt to sustain new growth. Once planted, the tree should be given some shade. To have the healthy, growth and fruiting well, the mangosteen should be fertilized continuously every year since planting in the orchard. There is still no fertilizer recommendation for mangosteen so that the following dosage is set up.

Table B3.5 Annual Fertilization for Mangosteen

Age of tree	Manure (kg/tree)	Urea (g/tree)	TSP (g/tree)	KCl (g/tree)
6 months	20 (as basic fertilization)	120	40	80
1 year	40	240	120	200
2 year	40	240	120	300
3 year	40	240	300	300
4 year	40	400	300	350
5 year	40	600	500	500
6 year henceforth	40	700	500	500

There are few pest and disease that attack the tree. Occasionally, the fruit is attacked by mites that damage the surface and make the fruit unattractive. The physiological gamboge disorder, in which the branches and fruit exude a yellow resin, may include bitterness in the fruit if the arils are infiltrated.

(4) Harvesting

Harvesting of the fruit is done by climbing the tree to pick fruits one by one and put them in the basket or to use bamboo or plastic pole with plastic net. For local market, the fruit harvested at 110 days after flowering (50 to 75% purple red stage) is delivered. For export purposes, the fruit may be harvested at 104 days (purple dotted). The fruit quality is not different with full mature fruit at 120 days or red purple colored.

3.1.7 Marquisa

Marquisa, the purple passion fruit (Passiflora edulis Sims), has a good marketing prospects in the country as well as for export. The crop is entering an important phase in commercial production of the fruit in the country. Domestic consumption of fresh and processed fruits is increasing through the year.

(1) Variety

In 1994, Malino variety was recommended by the MOA. The fruits are globose, green colored when young and greenish violet when mature. The skin is thin (3 to 5 mm), glossy and shining. The aril is juicy colored with golden yellow, sprightly sweet sub acid and nice flavor.

(2) Adaptability

Marquisa belongs to the wet highland crop and grows well between the height of 1,000 m and 2,000 m above sea level. It requires a warm climate with a well-distributed rainfall. Rainfall of 1,200 mm distributed all the year is considered essential for commercial marquisa growing. Light and heat are the other factors required by the plant for its flowering and fruit set. Ensuring the adequate exposure of the shoots by conducting training is an important growing activity for marquisa.

The plant is also sensitive to temperature, growing well between 20 and 30 °C. The soil for marquisa should be deep, well drained, and sandy loams to sandy clay loams.

(3) Cultural Requirement

Land preparation should be well done including well ploughing, harrowing or hand digging and removal of all perennial weeds. The planting holes of 30 x 30 x 30 cm is quite enough and sub-soil is mixed with 20 kg of farmyard manure. Planting distances is 4 x 5 m with plant population of 500 plant/ha.

As a climbing plant, marquisa needs a supporting structures or trellis of 2,0 m high and 1.0 to 1.5 m wide. Planting is carried out at the beginning of the wet season, and if no rain the young plant is watered with 2 to 3 lit/day. The mulch of dry grass, straw or any kind is given surrounding but not attached to the base of each stem.

Weeding should be done regularly. During this activity, care must be taken not to injure the vine. Through the wound, the pathogen will infect the plant. Ensuring the adequate exposure of the shoots, training is an important growing activity for marquisa that is reducing the matting of vines on the trellis.

There is no certainly determination of fertilizer application in the country. According to an experience, 1.6 kg of the mix fertilizers of ZA, DS and ZK with the ratio of 4:3:1 is enough to one marquisa vine per year. The fertilizer is given twice a year in the early and last of wet season together with 20 kg of farmyard manure.

Some pest and insects problem to the vine are: fruit fly (Dacus cucurbitae) which punctures the immature and mature fruits; California Red Scale (Aonidiella aurantii) and Mealybug (Planococcus pasificus) which attack marquisa vines; and Passionvine Mite (Brevipalpus phoenicis) which causes leaf drop, bud failure and stunned growth but never damage to the fruit.

Pest control is an important activity in commercial marquisa production. The pest control has to be carried out for destruction of the pest, but care should be taken to protect bees as pollinating insect. Since the passion fruit requires cross pollination for fruit set, the importance of pollinating agents cannot be overemphasized. Marquisa flowers begin opening about 12:00 noon and close at about 6:00 in the evening. To prevent destruction of pollinating insects during flowering season, spraying is conducted during morning hours.

Some important diseases that attack marquisa vine are Fusarium Wilt (Fusarium oxysporum) and Brown Spot (Alternaria passiflora). Brown Spot causes serious losses. Septoria spot (Septoria passiflora) causes brown spots on the leaves and stems with minute black fruiting bodies. Phytopthora blight (Phytopthora nicotianae) causes blackening and death of new growth defoliation, wilting and collapse of the vine. Scab (Cladosporium herbarium) caused by a fungus forms small circular spots on the fruit with the tissue beneath growing into hard raised scabs. Scab may also occur on the leaves and forms small circular translucent spots which become covered with grey powdery masses of spores.

(4) Harvesting

After six to nine months from planting, the first yield may be harvested. But the maximum harvesting will be reached at two years old. The flowers are produced at the end of wet season, so the fruits will be harvested in dry season.

3.1.8 Rambutan

Rambutan belongs to important fruits and very popular in the country. It is beautiful whether in foliage, flower or fruit. The appearance is somewhat attractive with yellowish red or bright red color. The aril is specific, tough, crispy, sweet and delicious. The sweet and slightly acid are considered as a good flavor. It has also a good nutritive value as a source of ascorbic acid or vitamin C. The Westerns and others people who already know and enjoy lychee fruit, called rambutan as haired lychee. As a tropical fruit, rambutan has a good prospect for export market in sub-tropical countries. The fruit season in the country coincides with winter season in northern part, where there are shortage supply of fruits in each of those countries.

(1) Variety

There are eight prime varieties already recommended by the MOA; i.e., Binjai, Rapiah, Lebak Bulus, Nona, Antalagi, Garuda, Sibatuk Ganal and Sibongkok.

The fruit is produced in terminal clusters with varying shape, that is, from round to oval and covered with soft fleshy spines. Size of fruit varies according to the variety. For most varieties, the color of fruit is either bright crimson yellow or dark red, while some varieties are greenish with shades of orange. The juicy pulp or aril is pearly white and translucent. It is covered with a leathery pericarp. It is sweet and delicious and somewhat acidulous similar to the flavor and taste of grapes. A superior rambutan variety should possess characteristics that satisfy the producers, retailers and consumers. Fruit quality is obviously most important; size of fruit, attractive color and appearance, thick aril (high edible portion), good flavor and taste, aril separation from seed coat, and good texture of the aril. For the farmer, a superior variety is one which gives good performance; high yields, resistance to pests and diseases, adaptability to different environmental conditions, especially rainfall and soil, good fruit bunching habits, uniform ripening, and earliness of fruiting.

(2) Adaptability

Rambutan is strictly a tropical lowland crop. It thrives best in humid and hot regions where the rainfall is well distributed with precipitation ranging from 2,000 to 5,000 mm per annum.

In Indonesia, rambutan grows well up to the altitude of 600 m above sea level and in areas with 12 wet months all the year until 9 wet months and 2 dry months with soil water table of not more than 2 m. Rambutan can be raised in varying type of soil. Good result, however, is obtained when they are planted in a deep loamy soil with good drainage.

(3) Cultural Requirement

Rambutan can be propagated vegetatively by marcotting, grafting or budding. Budding can be done on 8 to 12 months old rootstock, using modified Forkert method. Generally rootstock to be used is rambutan Sinyonya which is an unpeeled or uncommercial variety. The most efficient rootstock is Simacan. Other varieties of Sinyonya and Sitangkwe are good for rootstock. The later has better root system.

A planting hole must be prepared large enough to easily accommodate the root system. Plant density is 100 plant/ha with planting distance of 10 x 10 m. Before planting it is advisable to mix the top soil of the hole with 40 kg of farmyard manure. It is good to provide shade for the

tree until it is established well in the field. If no rain, the young plant should be watered 3 to 4 lit/day.

Cover crop will keep the soil moist and increase its fertility, aside from checking the growth of noxious weeds. Weeds should be kept down at all times in order not to retard the growth of the young trees. In rambutan, like many other tropical fruit trees, very little pruning is practiced.

There are many insects that attack leaves, flowers, fruits and shoots of rambutan plant, but until now no serious problem with the pests.

Rambutan disease incidence in production areas in the country is rare. Probably, Powdery Mildew (Oidium nephelii Hadiwidjaya) is one of the more widespread diseases in the country. The pathogen infects all stage of the growth, particularly young leaves, inflorescences and young fruits. The pathogen, only infected small thin of epidermis of leaves, flowers and fruits, appears as a white-yellow and dusty deposit. Each variety shows different susceptibility to the mildew; Silengkeng is very susceptibility, while Lebakbulus, Sitangkwe and Simacan are moderate or less susceptible. The mildew can be controlled by dusting with sulphur powder or other fungicides such as benomyl or zineb. To prevent the plant from the infestation of the fungus, the dried and died twigs need to be pruned and burnt.

There is no particular fertilizer dosage for rambutan in the country. The following suggestion is commonly given to rambutan cultivation.

Table B3.6 Annual Fertilization for Rambutan

Age of Plant (year)	Manure (kg/tree)	Urea (g/tree)	TSP (g/tree)	KCl (g/tree)
0 to 5	20 to 50	75 to 200	50 to 125	150 to 250
5 to 10	50	250 to 675	125 to 250	300 to 500
More than 10	50	100	50	50

(4) Harvesting

Vegetative seedlings will bear fruits after 2 to 5 years; budded or grafted tree will start fruit bearing after 4 to 5 years and air layering after 2 to 3 years. The yield in initial stage is still low although increasing every year and getting somewhat stabilized in 15 to 20 years old. The fruit yield is still increasing up to 40 years old, afterwards start to decrease. The tree at 50 to 60 years old should be removed and replanted again.

Rambutan flowering starts at the end of dry season, so harvesting will be in the wet season every year. Harvesting is done by means of a pole with a sharp knife to cut the stem of the cluster of fruits. Care should be taken to avoid bruising and cruishing the fruit. One tree produces as much as 200 to 300 kg of fruit per year.

3.1.9 Salak

Salak is a rain forest palm native to Indonesia. It is eaten fresh as a dessert. The fruit has a unique taste, a combination of apple, pineapple and banana. Ripe fruit will be kept for only a few days before they burst open.

(1) Variety

The MOA recommended six prime varieties of Salak; i.e., Nglumut, Enrekang, Pondoh, Swaru, Bali and Gula Pasir.

(2) Adaptability

Salak thrives under humid lowland areas and grows well from sea level to 500 m above sea level. It needs rainfall distribution throughout the year and shade trees. The light requirements is 40 to 70%. In the dryer areas, with 6 dry months, salak plant may tolerate to grow well if soil water table not more than 1.5 m deep.

(3) Cultural Requirement

Young and bear salak plants need heavy shade. Salak plant is dioecious so that both male and female trees must be present in a planting. One male per six to eight females is sufficient to ensure proper pollination and fruit set. Plant density is 2,000 tree/ha with planting distance of 2 x 2.5 m.

Weeding is done only at the initial stages after 6 months planting. Later the canopy soon tends to cover the ground and prevent any weed growth. The dry leaves should be cut as these will induce the growth of the new good leaves. Pruning activities will give good aeration among the trees and push down infestation of the diseases. Pruning will also induce flower formation.

Fertilizers for salak are given twice a year at the beginning and end of the wet season. The general fertilization dosage for each young non-fruit bearing tree is 25 g of urea, 20 g of TSP and 30 g of KCl. For the productive tree, the dosage should be doubled. Farmers in Central Java put fertilize for Pondoh as below.

Table B.3.7 Annual Fertilization for Salak Pondoh

Age of The Plant (year)	Manure (kg/tree)	ZA (g/tree)	TSP (g/tree)	KCL (g/tree)
1	10	75	50	75
2	5	87.5	62.5	37.5
3	6.25	100	75	50
4	7.5	112.5	87.5	62.5
5	8.75	125	100	75
6-10	10	137.5	112.5	87.5

In very humid and poor condition areas, Pink disease (Corticium salmonicolor) causes serious loss of fruits and plants. To prevent the infection of the pathogen by early removal of rot fruits, proper ventilation to lower the humidity among the crop is also important.

(4) Harvesting

After three years, the fruits can be harvested. It takes 7 months after female flowers pollinated. Salak will produce fruits all the year. If the plant can grow in conducive conditions, the heavy fruit season will be twice a year in May and December each year. To produce big and good quality fruits, thinning should be done. First fruit thinning is carried out after 3 months of fruit set, and the second and third fruit thinning is carried out again after 2 and 4 weeks later.

Each salak tree will produce 4 shoots every year. Each shoot will produce 4 bunches and each bunch will produce 15 to 25 fruits. The best time to harvest the fruits is when they are already ripe.

3.2 Pest and Disease Control

Pest and disease incidences will be conducive where temperature and humidity are always high. The life cycles of insect are continuously year around. It means that the presence of the pest

insect and other pathogen can be found anywhere to attack the crops. The constant alertness to prevent crops should be taken care by the farmer.

If pests and diseases do not appear, it may be due to the ecosystem relatively stable by chance. In such ecosystem, the whole members of a habitat, the pest and their predators, and the whole living organism are integrated solidly in balance. But when one time the ecosystem suddenly changes because climate factor or crop population becomes different or alter, pests and diseases might be developed explosively. Such attacking might be happened suddenly, seriously and fastly, causing big damage and loss.

Major pest and diseases of fruit trees are shown in Table B3.8.

Table B3.8 Major Pest and Disease of Fruit Trees

Commodity	Pest	Disease
1. Avocado	Stem borer	Antracnosa Scab Botryos phaeria fruit rot Phytopthora stem cancer Phytopthora root rot
2. Banana	Banana weevil Banana scabmoth	Bacterial wilt Fusarium wilt Bunchy top virus Cercospora leaf spot
3. Duku	Fruit fly Fruit borer	Dye back gloeosporium
4. Durian	Stem borer Fruit borer Squirrel	Phytopthora root rot Phythium root rot Patch cancer
5. Mango	Mango hoppers Mango weevil Fruit fly Stem borer	Antracnose Powdery mildew Bark disease Pink disease
6. Mangosteen	Mite	Stem cancer Physiological gamboge disorder
7. Marquisa	Fruit fly Mite California red scale Mealy bug	Fusarium wilt Brown spot Fruit scab
8. Rambutan	Leaf cartepillars	Powdery mildew
9. Salak	Weevils	Pink disease

3.3 Intercropping and Cover Cropping

(1) Intercroping

During young plant stage, spaces among fruits trees might be preferably planted with the intercropping plants, such as corn, peanut, cassava, and so on. These crop have two main important roles, supporting annual farm cash income and protecting land surface erosion from the rain drops. If possible to have more protection to the soil, the whole cultivated surface land should be covered all the year with the intercropping plants or afterwards followed with the cover cropping planting. Besides, this operation will produce raw materials for mulching or compost processing purposes.

Taking into account planting distance of each target fruit, the following intercropping systems can be practiced according to the type of annual crops:

- Peanut (plant distance 10 x 40 cm);
- Maize (plant distance 50 x 100 cm); and
- Cassava (plant distance 100 x 250 cm).

In marquisa (plant distance 2.0 x 5.0 m) and salak (plant distance 2.0 x 2.5 m) orchards, intercropping density is similar as follows :

- Peanut (plant distance 10 x 40 cm); and
- Maize (plant distance 50 x 100 cm).

(2) Cover Cropping

Cover crop can protect soil surface erosion from the rain drops. Also, it will produce raw materials for mulching and green or organic manure. That is the reason why the cover cropping plants are always used to be maintaining soil fertility and productivity in orchard, especially on marginal and sensitive soil areas.

Among cover crops, recommendable ones are Calopogonium muconoides, Centrosema pubescens, Mimosa invisa, Lantana camara, Crotataria anegyroides, Thephrosia candida and many other species.

(3) Organic Manure

Soil organic matter may improve physics and structure, permeability and porosity, water holding capacity, and organic matter content of the soil. Application of organic manure has an important role in establishing productive orchard. It will assure optimum growth and development to each of the target fruits. That is the reason why organic matter application is a prerequisite. In certain proposed sites, it may be difficult to get organic or farmyard manure. To solve such problem, it may be effective to use the following:

- Farm yard manure if it is available;
- Cover cropping planting in each fruit orchards;
- Waste harvested intercropping plants as raw materials for compost; and
- Additives bio-chemical compost processing.

4. FRUIT PRODUCTION

4.1 Traditional and Indigenous Agro-Forestry System

Fruit growing system in Indonesia is identically related to the traditional and indigenous agro-forestry system, consisting of the home garden, annual crop field, mixed crop field and wood forest. The home garden or "*Pekarangan*" is generally planted with many kinds of plants, annual and perennial, including many kinds of leaf, fruit and root vegetables (source of vitamin), taro, sweet potato, cassava, banana and corn (source of carbohydrate), various spice and medical plants, many kinds of fruit trees, and poultry and fishpond (source of protein). The home garden is located within the village compound. Harvests of "*Pekarangan*" are used as daily consumption and for sale. The fruits trees are regarded as an annual income source instead of home consumption.

The annual crop field "*Tegalan*" is located outside the village compound, planted with annual crops (primarily rice, cassava, corn and various bean crops) in middle elevation and vegetables in higher elevation. It is enclosed by bananas or other trees. The mixed crop field "*Kebun campuran*" is also at the outside compound, planted with perennial crops, mostly estate crops,

under which annual crops are cultivated. The wood forest "*Kebun*" or "*Talun*" has trees planted and spontaneously grown in the outside of compound, sometimes including perennial crops.

Even small scale holding, the farmland in general consists of "*Sawah, Tegalan* and *Pekarangan*". The first two constitute main farm activities giving more attention, labor and budget. The last one is only a side line farm activity. These activities have effects on each other. Outputs or even side products and waste of a particular activities may enter as inputs into the other activities or these may compete for the application of the limited resources to each farm activity.

Climate and soil are determinative factors in selecting a site for orchard development. An area with available water all the year (rainfall, soil water or irrigation), lower elevation below 700 m above sea level (related to the average annual temperature) or good soil physic type (good soil drainage and aeration) can be expected to have a big potential for orchard development. Existence of big cities and towns is also another important factor to encourage farmers to participate in orchard development by means of fruit market promotion. While, an area more than 1,000 m above sea level, coupled with long dry season or poor drainage condition has less orchard development potential.

These facts mentioned above reveal that orchard development for increasing small landholding farmers income could be carried out at "*Tegalan*". Aiming to motivate the farmers to reach their own goal, incentives need to be given to them including public supports to initial development and extension activities.

4.2 Agro-ecological Condition of the Study Area

The Study Area covers four Provinces; North Sumatra, West Java, East Java and South Sulawesi, each of which has agricultural land of 4,201,705 ha (73% to Indonesia's total), 3,69,958 ha (5.8% to Indonesia's total), 3,198,775 ha (5.5% to Indonesia's total) and 3,043,101 ha (5.3% to Indonesia's total), respectively.

The target tropical fruits in the Study Area are composed of nine fruit crops; i.e., avocado, banana, duku, durian, mango, mangosteen, marquisa, rambutan and salak. The agro-ecological condition of the Study Area is summarized below.

(1) North Sumatra

The agro-ecological condition for fruit tree growing is generally favourable in all the Districts of the Province. In maintaining the growth of fruit trees, attention should be paid to soil type, especially Yellow-red Podsolic Soils. In Langkat, drainage improvement is required for orchard development. The agro-ecological condition of each District shown in Table B-4-1.

(2) West Java

There exist no obstructions in the agro-ecological condition to grow fruit trees. However, special attention is required for steep slope sites in Bogor, Bandung and Purwakarta from the viewpoint land conservation. The Agro-ecological condition of each District is shown in Table B-4-2.

(3) East Java

The agro-ecological condition in Pasuruan and Jombang is somewhat difficult, too dry to grow the target fruit trees. During the dry season, those sites need to ensure water resources. Steep slope is also an important factor such as the sites in Jombang and Trenggalek. The agro-ecological condition of each District is shown in Table B-4-3.

(4) South Sulawesi

The agro-ecological condition in South Sulawesi reveals that climate in Sidenreng Rappang with 6 wet months and 2 dry months and Wajo with 8 wet months and 2 dry months is somewhat less dry for mango. During the dry season mango in Maros, Bone and Majene and rambutan in Barru need watering. The agro-ecological condition of each District is shown in Table B-4-4.

4.3 Farm Management Calender

In securing the optimum growth of target fruits throughout the year, the standard farm management operations should be practiced. Farm management calendars for the target fruits are set up as shown in Tables B-4-5 to B-4-13. Farm labor and annual farm input requirements for each target fruit are estimated as shown in Tables B-4-14 and B-4-15, respectively.

4.4 Anticipated Yield

Peak fruit season in the Study Area is shown in Figure B-4-1. Through analysis on the present yield levels of target fruits in each Province by referring to statistical data and taking into consideration the optimum fertilizer dosage to be practiced, the annual target yield is anticipated as shown in Table B-4-16. The yield at the peak production stage is summarized in Table B4.1. In this Study, however, no attention is paid to yield differences according to agro-ecological conditions.

Table B4.1 Anticipated Fruit Yield at Peak Production Stage

Commodity	Anticipated Yield		Peak Year After Planting
	(kg/tree)	(ton/ha)	(year)
1. Avocado	80.0	8.0	11
2. Banana	20.0	20.0	3
3. Duku	85.0	8.5	11
4. Durian	80.0	8.0	10
5. Mango	135.0	13.5	10
6. Mangosteen	85.0	8.5	11
7. Marquisa	18.0	9.0	2
8. Rambutan	100.0	10.0	10
9. Salak	5.0	10.0	8

4.5 Prospected Production

Based on the anticipated annual yield, the prospect fruit production is estimated as shown in Table B-4-17, taking into account planting schedule in each orchard and post harvest losses. The planting schedule is set to be 50 ha in the first year, 200 ha in the second year and 250 ha in the third year. Losses in the course of harvesting and post harvesting practices and home consumption by farmers are taken into account in estimating marketable quantity of produce, which are 80% of the total production output.