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DIRECTORATE GENERAL OF
FOOD CROPS AND HORTICULTURE
MINISTRY OF AGRICULTURE
GOVERNMENT OF THE REPUBLIC OF INDONESIA

THE STUDY ON THE IMPROVEMENT IN QUALITY OF THE TROPICAL FRUITS

VOLUME II

APPENDIX

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DIRECTORATE GENERAL OF FOOD CROPS AND HORTICULTURE
MINISTRY OF AGRICULTURE THE REPUBLIC OF INDONESIA
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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.

Table B-2-1 Soil Type in Indonesia

No	Type of Soil	Organic matter content	N P K and Ca Content	pH	Solum (m)	Colour	Erosion	Productivity	Texture	Permeability	Water Holding Capacity
1.	Podzol (Podzolic) • Red Podzol • Red Brown Podzol • Yellow Red Podzol • Yellow Podzol	Less 10%	Low	3.5-5	1-2.0	Red to Yellow	High	Low to Moderate	Sandy Loam to Clay Loam	Moderate to Slow	lack
2.	Mediterranean • Red Mediterranean • Brown Mediterranean • Yellow Mediterranean	Less 3%	Moderate	6-7.5	1-2.0	Brown to Red	Moderate to High	Moderate to High	Loam to Clay	Moderate	Moderate
3.	Grumusol • Gray Grumusol • Black Grumusol	1-3%	Poor to Moderate	6-8.0	1-2.0	Gray to Black	High	Low to Moderate	Clay Loam to Clay	Slow	Good
4.	Laterite • Red Laterite • Red Brown Laterite • Yellow Brown Laterite • Brown Laterite	3-10%	Poor to Moderate	4.5-6.5	1.5-10	Red, Brown to Yellow	Low	Moderate to High	Clay	Fast	Good
5.	Regosol • Gray Regosol • Brown Regosol	Poor	Poor	4.5-7.3	Various	Gray to Brown or Yellowish Brown	High	Low to High	Sand to Silt Loam	Easy	lack
6.	Alluvial • Gray Alluvial • Brown Alluvial	Poor	Relative High	4.5-6.0	Various	Gray to Black	High	Low to High	Clay	Slow	
7.	Andosol	10-30%	Moderate to High	5-7.0	1-2.0	Black, Gray to dark Brown	High	Moderate to High	Silt, Silt Loam to Loam	Fast	Good
8.	Rezensi	4-10%	Low	Acid and 6.0-8.0	0.5-1.0	Gray to Black	High	Moderate	Clay and Sandy	Moderate to Slow	Good
9.	Lithosol	None	Varied	Varied	Less than 0.5	Varied	High	Low	Sandy	Varied	
10.	Gray Hidromorphic	Moderate	Low	4.5-6.0	0.5-1.0	Yellowish Gra	High	Low to Moderate	Clay to Loamy Clay	Slow	Good
11.	Planosol	Low	Low	Acid to 6.0-7.5	Less than 1.0	Gray	High	Low	Clay	Slow	Good
12.	Low humus gley	Low	Low to Moderate	Acid	Less than 0.5	Dark Gray to Black		Low	Silty Clay to Silt	Slow	
13.	Humus gley	High	Low to Moderate	Acid	Less than 0.5	Black		Low	Silt		
14.	Organosol (peat soil)	more 20% more 20%	Low	Acid (3.5-4.0)		Brownish Black			Varied Sandy Clay		

Source: Subagyo (1970)

Table B-2-2 Agro-ecological Requirements of Target Fruits

Target Fruit	Altitude (m)	Climate Type*				
		A1-A2	B1	B2	C	D
		Soil Water **				
1. Avocado	0 to 1,500	bcd	bc	bc	bc	-
2. Banana	0 to 1,000	abcd	abc	abc	ab	-
3. Duku	0 to 650	abcd	abc	abc	-	-
4. Durian	0 to 700	bcd	bcd	-	-	-
5. Mango	0 to 500	-	-	abcd	abc	abc
6. Mangosteen	0 to 800	abcd	ab	ab	ab	-
7. Marquisa	1,000	bcd	bc	bc	-	-
8. Rambutan	0 to 600	bcd	bcd	bcd	-	-
9. Salak	0 to 500	abcd	abc	abc	ab	-

Source: Kaslan Tohir

* Climate Type:

A1 type: 12 wet months and 0 dry month
A2 type: less than 12 months and 0 dry month
B1 type: 9 to 10 wet months and 1 to 2 dry month
B2 type: 7 to 8 wet months and 2 to 4 dry month
C type: 5 to 6 wet months and 6 dry month
D type: 3 to 4 wet months and 6 to 8 dry months

** Soil Water:

a : soil water table less than 50 cm
b : soil water table between 50 to 150 cm
c : soil water table between 150 to 200 cm
d : soil water table more than 200 cm

Table B-2-3 Distribution of Target Fruits over Various Centres (1/2)

Region and Type of Soil as far as known	Height above sea level (m)	Climate			Target Fruits								
		Number of wet & dry months	Average length of wet & dry periode in months	Quotient	Avocado	Banana	Durian	Lanzon	Mango	angostee	Marquisa	Rambuta	Salak
Bogor, West Java (lat)	266	12 - 0	11,5 - 0.3	2	A	B	D	L	Ma	M	-	R	S
Muara Enim, Palembang (lat)	15	12 - 0	10,8 - 0,6	6	-	-	D	-	-	-	-	R	-
Binjai, North Sumatra (lat)	28	12 - 0	10,3 - 0,7	7	-	B	D	-	-	-	-	R***	-
Lahat, Palembang (lat)	100	12 - 0	10,3 - 1,1	10	-	-	D	-	-	-	-	R	-
Payakumbuh, West Sumatra (lat)	512	12 - 0	9,3 - 1,1	12	-	B	D	-	-	-	-	R	S
Depok, West Java (lat)	95	12 - 0	9,9 - 1,0	10	A	B	D	L***	-	M	-	R	S
Wanayasa, West Java (lat)	650	12 - 0	9,8 - 1,1	11	A	B	D	L	-	M	-	R	-
Cipeter, West Java (lat)	565	12 - 0	9,3 - 1,1	12	A	B	D	L	-	M	-	R	S
Kandangan, South Kalimantan (lat)	20	12 - 0	9,4 - 1,3	14	-	-	D	-	-	M	-	R	-
Lho'nga, Aceh (lat)	0	12 - 0	8,7 - 1,3	15	-	-	D	-	-	M	-	R***	-
Kayuagung, Palembang (lat)	10	9 - 0	8,6 - 1,8	20	-	-	D	-	-	-	-	R	-
Purbolinggo, Central Java (lat)	42	10 - 0	9,1 - 1,8	20	-	B	D	L	-	M	-	R	-
Sukabumi, West Java (lat)	600	8 - 0	8,9 - 1,9	20	A	B***	D	L	-	M	-	R	S
Purwakarta, West Java (lat)	82	11 - 0	9,1 - 2,0	22	A	B	D	L	-	M	-	R	S
Tanjung Raya, Palembang (lat)	8	12 - 0	8,5 - 1,9	22	-	-	D	-	-	-	-	R	-
Bangli, Bali (lat)	500	10 - 0	8,5 - 2,0	23	-	B	-	-	-	-	-	-	S
Watulimo, East Java (?)	295	10 - 0	9,2 - 2,2	24	-	-	D	-	-	M	-	-	-
Moga, Central Java (lat)	436	10 - 0	9,0 - 2,3	24	A	B	D	L	-	M	-	-	-
Ciamis, West Java (lat)	238	9 - 0	8,9 - 2,2	25	A	B	D	L	-	M	-	R	S
Bandar, Central Java (lat)	408	10 - 0	9,1 - 2,3	25	-	B	D	-	-	-	-	R	-
Serang, West Java (lat)	25	9 - 1	7,5 - 2,1	28	A	B	D	L	-	M	-	R	S
Jati, East Java (?)	88	9 - 0	8,1 - 2,5	31	-	-	-	-	-	M	-	-	-
Sumedang, West Java (lat)	457	9 - 1	8,3 - 2,7	32	A	B	D	L	-	M	-	R	-
Tempel, Central Java (lat)	500	9 - 0	8,7 - 2,8	32	-	B	D	-	-	-	-	R	S***
Banjar, West Java (lat)	40	9 - 1	8.4 - 2.8	33	A	B	D	L	-	M	-	R	S
Besuki, East Java (?)	87	10 - 1	7.4 - 2.5	33	-	-	-	-	-	M	-	-	-
Ambarawa, Central Java (lat)	514	9 - 0	8.2 - 2.0	34	A	B	D	-	-	-	-	R	-
Indrapuri, Aceh (?)	0	10 - 0	7.5 - 2.6	35	-	-	D	-	-	-	-	R	-
Kaliwiro, Central Java (lat)	400	10 - 0	8.3 - 2.9	35	-	B	D	L	-	M	-	R	-
Kampak, East Java (?)	120	9 - 1	8.3 - 3.0	36	-	-	-	-	-	M	-	-	-
Temuguruh, East Java (?)	192	9 - 3	8.0 - 3.3	37	A	B***	D	-	-	-	-	R	-
Bumiayu, West Java (lat)	152	9 - 1	8.3 - 3.1	37	A	B	D	L	-	-	-	R	S
Kaliwungu, Central Java (lat)	4	9 - 3	7.8 - 3.0	39	-	B	D	-	-	-	-	-	-

Resources : Terra, GJA (1952); Some Ecological Requireme

* No extreme dry months; irregular, misty climate

** Irrigated for mangosteen and lanzon.
Regular culture proved to be impossible under local conditions.

*** Special growing center

Table B-2-3 Distribution of Target Fruits over Various Centres (2/2)

Region and Type of Soil as far as known	Height above sea level (m)	Climate			Target Fruits								
		Number of wet & dry months	Average length of wet & dry periode in months	Quotient	Avocado	Banana	Durian	Lanzon	Mango	Mangostee	Marquisa	Rambutan	Salak
Muntilan, Central Java (lat)	359	9 - 3	8.3 - 3.2	39	A	B	D	L	-	-	-	R	S
Bawen, Central Java (lat)	547	10 - 2	6.7 - 2.7	40	A	-	D	L	-	-	-	R	-
Jambu, East Java (?)	83	9 - 2	7.7 - 3.2	41	-	-	D	-	-	-	-	R	-
Pasar Minggu, Jakarta (lat)	35	10 - 1	7.9 - 3.2	41	A	-	D	L	-	M	-	R***	S
Ambal, Central Java (sand)	8	9 - 0	7.8 - 3.5	45	A	B	-	L	-	M	-	R	-
Bangkalan, Madura (mixed)	5	8 - 2	7.6 - 3.6	47	A	B	D	L	-	-	-	R	S***
Kaligesing, Central Java (lat)	100	9 - 3	7.9 - 3.8	48	-	-	D	L	-	M***	-	R	-
Kramatwatu, West Java (lat)	15	8 - 2	6.7 - 3.2	48	-	-	D	L	-	M	-	R	S
Jakarta (lat)	7	8 - 1	6.7 - 3.3	49	A	-	-	-	-	M	-	R	-
Magetan, East Java (lat)	52	8 - 3	7.6 - 3.9	51	-	B	D	-	-	-	-	-	-
Singosari, East Java (lat)	250	7 - 3	7.2 - 3.7	51	A	B	D	L***	-	-	-	R	S
Puspo, East Java (lat)	640	9 - 2	7.5 - 3.8	51	-	-	D***	-	-	-	-	R	-
Magelang, Central Java (lat)	380	9 - 1	7.5 - 3.8	51	A	-	-	L	-	-	-	R	-
Wlingi, East Java (lat)	300	8 - 2	7.5 - 3.9	52	-	-	-	L	-	-	-	-	-
Mendut, East Java (?)	237	9 - 3	7.0 - 3.8	54	A	-	-	L	-	-	-	R	-
Tumpang, Central Java (lat)	600	7 - 3	6.9 - 3.8	55	A	-	-	L	-	-	-	R	-
Blitar, East Java (Lat)	165	7 - 3	6.7 - 4.2	63	A	-	-	L	-	-	-	-	S
Kediri, East Java (?)	62	7 - 3	6.7 - 4.2	63	A	-	-	-	Ma	-	-	-	S
Sawahan, East Java (?)	570	7 - 3	7.1 - 4.6	65	-	-	-	L	Ma	-	-	-	-
Kanigoro, East Java (Marg)	70	7 - 3	6.6 - 4.5	68	-	-	-	-	Ma	-	-	-	S
Plumbon, West Java (Marg)	17	7 - 3	6.4 - 4.4	69	A	-	-	-	Ma***	-	-	-	-
Bangodua, West Java (Marg)	15	7 - 3	6.5 - 4.5	69	-	-	-	-	Ma***	-	-	-	-
Ngunut, East Java (?)	103	7 - 3	6.1 - 4.7	76	-	-	-	L	Ma	-	-	-	-
Kawedan, East Java (?)	220	7 - 3	6.5 - 4.9	76	-	-	-	-	Ma	-	-	-	-
Ujung Pandang, South Sulawesi (Marg)	3	6 - 4	6.0 - 4.8	80	-	-	-	-	Ma	-	-	-	-
Nganjuk, East Java (Marg)	60	7 - 3	6.0 - 5.1	85	-	-	-	-	Ma	-	-	-	-
Pamekasan, Madura (Marg)	15	7 - 3	6.0 - 5.3	88	-	-	-	-	Ma***	-	-	-	-
Winongan, East Java (?) **	10	5 - 4	5.2 - 5.9	113	-	-	-	L	Ma***	-	-	-	-
Pasuruan, East Java (Marg)	5	5 - 4	4.8 - 6.1	125	-	-	-	-	Ma***	-	-	-	-
Probolinggo, East Java (Marg)	10	5 - 4	4.9 - 6.3	129	-	-	-	-	Ma***	-	-	-	-
Banyuwangi, East Java (?) *	5	4 - 1	4.3 - 5.7	132	A	-	-	L	Ma	-	-	-	-
Kupang, Timor (Marg)	2	4 - 6	4.2 - 7.2	171	-	-	-	-	Ma	-	-	-	-

Resources : Terra, GJA (1952); Some Ecological Requirements of Indonesian Fruit Tr

* No extreme dry months; irregular, misty climate

** Irrigated for mangosteen and lanzon.
Regular culture proved to be impossible under local conditions.

*** Special growing center

Table B-2-4 Growing Centers of Six Targert Fruits in Indonesia

Commodity	Region	Province	Elevation (m above sea level)	Number		Average Length		Quotient
				Wet month	Dry month	Wet month	Dry month	
Banana, Gros Michel	Sukabumi	West Java	600	8	0	8.9	1.9	20
Durian	Pupo	East Java	640	9	2	7.5	3.8	51
Mango	Plumbon	West Java	17	7	3	6.4	4.4	69
	Bangoduo	West Java	15	7	3	6.5	4.5	69
	Pamekasan	East Java	15	7	3	6.0	5.3	88
	Wingongan	East Java	10	5	4	5.2	5.9	113
	Pasuruan	East Java	5	5	5	4.8	6.1	125
	Probolinggo	East Java	10	5	6	4.9	6.3	129
Salak	Tempel	Central Java	500	9	0	8.7	2.8	32
	Bangkalan	East Java	5	8	2	7.6	3.6	47
Rambutan	Binjai	North Sumatra	28	12	0	10.3	0.7	7
	Lho'Nga	D.I. Aceh	0	12	0	8.7	1.3	15
	Pasar Minggu	D.K.I. Jakarta	53	10	1	7.9	3.2	41
	Depok	West Java	95	12	0	9.9	1.0	10
	Singosari	East Java	250	7	3	7.2	3.7	51
Mangosteen	Kaligesing	Central Java	100	9	3	7.9	3.8	48

Source: G.J.A.Terra

Table B-4-1 Agro-ecological Condition in North Sumatra Province

District/ sub-District	Fruit	Area (ha)	Elevation (m)	Climate Type* Number of Wet and Dry months	Topography	Slope (%)	Soil Type
Langkat							
Binjai	Rambutan	500	10	A_2 type (10-0)	Plain	0-2	Andosol, Regosol, Alluvial, and Yellow red podzolic
Karo							
Simpang Empat	Marquisa	1,000	800-1000	A_2 type (7-0)	Flat, undulating, rolling, and hilly	15-40	Andosol and Yellow red podzolic
Dairi							
Siempatnempu	Durian	50	100-500	A_2 type (10-0)	Flat, undulating, rolling to hilly	2-30	Yellow red podzolic
Silima Pungga-Pungga	Durian	100					
Siempatnempu Hilir	Durian	100				3-8	
Tiga Lingga	Durian	50	300-700				
Tapanuli Utara							
Garoga	Mangosteen	500	400-700	A_2 type (10-0)	Flat, undulating, rolling to hilly	0-40	Podzolic, Regosol and Lithosol
Garoga	Durian	300				2-40	Alluvial, Latosols, Podzolic, Regosol, and Lithosol
Pahae Julu	Durian	100	400-500				
Pahae Jae	Durian	100				0-40	
Tapanuli Tengah							
Sorkam	Durian	250	100-200	A_1 type (12-0)	Plain	0-2	Yellow red podzolic
Lumut	Durian	250	2-15		Plain to undulating		
Sibabangun	Durian	250					
Tapanuli Selatan							
Batang Natal	Mangosteen	800	400-700	B_2 type (7-2)	Flat, undulating, rolling to hilly	0-25	Alluvial, Latosols, Organosol Regosol, Grumusol, Yellow red podzolic and Lithosol
Siais	Salak	800	300-500				
Padang Sidempuan Barat	Salak	500	300-600				
Padang Sidempuan Timur	Salak	200	250-600				

*** Schmidt and Fergusson method.**

The method divided into 6 types of climates :

1. A_1 type or wet climate, which has 12 wet months and 0 dry months
2. A_2 type or wet enough climate, which has less than 12 wet months and 0 dry months } wet climate without dry month
3. B_1 type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B_2 type or dry wet half climate, which has 7-8 wet months and 2-4 dry months } wet climate with dry season
5. C type or dry enough climate, which has 5-6 wet months and 6 dry months
6. D type or dry climate, which has 3-4 wet months and 6-8 dry months. } dry climate has more than 4 dry months

Topography	Slope	Height
plain	0 - 3 %	0 - 5 m
undulating	3 - 8 %	5 - 15 m
rolling	8 - 15 %	15 - 50 m
hilly	15 - 30 %	50 - 200 m
mountainous	> 30 %	> 200 m

Table B-4-2 Agro-ecological Condition in West Java Province

District/ sub-District	Fruit	Area (ha)	Elevation (m)	Climate Type* Number of Wet and Dry months	Topography	Slope (%)	Soil Type
Bogor Cigudeg	Durian	500	150-700	A_2 type (11-0)	Rolling to hilly	15-30	Latosols
Bandung Cicalengka	Avocado	500	600-1000	B_1 type (11-1)	Flat, rolling to hilly	15-30	Alluvial
Tasikmalaya Cibeureum Manonjaya Kawalu	Salak Salak Salak	500 300 200	200-400	A_1 type (12-0)	Undulating to rolling	15-30	Regosol, and Yellow red podzolic Latosol, Yellow red podzolic, and Regosol
Ciamis Sukadana	Duku	500	100-350	B_2 type (8-2)	Rolling	15-40	Latosols
Sumedang Tomo Ujungjaya	Mango Mango	530 470	25-100 25-100	B_2 type (7-3) B_2 type (7-3)	Flat to undulating	0-15	Grumusol, and alluvial
Purwakarta Wanayasa	Mangosteen	500	400-600	A_1 type (12-0)	Undulating to rolling	15-40	Latosols

*** Schmidt and Fergusson method.**

The method divided into 6 types of climates :

1. A_1 type or wet climate, which has 12 wet months and 0 dry months
2. A_2 type or wet enough climate, which has less than 12 wet months and 0 dry months } wet climate without dry month
3. B_1 type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B_2 type or dry wet half climate, which has 7-8 wet months and 2-4 dry months } wet climate with dry season
5. C type or dry enough climate, which has 5-6 wet months and 6 dry months
6. D type or dry climate, which has 3-4 wet months and 6-8 dry months. } dry climate has more than 4 dry months

Topography	Slope	Height
plain	0 - 3 %	0 - 5 m
undulating	3 - 8 %	5 - 15 m
rolling	8 - 15 %	15 - 50 m
hilly	15 - 30 %	50 - 200 m
mountainous	> 30 %	> 200 m

Table B-4-3 Agro-ecological Condition in East Java Province

District/ sub-District	Fruit	Area (ha)	Elevation (m)	Climate Type* Number of Wet and Dry months	Topography	Slope (%)	Soil Type
Jombang							
Wonosalam	Durian	1,000	600-700	B_2 type (6-4)	Hilly to mountainous	15-40	Latosol
Bareng	Durian	150	400-500	C type (6-5)	Hilly to mountainous	15-40	
Kesamben	Banana	150	23		Plain	0-2	
Sumobito	Banana	100	28		Plain	0-2	
Diwek	Banana	100	60		Plain	0-2	
Tembelang	Banana	150	46		Plain	0-2	
Tulungangung							
Ngatru	Duku	600	25-100	B_2 type (6-3)	Plain	0-2	Alluvial
Kedungwaru	Duku	400	25-100		Plain	0-2	Alluvial
Trenggalek							
Bendungan	Durian	1,000	300-900	A_2 type (9-1)	Hilly to mountainous	15-40	Latosols, Mediterranean, and Lithosol
Malang							
Gondang Legi	Salak	700	300-400	B_2 type (7-4)	Flat to undulating	0-15	Alluvial, Mediterranean and Regosol
Bululawang	Salak	600	100-500		Flat to undulating		
Tajinan	Salak	400	500-1500		Hilly to mountainous		
Pasuruan							
Grati	Mango	375	0-25	D type (5-7)	Plain	0-2	Alluvial, and Mediterranean
Nguling	Mango	375	0-25		Plain	0-2	Alluvial and Mediterranean
Lumajang							
Yosowilangur	Banana	100	10-20	B_2 type (8-3)	Plain	0-2	Regosol
Tekung	Banana	150	20-25		Plain	0-2	Regosol and Gleysol
Kunir	Banana	100	25-30		Plain	0-2	Regosol
Senduro	Banana	150	200-700		Hilly	15-40	Latosol and Regosol
Klakah	Avocado	200	100-200		Hilly	15-40	Mediterranean, Latosol and Regosol
Runuyoso	Avocado	600	200-300		Rolling	2-15	Regosol and Mediterranean
Randuagung	Avocado	100	100-700		Plain	2-15	Latosols
Kudungjajang	Avocado	100	150		Rolling	2-15	

*** Schmidt and Fergusson method.**

The method divided into 6 types of climates :

1. A_1 type or wet climate, which has 12 wet months and 0 dry months
2. A_2 type or wet enough climate, which has less than 12 wet months and 0 dry months } wet climate without dry month
3. B_1 type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B_2 type or dry wet half climate, which has 7-8 wet months and 2-4 dry months } wet climate with dry season
5. C type or dry enough climate, which has 5-6 wet months and 6 dry months
6. D type or dry climate, which has 3-4 wet months and 6-8 dry months. } dry climate has more than 4 dry months

Topography	Slope	Height
plain	0 - 3 %	0 - 5 m
undulating	3 - 8 %	5 - 15 m
rolling	8 - 15 %	15 - 50 m
hilly	15 - 30 %	50 - 200 m
mountainous	> 30 %	> 200 m

Table B-4-4 Agro-ecological Condition in South Sulawesi Province (1/2)

District/ sub-District	Fruit	Area (ha)	Elevation (m)	Climate Type* Number of Wet and Dry months	Topography	Slope (%)	Soil Type
Maros							
Tanralili	Mango	500	50-150	B_2 type (7-4)	Plain to undulating	0-2	Latosols, Mediterranean, Andosol and Lithosol
Gowa							
Tompobulu	Marquisa	1,000	1,000-1,200	B_2 type (8-2)	Hilly to mountainous	20-40	Latosols, and Mediterranean
Tompobulu	Avocado	150					
Tinggi Moncong	Avocado	200					Latosols, Mediterranean, and Yellow red podzolic
Parangloe	Avocado	150					
Bone							
Patinpeng	Mango	500	0-100	B_2 type (7-4)	Plain	0-2	Mediterranean
Wajo							
Pammana/S.Paru	Mango	500	25-50	B_2 type (8-2)	Rolling to hilly	8-30	Mediterranean, Grumusol and Alluvial
Sidenreng Rappang							
Panca Rijang	Mango	500	0-500	B_2 type (6-2)	Plain to rolling	0-15	Alluvial, Regosol and Yellow red podzolic
Soppeng							
Marioiwawo	Avocado	250	60-200	A_1 type (12-0)	Rolling to hilly	0-15	Regosol, Mediterranean and Lithosol
Marioriawa	Avocado	250			Rolling to hilly	16-25	Mediterranean
Enrekang							
Meiwa	Rambutan	500	165	A_1 type (12-0)	Undulating	10-15	Podzolic and Mediterranean (PH 5-6)
Tana Toraja							
Mengkendek	Mangosteen	500	300-800	A_2 type (9-0)	Rolling to hilly	10-15	Yellow red podzolic
Saluputti	Marquisa	2,000	800-1500	B_1 type (9-1)	Hilly to mountainous	15-30	Yellow red podzolic
Rindingallo	Marquisa	1,000					Yellow red podzolic

*** Schmidt and Fergusson method.**

The method divided into 6 types of climates :

1. A_1 type or wet climate, which has 12 wet months and 0 dry months
2. A_2 type or wet enough climate, which has less than 12 wet months and 0 dry months
3. B_1 type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B_2 type or dry wet half climate, which has 7-8 wet months and 2-4 dry months
5. C type or dry enough climate, which has 5-6 wet months and 6 dry months
6. D type or dry climate, which has 3-4 wet months and 6-8 dry months.

} wet climate without dry month

} wet climate with dry season

} dry climate has more than 4 dry

Topography	Slope	Height
plain	0 - 3 %	0 - 5 m
undulating	3 - 8 %	5 - 15 m
rolling	8 - 15 %	15 - 50 m
hilly	15 - 30 %	50 - 200 m
mountainous	> 30 %	> 200 m

Table B-4-4 Agro-ecological Condition in South Sulawesi Province (2/2)

District/ sub-District	Fruit	Area (ha)	Elevation (m)	Climate Type* Number of Wet and Dry months	Topography	Slope (%)	Soil Type
Polewali Mamasa Mambi	Mangosteen	500	400-600	A_1 type (12-0)	Rolling to hilly	10-30	Mediterranean
Majene Sendana	Mango	500	40-50	B_2 type (7-3)	Rolling to hilly	5-30	Mediterranean
Mamuju Kalukku Budong-Budong	Rambutan Rambutan	1,000 1,350	5-500	B_1 type (10-1)	Flat to rolling	10-20	Alluvial, Podzolic and Grumusol (PH 5.5)
Pinrang Patampanua Duampanua	Rambutan Rambutan	300 200	100-150	B_1 type (10-0)	Undulating Rolling	5-15	Alluvial, Regosol and Podzolic Alluvial and Podzolic
Barru Tanete Rilau Tanete Riaja	Rambutan Rambutan	200 500	100-300 400-600	B_2 type (7-3)	Flat to undulating Rolling to hilly	5-10 10-20	Regosol and Alluvial Regosol

*** Schmidt and Fergusson method.**

The method divided into 6 types of climates :

1. A_1 type or wet climate, which has 12 wet months and 0 dry months
2. A_2 type or wet enough climate, which has less than 12 wet months and 0 dry months } wet climate without dry month
3. B_1 type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B_2 type or dry wet half climate, which has 7-8 wet months and 2-4 dry months } wet climate with dry season
5. C type or dry enough climate, which has 5-6 wet months and 6 dry months
6. D type or dry climate, which has 3-4 wet months and 6-8 dry months. } dry climate has more than 4 dry

Topography	Slope	Height
plain	0 - 3 %	0 - 5 m
undulating	3 - 8 %	5 - 15 m
rolling	8 - 15 %	15 - 50 m
hilly	15 - 30 %	50 - 200 m
mountainous	> 30 %	> 200 m

Table B-4-5 Avocado Management Calendar (1/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
A. Non Bearing Tree													
1. Planting													
1.1 Variety: - Ijo panjang (long green) - Ijo bunder (round green)													
1.2 In the beginning of rainy season. Or any time if there is available economically water to be watering								*					
1.3 The young tree needs shading and watering if no rain (3-5 liter/tree/day)													
2. Fertilization													
2.1 Soil conditioner If soil pH below 5.5 adjust with lime at rate of 2.5-3.5 ton/ha; at least each 5 years								*					
2.2 Organic manure (per tree) First application as basic fertilization in planting time; the next will be in rainy season													
2.2.1 40 kg farmyard manure	1							*					
50 kg farmyard manure	2									*			
80 kg farmyard manure	3									*			
90 kg farmyard manure	4									*			
2.3 Inorganic fertilizer (per tree) Twice a year at the beginning and the end of rainy season													
2.3.1 Urea 110 g	1						*						*
150 g	2						*						*
200 g	3						*						*
250 g	4						*						*
2.3.2 TSP 250 g	1						*						*
300 g	2						*						*
400 g	3						*						*
500 g	4						*						*
2.3.3 KCl 100 g	1						*						*
100 g	2						*						*
150 g	3						*						*
200 g	4						*						*
3. Irrigation If no rain the tree needs watering 20-25 liter/tree/day													
3.1 Dry season		←	←	←	←	←	→						
3.2 Rainy season								←	←	←	←	←	→
4. Pest control (each year) Spray with insecticide and fungicide to control/to prevent stem borer, antracnosa, cancer, rootrot etc.				*				*				*	
5. Other operations													
5.1 Soil under the crown has to be chopped				*				*				*	
5.2 Dry and dead twig has to be prunned and burnt				*				*				*	

Table B-4-5 Avocado Management Calendar (2/2)

Operation			Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
B. Bearing Tree															
1. Fertilization															
1.1 Soil conditions															
After 5 years apply second liming at the rated 2.5-3.5 ton/ha in the rainy season			5							*					
			6							*					
			7												
			8												
			9												
			10												
1.2 Organic manure(per tree) Apply once a year in rainy season															
1.2.1	120 kg farmyard manure		5							*					
	145 kg farmyard manure		6							*					
	145 kg farmyard manure		7							*					
	120 kg farmyard manure		8							*					
	120 kg farmyard manure		9							*					
	145 kg farmyard manure		10							*					
1.3 Inorganic fertilizer (per tree) Twice a year, in the beginning and the end of rainy season															
1.3.1	Urea	1110 g	5						*						*
		1250 g	6						*						*
		1350 g	7						*						*
		1500 g	8						*						*
		1600 g	9						*						*
		1700 g	10						*						*
1.3.2	TSP	1600 g	5						*						*
		1600 g	6						*						*
		1600 g	7						*						*
		1600 g	8						*						*
		1600 g	9						*						*
		1600 g	10						*						*
1.3.3	KCl	2000 g	5						*						*
		2000 g	6						*						*
		2000 g	7						*						*
		2000 g	8						*						*
		2000 g	9						*						*
		2000 g	10						*						*
2. Irrigation Similar to the nonbearing plant															
2.1 Dry season				◄					►						
2.2 Rainy season										◄					►
3. Pest control Similar to the non bearing plant						*				*				*	
4. Other operation Similar to the non bearing plant						*				*				*	
5. Harvesting															
5.1 Flowering season, fruit setting and maturity								◄					►		
5.2 Harvesting season														◄	►

Table B-4-6 Banana Management Calendar

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1. Planting													
1.1 Variety: - Cavendish - Horn plantation (Pisang agung)													
1.2 In the beginning of rainy season. Or any time if there is available economically water to be watering								*					
1.3 The young tree needs shading and watering if no rain (3-5 liter/tree/day)													
2. Fertilization													
2.1 Soil conditioner If soil pH below 5.5 adjust with lime at rate of 2.5-3.5 ton/ha; at least each 5 years								*					
2.2 Organic manure (per tree) First application as basic fertilization in planting time; the next will be in rainy season													
2.2.1 40 kg farmyard manure	1							*					
40 kg farmyard manure	2									*			
40 kg farmyard manure	3									*			
2.3 Inorganic fertilizer (per tree) Twice a year at the beginning and the end of rainy season													
2.3.1 Urea 75 g	1								*				*
375 g	2								*				*
500 g	3								*				*
2.3.2 TSP 50 g	1								*				*
100 g	2								*				*
100 g	3								*				*
2.3.3 KCl 50 g	1								*				*
150 g	2								*				*
250 g	3								*				*
3. Irrigation If no rain the tree needs watering 20-25 liter/tree/day													
3.1 Dry season		←						→					
3.2 Rainy season								←					→
4. Pest control (each year)													
4.1 Control for banana weevil, scab moth, rust thrips, aphid and leaf spot				*				*				*	
4.2 Banana weevil cultural control by destroying the sheltering and feeding places (pseudostem)					*				*				*
4.3 Banana cocevil trapping control					*				*				*
5. Other operations													
5.1 Weeding					*				*				*
5.2 Desuckering every 4 months					*				*				*
5.3 Propping serves to protect bearing plants			*				*				*		
5.4 Bagging of bunches			*				*				*		
5.5 Removal of the male bud			*				*				*		
5.6 Waste harvested pseudostem may be collected at other place to be composted and later used as organic matter					*				*				*
6. Harvesting													
6.1 Every 4 months for 3 years in July, November and March	1												
	2				*				*				*
	3				*				*				*
	4				*				*				*

Table B-4-7 Duku Management Calendar (1/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
A. Non Bearing Tree													
1. Planting													
1.1 Variety: - Local - Palembang													
1.2 In the beginning of rainy season. Or any time if there is available economically water to be watering								*					
1.3 The young tree needs shading and watering if no rain (3-5 liter/tree/day)													
2. Fertilization													
2.1 Soil conditioner If soil pH below 5.5 adjust with lime at rate of 2.5-3.5 ton/ha; at least each 5 years								*					
2.2 Organic manure (per tree) First application as basic fertilization in planting time; the next will be in rainy season													
2.2.1 15 kg farmyard manure	1							*					
20 kg farmyard manure	2									*			
30 kg farmyard manure	3									*			
35 kg farmyard manure	4									*			
2.3 Inorganic fertilizer (per tree) Twice a year at the beginning and the end of rainy season													
2.3.1 Urea 50 g	1						*						*
50 g	2						*						*
50 g	3						*						*
75 g	4						*						*
2.3.2 TSP 25 g	1						*						*
25 g	2						*						*
25 g	3						*						*
30 g	4						*						*
2.3.3 KCl 10 g	1						*						*
10 g	2						*						*
10 g	3						*						*
200 g	4						*						*
3. Irrigation If no rain the tree needs watering 20-25 liter/tree/day													
3.1 Dry season		◄	─	─	─	─	─	►					
3.2 Rainy season								◄	─	─	─	─	►
4. Pest control (each year) Spray with insecticide and fungicide to prevent/to control fruit flies and borer, dye back, gloesporium etc.				*				*				*	
5. Other operations													
5.1 Soil under the crown has to be chopped		*				*				*			
5.2 Dry and dead twig has to be prunned and burnt		*				*				*			

Table B-4-7 Duku Management Calendar (2/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
B. Bearing Tree													
1. Fertilization													
1.1 Soil conditioner													
After 5 years apply second liming at the rated 2.5-3.5 ton/ha in the rainy season	5							*					
	6							*					
	7												
	8												
	9												
	10												
1.2 Organic manure (per tree) Apply once a year in rainy season													
1.2.1 40 kg farmyard manure	5							*					
40 kg farmyard manure	6							*					
40 kg farmyard manure	7							*					
40 kg farmyard manure	8							*					
40 kg farmyard manure	9							*					
40 kg farmyard manure	10							*					
1.3 Inorganic fertilizer (per tree) Twice a year, in the beginning and the end of rainy season													
1.3.1 Urea 75 g	5						*						*
75 g	6						*						*
80 g	7						*						*
80 g	8						*						*
90 g	9						*						*
90 g	10						*						*
1.3.2 TSP 30 g	5						*						*
30 g	6						*						*
40 g	7						*						*
40 g	8						*						*
50 g	9						*						*
50 g	10						*						*
1.3.3 KCl 20 g	5						*						*
20 g	6						*						*
30 g	7						*						*
30 g	8						*						*
40 g	9						*						*
40 g	10						*						*
2. Irrigation Similar to the nonbearing plant													
2.1 Dry season		◄						►					
2.2 Rainy season								◄					►
3. Pest control Similar to the non bearing plant				*				*				*	
4. Other operation Similar to the non bearing plant		*				*				*			
5. Harvesting													
5.1 Flowering season, fruit setting and maturity							◄				►		
5.2 Harvesting season		►										◄	

Table B-4-8 Durian Management Calendar (1/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
A. Non Bearing Tree													
1. Planting													
1.1 Variety: - Sitembaga, Sijantung, Otong, Kani, Matahari and Hepi													
1.2 In the beginning of rainy season. Or any time if there is available economically water to be watering								*					
1.3 The young tree needs shading and watering if no rain (3-5 liter/tree/day)													
2. Fertilization													
2.1 Soil conditioner If soil pH below 5.5 adjust with lime at rate of 2.5-3.5 ton/ha; at least each 5 years								*					
2.2 Organic manure (per tree) First application as basic fertilization in planting time; the next will be in rainy season													
2.2.1 40 kg farmyard manure	1							*					
50 kg farmyard manure	2									*			
80 kg farmyard manure	3									*			
90 kg farmyard manure	4									*			
2.3 Inorganic fertilizer (per tree) Twice a year at the beginning and the end of rainy season													
2.3.1 Urea 8 g	1						*						*
30 g	2						*						*
60 g	3						*						*
60 g	4						*						*
2.3.2 TSP 16 g	1						*						*
60 g	2						*						*
120 g	3						*						*
120 g	4						*						*
2.3.3 KCl 16 g	1						*						*
60 g	2						*						*
120 g	3						*						*
120 g	4						*						*
3. Irrigation If no rain the tree needs watering 20-25 liter/tree/day													
3.1 Dry season		◄	─	─	─	─	─	►					
3.2 Rainy season								◄	─	─	─	─	►
4. Pest control (every 4 months) Spray with insecticide and fungicide to prevent/control - caterpillars, aphids, soft scale, flower, fruit and stem borer - leaf blight, die back, twig blight, antracnosa, powdery mildew and pink disease					*			*				*	
5. Other operations													
5.1 Soil under the crown has to be chopped					*			*				*	
5.2 Dry and dead twig has to be prunned and burnt					*			*				*	

Table B-4-8 Durian Management Calendar (2/2)

Operation		Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
B. Bearing Tree														
1. Fertilization														
1.1 Soil conditions														
After 5 years apply second liming at the rated 2.5-3.5 ton/ha in the rainy season		5							*					
		6												
		7												
		8												
		9												
		10												
1.2 Organic manure (per tree) Apply once a year in rainy season														
1.2.1	120 kg farmyard manure	5							*					
	145 kg farmyard manure	6							*					
	145 kg farmyard manure	7							*					
	120 kg farmyard manure	8							*					
	120 kg farmyard manure	9							*					
	145 kg farmyard manure	10							*					
1.3 Inorganic fertilizer (per tree) Twice a year, in the beginning and the end of rainy season														
1.3.1 Urea	60 g	5						*						*
	60 g	6						*						*
	60 g	7						*						*
	60 g	8						*						*
	60 g	9						*						*
	60 g	10						*						*
1.3.2 TSP	120 g	5						*						*
	120 g	6						*						*
	120 g	7						*						*
	120 g	8						*						*
	120 g	9						*						*
	120 g	10						*						*
1.3.3 KCl	120 g	5						*						*
	120 g	6						*						*
	120 g	7						*						*
	120 g	8						*						*
	120 g	9						*						*
	120 g	10						*						*
2. Irrigation Similar to the nonbearing plant														
2.1 Dry season			◄						►					
2.2 Rainy season									◄					►
3. Pest control Similar to the non bearing plant					*				*				*	
4. Other operation Similar to the non bearing plant					*				*				*	
5. Harvesting														
5.1 Flowering season, fruit setting and maturity									◄		►			
5.2 Harvesting season												◄		►

Table B-4-9 Mango Management Calendar (1/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
A. Non Bearing Tree													
1. Planting													
1.1 Variety: Arumanis, Gedonggincu, Manalagi													
1.2 In the beginning of rainy season. Or any time if there is available economically water to be watering								*					
1.3 The young tree needs shading and watering if no rain (3-5 liter/tree/day)													
2. Pruning for tree formation													
2.1 Prune the young of one year old plant 50-60 cm from soil to have only one single trunk with three-well placed primary branches	1							*					
2.2 Prune each three branches 30 cm from the trunk at two years old to have three-well placed secondary branches	2							*					
2.3 The similar pruning will at three years old plant	3							*					
3. Fertilization													
3.1 Soil conditioner If soil pH below 5.5 adjust with lime at rate of 2.5-3.5 ton/ha; at least each 5 years								*					
3.2 Organic manure (per tree) First application as basic fertilization in planting time; the next will be in rainy season													
3.2.1 20 kg farmyard manure	1							*					
30 kg farmyard manure	2									*			
40 kg farmyard manure	3									*			
50 kg farmyard manure	4									*			
3.3 Inorganic fertilizer (per tree) Twice a year at the beginning and the end of rainy season													
3.3.1 Urea 100 g	1						*						*
125 g	2						*						*
150 g	3						*						*
200 g	4						*						*
3.3.2 TSP 25 g	1						*						*
50 g	2						*						*
75 g	3						*						*
75 g	4						*						*
3.3.3 KCl 100 g	1						*						*
125 g	2						*						*
150 g	3						*						*
150 g	4						*						*
4. Irrigation If no rain the tree needs watering 20-25 liter/tree/day													
4.1 Dry season		←	←	←	←	←	→						
4.2 Rainy season								←	←	←	←	←	→
5. Pest control (each year) Spray with insecticide and fungicide to prevent/to control - stem and shoot borers, psyllids, weevil, caterpillar, fermits and scale insects - antracnosa, powdery mildew, red rust, root rot, bark and pink disease borer, antracnosa, cancer, rootrot				*				*				*	

Table B-4-9 Mango Management Calendar (2/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
6. Other operations (every 4 months)													
6.1 Soil under the crown has to be chopped				*				*				*	
6.2 Dry and dead twig has to be prunned and burnt				*				*				*	
B. Bearing Tree													
1. Fertilization													
1.1 Soil conditioner													
After 5 years apply second liming at the rated 2.5-3.5 ton/ha in the rainy season	5							*					
	6												
	7												
	8												
	9												
	10												
1.2 Organic manure (per tree) Apply once a year in rainy season													
1.2.1 70 kg farmyard manure	5							*					
100 kg farmyard manure	6							*					
100 kg farmyard manure	7							*					
100 kg farmyard manure	8							*					
100 kg farmyard manure	9							*					
100 kg farmyard manure	10							*					
1.3 Inorganic fertilizer (per tree) Twice a year, in the beginning and the end of rainy season													
1.3.1 Urea 300 g	5						*						*
435 g	6						*						*
435 g	7						*						*
435 g	8						*						*
435 g	9						*						*
435 g	10						*						*
1.3.2 TSP 150 g	5						*						*
215 g	6						*						*
215 g	7						*						*
215 g	8						*						*
215 g	9						*						*
215 g	10						*						*
1.3.3 KCl 400 g	5						*						*
580 g	6						*						*
580 g	7						*						*
580 g	8						*						*
580 g	9						*						*
580 g	10						*						*
2. Irrigation Similar to the nonbearing plant													
2.1 Dry season		◄						►					
2.2 Rainy season								◄					►
3. Pest control Similar to the non bearing plant		*				*				*			
4. Other operation Similar to the non bearing plant				*				*				*	
5. Harvesting													
5.1 Flowering season, fruit setting and maturity							◄			►			
5.2 Harvesting season								◄			►		

Table B-4-10 Mangosteen Management Calendar (1/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
A. Non Bearing Tree													
1. Planting													
1.1 Variety: - Local - Kaligesing													
1.2 In the beginning of rainy season. Or any time if there is available economically water to be watering								*					
1.3 The young tree needs shading and watering if no rain (3-5 liter/tree/day)													
2. Fertilization													
2.1 Soil conditioner If soil pH below 5.5 adjust with lime at rate of 2.5-3.5 ton/ha; at least each 5 years								*					
2.2 Organic manure (per tree) First application as basic fertilization in planting time; the next will be in rainy season													
2.2.1 40 kg farmyard manure	1							*					
40 kg farmyard manure	2									*			
40 kg farmyard manure	3									*			
40 kg farmyard manure	4									*			
2.3 Inorganic fertilizer (per tree) Twice a year at the beginning and the end of rainy season													
2.3.1 Urea 120 g	1						*						*
120 g	2						*						*
120 g	3						*						*
120 g	4						*						*
2.3.2 TSP 60 g	1						*						*
60 g	2						*						*
150 g	3						*						*
150 g	4						*						*
2.3.3 KCl 100 g	1						*						*
150 g	2						*						*
150 g	3						*						*
175 g	4						*						*
3. Irrigation If no rain the tree needs watering 20-25 liter/tree/day													
3.1 Dry season		◄	—	—	—	—	—	►					
3.2 Rainy season								◄	—	—	—	—	►
4. Pest control (each year) Spray with insecticide to prevent/control mites				*				*				*	
5. Other operations													
5.1 Soil under the crown has to be chopped				*				*				*	
5.2 Dry and dead twig has to be prunned and burnt				*				*				*	

Table B-4-10 Mangosteen Management Calendar (2/2)

Operation			Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
B. Bearing Tree															
1. Fertilization															
1.1 Soil conditioner															
After 5 years apply second			5												
liming at the rated 2.5-3.5			6							*					
ton/ha in the rainy season			7												
			8												
			9												
			10												
1.2 Organic manure (per tree)															
Apply once a year in rainy season															
1.2.1	40 kg farmyard manure		5							*					
	40 kg farmyard manure		6							*					
	40 kg farmyard manure		7							*					
	40 kg farmyard manure		8							*					
	40 kg farmyard manure		9							*					
	40 kg farmyard manure		10							*					
1.3 Inorganic fertilizer (per tree)															
Twice a year, in the beginning and the end of rainy season															
1.3.1 Urea		350 g	5						*						*
		350 g	6						*						*
		350 g	7						*						*
		350 g	8						*						*
		350 g	9						*						*
		350 g	10						*						*
1.3.2 TSP		250 g	5						*						*
		250 g	6						*						*
		250 g	7						*						*
		250 g	8						*						*
		250 g	9						*						*
		250 g	10						*						*
1.3.3 KCl		250 g	5						*						*
		250 g	6						*						*
		250 g	7						*						*
		250 g	8						*						*
		250 g	9						*						*
		250 g	10						*						*
2. Irrigation															
Similar to the nonbearing plant															
2.1 Dry season				←	—	—	—	—	→						
2.2 Rainy season										←	—	—	—	—	→
3. Pest control						*				*				*	
Similar to the non bearing plant															
4. Other operation						*				*				*	
Similar to the non bearing plant															
5. Harvesting															
5.1 Flowering season, fruit setting and maturity										←	—	—	→		
5.2 Harvesting season													←	—	→

Table B-4-11 Marquisa Management Calendar

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1. Planting													
1.1 Variety: - Asam Brastagi - Malino													
1.2 In the beginning of rainy season. Or any time if there is available economically water to be watering							*						
1.3 The young tree needs shading and watering if no rain (3-5 liter/tree/day)													
2. Fertilization													
2.1 Soil conditioner If soil pH below 5.5 adjust with lime at rate of 2.5-3.5 ton/ha; at least each 5 years													
2.2 Organic manure (per tree) First application as basic fertilization in planting time; the next will be in rainy season													
2.2.1 15 kg farmyard manure	1						*						
20 kg farmyard manure	2							*					
20 kg farmyard manure	3							*					
20 kg farmyard manure	4							*					
2.3 Inorganic fertilizer (per tree) Twice a year at the beginning and the end of rainy season													
2.3.1 Urea 187.5 g	1						*						*
187.5 g	2						*						*
187.5 g	3						*						*
187.5 g	4						*						*
187.5 g	5						*						*
2.3.2 TSP 281 g	1						*						*
281 g	2						*						*
281 g	3						*						*
281 g	4						*						*
281 g	5						*						*
2.3.3 KCl 87.5 g	1						*						*
87.5 g	2						*						*
87.5 g	3						*						*
87.5 g	4						*						*
87.5 g	5						*						*
3. Irrigation If no rain the tree needs watering 20-25 liter/tree/day													
3.1 Dry season		◄	—	—	—	—	—	►					
3.2 Rainy season								◄	—	—	—	—	►
4. Pest control													
4.1 Spray with insecticide and fungicide to control/to prevent from - scale, mite, fruit fly etc. - anthracnosa, scab, phytophthora blight, crown rot, septoria and brown spot				*				*				*	
5. Other operations													
5.1 Dead and diseased vines has to be removed, replanted at least 2 m away				*				*				*	
5.2 Dry and dead vines has to be prunned and burnt				*				*				*	
5.3 If heavy regetative growth happened some vines of the lower part in touch with the ground has to be removed				*				*				*	
6. Harvesting													
6.1 Flowering season, fruit setting and maturity								◄	—	—	►		
6.2 Harvesting season											◄	—	►

Table B-4-12 Rambutan Management Calendar (1/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
A. Non Bearing Tree													
1. Planting													
1.1 Variety: - Brahrang - Binjai - Lebakbulus - Rapeah													
1.2 In the beginning of rainy season. Or any time if there is available economically water to be watering								*					
1.3 The young tree needs shading and watering if no rain (3-5 liter/tree/day)													
2. Fertilization													
2.1 Soil conditioner If soil pH below 5.5 adjust with lime at rate of 2.5-3.5 ton/ha; at least each 5 years								*					
2.2 Organic manure (per tree) First application as basic fertilization in planting time; the next will be in rainy season													
2.2.1 15 kg farmyard manure	1							*					
20 kg farmyard manure	2									*			
30 kg farmyard manure	3									*			
35 kg farmyard manure	4									*			
2.3 Inorganic fertilizer (per tree) Twice a year at the beginning and the end of rainy season													
2.3.1 Urea 40 g	1						*						*
50 g	2						*						*
60 g	3						*						*
75 g	4						*						*
2.3.2 TSP 25 g	1						*						*
30 g	2						*						*
40 g	3						*						*
100 g	4						*						*
2.3.3 KCl 75 g	1						*						*
80 g	2						*						*
90 g	3						*						*
100 g	4						*						*
3. Irrigation If no rain the tree needs watering 20-25 liter/tree/day													
3.1 Dry season		◄	—	—	—	—	—	►					
3.2 Rainy season								◄	—	—	—	—	►
4. Pest control (each year) Spray with insecticide and fungicide to control/to prevent from the - insect and catterpillars attack leave, flower, fruit and shoot - powdary nutdew				*				*				*	
5. Other operations													
5.1 Soil under the crown has to be chopped				*				*				*	
5.2 Dry and dead twig has to be prunned and burnt				*				*				*	

Table B-4-12 Rambutan Management Calendar (2/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
B. Bearing Tree													
1. Fertilization													
1.1 Soil conditioner													
In the six year old, apply the	5												
second liming at the rate of	6							*					
2.5-3.5 ton/ha. in rainy season	7												
	8												
	9												
1.2 Organic manure (per tree)													
Apply once a year in rainy season													
1.2.1 40 kg farmyard manure	5									*			
60 kg farmyard manure	6									*			
70 kg farmyard manure	7									*			
80 kg farmyard manure	8									*			
90 kg farmyard manure	9									*			
100 kg farmyard manure	10									*			
1.3 Inorganic fertilizer (per tree)													
Twice a year, in the beginning and the end of rainy season													
1.3.1 Urea 85 g	5						*						*
125 g	6						*						*
175 g	7						*						*
225 g	8						*						*
275 g	9						*						*
335 g	10						*						*
1.3.2 TSP 50 g	5						*						*
60 g	6						*						*
75 g	7						*						*
85 g	8						*						*
105 g	9						*						*
125 g	10						*						*
1.3.3 KCl 110 g	5						*						*
150 g	6						*						*
175 g	7						*						*
200 g	8						*						*
225 g	9						*						*
250 g	10						*						*
2. Irrigation													
Similar to the nonbearing plant													
2.1 Dry season		◄	—	—	—	—	►						
2.2 Rainy season								◄	—	—	—	—	►
3. Pest control				*				*				*	
Similar to the non bearing plant													
4. Other operation				*				*				*	
Similar to the non bearing plant													
5. Harvesting													
5.1 Flowering season, fruit setting and maturity								◄	—	—	►		
5.2 Harvesting season											◄	—	►

Table B-4-13 Salak Management Calendar (1/2)

Operation	Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
A. Non Bearing Plant													
1. Planting													
1.1 Variety: - local variety - Suwaru - Pondoh													
1.2 In the beginning of rainy season. Or any time if there is available economically water to be watering								*					
1.3 The young tree needs shading and watering if no rain (3-5 liter/tree/day)													
2. Fertilization													
2.1 Soil conditioner If soil pH below 5.5 adjust with lime at rate of 2.5-3.5 ton/ha; at least each 5 years								*					
2.2 Organic manure (per tree) First application as basic fertilization in planting time; the next will be in rainy season													
2.2.1 10 kg farmyard manure	1							*					
12.5 kg farmyard manure	2									*			
15 kg farmyard manure	3									*			
2.3 Inorganic fertilizer (per tree) Twice a year at the beginning and the end of rainy season													
2.3.1 Urea 18.5 g	1						*						*
22.5 g	2						*						*
28.5 g	3						*						*
2.3.2 TSP 25 g	1						*						*
30 g	2						*						*
37.5 g	3						*						*
2.3.3 KCl 12.5 g	1						*						*
18.5 g	2						*						*
25 g	3						*						*
3. Irrigation If no rain the tree needs watering 20-25 liter/tree/day													
3.1 Dry season		◄	─	─	─	─	─	►					
3.2 Rainy season								◄	─	─	─	─	►
4. Pest control (each year) Apply insecticide and fungicide to control/to prevent from - weevil - pink disease				*				*				*	
5. Other operations													
5.1 Dry and dead leaf has to be prunned				*				*				*	
5.2 Pruning gives good aeration, induce flower formation and push down investation of the diseases				*				*				*	

Table B-4-13 Salak Management Calendar (2/2)

Operation		Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
B. Bearing Plant														
1. Fertilization														
1.1 Soil conditioner														
After 5 years apply second liming at the rated 2.5-3.5 ton/ha in the rainy season		4												
		5												
		6							*					
		7												
		8												
		9												
		10												
1.2 Organic manure (per tree) Apply once a year in rainy season														
1.2.1	17.5 kg farmyard manure	4							*					
	20 kg farmyard manure	5							*					
	20 kg farmyard manure	6							*					
	20 kg farmyard manure	7							*					
	20 kg farmyard manure	8							*					
	20 kg farmyard manure	9							*					
	20 kg farmyard manure	10							*					
1.3 Inorganic fertilizer (per tree) Twice a year, in the beginning and the end of rainy season														
1.3.1 Urea	17.5 g	4						*						*
	20 g	5						*						*
	35 g	6						*						*
	35 g	7						*						*
	35 g	8						*						*
	35 g	9						*						*
	35 g	10						*						*
1.3.2 TSP	43.5 g	4						*						*
	50 g	5						*						*
	50 g	6						*						*
	50 g	7						*						*
	50 g	8						*						*
	50 g	9						*						*
	50 g	10						*						*
1.3.3 KCl	30 g	4						*						*
	37.5 g	5						*						*
	43.5 g	6						*						*
	43.5 g	7						*						*
	43.5 g	8						*						*
	43.5 g	9						*						*
	43.5 g	10						*						*
2. Irrigation Similar to the nonbearing plant														
2.1 Dry season			◄	—	—	—	—	—	►					
2.2 Rainy season									◄	—	—	—	—	►
3. Pest control Similar to the non bearing plant					*				*				*	
4. Other operation Similar to the non bearing plant					*				*				*	
5. Harvesting														
5.1 Flowering season, fruit setting and maturity			◄	—	—	—	—	—	—	►				
5.2 Fruit thinning														
	5.2.1 First thinning					*								
	5.2.2 Second thinning						*							
	5.2.3 Third thinning							*						
5.3 Harvesting season										◄	—	—	—	►

Table B-4-14 Annual Labor Requirement by Farming Practice (1/9)

Commodity : *Avocado* Unit : man-day/ha

Item	Farming Practice	Labor Requirement		
		Family	Hired	Total
1st year				
1. Land Finishing	Finishing of land after preparation	--	8.0	8.0
2. Land cultivation	Plowing	--	8.0	8.0
3. Holes preparation	Digging of holes with a size of 0.6 x 0.6 x 0.6 m	--	12.0	12.0
4. Manuring	Putting of organic manure into holes	--	20.0	20.0
5. Planting	Planting of seedlings with a distance of 10 x 10 m	8.0	--	8.0
6. Fertilizing	Applying of basic fertilizers	2.6	--	2.6
	Total	**10.6**	**48.0**	**58.6**
2nd year				
1. Fertilizing	Applying of fertilizers and soil conditioner	4.1	--	4.1
2. Pest control	Applying of agro-chemicals (when necessary)	--	16.0	16.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Water supply	Watering to fruit trees	40.0	--	40.0
5. Supplemental planting	Planting of supplemental seedlings with manure and fertilizers	--	8.6	8.6
	Total	**52.1**	**24.6**	**76.7**
3rd year				
1. Fertilizing	Applying of fertilizers (twice a year)	5.8	--	5.8
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Water supply	Watering to fruit trees	20.0	--	20.0
	Total	**33.8**	**8.0**	**41.8**
4th year				
1. Fertilizing	Applying of fertilizers (twice a year)	9.2	--	9.2
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Water supply	Watering to fruit trees	20.0	--	20.0
	Total	**37.2**	**8.0**	**45.2**
5th year				
1. Fertilizing	Applying of fertilizers	12.0	--	12.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Harvesting	Picking of fruits	55.0	--	55.0
	Total	**75.0**	**8.0**	**83.0**

Year	Picking Fruits		Other Activities	
	Family	Hired	Family	Hired
6	75.0	35.0	20.0	8.0
7	75.0	110.0	20.0	8.0
8	75.0	220.0	20.0	8.0
9	75.0	330.0	20.0	8.0
10	75.0	440.0	20.0	8.0
11	75.0	510.0	20.0	8.0
12	75.0	510.0	20.0	8.0

Table B-4-14 Annual Labor Requirement by Farming Practice (2/9)

Commodity : *Banana* Unit : man-day/ha

Item	Farming Practice	Family	Hired	Total
1st year				
1. Land Finishing	Finishing of land after preparation	--	80.0	80.0
2. Land cultivation	Plowing	--	80.0	80.0
3. Holes preparation	Digging of holes with a size of 0.6 x 0.6 x 0.6 m	--	100.0	100.0
4. Manuring	Putting of organic manure into holes	--	120.0	120.0
5. Fertilizing	Applying of basic fertilizers	116.0	--	116.0
6. Planting	Planting of seedlings with a distance of 2 x 5 m	80.0	--	80.0
	Total	**196.0**	**380.0**	**576.0**
2nd year				
1. Water supply	Watering to fruit trees	120.0	--	120.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	80.0	80.0
3. Weed control	Weeding of land surface	105.0	--	105.0
4. Fertilizing	Applying of fertilizers	101.5	--	101.5
5. Tree maintenance	Trimming and pruning of trees	40.0	--	40.0
6. Fruit bearing control	Thinning and covering of fruits	5.0	--	5.0
7. Harvesting	Cutting of bunches	20.0	--	20.0
	Total	**391.5**	**80.0**	**471.5**
3rd year				
1. Weed control	Weeding of land surface	135.0	--	135.0
2. Fertilizing	Applying of fertilizers	130.5	--	130.5
3. Tree maintenance	Trimming and pruning of trees	160.0	--	160.0
4. Fruit bearing control	Thinning and covering of fruits	20.0	--	20.0
5. Harvesting	Cutting of bunches	40.0	--	40.0
	Total	**485.5**	**0.0**	**485.5**
4th year				
1. Fertilizing	Applying of fertilizers	116.0	--	116.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	40.0	40.0
3. Weed control	Weeding of land surface	120.0	--	120.0
4. Tree maintenance	Trimming and pruning of trees	160.0	--	160.0
5. Fruit bearing control	Thinning and covering of fruits	20.0	--	20.0
6. Harvesting	Cutting of bunches	40.0	--	40.0
7. Replanting	Replanting of seedling with manure and fertilizers	104.0	--	104.0
	Total	**560.0**	**40.0**	**600.0**

Table B-4-14 Annual Labor Requirement by Farming Practice (3/9)

Commodity : *Duku* Unit : man-day/ha

Item	Farming Practice	Family	Hired	Total
1st year				
1. Land Finishing	Finishing of land after preparation	--	8.0	8.0
2. Land cultivation	Plowing	--	8.0	8.0
3. Holes preparation	Digging of holes with a size of 1.0 x 1.0 x 1.0	--	20.0	20.0
4. Manuring	Putting of organic manure into holes	--	12.0	12.0
5. Planting	Planting of seedlings with a distance of 10 x 10	4.8	--	4.8
6. Fertilizing	Applying of basic fertilizers	8.0	--	8.0
	Total	**12.8**	**48.0**	**60.8**
2nd year				
1. Fertilizing	Applying of fertilizers and soil conditioner	4.2	--	4.2
2. Pest control	Applying of agro-chemicals (when necessary)	--	12.0	12.0
3. Weed control	Weeding of land surface	4.0	--	4.0
4. Water supply	Watering to fruit trees	24.0		24.0
5. Supplemental planting	Planting of supplemental seedlings with manure and fertilizers	--	8.8	8.8
	Total	**32.2**	**20.8**	**53.0**
3rd year				
1. Fertilizing	Applying of fertilizers (twice a year)	8.4	--	8.4
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Water supply	Watering to fruit trees	12.0	--	12.0
5. Tree maintenance	Trimming and pruning of trees	8.0	--	8.0
	Total	**36.4**	**8.0**	**44.4**
4th year				
1. Fertilizing	Applying of fertilizers (twice a year)	11.0	--	11.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Tree maintenance	Trimming and pruning of trees	8.0	--	8.0
	Total	**27.0**	**8.0**	**35.0**
5th year				
1. Fertilizing	Applying of fertilizers	6.8	--	6.8
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	4.0	--	4.0
4. Tree maintenance	Trimming and pruning of trees	8.0	--	8.0
5. Harvesting	Picking of fruits	30.0	--	30.0
	Total	**48.8**	**8.0**	**56.8**

Note: Labor requirement from 6th year

Year	Picking Fruits		Other Activities.	
	Family	Hired	Family	Hired
6	60.0	0.0	18.8	8.0
7	75.0	15.0	18.8	8.0
8	75.0	105.0	18.8	8.0
9	75.0	195.0	18.8	8.0
10	75.0	315.0	18.8	8.0
11	75.0	435.0	18.8	8.0
12	75.0	435.0	18.8	8.0

Table B-1-14 Annual Labor Requirement by Farming Practice (4/9)

Commodity : *Durian*

Unit : man-day/ha

Item	Farming Practice	Family	Hired	Total
1st year				
1. Land Finishing	Finishing of land after preparation	--	8.0	8.0
2. Land cultivation	Plowing	--	8.0	8.0
3. Holes preparation	Digging of holes with a size of 0.6 x 0.6 x 0.6 m	--	12.0	12.0
4. Manuring	Putting of organic manure into holes	--	20.0	20.0
5. Planting	Planting of seedlings with a distance of 10 x 10 m	8.0	--	8.0
6. Fertilizing	Applying of basic fertilizers	2.6	--	2.6
	Total	**10.6**	**48.0**	**58.6**
2nd year				
1. Fertilizing	Applying of fertilizers and soil conditioner	4.1	--	4.1
2. Pest control	Applying of agro-chemicals (when necessary)	--	16.0	16.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Water supply	Watering to fruit trees	40.0	--	40.0
5. Supplemental planting	Planting of supplemental seedlings with manure and fertilizers	--	8.6	8.6
	Total	**52.1**	**24.6**	**76.7**
3rd year				
1. Fertilizing	Applying of fertilizers (twice a year)	5.8		5.8
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Water supply	Watering to fruit trees	20.0	--	20.0
	Total	**33.8**	**8.0**	**41.8**
4th year				
1. Fertilizing	Applying of fertilizers (twice a year)	9.2	--	9.2
2. Pest control	Applying of agro-chemicals (when necessary)	--	8	8.0
3. Weed control	Weeding of land surface	8	--	8.0
4. Water supply	Watering to fruit trees	20	--	20.0
	Total	**37.2**	**8.0**	**45.2**
5th year				
1. Fertilizing	Applying of fertilizers	12.0	--	12.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Harvesting	Picking of fruits	55.0	--	55.0
	Total	**75.0**	**8.0**	**83.0**

Note: Labor requirement from 6th year

Year	Picking Fruits		Other Activities	
	Family	Hired	Family	Hired
6	75.0	20.0	20.0	8.0
7	75.0	90.0	20.0	8.0
8	75.0	145.0	20.0	8.0
9	75.0	225.0	20.0	8.0
10	75.0	365.0	20.0	8.0
11	75.0	365.0	20.0	8.0
12	75.0	365.0	20.0	8.0

Table B-4-14 Annual Labor Requirement by Farming Practice (5/9)

Commodity : *Mango*

Unit : man-day/ha

Item	Farming Practice	Family	Hired	Total
1st year				
1. Land Finishing	Finishing of land after preparation	--	8.0	8.0
2. Land cultivation	Plowing	--	8.0	8.0
3. Holes preparation	Digging of holes with a size of 1.0 x 1.0 x 1.0 m	--	20.0	20.0
4. Manuring	Putting of organic manure into holes	--	12.0	12.0
5. Planting	Planting of seedlings with a distance of 10 x 10 m	4.8	--	4.8
6. Fertilizing	Applying of basic fertilizers	8.0	--	8.0
	Total	**12.8**	**48.0**	**60.8**
2nd year				
1. Fertilizing	Applying of fertilizers and soil conditioner	4.2	--	4.2
2. Pest control	Applying of agro-chemicals (when necessary)	--	12.0	12.0
3. Weed control	Weeding of land surface	4.0	--	4.0
4. Water supply	Watering to fruit trees	24.0		24.0
5. Supplemental planting	Planting of supplemental seedlings with manure and fertilizers	--	8.8	8.8
	Total	**32.2**	**20.8**	**53.0**
3rd year				
1. Fertilizing	Applying of fertilizers (twice a year)	8.4	--	8.4
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Water supply	Watering to fruit trees	12.0	--	12.0
5. Tree maintenance	Trimming and pruning of trees	8.0	--	8.0
	Total	**36.4**	**8.0**	**44.4**
4th year				
1. Fertilizing	Applying of fertilizers (twice a year)	11.0	--	11.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Tree maintenance	Trimming and pruning of trees	8.0	--	8.0
	Total	**27.0**	**8.0**	**35.0**
5th year				
1. Fertilizing	Applying of fertilizers (twice a year)	6.8	--	6.8
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	4.0	--	4.0
4. Tree maintenance	Trimming and pruning of trees	8.0	--	8.0
5. Harvesting	Picking of fruits	30.0	--	30.0
	Total	**48.8**	**8.0**	**56.8**

Note: Labor requirement from 6th year

Year	Picking Fruits		Other Activities.	
	Family	Hired	Family	Hired
6	75.0	15.0	18.8	8.0
7	75.0	75.0	18.8	8.0
8	75.0	175.0	18.8	8.0
9	75.0	275.0	18.8	8.0
10	75.0	375.0	18.8	8.0
11	75.0	375.0	18.8	8.0
12	75.0	375.0	18.8	8.0

Table B-4-14 Annual Labor Requirement by Farming Practice (6/9)

Commodity : *Mangosteen*

Unit : man-day/ha

Item	Farming Practice	Family	Hired	Total
1 st year				
1. Land Finishing	Finishing of land after preparation	--	8.0	8.0
2. Land cultivation	Plowing	--	8.0	8.0
3. Holes preparation	Digging of holes with a size of 1.0 x 1.0 x 1.0 m	--	20.0	20.0
4. Manuring	Putting of organic manure into holes	--	12.0	12.0
5. Planting	Planting of seedlings with a distance of 10 x 10 m	4.8	--	4.8
6. Fertilizing	Applying of basic fertilizers	8.0	--	8.0
	Total	**12.8**	**48.0**	**60.8**
2nd year				
1. Fertilizing	Applying of fertilizers and soil conditioner	4.2	--	4.2
2. Pest control	Applying of agro-chemicals (when necessary)	--	12.0	12.0
3. Weed control	Weeding of land surface	4.0	--	4.0
4. Water supply	Watering to fruit trees	24.0	--	24.0
5. Supplemental planting	Planting of supplemental seedlings with manure and fertilizers	--	8.8	8.8
	Total	**32.2**	**20.8**	**53.0**
3rd year				
1. Fertilizing	Applying of fertilizers (twice a year)	8.4	--	8.4
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Water supply	Watering to fruit trees	12.0	--	12.0
5. Tree maintenance	Trimming and pruning of trees	8.0	--	8.0
	Total	**36.4**	**8.0**	**44.4**
4th year				
1. Fertilizing	Applying of fertilizers (twice a year)	11.0	--	11.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	8.0	--	8.0
4. Tree maintenance	Trimming and pruning of trees	8.0	--	8.0
	Total	**27.0**	**8.0**	**35.0**
5 th year				
1. Fertilizing	Applying of fertilizers	6.8	--	6.8
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	4.0	--	4.0
4. Tree maintenance	Trimming and pruning of trees	8.0	--	8.0
5. Harvesting	Picking of fruits	45.0	--	45.0
	Total	**63.8**	**8.0**	**71.8**

Note: Labor requirement from 6th year

Year	Picking Fruits		Other Activities.	
	Family	Hired	Family	Hired
6	75.0	15.0	18.8	8.0
7	75.0	60.0	18.8	8.0
8	75.0	195.0	18.8	8.0
9	75.0	330.0	18.8	8.0
10	75.0	510.0	18.8	8.0
11	75.0	690.0	18.8	8.0
12	75.0	690.0	18.8	8.0

Table B-4-14 Annual Labor Requirement by Farming Practice (7/9)

Commodity : *Marquisa* Unit : man-day/ha

Item	Farming Practice	Family	Hired	Total
1st year				
1. Land Finishing	Finishing of land after preparation	--	32.0	32.0
2. Land cultivation	Plowing	--	32.0	32.0
3. Holes preparation	Digging of holes with a size of 0.3 x 0.3 x 0.3 m	--	15.0	15.0
4. Manuring	Putting of organic manure into holes	--	15.0	15.0
5. Planting	Planting of seedlings with a distance of 4 x 5 m	40.0	--	40.0
6. Fertilizing	Applying of basic fertilizers	39.2	--	39.2
7. Tree maintenance	Setting of support wire fence	--	20.0	20.0
	Total	**79.2**	**114.0**	**193.2**
2nd year				
1. Tree maintenance	Trimming and pruning of trees	16.0		
2. Harvesting	Picking of fruits	12.0		
3. Manuring	Putting organic manure to trees	14.4	--	14.4
4. Fertilizing	Applying of fertilizers (twice a year)	39.2	--	39.2
5. Pest control	Applying of agro-chemicals (when necessary)	--	32.0	32.0
6. Weed control	Weeding of land surface	32.0	--	32.0
7. Supplemental planting	Planting of supplemental seedlings with manure and fertilizers	--	18.8	18.8
	Total	**113.6**	**50.8**	**136.4**
3rd year				
1. Tree maintenance	Trimming and pruning of trees	16.0	--	16.0
2. Harvesting	Picking of fruits	24.0	--	24.0
3. Manuring	Putting of organic manure to trees	18.0	--	18.0
4. Fertilizing	Applying of fertilizers (twice a year)	39.2	--	39.2
5. Pest control	Applying of agro-chemicals (when necessary)	--	32.0	32.0
6. Weed control	Weeding of land surface	56.0	--	56.0
	Total	**153.2**	**32.0**	**185.2**
4th year				
1. Tree maintenance	Trimming and pruning of trees	16.0	--	16.0
2. Harvesting	Picking of fruits	72.0	--	72.0
3. Replanting	Replanting of fruit trees (0.2 Ha)	42.0	--	42.0
4. Manuring	Putting of organic manure to trees	18.0	--	18.0
5. Fertilizing	Applying of fertilizers (twice a year)	39.2	--	39.2
6. Pest control	Applying of agro-chemicals (when necessary)	--	32.0	32.0
7. Weed control	Weeding of land surface	56.0	--	56.0
	Total	**243.2**	**32.0**	**275.2**
5th year				
1. Tree maintenance	Trimming and pruning of trees	16.0	--	16.0
2. Harvesting	Picking of fruits	144.0	--	144.0
3. Replanting	Replanting of fruit trees (0.25 Ha)	42.0	--	42.0
4. Manuring	Putting of organic manure to trees	18.0	--	18.0
5. Fertilizing	Applying of fertilizers (twice a year)	39.2	--	39.2
6. Pest control	Applying of agro-chemicals (when necessary)	--	32.0	32.0
7. Weed control	Weeding of land surface	56.0	--	56.0
	Total	**315.2**	**32.0**	**347.2**

Note: Labor requirement from 6th year

Year	Picking Fruits		Other Activities	
	Family	Hired	Family	Hired
6	150.0	30.0	259.2	32.0
7	150.0	30.0	259.2	32.0
8	150.0	30.0	259.2	32.0
9	150.0	30.0	259.2	32.0
10	150.0	30.0	259.2	32.0
11	150.0	30.0	259.2	32.0
12	150.0	30.0	259.2	32.0

Table B-4-14 Annual Labor Requirement by Farming Practice (8/9)

Commodity : *Rambutan* Unit : man-day/ha

Item	Farming Practice	Family	Hired	Total
1st year				
1. Land Finishing	Finishing of land after preparation	--	8.0	8.0
2. Land cultivation	Plowing	--	8.0	8.0
3. Holes preparation	Digging of holes with a size of 1.0 x 1.0 x 1.0 m	--	20.0	20.0
4. Manuring	Putting of organic manure into holes	--	20.0	20.0
5. Planting	Planting of seedlings with a distance of 10 x 10 m	8.0	--	8.0
6. Fertilizing	Applying of basic fertilizers	2.2	--	2.2
	Total	**10.2**	**56.0**	**66.2**
2nd year				
1. Fertilizing	Applying of fertilizers and soil conditioner	1.9	--	1.9
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	4.0	--	4.0
4. Water supply	Watering to fruit trees	40.0	--	40.0
5. Supplemental planting	Planting of supplemental seedlings with	--	10.1	10.1
	manure and fertilizers	--	--	0.0
	Total	**45.9**	**18.1**	**64.0**
3rd year				
1. Fertilizing	Applying of fertilizers	4.1	--	4.1
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	10.0	--	10.0
4. Water supply	Watering to fruit trees	20.0	--	20.0
	Total	**34.1**	**8.0**	**42.1**
4th year				
1. Fertilizing	Applying of fertilizers	4.4	--	4.4
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	10.0	--	10.0
	Total	**14.4**	**8.0**	**22.4**
5th year				
1. Fertilizing	Applying of fertilizers	2.2	--	2.2
2. Pest control	Applying of agro-chemicals (when necessary)	--	8.0	8.0
3. Weed control	Weeding of land surface	4.0	--	4.0
4. Harvesting	Picking of fruits	8.0	--	8.0
	Total	**14.2**	**8.0**	**22.2**

Note: Labor requirement from 6th year

Year	Picking Fruits		Other Activities.	
	Family	Hired	Family	Hired
6	20.0	0.0	6.2	8.0
7	44.0	0.0	6.2	8.0
8	75.0	5.0	6.2	8.0
9	75.0	45.0	6.2	8.0
10	75.0	85.0	6.2	8.0
11	75.0	125.0	6.2	8.0
12	75.0	125.0	6.2	8.0

Table B-4-14 Annual Labor Requirement by Farming Practice (9/9)

Commodity : *Salak* Unit : man-day/ha

Item	Farming Practice	Family	Hired	Total
1st year				
1. Land Finishing	Finishing of land after preparation	--	40.0	40.0
2. Land cultivation	Plowing	--	40.0	40.0
3. Holes preparation	Digging of holes with a size of 0.6 x 0.6 x 0.6 m	--	60.0	60.0
4. Manuring	Putting of organic manure into holes	--	50.0	50.0
5. Planting	Planting of seedlings with a distance of 2 x 2.5 m	12.0	--	12.0
6. Fertilizing	Applying of basic fertilizers	40.0	--	40.0
	Total	**52.0**	**190.0**	**242.0**
2nd year				
1. Fertilizing	Applying of fertilizers (twice a year)	15.0	--	15.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	80.0	80.0
3. Weed control	Weeding of land surface	40.0	--	40.0
4. Water supply	Watering to fruit trees	88.0	12.0	100.0
5. Supplemental planting	Planting of supplemental seedlings with	--	33.0	33.0
	manure and fertilizers	--	--	0.0
	Total	**143.0**	**125.0**	**268.0**
3rd year				
1. Fertilizing	Applying of fertilizers (twice a year)	18.0	--	18.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	40.0	40.0
3. Weed control	Weeding of land surface	40.0	--	40.0
4. Water supply	Watering to fruit trees	50.0	--	50.0
5. Tree maintenance	Pruning and thinning out of trees	50.0	--	50.0
	Total	**158.0**	**40.0**	**198.0**
4th year				
1. Fertilizing	Applying of fertilizers (twice a year)	18.0	--	18.0
2. Pest control	Applying of agro-chemicals (when necessary)	--	40.0	40.0
3. Weed control	Weeding of land surface	40.0	--	40.0
4. Water supply	Watering to fruit trees	50.0	--	50.0
5. Tree maintenance	Pruning and thinning out of trees	50.0	--	50.0
6. Harvesting	Picking of fruits (twice a year)	80.0	--	80.0
	Total	**238.0**	**40.0**	**278.0**

Note: Labor requirement from 6th year

Year	Picking Fruits		Other Activities.	
	Family	Hired	Family	Hired
6	100.0	0.0	158.0	40.0
7	150.0	30.0	158.0	40.0
8	150.0	130.0	158.0	40.0
9	150.0	250.0	158.0	40.0
10	150.0	250.0	158.0	40.0
11	150.0	250.0	158.0	40.0
12	150.0	250.0	158.0	40.0

Table B-4-15 Annual Farm Input Requirements per Hectare (1/5)

Crops / Inputs	unit	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Avocado													
* Seedling													
-Purchased seed	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
* Fertilizer													
- Urea	kg	20.0	28.0	38.0	48.0	186.0	244.0	266.0	286.0	306.0	326.0	346.0	350.0
- TSP	kg	50.0	62.0	79.0	96.5	144.0	199.0	254.0	309.0	320.0	320.0	320.0	320.0
- KCl	kg	20.0	24.0	31.0	38.5	112.0	202.0	292.0	382.0	400.0	400.0	400.0	400.0
*Agro-chemicals													
- Pesticide	lit	1.0	1.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Other materials													
- Organic manure	ton	4.0	0.8	-	-	-	-	-	-	-	-	-	-
- Organic materials	lit	-	1.6	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
* Labor													
- Family	m/d	10.6	52.1	33.8	37.2	75.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
- Hired	md	48.0	24.6	8.0	8.0	8.0	0.0	118.0	228.0	338.0	448.0	518.0	518.0
Banana													
* Seedling													
-Purchased seed	no.	1000.0	-	-	-	1000.0	-	-	-	-	1000.0	-	-
* Fertilizer													
- Urea	kg	50.0	250.0	350.0	375.0	325.0	300.0	375.0	325.0	300.0	375.0	325.0	300.0
- TSP	kg	50.0	100.0	100.0	125.0	125.0	100.0	125.0	125.0	100.0	125.0	125.0	100.0
- KCl	kg	50.0	150.0	250.0	300.0	300.0	200.0	275.0	300.0	200.0	275.0	300.0	200.0
*Agro-chemicals													
- Pesticide	lit	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
- Fungicide	kg	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
* Other materials													
- Organic manure	ton	40.0	-	-	20.0	20.0	-	20.0	20.0	-	20.0	20.0	-
- Organic materials	lit	-	20.0	20.0	15.0	15.0	20.0	15.0	15.0	20.0	15.0	15.0	20.0
- Plastic cover	no.	-	1000.0	2000.0	2000.0	2000.0	-	1000.0	2000.0	2000.0	2000.0	-	1000.0
* Labor													
- Family	m/d	196.0	391.5	485.0	560.0	560.0	365.5	391.5	485.0	485.0	560.0	365.5	391.5
- Hired	md	380.0	80.0	40.0	40.0	40.0	80.0	80.0	40.0	40.0	40.0	80.0	80.0

Source : JICA Study Team

Table B-4-15 Annual Farm Input Requirements per Hectare (2/5)

Crops / Inputs	unit	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Duku													
* Seedling													
-Purchased seed	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
* Fertilizer													
- Compound	kg	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
- TSP	kg	-	-	-	-	-	-	-	-	-	-	-	-
- KCl	kg	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
*Agro-chemicals													
- Pesticide	lit	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Other materials													
- Organic manure	ton	20.0	0.4	-	-	-	-	-	-	-	-	-	-
- Organic materials	lit	-	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
* Labor													
- Family	m/d	12.8	32.2	36.4	27.0	48.8	78.8	93.8	93.8	93.8	93.8	93.8	93.8
- Hired	md	48.0	20.8	8.0	8.0	8.0	8.0	23.0	113.0	203.0	323.0	443.0	443.0
Durian													
* Seedling													
-Purchased seed	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
* Fertilizer													
- Urea	kg	1.6	5.1	10.8	12.0	18.4	20.0	20.0	20.0	20.0	20.0	20.0	20.0
- TSP	kg	3.2	10.2	21.6	24.0	36.8	40.0	40.0	40.0	40.0	40.0	40.0	40.0
- KCl	kg	3.2	10.2	21.6	24.0	36.8	40.0	40.0	40.0	40.0	40.0	40.0	40.0
*Agro-chemicals													
- Pesticide	lit	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Other materials													
- Organic manure	ton	4.0	0.8	-	-	-	-	-	-	-	-	-	-
- Organic materials	lit	-	-	-	-	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
* Labor													
- Family	m/d	10.6	52.1	33.8	37.2	75.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
- Hired	md	48.0	24.6	8.0	8.0	80.0	28.0	98.0	153.0	233.0	373.0	373.0	373.0

Source : JICA Study Team

Table B-4-15 Annual Farm Input Requirements per Hectare (3/5)

Crops / Inputs	unit	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Mango													
* Seedling													
-Purchased seed	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
* Fertilizer													
- Urea	kg	20.0	24.0	29.0	38.0	56.0	81.6	87.0	87.0	87.0	87.0	87.0	87.0
- TSP	kg	5.0	9.0	14.0	15.0	27.0	40.8	43.5	43.5	43.5	43.5	43.5	43.5
- KCl	kg	20.0	24.0	29.0	30.0	70.0	108.8	116.0	116.0	116.0	116.0	116.0	116.0
*Agro-chemicals													
- Pesticide	lit	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Other materials													
- Organic manure	ton	20.0	0.4	-	-	-	-	-	-	-	-	-	-
- Organic materials	lit	-	1.2	1.9	2.4	3.3	4.7	5.0	5.0	5.0	5.0	5.0	5.0
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
* Labor													
- Family	m/d	12.8	32.2	36.4	27.0	48.8	93.8	93.8	93.8	93.8	93.8	93.8	93.8
- Hired	md	48.0	20.8	8.0	8.0	8.0	23.0	83.0	158.0	233.0	293.0	383.0	383.0
Mangosteen													
* Seedling													
-Purchased seed	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
* Fertilizer													
- Urea	kg	36.0	26.4	24.0	36.8	56.0	68.0	70.0	70.0	70.0	70.0	70.0	70.0
- TSP	kg	16.0	12.8	26.4	30.0	46.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
- KCl	kg	28.0	29.6	30.0	34.0	47.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
*Agro-chemicals													
- Pesticide	lit	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Other materials													
- Organic manure	ton	6.0	1.2	-	-	-	-	-	-	-	-	-	-
- Organic materials	lit	-	1.6	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
* Labor													
- Family	m/d	12.8	32.2	36.4	27.0	63.8	93.8	93.8	93.8	93.8	93.8	93.8	93.8
- Hired	md	48.0	20.8	8.0	8.0	8.0	23.0	68.0	203.0	338.0	518.0	698.0	698.0
	md												

Source : JICA Study Team

Table B-4-15 Annual Farm Input Requirements per Hectare (4/5)

Crops / Inputs	unit	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Marquisa													
* Seedling													
-Purchased seed	no.	500.0	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
* Fertilizer													
- ZA + DS + ZK	kg	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0	800.0
- TSP	kg	-	-	-	-	-	-	-	-	-	-	-	-
- KCl	kg	-	-	-	-	-	-	-	-	-	-	-	-
*Agro-chemicals													
- Pesticide	lit	12.5	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
- Fungicide	kg	25.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
* Other materials													
- Organic manure	ton	10.0	2.0	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Organic materials	lit	-	4.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
* Labor													
- Family	m/d	79.2	113.6	153.2	243.2	315.2	321.2	321.2	321.2	321.2	321.2	321.2	321.2
- Hired	md	114.0	50.8	32.0	32.0	32.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0
Rambutan													
* Seedling													
-Purchased seed	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
* Fertilizer													
- Urea	kg	10.0	12.0	14.5	17.0	19.5	24.0	31.0	40.5	52.5	67.0	94.0	100.0
- TSP	kg	5.0	7.0	9.5	12.0	14.5	16.6	18.6	20.6	22.6	24.6	45.0	50.0
- KCl	kg	15.0	17.0	19.5	22.0	24.5	29.0	34.0	39.0	44.0	49.0	50.0	50.0
*Agro-chemicals													
- Pesticide	lit	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Other materials													
- Organic manure	ton	2.0	0.4	-	-	-	-	-	-	-	-	-	-
- Organic materials	lit	-	1.2	1.9	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
* Labor													
- Family	m/d	10.2	45.9	34.1	14.4	14.2	26.2	50.2	81.2	81.2	81.2	81.2	81.2
- Hired	md	56.0	18.1	8.0	8.0	8.0	8.0	8.0	13.0	53.0	93.0	133.0	133.0

Source : JICA Study Team

Table B-4-15 Annual Farm Input Requirements per Hectare (5/5)

Crops / Inputs	unit	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Salak													
* Seedling													
-Purchased seed	no.	2000.0	400.0	-	-	-	-	-	-	-	-	-	-
* Fertilizer													
- Urea	kg	50.0	50.0	50.0	90.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
- TSP	kg	40.0	40.0	40.0	72.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
- KCl	kg	60.0	60.0	60.0	108.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
*Agro-chemicals													
- Pesticide	lit	1.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Other materials													
- Organic manure	ton	20.0	4.0	-	-	-	-	-	-	-	-	-	-
- Organic materials	lit	-	8.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
* Labor													
- Family	m/d	52.0	143.0	158.0	238.0	258.0	308.0	308.0	308.0	308.0	308.0	308.0	308.0
- Hired	md	190.0	125.0	40.0	40.0	40.0	70.0	170.0	290.0	290.0	290.0	290.0	290.0

Source : JICA Study Team

Table B-4-16 Annual Target Yield

(Unit : ton/ha)

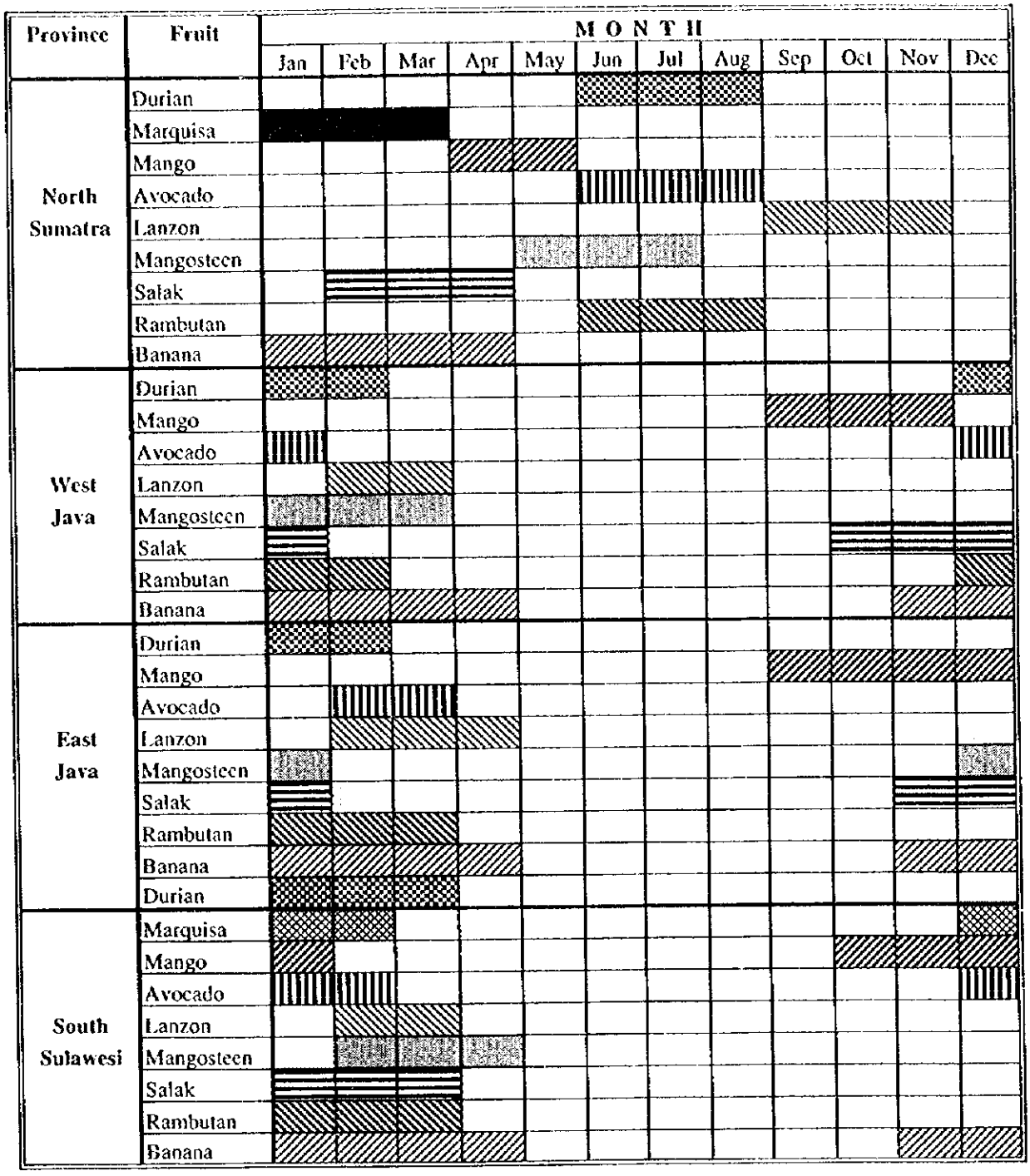
Year	Fruit Commodity									Intercrop	
	Avocado	Banana	Duku	Durian	Mango	Mangosteen	Marquisa	Rambutan	Salak	Maize	Groundnut
1	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.2
2	0.00	10.0	0.0	0.00	0.0	0.0	1.2	0.0	0.0	2.4	1.2
3	0.00	20.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	2.4	1.2
4	0.00	20.0	0.0	0.0	0.0	0.0	3.6	0.0	1.0	2.4	1.2
5	0.75	20.0	0.5	1.0	0.9	0.5	7.2	0.4	2.5	2.4	1.2
6	1.50	20.0	1.0	2.0	2.7	1.0	9.0	1.0	4.5	2.4	1.2
7	2.50	20.0	1.5	3.0	4.5	1.5	9.0	2.2	7.0	2.4	1.2
8	4.00	20.0	3.0	4.0	6.8	3.0	9.0	4.0	10.0	2.4	1.2
9	5.50	20.0	4.5	6.0	9.0	4.5	9.0	6.0	10.0	2.4	1.2
10	7.00	20.0	6.5	8.0	10.8	6.5	9.0	8.0	10.0	2.4	1.2
11	8.00	20.0	8.5	8.0	13.5	8.5	9.0	10.0	10.0	2.4	1.2
12	8.00	20.0	8.5	8.0	13.5	8.5	9.0	10.0	10.0	2.4	1.2

Source : JICA Study Team

Table B-4-17 Prospected Fruit Production and Market Supply

District	Planted Area (ha)	Fruit Commodity	Prospected Production (ton)	Prospected Market Supply (ton)
1. Dairi	300	Durian	2,400	1,920
2. Tapanuli Tengah	750	Durian	6,000	4,800
3. Tapanuli Utara	500	Durian	4,000	3,200
4. Tapanuli Selatan	800	Mangosteen	6,800	5,440
5. Tapanuli Utara	500	Mangosteen	4,250	3,400
6. Karo	1,000	Marquisa	9,000	7,200
7. Langkat	500	Rambutan	5,000	4,000
8. Tapanuli Selatan	1,500	Salak	15,000	12,000
9. Bandung	500	Avocado	4,000	3,200
10. Ciamis	500	Duku	4,250	3,400
11. Bogor	500	Durian	4,000	3,200
12. Sumedang	1,000	Mango	13,500	10,800
13. Purwakarta	500	Mangosteen	4,250	3,400
14. Tasikmalaya	1,000	Salak	10,000	8,000
15. Lumajang	1,000	Avocado	8,000	6,400
16. Lumajang	500	Banana	10,000	8,000
17. Jombang	500	Banana	10,000	8,000
18. Jombang	1,150	Durian	9,200	7,390
19. Trenggalek	1,000	Durian	8,000	6,400
20. Tulungagung	1,000	Duku	8,500	6,800
21. Malang	1,700	Salak	17,000	13,600
22. Pasuruan	750	Mango	10,125	8,100
23. Gowa	500	Avocado	4,000	3,200
24. Soppeng	500	Avocado	4,000	3,200
25. Sidenreng Rappang	500	Mango	6,750	5,400
26. Majene	500	Mango	6,750	5,400
27. Bone	500	Mango	6,750	5,400
28. Maros	500	Mango	6,750	5,400
29. Wajo	500	Mango	6,750	5,400
30. Tana Toraja	500	Mangosteen	4,250	3,400
31. Polewali Mamasa	500	Mangosteen	4,250	3,400
32. Gowa	1,000	Marquisa	9,000	7,200
33. Tana Toraja	3,000	Marquisa	27,000	21,600
34. Mamuju	2,350	Rambutan	23,500	18,800
35. Enrekang	500	Rambutan	5,000	4,000
36. Pinrang	500	Rambutan	5,000	4,000
37. Barru	700	Rambutan	7,000	5,600

Figure B-4-1 Peak Fruit Season in the Study Area



Source: JICA Study Team

JAPAN INTERNATIONAL
COOPERATION AGENCY

DIRECTORATE GENERAL OF
FOOD CROPS AND HORTICULTURE
MINISTRY OF AGRICULTURE
GOVERNMENT OF THE REPUBLIC OF INDONESIA

THE STUDY ON THE IMPROVEMENT IN QUALITY OF THE TROPICAL FRUITS

VOLUME II

APPENDIX

JUNE 1998

NIPPON KOEI CO., LTD.

LIST OF REPORTS

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CURRENCY EQUIVALENTS

(February 1998)

US$ 1.00 = Rp. 9,000
(avarage of buying and selling rates)

US$ 1.0 = ¥ 125

ABBREVIATIONS AND GLOSSARY

AAET	Badan dan Pandidihan Latihan Pertanian	Agency for Agricultural Extension and Training
AARD	Badan Penelitian dan Pengembangan Pertanian	Agency for Agricultural Research and Development
ADB	Bank Pembangunan Asia	Asian Development Bank
AFTA		ASEAN Free Trade Area
AMDAL	Analisa Mengenai Dampak Lingkungan	Environmental Impact Assessment
APBD	Anggaran Pendapatan dan Belanja Daerah	Local Budget of Receipts and Expenditure
APBN	Anggaran Pendapatan dan Belanja Negara	National Budget of Receipts and Expenditure
ASEAN		Association of Southeast Asian Nations
BAPPEDA	Badan Perencanaan Pembangunan Daerah	Provincial Development Planning Board
BAPPENAS	Badan Perencanaan Pembangunan Nasional	National Development Planning Agency
BBI	Balai Benih Induk	Seed Production Center
BBP	Balai Benih Pembantu	Local Seed Production Farm
BBU	Balai Benih Umum	Main Seed Production Farm
BIPP	Balai Informasi dan Penyulunan Pertanian	Rural Agricultural Information and Extension Center
BPP	Balai Penyuluhan Pertanian	Rural Agricultural Extension Center
BPSB	Balai Pengawasan dan Sertifikasi Benih	Seed Certification and Control Services
BPTP	Balai Pengkajian Teknokogi Pertanian	Assessment Institute for Agricultural Technology
BRI	Bank Rakyat Indonesia	Pepple's Bank of Indonesia
BUMN	Badan Usaha Milik Negara	State Owned Enterprise
Bupati	Kupala Daerah Tingkat II	District Chief
CAE		Center for Agricultural Extension (MOA)
CAQ		Center for Agricultural Quarantine (MOA)
Camat	Kepala Kecamatan	Sub-district Chief
CBS (BPS)	Biro Pusat Statistik	Central Bureau of Statistics
CIF		Cost, insurance and freight
CRIH		Central Research Institute for Horticulture
DAS	Dinas Pertanian Tingkat II	District Agricultural Service
DATI I	Daerah Tingkat I	Provincial Level Government
DATI II	Daerah Tingkat II	District Level Government
DEKOPIN	Dewan Koperasi Indonesia	Indonesia National Union of Cooperatives
Desa		Village

DGFCH	Direktorat Jenderal Tanaman Pangan dan Hortikultura	Directorate General of Food Crops and Horticulture (MOA)
DINAS		Provincial Government Sector Development Offices
DIPERTA	Dinas Pertanian	Provincial Agricultural Service
DI	Daerah Istimewa	Special Territory
DIP	Daftar Isian Proyek	Approved Project Budget
DKI	Daerah Khusus Ibukota	Special Capital District
Dusun		Cluster of Villages
FOB		Free on board
F/S	Studi Kelayakan	Feasibility Study
GATT		General Agreement on Tariffs and Trade
GBHN	Garis-garis Besar Haluan Negara	Guidelines of State Policy
GDP	Pendapatan Nasional Bruto	Gross Domestic Product
GNP	Pendapatan Nasional Netto	Gross National Product
GOI	Pemerintah Indonesia	Government of Indonesia
GOJ	Pemerintah Jepang	Government of Japan
GRDP	Produk Domestik Regional Bruto	Gross Regional Domestic Product
HGU	Hak Guna Usaha	Land Use Right
HRD	Pengembangan Sumber Daya Manusia	Human Resource Development
HYV	Jenis Unggul	High Yielding Variety
IBRD	Bank Rekonstruksi dan Pembangunan Internasional	International Bank for Reconstruction and Development (World Bank)
IDT	Inpres Desa Tertinggal	Presidential Instruction for Program Aid to Less Developed Villages
IHDUA		Integrated Horticulture Development in Upland Areas
Ijon		Buying system of crops from a farmer by paying long time before the harvest
INMAS	Intensifikasi Massal	Mass Intensification (farm input program)
INPRES	Instruksi Presiden	Presidential Instruction (rural public works program)
INSUS	Intensifikasi Khusus	Special Intensification Program (farm input credit program for groups of farmers)
IPEDA	Iuran Pembangunan Daerah	Land Tax
JICA		Japan International Cooperation Agency
Kabupaten		District (Level II Local Government)
Kecamatan		Sub-district(administrative division of Province)
KANWIL	Kantor Wilayah	Provincial Office of Central Line Agency
KCl		Potassium Chloride
Kelompok Tani		Farmers Group

Kepala		Head of Organization
KIK	Kredit Industri Kecil	Small Industry Credit
KMKP	Kredit Modal Kerja Permanen	Credit for Permanent Working Capital
Kotamadya		Municipality (Level II Local Government)
KUD	Koperasi Unit Desa	Village Unit Cooperative
KUT	Kredit Usaha Tani	Credit for Farmer
LKMD	Lembaga Ketahanan Masyarakat Desa	Village Resilience Body
LPTP	Loka Pengkajian Teknokogi Pertanian	Assessment Station for Agricultural Technology
MOA	Departmen Pertanian	Ministry of Agriculture
MOCSED		Ministry of Cooperatives and Small Enterprises Development
MPW	Departemen Perkerjan Umum	Ministry of Public Works
M/P	Rencana Induk	Master Plan
NGO		Non-Governmental Organization
ODP(s)		Orchard Development Project(s)
OECF		Overseas Economic Cooperation Fund
O&M		Operation and Maintenance
Palawija		Secondary crop (planted after rice)
Pancasila		The five principles of the Republic of Indonesia (Belief in God, Humanism, Consciousness, Sovereignty of the People, Social Justice)
PJP-II	Pambangunan Jangka Panjang	Second Long-Term (25 Year) Development Plan
PMO	Kantor Manajemen Proyek	Project Manager Office
PMU	Unit Manajemen Proyek	Project Management Unit
PPL	Penyuluh Pertanian Lapangan	Agricultural Field Extension Worker
PPM	Penyuluh Pertanian Madya	Mid-level Agricultural Extension Officer
PPS	Penyuluh Pertanian Spesialis	Agricultural Extension Specialist
PRAS	Dinas Pertanian Tingkat I	Provincial Agricultural Service
RAD	Pembangunan Pertanian Daerah	Regional Agricultural Development
RFI		Regional Financial Institute
Repelita	Rencana Pembangunan Lima Tahun	Five-Year Development Plan
SGP	Kelompok Pengolahan Usaha Kecil	Smallholder Group Processing
SPC	Pusat Pengolahan Kelompok Usaha Kecil	Smallholder Group Processing Center
SPL		Second Program Loan (OECF)
SUSENAS	Survei Sosial Ekonomi Nasional	National Socio-Economic Survey
Tebasan		Buying system of crops just before their harvest
TSP		Triple Super Phosphate
VAT	Pajak Pertambahan Nilai	Value Added Tax
WTO		World Trade Organization

MEASUREMENTS

Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer

Area

m^2	=	square meter
ha	=	hectare
km^2	=	square kilometer
bata	=	14m x 14m (local unit used in West Java)

Volume

cm^3	=	cubic centimeter
l	=	liter
kl	=	kiloliter
m^3	=	cubic meter

Derived Measures

m^3/s	=	cubic meter per second
kWh	=	kilowatthour
MWh	=	megawatthour

Weight

g	=	gram
kg	=	kilogram
ton	=	metric ton
quintal	=	100 kilograms

Currency

US$	=	US Dollar
Rp.	=	Rupiah
¥	=	Yen

Time

s	=	second
min	=	minute
h	=	hour
d	=	day
y	=	year
%	=	percent

Other Measure

°	=	degree
°C	=	degree(s) Celsius
10^3	=	thousand
10^6	=	million
10^9	=	billion

Fiscal Year

April 1 - March 31

Appendix A

Seedling

APPENDIX A
SEEDLING

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APPENDIX A
SEEDLING

1. INTRODUCTION

In Indonesia, farmers have usually planted a few fruit trees in their home garden for subsistent purposes. This practice without any fertilization and post-harvest handling activities is quite different from their rice cultivation in irrigated paddy field or industrial crop planting in estate crop field even though its farming scale is small. Since the commencement of Repelita V, new policy targeting to encourage farmers to grow fruit trees on their farm land has been promoted by the Government of Indonesia. In the course of promotion, a wide range of issues have been identified, which are hindering the target realization. For successful fruit growing, such problems should be tackled paying special attention to how to make markets and consumers recognize the quality of fruits as well as to gain high value-added through taking business-minded and market-oriented actions. Among others, the use of good and enough planting materials including fruit seedlings is prerequisite to improve the quality of tropical fruits.

In this Study, the present situation of fruit seedling production and supply in four Provinces has been examined aiming to find technical improvement measures and institutional arrangements. The target fruits are listed up as below together with the respective botanical names :

- Avocado	Persea americana Mill. and Persea gratissima Gaertin.;
- Banana	Musa sapientum Linn. and Musa paradisiaca Linn. sapientum O.Kuntze
- Duku	Lansium domesticum Jacq. var. duku Jacq. and Lansium domesticum Jacq. var. typica Baker
- Durian	Durio zibethinus Murr.
- Mango	Mango indica Linn.
- Mangosteen	Garcinia mangostana Linn.
- Marquisa	Passion fruit, Passiflora eduis Sims
- Rambutan	Nephelium lappaceum Linn. and Litchi chevelu II; and
- Salak	Zalacca edulis Blume, Zallaca edulis Reinw.ex Blume, Zalacca blumeana Mart. and Calamus zalacca Gaertn

2. SEEDLING PRODUCTION SYSTEM IN INDONESIA

2.1 Production, Propagation and Distribution

Organizations involved in fruit seedling development consist of central and local government agencies as well as private sector. In the Ministry of Agriculture (MOA), the Directorate General of Food Crops and Horticulture (DGFCH) is responsible agency under which the Sub-Directorate of Horticulture Seed Development of the Directorate of Seed Development of and the Seed Certification and Control Services (BPSB) handle administrative and technical aspects. At Provincial level, Central Seed Farm (BBI) and Main Seed Farm (BBU) are main players under the control of the Provincial Agricultural Services. The private sector includes importers, seed growers and nurseries.

(1) Central Seed Farm

The task and function of BBI are as follows:

- Provision of fruit seedlings with Foundation Seed and Stock Seed classes;
- Provision of technical guidance to BBU and BBP;
- Observation of seed technology;
- Seedling information center;
- Purifying of high quality variety that has been circulated for a long time;
- Testing on variety from plant breeder; and
- Provision of training and meeting forum for extension workers, key farmers, seed growers, officers and experts.

The activities comprise multiplication, training, and construction of Foundation Block (FB) and Scion Multiplication Block (SMB). In order to improve fruit quality, multiplication targets are:

- Mother plant for up-trunk (scion) which is suited for local agro-climate and has a high-economic value; and
- Low-trunk of main tree which is recommended/compatible.

To produce clone of mother plant, the multiplication is implemented by developing FB and SMB. This can make the channel of seedlings clear with guarantee of quality. The short-term purposes of constructing FB and SMB are:

- FB is used as a source of seed and scion for SMB which is build at each BBI and/or BBU;
- SMB is used as a source of seed and scion for BBU/BBP and/or horticulture seed growers;
- Appropriate amount of fruit seedlings are produced in short time, giving guarantee of origin, variety and quality of seedlings; and
- Education and training programs are provided to BBU's staff, seed growers, instructor and farmer groups.

The long term purposes are:

- To collect a mother plant which is a continuous multiplication source;
- To secure and preserve *gem-plasma* source of varieties facilities released by the MOA;
- To function as a seedling information center, meeting place, course/training and surveying, observing and job-training place; and
- To support agro-industry development by providing high quality raw materials.

In FB, mother plants are planted with the same distance of production field. These entries come from the mother plant released by the MOA as first rank/grade. In SMB which is managed by public or private sector, fruit trees are planted with a very close distance to produce scions.

Breeding and propagation of recommendable mother plants aim to supply of cloning plantlet of high quality varieties which have been released by the MOA in order to fulfill orchard

development target. The objective and target of breeding and propagation plan are determined in due consideration of seven factors such as type, variety, quality, quantity, location, price and time. With multiplication system through FB and SMB, the origin of seedling can be known.

Mother plant is a fruit cultivator having an advantage compared with other cultivators and can be considered the best source of multiplication. The adaptability of mother plant to produce seedlings should be conformed as follows:

- Up-trunk for entries from the viewpoint of their excellency known precisely, high quality fruit (traditional clone), high productivity (standard clone), and at least three seasons/times of fruit bearing (selected clone); and

- Low-trunk for root stock paying special attention to restraint of root disease/sub-optimum environments, compatible/fit with up-trunk, short-trunk but growing fast and strong, and resistance to prime disease.

The capability of BBI in breeding and propagating mother plants is still limited because of lack of capable human resources and poor facility and infrastructure. In order to improve such situation, several actions should be taken as follows:

- To complete BBI's facility and infrastructure so as to produce cloning fruit seedling and improve quality of fruits;
- To improve BBI's staff capability, either technically or administratively;
- To improve skills and know-how of seed growers/seedling producer through training and comparative study;
- To provide training facilities such a dormitory and office equipment;
- To construct office facilities, seed warehouse, shade house, screen house and irrigation facilities; and
- To upgrade or construct a tissue-culture laboratory with necessary equipment.

(2) Main Seed Farm

As for fruit seedlings, BBU functions as a multiplication unit of which scion comes from SMB. Each BBU for horticulture has one chief, three technical staff, one administrative officer and some site officer or farming instructors. The standard facilities of BBU is to be equipped in line with its duties and commodity. To meet the requirement and strongly related to the area covered by BBU, the average size is 5 ha.

2.2 Certification and Control

As a technical implementation unit of the DGFCH, the BPSB for food crops and horticulture is established at 15 locations in Indonesia as follows:

- BPSB/TPH I located in Bandung covering West Java and D.K.I. Jakarta;
- BPSB/TPH II located in Tegalgondo covering Central Java and D.I. Yogyakarta;
- BPSB/TPH III located in Wonocolo covering East Java;
- BPSB/TPH IV located in Medan covering North Sumatra;
- BPSB/TPH V located in Bukit Tinggi covering West Sumatra, Riau and Jambi;
- BPSB/TPH VI located in Maros covering South Sulawesi, South East Sulawesi;
- BPSB/TPH VII located in Denpasar covering Bali;

- BPSB/TPH VIII located in Tanjung Karang covering Lampung;
- BPSB/TPH IX located in Palembang covering South Sumatra and Bengkulu;
- BPSB/TPH X located in Mataram covering West Nusa Tenggara and East Nusa Tenggara;
- BPSB/TPH XI located in Banjar Masin covering South Kalimantan and East Kalimantan;
- BPSB/TPH XII located in Banda Aceh covering D.I. Aceh;
- BPSB/TPH XIII located in North Sulawesi covering North Sulawesi and Central Sulawesi;
- Loka PSB/TPH I located in Pontianak covering Central Kalimantan; and
- Loka PSB/TPH II located in Jayapura covering Maluku.

The tasks and functions of BPSB are judgment of cultivars, certification of seed, examination of seed by laboratory method and control of seed markets. The judgment of cultivar includes;

- Examination of multiplication for paddy, palawija and horticulture;
- Introduction of cultivar for paddy, palawija and horticulture;
- Judgment of variety distribution;
- Collection of local variety;
- Observation of cultivar/variety;
- Processing data of multiplication examination, introduction of cultivar and observation of cultivar; and
- Recording and storing data which related to the above activities.

The examination of seed by laboratory method covers water content, purification, germination, vigor, viability, seed healthy, heterogeneity and correctness seed, determination of seed weight, expanding of seed exanination method, and recording and storing data which related to the above activity.

The seed market is controlled based on current Government's regulation focusing upon;

- Inventory of seed trader;
- Reception of application for registration and evaluation of bonafide seed trader;
- Giving opinion and suggestion for awarded and cancellation registered mark as seed trader;
- Inspection on correctness of label from seed which will be trade in;
- Inspection on recording of seed which will be trade in and/or it has been trade in;
- Giving notice, prohibition and cancellation of seed circulation prohibition which being trade in;
- Provide guidance to trader and seed user about current seed regulation, benefit of quality seed and how to obtained seed;
- Solution of cases which were raised in procurement, trade and utilization of seed accordingly the current regulation;
- Collecting and analyzing data about application of seed regulation by means of field examination and laboratory examination for each seed; and
- Recording and storing data which related to the above activities.

The certification of seeds covers:

- Field inspection;
- Controlling harvesting and land forming;
- Controlling harvesting equipment and processing data;
- Seed sampling for laboratory examination;
- Making decision to determined passed or not passed;
- Controlling label and seal fitting;
- Collecting judgment data for completing seed certification system;
- Procurement label;
- Expanding seed certification method; and
- Recording and storing data which related to the above activities.

The seed certification provided by the BPSB gives guarantee of place, package and hierarchy of seed class. The hierarchy of seed class is as follows:

- Foundation seed class is indicated by white colored label;
- Stock seed class is indicated by purple colored label;
- Extension seed class is indicated by blue colored label; and
- Labeled seed class is indicated by pink colored label.

As described in the above, the current BPSB's functions and activities focus upon food crops and less attention has been paid to horticulture.

2.3 Policy and Strategy for Quality Improvement of Fruit Seedlings

(1) Development of Fruit Tree Variety

The present policy and strategy for development of new fruit verity are as follows:

- Development of breeding system to provide high quality variety;
- Improvement of variety selection system;
- Utilization of hybridization ;
- Introduction of new varieties from neighboring countries; and
- Utilization of bud mutation through research by irradiation technique.

(2) Research and Development Plan of New Fruit Variety Development

The current research and development plan of new fruit variety development is conducted focusing upon: (i) agroclimatic and land suitability, (ii) demand of national and international market (consumer), (iii) utilization and development of specific (local) variety

(3) Determination Process of New Fruit Variety Development Plan

For the purpose of determining new fruit variety development plan, the MOA established the national seed committee, of which constituent members are the DGFCH, Agency for Agribusiness Agency, and Agriculture Research and Development (AARD) and other relevant agencies, to make discussions considering such factors as resistance against diseased and pests, and improvement of fruit quality. For the improvement of fruit quality, attention is paid to the following aspects:

- Use of superior variety with activities covering selection of mother plant, introduction of new variety and fruit contest;
- Improvement of production management with activities consisting of utilization of modern technology including fertilizer, pesticides, pruning and irrigation;
- Durability for storage and transportation with activities directed to use cold storage, waxing and control atmosphere chamber;
- Processing suitability;
- Consumers acceptability;
- Early bearing;
- High productivity; and
- High quality of fruit.

(4) Organizational Structure

The development plan is implemented by the National Fruit Research Institute located at Solok in West Sumatra. All the outputs of development activities are to be evaluated by conducting adaptability test at the Assessment Institutes and Stations for Agricultural Technology established at 17 locations throughout the country under the management of the AARD. In case of fruits, BPTP at Sukarami in West Sumatra is in charge.

2.4 Policy and Strategy for Supply of Qualified Seedlings

The policy and strategy for the supply of quality fruit seedlings are:

- To extend the ability and technical knowledge of government officers concerned, seed grower, seedling nursery men and seed retailer through training, courses and comparative study on seedling;
- To increase and strengthen the evaluation, exploration and determination in preparing and releasing high quality variety as well as applied technology and equipment;
- To develop an advanced technology like tissue culture and to distribute the technology to private company who supplies seedling for horticulture development projects;
- To develop and improve BBI and BBU coupled with their FB and SMB in order to serve quality guaranteed materials to seed growers;
- To distribute the information on the qualified seedling and high yielding variety through campaign and promotion to community;
- To increase the capability of BPSB in terms of service, controls and guidance to seed growers, seedling producers and seed retailers and their organization to produce qualified fruit seedlings;
- To increase quality of seedling through strengthening certification efforts in order to guarantee seedling supply based on the 3-quality standards that have been declared; and
- To develop and strengthen the regulation related to seedling through Adaptation Test Regulation.