

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	Back
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	Back
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 Sandy	Moderate to Slow	Good
9.	Lithosol	None	Varied	Varied	Less than 0.5	Varied	High	Low	Sandy	Varied	
10.	Gray Hydromorphic	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	bed	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	bed	bed	-	-	-
5. Mango	0 to 500	-	-	abcd	abc	abc
6. Mangosteen	0 to 800	abcd	ab	ab	ab	-
7. Marquisa	1,000	bed	bc	bc	-	-
8. Rambutan	0 to 600	bed	bed	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	ungostee	Marquisa	Rambuta	Sulak	
Bogor, West Java (lat)	266	12-0	11,5-0,3	2	A	B	D	L	Mia	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	S
Payakumbuh, West Sumatra (lat)	512	12-0	9,3-1,1	12	.	B	D	L***	.	M	.	.	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	S
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	.	.	M	.	.	R	S
Purbolinggo, Central Java (lat)	42	10-0	9,1-1,8	20	.	B	D	L	.	M	.	.	R	S
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	.	B	D	.	.	M	.	.	.	S
Bangli, Bali (lat)	500	10-0	8,5-2,0	23	.	.	D	.	.	M	.	.	.	.
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	.	.	.	S
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	L	.	M	.	.	R	S
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	.	.	D	L	.	M	.	.	R	.
Sumedang, West Java (lat)	457	9-1	8,3-2,7	32	A	B	D	L	.	M	.	.	R	S***
Tempel, Central Java (lat)	500	9-0	8,7-2,8	32	.	B	D	L	.	M	.	.	R	S
Banjat, West Java (lat)	40	9-1	8,4-2,8	33	A	B	D	L	.	M	.	.	R	.
Besuki, East Java (?)	87	10-1	7,4-2,5	33	.	.	D	.	.	M	.	.	.	.
Ambarawa, Central Java (lat)	514	9-0	8,2-2,0	34	A	B	D	L	.	M	.	.	R	.
Indrapuri, Aceh (?)	0	10-0	7,5-2,6	35	.	.	D	L	.	M	.	.	R	.
Kaliworo, 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	.	.	D	.	.	M	.	.	R	.
Temuguruh, East Java (?)	192	9-3	8,0-3,3	37	A	B***	D	.	.	M	.	.	R	S
Bumiayu, West Java (lat)	152	9-1	8,3-3,1	37	A	B	D	L	.	M	.	.	R	S
Kaliwangi, Central Java (lat)	4	9-3	7,8-3,0	39	.	B	D	.	.	M	.	.	R	.

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 periods in months	Quotient	Avocado	Banana	Durian	Lanzon	Mango	Mangostee	Marquisa	Rambutan	Salak	
Muntian, 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	
Amibal, 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	-	M***	-	R	S***	
Kaligesing, Central Java (lat)	100	9-3	7.9-3.8	48	-	-	D	L	-	M	-	R	S	
Kramatwatu, West Java (lat)	15	8-2	6.7-3.2	48	-	-	D	L	-	M	-	R	-	
Jakarta (lat)	7	8-1	6.7-3.3	49	A	-	D	-	-	-	-	-	-	
Magetan, East Java (lat)	52	8-3	7.6-3.9	51	-	B	D	-	-	-	-	-	S	
Singosari, East Java (lat)	250	7-3	7.2-3.7	51	A	B	D	L***	-	-	-	-	-	
Puspo, East Java (lat)	640	9-2	7.5-3.8	51	-	-	D***	-	-	-	-	-	-	
Magelang, Central Java (lat)	380	9-1	7.5-3.8	51	A	-	-	L	-	-	-	-	-	
Wingsi, 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	-	-	-	-	-	
Tumpang, Central Java (lat)	600	7-3	6.9-3.8	55	A	-	-	L	-	-	-	-	-	
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	-	-	L	-	-	-	-	S	
Sawahan, East Java (?)	570	7-3	7.1-4.6	65	-	-	-	-	-	-	-	-	-	
Kanigoro, East Java (Marg)	70	7-3	6.6-4.5	68	-	-	-	-	-	-	-	-	S	
Plumbon, West Java (Marg)	17	7-3	6.4-4.4	69	A	-	-	-	-	-	-	-	-	
Bangodua, West Java (Marg)	15	7-3	6.5-4.5	69	-	-	-	-	-	-	-	-	-	
Ngunut, East Java (?)	103	7-3	6.1-4.7	76	-	-	-	L	-	-	-	-	-	
Kawedan, East Java (?)	220	7-3	6.5-4.9	76	-	-	-	-	-	-	-	-	-	
Ujung Pandang, South Sulawesi (Marg)	3	6-4	6.0-4.8	80	-	-	-	-	-	-	-	-	-	
Nganjuk, East Java (Marg)	60	7-3	6.0-5.1	85	-	-	-	-	-	-	-	-	-	
Pamekasan, Madura (Marg)	15	7-3	6.0-5.3	88	-	-	-	-	-	-	-	-	-	
Winongan, East Java (?)	10	5-4	5.2-5.9	113	-	-	-	L	-	-	-	-	-	
Pasuruan, East Java (Marg)	5	5-4	4.8-6.1	125	-	-	-	-	-	-	-	-	-	
Probolinggo, East Java (Marg)	10	5-4	4.9-6.3	129	-	-	-	-	-	-	-	-	-	
Banyuwangi, East Java (?)	5	4-1	4.3-5.7	132	A	-	-	L	-	-	-	-	-	
Kupang, Timor (Marg)	2	4-6	4.2-7.2	171	-	-	-	-	-	-	-	-	-	

Resources: Terra, GIA (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
				9	2	7.5	3.8	51
Durian	Pupo	East Java	640	7	3	6.4	4.4	69
				7	3	6.5	4.5	69
				7	3	6.0	5.3	88
				5	4	5.2	5.9	113
				5	5	4.8	6.1	125
				5	6	4.9	6.3	129
				9	0	8.7	2.8	32
Salak	Tempel	Central Java	500	8	2	7.6	3.6	47
				12	0	10.3	0.7	7
Rambutan	Binjai	North Sumatra	28	12	0	8.7	1.3	15
				10	1	7.9	3.2	41
				12	0	9.9	1.0	10
				7	3	7.2	3.7	51
				9	3	7.9	3.8	48
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	Ramboutan	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 Punga-Punga Siempatnempu Hilir Tiga Lingga	Durian Durian Durian	100 100 50	300-700			3-8	
Tapanuli Utara Garoga	Mangosteen	500	400-700	A ₂ type (10-0)	Flat, undulating, rolling to hilly	0-40	Podzolic, Regosol and Lithosol
Garoga Pahae Julu	Durian Durian	300 100	400-500			2-40	Alluvial, Latosols, Podzolic, Regosol, and Lithosol
Pahae Jae	Durian	100				0-40	
Tapanuli Tengah Sorkam Lumut Sibabangun	Durian Durian Durian	250 250 250	100-200 2-15	A ₁ type (12-0)	Plain Plain to undulating	0-2	Yellow red podzolic
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 Padang Sidempuan Barat Padang Sidempuan Timur	Salak Salak Salak	800 500 200	300-500 300-600 250-600				

* Schmidt and Fergusson method.

The method divided into 6 types of climates :

1. A₁ type or wet climate, which has 12 wet months and 0 dry months
2. A₂ type or wet enough climate, which has less than 12 wet months and 0 dry months
3. B₁ type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B₂ 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.

Topography
 plain }
 undulating } wet climate without dry month
 rolling }
 hilly } wet climate with dry season
 mountainous }
 > 300 m } dry climate has more than 4 dry months

Slope
 0-3% }
 3-8% }
 8-15% }
 15-30% }
 > 30% }

Height
 0-5 m }
 5-15 m }
 15-50 m }
 50-200 m }
 > 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 Cigugur	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 Cibeurum Manonjaya	Salak Salak	500 300	200-400	A ₁ type (12-0)	Undulating to rolling	15-30	Regosol, and Yellow red podzolic Latosol, Yellow red podzolic, and Regosol
Kawalu	Salak	200					
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

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3. B₁ type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B₂ 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	Topography	Slope	Height
	plain	0-3%	0-5 m
	undulating	3-8%	5-15 m
} wet climate with dry season	rolling	8-15%	15-50 m
	hilly	15-30%	50-200 m
} dry climate has more than 4 dry months	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	
Tulungagung							
Ngaturu	Duku	600	25-100	B ₂ type (6-3)	Plain	0-2	Alluvial
Kedungwanu	Duku	400	25-100		Plain	0-2	Alluvial
Trompsalek							
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		
Tujiran	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
Runyoso	Avocado	600	200-300		Rolling	2-15	Regosol and Mediterranean
Randuagung	Avocado	100	100-700		Plain	2-15	Latosols
Kudungjatiang	Avocado	100	150		Rolling	2-15	

* Schmidt and Fergusson method.

The method divided into 6 types of climates :

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3. B₁ type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B₂ 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.

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

- } wet climate without dry month
- } wet climate with dry season
- } dry climate has more than 4 dry months

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 Tompobulu Tinggi Moncong	Marquisa Avocado Avocado	1,000 150 200	1,000-1,200	B ₂ type (8-2)	Hilly to mountainous	20-40	Latosols, and Mediterranean 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	8-50	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 Mantowawo Marianawa	Avocado Avocado	250 250	60-200	A ₁ type (12-0)	Rolling to hilly Rolling to hilly	0-15 16-25	Regosol, Mediterranean and Lithosol Mediterranean
Enrekang Metwa	Rambutan	500	165	A ₁ type (12-0)	Undulating	10-15	Podzolic and Mediterranean (PH 5-6)
Tana Toraja Mengkendek Saluputti Rindingallo	Mangosteen Marquisa Marquisa	500 2,000 1,000	300-800 800-1500	A ₂ type (9-0) B ₁ type (9-1)	Rolling to hilly Hilly to mountainous	10-15 15-30	Yellow red podzolic Yellow red podzolic Yellow red podzolic

* Schmidt and Fergusson method.

The method divided into 6 types of climates :

1. A₁ type or wet climate, which has 12 wet months and 0 dry months
2. A₂ type or wet enough climate, which has less than 12 wet months and 0 dry months
3. B₁ type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B₂ 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.

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

} wet climate without dry month
 } wet climate with dry season
 } dry climate has more than 4 dry

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
Barro 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. A₁ type or wet climate, which has 12 wet months and 0 dry months
2. A₂ type or wet enough climate, which has less than 12 wet months and 0 dry months
3. B₁ type or wet half climate, which has 9-10 wet months and 1-2 dry months
4. B₂ 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.

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

} wet climate without dry month
 } wet climate with dry season
 } dry climate has more than 4 dry

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

Operation	Year	Apr.	May	Jun	Jul	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
A. Non Bearing Tree													
1. Planting													
1.1 Variety:													
- ljo panjang (long green)													
- ljo 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, antraenosa, 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 pruned 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 pruned 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													
I. 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													
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 fertiliza- tion 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 pruned 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	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													
1.2.1 120 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 fertili- zation 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 pruned 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 pruned 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 pruned 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 caterpillars attack leave, flower, fruit and shoot													
- powdery nutdew													
5. Other operations													
5.1 Soil under the crown has to be chopped				*				*				*	
5.2 Dry and dead twig has to be pruned 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 second liming at the rate of 2.5-3.5 ton/ha. in rainy season	5												
	6							*					
	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 pruned				*				*				*	
5.2 Pruning gives good aeration, induce flower formation and push down investment 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	4												
liming at the rated 2.5-3.5	5												
ton/ha in the rainy season	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
<u>1st year</u>				
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
<u>2nd year</u>				
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
<u>3rd year</u>				
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
<u>4th year</u>				
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
<u>5th year</u>				
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-4-44 Annual Labor Requirement by Farming Practice (2/9)

Commodity : *Banana*

Unit : man-day/ha

Item	Farming Practice	Unit : man-day/ha		
		Family	Hired	Total
<u>1st year</u>				
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
<u>2nd year</u>				
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
<u>3rd year</u>				
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
<u>4th year</u>				
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	Labor Requirement (man-day/ha)		
		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	Unit : man-day/ha		
		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

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	Unit : man-day/ha		
		Family	Hired	Total
<u>1st year</u>				
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
<u>2nd year</u>				
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
<u>3rd year</u>				
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
<u>4th year</u>				
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
<u>5th year</u>				
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)

Unit : man-day/ha

Commodity : *Mangosteen*

Item	Farming Practice	Labor Requirement (man-day/ha)		
		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	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-4.1.1 Annual Labor Requirement by Farming Practice (7/9)

Commodity : <i>Marquisa</i>		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	--	16.0
2. Harvesting	Picking of fruits	12.0	--	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	Unit : man-day/ha		
		Family	Hired	Total
<u>1st year</u>				
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
<u>2nd year</u>				
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 manure and fertilizers	--	10.1	10.1
	Total	45.9	18.1	64.0
<u>3rd year</u>				
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
<u>4th year</u>				
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
<u>5th year</u>				
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 manure and fertilizers	--	33.0	33.0
	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	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
- Purchased seed													
• Fertilizer	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
- Urea	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
- TSP	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
- KCl	kg												
• Agro-chemicals	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
- Pesticide	kg	-	-	-	-	-	-	-	-	-	-	-	-
- Fungicide	ton	4.0	0.8	-	-	-	-	-	-	-	-	-	-
• Other materials	lit	-	1.6	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Organic manure	no.	-	-	-	-	-	-	-	-	-	-	-	-
- Organic materials	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
- Plastic cover	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
• Labor													
- Family													
- Hired													
Banana													
• Seedling	no.	1000.0	-	-	-	1000.0	-	-	-	-	1000.0	-	-
- Purchased seed													
• Fertilizer	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
- Urea	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
- TSP	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
- KCl	kg												
• Agro-chemicals	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
- Pesticide	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
- Fungicide	ton	40.0	-	-	20.0	20.0	-	20.0	20.0	-	20.0	20.0	-
• Other materials	lit	-	20.0	20.0	15.0	15.0	20.0	15.0	15.0	20.0	15.0	15.0	20.0
- Organic manure	no.	-	1000.0	2000.0	2000.0	2000.0	-	1000.0	2000.0	2000.0	2000.0	-	1000.0
- Organic materials	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
- Plastic cover	ffd	380.0	80.0	40.0	40.0	40.0	80.0	80.0	40.0	40.0	40.0	80.0	80.0
• Labor													
- Family													
- Hired													

Source : JICA Study Team

Table B-4-1S 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	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
- Purchased seed													
* Fertilizer	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
- Compound	kg	-	-	-	-	-	-	-	-	-	-	-	-
- TSP	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
- KCl	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Agro-chemicals	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
- Pesticide	kg	-	-	-	-	-	-	-	-	-	-	-	-
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Other materials	ton	20.0	0.4	-	-	-	-	-	-	-	-	-	-
- Organic manure	lit	-	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
- Organic materials	no.	-	-	-	-	-	-	-	-	-	-	-	-
- Plastic cover													
* Labor	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
- Family	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
- Hired													
Durian													
* Seedling	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
- Purchased seed													
* Fertilizer	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
- Urea	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
- 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													
* Agro-chemicals	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
- Pesticide	kg	-	-	-	-	-	-	-	-	-	-	-	-
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
* Other materials	ton	4.0	0.8	-	-	-	-	-	-	-	-	-	-
- Organic manure	lit	-	-	-	-	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Organic materials	no.	-	-	-	-	-	-	-	-	-	-	-	-
- Plastic cover													
* Labor	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
- Family	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
- Hired	md												

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	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
- Purchased seed													
* Fertilizer	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
- Urea	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
- TSP	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
- KCl	kg												
* Agro-chemicals	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
- Pesticide	kg	-	-	-	-	-	-	-	-	-	-	-	-
- Fungicide	ton	20.0	0.4	-	-	-	-	-	-	-	-	-	-
* Other materials	lit	-	1.2	1.9	2.4	3.3	4.7	5.0	5.0	5.0	5.0	5.0	5.0
- Organic manure	no.	-	-	-	-	-	-	-	-	-	-	-	-
- Organic materials	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
- Plastic cover	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
* Labor													
- Family													
- Hired													
Mangosteen													
* Seedling	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
- Purchased seed													
* Fertilizer	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
- Urea	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
- TSP	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
- KCl	kg												
* Agro-chemicals	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
- Pesticide	kg	-	-	-	-	-	-	-	-	-	-	-	-
- Fungicide	ton	6.0	1.2	-	-	-	-	-	-	-	-	-	-
* Other materials	lit	-	1.6	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Organic manure	no.	-	-	-	-	-	-	-	-	-	-	-	-
- Organic materials	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
- Plastic cover	md	48.0	20.8	8.0	8.0	8.0	23.0	83.0	203.0	338.0	518.0	698.0	698.0
* Labor													
- Family													
- Hired													

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	no.	500.0	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
- Purchased seed	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
• Fertilizer	kg	-	-	-	-	-	-	-	-	-	-	-	-
- ZA + DS + ZK	kg	-	-	-	-	-	-	-	-	-	-	-	-
- TSP	kg	-	-	-	-	-	-	-	-	-	-	-	-
- KCl	kg	-	-	-	-	-	-	-	-	-	-	-	-
• Agro-chemicals	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
- Pesticide	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
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
• Other materials	ton	10.0	2.0	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
- Organic manure	lit	-	4.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
- Organic materials	no.	-	-	-	-	-	-	-	-	-	-	-	-
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
• Labor	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
- Family	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
- Hired	md	-	-	-	-	-	-	-	-	-	-	-	-
Rambutan													
• Seedling	no.	100.0	20.0	-	-	-	-	-	-	-	-	-	-
- Purchased seed	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
• Fertilizer	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
- Urea	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
- TSP	kg	-	-	-	-	-	-	-	-	-	-	-	-
- KCl	kg	-	-	-	-	-	-	-	-	-	-	-	-
• Agro-chemicals	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
- Pesticide	kg	-	-	-	-	-	-	-	-	-	-	-	-
- Fungicide	kg	-	-	-	-	-	-	-	-	-	-	-	-
• Other materials	ton	2.0	0.4	-	-	-	-	-	-	-	-	-	-
- Organic manure	lit	-	1.2	1.9	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
- Organic materials	no.	-	-	-	-	-	-	-	-	-	-	-	-
- Plastic cover	no.	-	-	-	-	-	-	-	-	-	-	-	-
• Labor	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
- Family	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
- Hired	md	-	-	-	-	-	-	-	-	-	-	-	-

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													
* Seeding	no.	2000.0	400.0	-	-	-	-	-	-	-	-	-	-
- Purchased seed													
* Fertilizer	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
- Urea	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
- TSP	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
- KCl													
* Agro-chemicals	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
- Pesticide	kg	-	-	-	-	-	-	-	-	-	-	-	-
- Fungicide													
* Other materials	ton	20.0	4.0	-	-	-	-	-	-	-	-	-	-
- Organic manure	lit	-	8.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
- Organic materials	no.	-	-	-	-	-	-	-	-	-	-	-	-
- Plaxtic cover													
* Labor	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
- Family	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
- Hired													

Source : JICA Study Team

Table B-4-16 Annual Target Yield

(Unit : ton/ha)

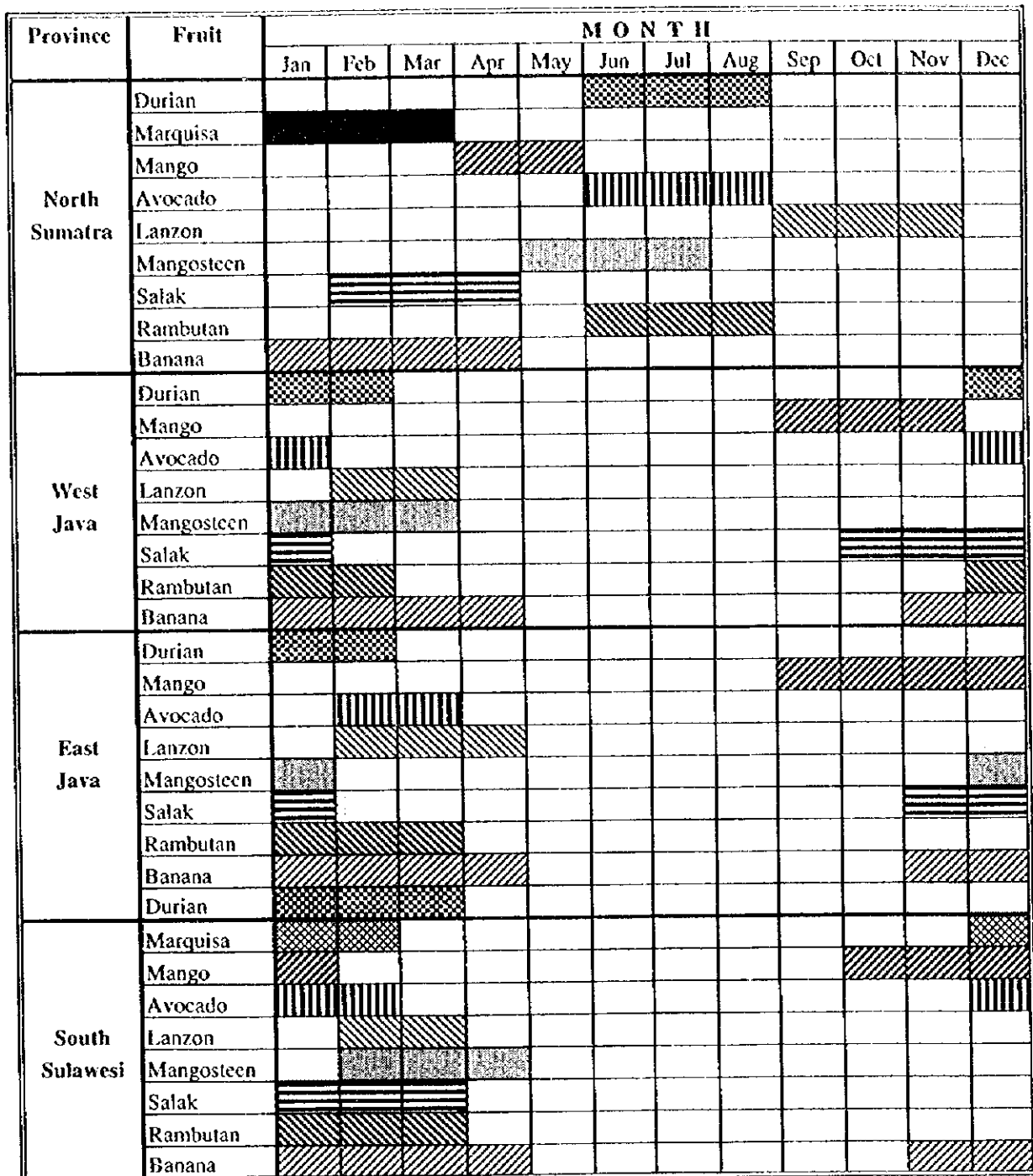
Year	Fruit Commodity										Intercrop	
	Avocado	Banana	Duku	Durian	Mango	Mangosteen	Marquisa	Rambutan	Salak	Maize	Groundnut	
1	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.2	
2	0.00	10.0	0.0	0.00	0.0	0.0	1.2	0.0	0.0	2.4	1.2	
3	0.00	20.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	2.4	1.2	
4	0.00	20.0	0.0	0.0	0.0	0.0	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

**THE STUDY ON THE IMPROVEMENT
IN QUALITY OF THE TROPICAL FRUITS**

Appendix C

Post-harvest Handling and Processing

**APPENDIX C
POST-HARVEST HANDLING AND PROCESSING**

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APPENDIX C POST-HARVEST HANDLING AND PROCESSING

1. INTRODUCTION

It is a fact that post-harvest losses of agricultural products in developing countries usually amount to more than 25% of the total production, as a result of mishandling, spoilage, and pest infestation. This means that a quarter of the produce never reaches consumers. This is a huge waste of money and efforts of farmers and growers.

Fruit is perishable more quickly than grain and tuber if proper care is not taken for its handling, including harvesting, sorting, grading, packaging, and transportation to the market.

It is commonly recognized that the important role of processing is to treat excess fruit from the market and also to convert deteriorated fruit to some form of product for value addition. Due to the lack of an appropriate collection and distribution system, however, the processed products are until now marketable only in communities located nearby production areas. To export such products to international market, it is indispensable to apply a contract farming system in which the quantity, quality and delivery time of the produce shall be clearly specified in order to ensure constant supply of raw materials for processing.

2. PRESENT CONDITION AND CONSTRAINTS OF POST-HARVEST HANDLING IN PROVINCES

2.1 North Sumatra Province

The production of tropical fruit in North Sumatra in the last five years is summarized in Table C2.1.

Table C2.1 Tropical Fruit Production in North Sumatra

Fruit	1992	1993	1994	1995	1996
Durian	43,556	44,347	46,599	45,040	48,546
Mangosteen	611	926	792	1,983	2,084
Marquisa	2,181	3,289	3,998	8,378	n.a.
Rambutan	10,639	12,821	13,603	13,954	14,276
Salak	61,258	77,411	57,353	79,233	79,987

Source: JICA Survey Team, Dec. 1997

Among the selected tropical fruits, durian, rambutan and salak show stable increase in yearly production with slight fluctuation. Production statistics are not fully available for marquisa and mangosteen. Their yearly production still remains at a lower level. At one of mangosteen production areas in Tapanuli Selatan District, a PPL/collector said that farmers became aware of the economic advantage of growing mangosteen trees a few years ago and they have just begun to spread NPK fertilizer.

The production of mangosteen in 1996 was merely 934 tons and most by distributed to urban areas such as Medan and Jakarta. Super quality mangosteen is exported to Singapore and Malaysia through traders. The quality should be smooth skin without any traces of scab. There

are no storage and packing houses in the production area. Traders handle the fruit with returnable clear plastic basket.

Salak production is the biggest among the selected tropical fruits in the Province. Some salak farmers in the production area adopt the "Ijon system" that is selling fruit while it is still on the tree, while salak farmers in Kec. Padangsidempuan Barat have established the "Development Centre" by themselves. There is a big difference in farm gate price between the Ijon system's salak and the Development Center's salak.

Durian farmers in Dairi harvest the fruit by themselves but there are no packing houses in the production area. Since only 30% of durian harvested is sold in the local market, most product is to be transported to urban areas. The transportation cost is usually very expensive: Transport by 2-ton pick up trucks owned by traders/collectors over a distance of 170 km from Dairi to Medan costs Rp. 200,000 to 300,000. The higher transportation cost reduces the farm gate price in remote production areas, that is the major constraint for producer farmers. The farm gate price of durian in Dairi is Rp. 1,500 per piece while that in Langkat District, which is about 55 km north of Medan is Rp. 4,000 per piece.

The production quantity of marquisa in Karo District amounted to 8,244 tons in 1996. There is a market both in Brastagi and Medan. The market in Brastagi supplies raw material for juice/syrup processing and that in Medan supplies fresh fruit and raw material for juice/syrup processing. Since the distance from the production area to Medan is less than 100 km, there are no particular difficulties for post-harvest handling and packaging.

Rambutan production has increased steady year by year in the Province and amounted 14,276 tons in 1996. The production in Langkat District is 3,792 tons which accounts for about 26% of the provincial share. Although 80% of rambutan growers practice mainly paddy farming, they are very active and have a keen interest in expanding their farmland and in applying irrigation system in order to extend the harvest season. There is a collection center in Kec. Binjai that was installed by collectors. Most farmers bring their crops to the collection centre for selling. Sorting, grading and bunching are carried out by collectors. Accordingly, there seems to be no constraint on post-harvest handling for farmers.

Salak growing farmers in Tapanuli Selatan District have the same constraint as durian growing farmers in Dairi District. Because there is no commercial value of salak in producing area, most product should be transported to Medan which is 380 km from Padangsidempuan, a local capital. Some portion is also transported to Jakarta by truck and ferry boat. It takes about 2 days and this long transportation affects significantly the shelf life of salak. Packaging of salak is usually made with traditional natural fiber woven bags of 25 kg that are not effective for deterioration prevention during transportation.

The life of mangosteen is not so long at ambient temperature, that is 3 days for red skin fruit and 8 days for yellow skin one. Fastest transportation to the market is therefore indispensable. Recently 5 regular flights become available weekly between Padangsidempuan and Medan. Fortunately, the difference between the price in the Kramat Jati wholesale market in Jakarta and the farm gate price at Tapanuli Selatan could cover the transportation cost at present as shown in Table C2.2.

Table C2.2 Difference Between Urban Market Price and Farm Gate Price

Farm Gate Price (Rp/kg) Tapanuli Selatan	Kramat Jati Wholesale Market (Rp/kg)		
	Oct. '96	Nov. '96	Dec. '96
2,000	2,319	2,661	2,661

Source : Laporan; Bulanan dan tahunan Perkembangan Harga & Tonase Sayur Mayur dan Buah-Buahan, Pasar Induk Kramat Jati Jakarta, 1996

2.2 West Java Province

The characteristic of fruit market in West Java is that demand always exceeds supply in the Province. Since the fruit produced in the Province is not sufficient to supply a huge market in adjacent D.K.I. Jakarta, it is necessary to import fruit from outside the Province to meet the demand throughout the year.

Table C2.3 shows the statistics of fruit production except mangosteen in the last five years as recorded by the Provincial Agricultural Services Office in Bandung.

Table C2.3 Tropical Fruit Production in West Java

(Unit: ton)

Fruit	1992	1993	1994	1995	1996
Avocado	42,853	39,811	43,305	39,415	105,161
Duku	19,341	21,219	8,268	12,281	18,666
Durian	68,674	44,724	33,712	47,185	135,693
Mango	179,219	90,980	114,564	188,624	122,449
Mangosteen	n.a.	n.a.	n.a.	n.a.	2,520
Salak	146,352	96,300	247,507	61,022	118,207

Source: Provincial Agricultural Services Office of West Java, Bandung, Dec. 1997

As clearly shown from the table, the production of avocado, duku, durian and salak has fluctuated fairly largely year by year. Rich harvest occurs only every two or three years mainly due to poor farm management.

Avocado production in Bandung District was 32,108 tons in 1996 which accounted for about 30% of the provincial production. The major constraint for farmers is the price fluctuation due to difficulties of marketing. The average farm gate price is Rp. 200/kg, but it varies in a range of Rp. 500/kg to Rp. 50/kg. In the peak season, farmers do not like to harvest the fruit because of the labour cost required for harvesting is higher than the farm gate price.

Duku is not so popular and its production totals about 111,000 tons in which the production in Kalimantan is the biggest, followed by that in Sumatra. In West Java, most duku trees in Ciamis District are naturally grown tall trees of more than 25 years old. Farmers adopt the "Tebasan system" that is a contract with collectors coming from urban areas for harvesting. Sorting and grading are carried out by collectors not by producer farmers. Neither collection center nor storage facility exists in the village.

The durian production area in Bogor District is a remote area isolated from the main road connecting Bogor to Jasinga and the condition of access road is extremely poor. Harvested durian should be carried by hand and delivered on foot to the nearby rural market. But the farm gate price of durian is rather high, that is Rp. 6000/piece, because the rural market is located close to big markets such as Bogor and Jakarta. There are no storage and packing houses in the village. If compared with the farm gate price of durian in Dairi, the price in Bogor is more than 4 times higher.

Mango is one of the typical tropical fruits in Java and its production in Java occupies about 64% of the total production in Indonesia. The constraints for mango growing farmers in Sumedang District in West Java are the following:

- 1) The trees are too high, therefore special tools are needed for harvesting.
- 2) Field transportation means such as cart are needed.
- 3) Packaging material is available in the rural area but it requires additional cost.

- 4) Currently sorting and grading are carried out at home by farmers' groups. There are problems for space.
- 5) Sometimes there is damage by insect and stem borer; application of pesticide is required.

The above-mentioned constraints are more or less in the same situation as other fruits.

Mangosteen in Purwakarta District has the same constraint at the time of harvesting. Most trees are too old and too high, and farmers have to pay Rp. 200/kg as labor cost for climbing up and picking fruit on trees to avoid damage to fruit. After harvesting, the fruit is sorted and graded by collectors according to the fruit size and appearance (color and cleanliness of skin). First class fruit is exported to Hongkong by air cargo. Indonesian Foreign Trade Statistics show that the quantity of mangosteen exported from Soekarno Hatta International Airport amounted to 221 tons in 1996, which consisted mainly of fruit produced in Purwakarta. At present, the ratio of first class fruit is merely 25% to 30%. It is strongly expected by farmers to improve the fruit quality, i.e. size, uniformity and clean appearance.

Salak produced in Tasikmalaya has already acquired its market in Bandung and Jakarta under the brand name of Manon Jaya. The production quantity reached 106,619 tons in 1996. The peak season is December and January and the farm gate price is Rp. 400/kg but it increases up to Rp. 700/kg in the dry season.

There are three varieties of mango grown in Sumedang District. Their farm gate prices by grade are summarized in Table C2.4

Table C2.4 Comparison of Farm Gate Price of Mango by Variety and by Grade

Grade	Arumanis	Gedong	Local
A	Rp. 3,000/Rp. 1,000	Rp. 5,000/Rp. 1,000	Rp. 2,000/Rp. 800
B	Rp. 2,000/Rp. 500	Rp. 4,000/Rp. 500	Rp. 1,500/Rp. 400
C	Rp. 1,000/no price	Rp. 3,000/no price	Rp. 1,000/no price

Source: JICA Study Team (information collected in December 1997)

The selection of varieties to be planted in the newly developed area shall require serious market research on the preference of consumers before implementation of the Project.

2.3 East Java Province

The statistics on tropical fruit production in East Java are summarized in Table C2.5.

Table C2.5 Tropical Fruit Production in East Java

(Unit: ton)

Commodity	1992	1993	1994	1995	1996
Avocado	21,638	34,678	28,675	41,163	62,711
Banana	507,199	461,757	537,999	673,999	685,604
Duku	n.a.	n.a.	3,408	6,506	3,399
Durian	19,059	15,995	23,724	24,822	31,120
Mango	350,668	393,907	459,192	478,118	534,741
Salak	20,218	24,949	8,393	48,298	40,671

Source: Propinsi Jawa Timur Dalam Angka, Sub Sektor Tanaman Pangan; 1997

As clearly shown in the table, the production of avocado, banana and mango is dominant in East Java, while that of duku, durian and salak is not so large, and statistics on duku are not available in full. A large quantity of mango is transported directly to the supermarket in Jakarta and some portion of banana is used as raw material for puree processing. In general, it can be said that supply and demand are well balanced.

Avocado production in the Province is increasing year by year. The farm gate price in Lumajang varies from Rp. 800 to 1,600/kg in the big harvest season, that is from January to February. There is another small season from May to June. The constraints for farmers are marketing and transportation. The average retail price of avocado in East Java was Rp. 1,114/kg in 1996 according to the statistics published by the Provincial Agricultural Services Office. There seems to be not so much price difference between the farm gate price in Lumajang and the average retail price in East Java. This is the reason for marketing constraint. Another constraint is the distance to the market. The distance from Lumajang to Surabaya is 140 km and that to Jakarta is more than 800 km. High transportation cost will naturally affect the farm gate price. There are no packing houses in Lumajang.

Banana production is the biggest among tropical fruit in the Province because it can be harvested throughout the year. There are two varieties of banana. One is Cavendish grown in Jombang District that is used as raw material for puree processing at Mojokerto. Another is Agung, a local variety grown in Lumajang. This is sold in fresh condition or used for traditional crispy processing. There are many small scale processors of fried chips and crispy in the Province. Cavendish banana is purchased by the processors at contract price.

Duku growing farmers in Tulungagung District adopted the "Ijon system" in harvesting. The Provincial Agricultural Services Office mentioned that duku in Tulungagung is a specific local variety which has special taste and flavor. It also has a very stable market. But statistics show that the production is not so large and it fluctuates significantly year by year. The farming technology seems very poor. No sorting and grading are done by collectors under the Ijon system. Accordingly, some traders sell duku mixed with Lanzon which is far inferior in quality and is cheaper than duku. As previously mentioned, duku is not so familiar with urban consumers in Java because the major production area is Kalimantan and Sumatra.

Durian production in Trenggalek District is still very low and its history is quite new, because the area was previously planted with cloves. Due to small demand and cheaper international price, the Provincial Agricultural Services Office recommended farmers to shift the durian plantation instead of clove trees. The constraints for farmers are: 1) Long distance to the urban market (170 km to Surabaya), and 2) The land is very steep and it needs soil conservation. As a matter of fact, the farm gate price of durian is the cheapest among the Provinces under study.

Mango production in East Java is growing rapidly year by year and now it occupies the biggest share in Indonesia. It is attributed to the many reasons. One is that the agroclimate in East Java is most suitable for mango growing and another reason is the development of large mango plantations by the private sector. The survey of typical mango plantations is summarized in Table C2.6. The only variety is Arumanis and every company owns its brand name for marketing. They have their own standards of post-harvest handling including packaging. Post-harvest treatment comprises sorting, washing, heat treatment, grading and packaging. Packaging is done with carton boxes a maximum weight of 20 kg. The boxes are provided with ventilation holes and inside buffer paper inside so as to avoid damage during transportation. It is expected that such a high level handling procedure could be disseminated among small-scale mango growing farmers in the Province.

Table C2.6 Size and Market of Mango Plantation Companies

Plantation Company	Estate Size	Market
PT. Galasari Gunungswadaya	310 ha (Drip irrigation)	Surabaya, Jakarta, Export
PT. Kebun Grati Agung	150 ha (Rainfed)	Surabaya, Jakarta, Export
PT. Sata Harum	100 ha (Rainfed)	Jakarta (Supermarket)

Source: JICA Survey Team, Dec. 1997

Indonesian Foreign Trade Statistics-Export show that a quantity of 566.3 tons of mango was exported in 1996, of which 198.6 tons were shipped from Tg. Perak Surabaya and 162.8 tons from Surabaya Airport. This means 64% of exported mango is from East Java. Government support such as sales promotion shall be greatly expected if the companies hope to increase export quantity and to obtain foreign exchange.

Salak production fluctuates significantly year by year and farmers in Malang District have various constraints. They are 1) Difficulty to get quality seedling for production of homogeneous fruit, 2) Absence of irrigation facilities to enable production throughout the year, and 3) Necessity of marketing in peak season. The shelf life of salak at ambient temperature is said to be only three days and there are no data on its shelf life in the most suitable cold storage condition.

The development of fruit industry in East Java has been attributed to the activities of ASPERTI (Horticulture Marketer Association). Their activities cover not only marketing but also standardization consisting of better seedling, improved farming, post-harvest handling, and packaging. This is a good example for fruit growing farmers to organize an association to conduct various works and procedures jointly by groups.

2.4 South Sulawesi Province

South Sulawesi is called "Food Crop Province" and the production of paddy, palawija crops and vegetables is dominant. The fruit production is also increasing recently but its technology is far behind that of paddy and palawija. The production in the last five years is shown in Table C2.7.

Table C2.7 Tropical Fruit Production in South Sulawesi

Fruit	(Unit: ton)				
	1992	1993	1994	1995	1996
Avocado	750	6,206	5,658	5,615	8,407
Mango	14,899	169,201	81,898	116,594	108,937
Mangosteen	n.a.	n.a.	n.a.	33	6
Marquisa	18,750	28,538	30,824	38,824	34,217
Rambutan	1,167	4,947	9,194	6,919	2,850

Source: Sulawesi Selatan Dalam Angka, 1995; JICA Survey Team, Dec. 1997

As clearly shown in the table, there was a significant fluctuation of the production quantity in each year. No statistics on mangosteen were available before 1994. This means mangosteen growing is quite new in the Province.

Farmers in Gowa District have an option either to grow vegetables or avocado and marquisa. The distance to the urban area is rather closer than any other area. There is a large market consuming vegetables in the urban area, and moreover there are a lot of home industries to utilizing marquisa for juice processing. Accordingly, constant production of avocado seems

difficult if there is a stable market to absorb its production. Farmers in Soppeng District grow avocado trees together with cacao, salak, banana, black pepper, and cashew. The competition with cacao growing constitutes a future constraint for avocado farming expansion.

Mango production is the biggest among tropical fruits in South Sulawesi, reaching 108,000 tons in 1996. Since the consumption in the Province is not so large, most mango shall be transported to other provinces in Sulawesi or to Kalimantan by ferry boat through Mamuju. The present production in the planned area and its market are summarized in Table C2.8.

Table C2.8 Mango Production in Potential Districts and Present Markets
(Unit: ton)

Potential District	Present production/Total production	Market
Bone	60,077/108,937	Ujung Pandang, Kendari, Manado
Majene	1,124/108,937	Local
Maros	1,996/108,937	Ujung Pandang, Ambon, Manado
Sidrap	3,702/108,937	Ujung Pandang, Kalimantan
Wajo	9,946/108,937	Ujung Pandang, Kalimantan

Source: JICA Survey Team, Aug. - Dec. 1997

Most farmers in South Sulawesi never do sorting, grading, and packaging. Collectors bring packaging materials to farms to buy fruit. Such materials are mostly traditional wooden crates, bamboo baskets or used cigarettes carton boxes. Since there are no walls inside the boxes or baskets, and usually their capacity is too large such as 50 or 100 kg, it is inconvenient to carry them and the fruits, particularly those placed at the bottom fruit are easily damaged.

Future development of mango production in South Sulawesi will depend on how growers can acquire the market through inter-insular trade. The distance of transportation will be longer and longer from now on. The significance of post-harvest handling will thus become much important. Table C2.9 shows the volume of farm products transported by ferry from Mamuju to Kalimantan.

Table C2.9 Volume of Shipments from Mamuju to Balikpapan
(Unit: ton)

	Rice	Corn	Soybean	Vegetable	Fruit
1995	578	299	2,027	394	201
1996	1,183	226	1,086	2,033	430
1997*	588	195	725	1,929	800

Source: Daftar; Kepala DINAS Pertanian Tan. Pangan., Mamuju

Note: *The figures of 1997 are as of the end of September.

Mangosteen growing is quite new in the Province as previously mentioned and its production quantity is still quite small. There are big markets in urban areas as well as in tourist hotels in rural areas. The constraint for farmers is not post-harvest handling but the procurement of good quality seedlings for the expansion of their orchards.

Marquisa production is widely practiced in Gowa and Tana Toraja Districts. There are juice processing factories in the both districts. As previously mentioned, farmers in Gowa have an option to grow either vegetables or marquisa/ avocado. In Tana Toraja, however, as most land is steep hill, marquisa growing is the only choice to survive for farmers with coffee growing. Since Tana Toraja is the base of foreign tourists, there is enough opportunity of marketing marquisa as fresh fruit and juice together with fresh mangosteen.

Rambutan supply is in deficiency in South Sulawesi. The production quantity is not so large and fluctuates substantially each year. The local government recommended to shift from Cacao farming to rambutan because of high agroclimatic suitability particularly in Mamuju District. Since there is high demand from the urban area at present, no constraint has been observed as to post-harvest handling. There are no packing house and collection center in any of the villages in the Province.

3. PRESENT CONDITION AND CONSTRAINTS TO FRUIT PRODUCTION IN PROVINCES

3.1 North Sumatra Province

Marquisa is the only fruit to be processed as juice/syrup in North Sumatra. There are two kinds of processors in the production area, Karo District. One is small scale processors operated by farmers' groups which have a capacity to treat one ton of marquisa per day and to produce 200 litres of syrup. The process flow is as follows:

Receiving → Washing with hot water → Cutting → Squeezing with spoon (manual) → Adding the same volume of water → Centrifugal separation → Raw juice → Boiling for 1 hour → Adding 1 kg of sugar to 1 litre of juice → Bottling (500 ml) → Sterilisation → Capping → Distribution to market

The total investment cost was Rp. 15 million in 1995, financed by a credit from the Provincial Agricultural Services Office in Medan with a repayment term of 5 years. Although the operators face the constraint of price fluctuation of marquisa, they hope to expand their processing capacity.

Another kind is medium size processors that process 500 tons of marquisa in one season and produce 150 tons of raw juice. Marquisa is harvested in two seasons in Karo, that is from April to June and from October to December. The processor operators keep good contact with chiefs of villages and let them know in advance the quantity of marquisa required and its purchasing price. Accordingly, they never suffer shortage of raw material supply since their operation began 10 years before.

Marquisa growing is competing with Valencia orange growing. The processor operators have no choice in selecting fruit of standard specification. The quality of juice is adjusted by blending raw juice previously produced and stocked. The product specification is as follows:

A-super	Sugar content:	more than 63%
B	" :	more than 42% and less than 63%
C	" :	more than 20% and less than 42%

A-super class fruit is being exported to Singapore and the United Kingdom. The process flow is as follows:

Receiving → Cutting the top of fruit → Squeezing by machine → Centrifugation → Storage (raw juice) → Mixing/Blending → Centrifugation → Bottling → Market

All machineries are simple and made in Indonesia according to the operators' own design. Marquisa processing is a typical home industry with a fairly large capacity. It employs 20 permanent workers and in the peak season more 50 workers are recruited temporarily. This is contributing to the increase in employment opportunities in the rural area. It is one of the desirable industries for rural development. There are no other fruit processors in North Sumatra than the four marquisa juice processors in Medan.

3.2 West Java Province

There are a lot of agro-processing factories in West Java such as canning of mushroom, asparagus, and pineapple. But fruit juice processors are quite few. PT. Ultra Jaya is one of the typical fruit juice processors located in Bandung. The main business of PT. Ultra Jaya is production of dairy milk and mixed milk and chocolate. It is treating 80 tons of fresh milk every day. It has 24 Tetra Pack lines for marketable products instead of bottling line. In order to utilise these lines, it is producing fruit juice such as apple, orange, strawberry, lychee, jambu, sirsak, pineapple, mango, and guava. Among them, raw materials for apple, orange and lychee juice are imported from the USA, Brazil, EC, and Taiwan. There are domestically produced fruits, but they cannot be used for raw materials from the aspect of taste and need of special processing.

PT. Ultra Jaya buys domestic fruit from collectors and wholesalers who have their own stores. Some examples are as follows:

- Pineapple - Juicy pineapple produced in Subang
- Mango - Juicy mango, variety Kopyor
- Guava - Produced in Pasar Minggu, Cirebon, Garut; yellow colour preferable

The processing capacity for such domestic fruit is 3 tons per hour. All the equipment is designed and fabricated by an European company and made of stainless steel.

Usually food processing companies have a good quality control laboratory responsible for checking raw materials received and controlling the process and product quality. Two samples are taken in every 10 minutes from the line, and incubated at 35°C whether sterilization is satisfactory or not.

For the processors to be internationally recognized, the application of ISO-9000 is required, but PT. Ultra Jaya is trying to apply the Hazard Analysis Critical Control Point (HACCP) and GMP (Good Manufacturing Practice) that are set by FDA of the USA. Regrettably, company does not have any research and development facility.

3.3 East Java Province

Just like West Java, there are a lot of agro-processing industries in East Java. The characteristic is that there are a fairly large number of banana processors producing dried banana, fried chips, and crispy in the Province. PT. Horti Nusantara is one of the typical banana processors having plantations for their own raw material supply. It has an estate of 100 ha in Mojokerto District growing Cavendish banana to be processed as puree. The area is divided into 25 ha as a nucleus farm cultivated by the company and 75 ha of corporate farmers.

PT. Horti Nusantara was established in 1995. Due to shortage of raw material, puree production in 1996 was merely 156 tons, that is less than 2% of the nominal production capacity. The company can process 4 tons of raw material per hour which can yield 2 tons of puree. Their nominal capacity is 12,600 tons with a two-shift working system. The process flow of puree manufacturing is summarised below:

Banana receiving → Washing → Peeling skin by hand → Cluster → Degassing vessel → Homogenizer → Sterilization by heat exchanger → Aseptic packaging (200 kg drum or 20 kg box)

All processing equipment is made of stainless steel by an European company. Puree is exported to EC through Rotterdam as raw material for baby food.

The company is trying to increase the number of contract farmers who grow Cavendish banana and supply it to its factory. Now there are about 100 farmers in Mojokerto, 150 farmers in

Malang, and 30 in Jombang. PT. Horti Nusantara is also growing 350,000 Cavendish seedlings by tissue culture.

3.4 South Sulawesi Province

There are about 30 marquisa juice processors in South Sulawesi. Three of them are in Gowa District and two in Tana Toraja which are the major marquisa growing areas. No other agro-processing facilities exist in the Province. The Province's food processing industry is lagging far behind other provinces even though it has plenty of agricultural products.

The biggest processor, PT. Marquisa Segar was established 7 years ago at Malino in Gowa District. Its nominal capacity is 4 tons for marquisa treatment and 1 ton for juice production per hour but since the establishment it has never run at full capacity due to shortage of raw material. In 1997, the factory operated intermittently from February to September and the efficiency was only 5% of its capacity. All the processing equipment has been designed and fabricated by European companies and made of stainless steel.

The company buys marquisa from collectors but the payment is made only one month after delivery. Most farmers like cash payment on delivery. Malino is located in highland where vegetable farming is most suitable from the agro-climatic viewpoint. Farmers have an option to grow either marquisa or vegetables which can easily be convertible to cash. There is a lack of motivation for farmers to grow marquisa for the processor. This is the major reason why PT. Marquisa Segar cannot acquire enough raw material.

There is another processor called PT. Karya Kita in Ujung Pandang. It has marquisa fields in both Gowa and Tana Toraja, from where it can get more than 50% of raw material for juice processing. The issue of management for PT. Marquisa Segar is how to get enough raw material. This is not a problem due to lack of capital, but lack of entrepreneurship.

3.5 Conclusion

From the aspect of processing, fruit can be classified into the following categories: 1) Dried fruit, 2) Fruit juice, 3) Canned fruit/frozen fruit, and 4) raw material for processed food.

The required process can be summarized in Table C3.1. together with the processed products.

Table C3.1 Processed Fruit by Processing Method

	Class 1	Class 2	Class 3
Process	Milling, Cutting, Mixing, Drying, Pressing	Cooking, Pasturization, Canning, Freezing	Chemical alteration, Texturization
Product	Dried fruit, Fruit juice	Canned fruit, Frozen fruit	Raw materials for processed food, Baby food, Pet food

In the table, the level of processing technology and investment required become higher from the left column to the right. At present, fruit juice, canned fruit and a small amount of baby food can be processed in Indonesia. In 1995, total processed food exported from Indonesia amounted US\$50 million, of which 90% consisted of packed pineapple. Among the selected tropical fruits to be studied, only marquisa syrup/juice has an established foreign market. It is strongly recommended that efforts should be continued to increase foreign exchange earnings by exporting marquisa syrup/juice.

The next possibility is to process mango and avocado in the form of syrup or puree. The reason is that in the case of avocado, there is excess production and farmers often suffer cheap farm gate prices. The same situation is observed in mango production at Sumedang in West Java. In

the peak season, the price of even first grade mango becomes extremely low. Some kind of processing should therefore be considered for value addition. A similar situation for mango is expected in South Sulawesi, because there are so many plans of expansion of fields while the market is very limited in the Island. Simple processing to manufacture dried mango is the most recommendable for the processing method for the remote areas. Durian and salak are processed only in the form of traditional sweet "Manisan". For mangosteen, it would be far better to export it as fresh fruit than processed fruit. Duku is a very sensitive fruit and its processing seems very difficult .

To set up new processing facilities, following items should be clarified during the Study:

- 1) What is the most realizable processing capacity considering the locally available raw material?
- 2) How much capital is required for facilities and land, and where to obtain the fund required?
- 3) Where to get processing technology and its expense?
- 4) Where is the market of products?
- 5) What are the profit and schedule of repayment?

Too many processors in Indonesia are suffering from the shortage of raw material, such as PT. Horti Nusantara in East Java and PT. Marquisa Segar in South Sulawesi. However, a large home industry processing marquisa juice in Karo, North Sumatra, has good relationship with marquisa growers. Under a contract farming system, in which a mutual agreement on the supply quantity and purchasing price is reached in advance. In such condition, the industry has never suffered from the shortage of raw material. This is a matter of management and entrepreneurship.

The most recommendable fruit processing industry for Indonesia is not large scale but medium scale home industry to use local machineries and also to use manual labours to some extent to increase rural employment opportunities. Processing facilities shall be installed in rural areas where raw material is available. Further processing operations, such as refining and bottling shall be done in urban areas to avoid expensive transportation cost.

4. GENERAL CONCEPT OF POST-HARVEST HANDLING

4.1 Significance of Pre-harvest Handling

Proper post-harvest handling would not improve the quality of fruit after it is harvested, but only extend its shelf life. Post-harvest handling activities consist of harvesting, sorting, grading, packaging, storage, and distribution in such a way to avoid infestation and damage during transportation. It should be noted that pre-harvest management such as soil suitability, good seedling, better agro-climate, proper fertilization, watering and proper pesticide application has more significance than post-harvest handling. To avoid yearly fluctuation of the production quantity through proper farm management is also important. Stable supply of raw material in terms of quantity and price is indispensable for the development of fruit processing industry.

4.2 Harvesting

Planning of crop selection and timing to meet expected market requirements is most important. Since most tropical fruit trees are perennial, farm management activities such as pruning, training, flower thinning, and fruit thinning would seriously affect fruit bearing condition. Another practices like watering and fertilizing are also useful. Usually it is easier to fasten harvesting time than to delay it.

Then, judgment of fruit maturity is important and this is decided by visual observation of color change on fruit skin and by counting the number of days after flowering. But for the fruit requiring long transportation such as mangosteen and mango for export, the fruit should be harvested before its full maturity.

Under this Study, mango Brix was tested at a collection centre in Pasuruan and Probolinggo in East Java. The Brix value of matured mango (Arumanis) was around 18, but the same mango for export purpose showed a Brix of 8 to 9, that is about 70% of maturity. After six days at ambient temperature, Brix increases to 18 to 19, that is full maturity. Harvesting should be done taking into account the time necessary for transportation.

The basic rules for harvesting are:

- To harvest during the coolest part of the day: early morning or late afternoon.
- To do not harvest when it is wet. Wet fruit will be overheated if not well ventilated, and will be more likely to decay.
- To protect harvested produce in the field by putting it under open-sided shade.

Harvesting is usually carried out by hand but sometimes it needs mechanical aid such as special tool for collecting fruit from tall trees. A fee is to be paid for collection by climbing up tall mangosteen trees. In Purwakarta, West Java, such a fee is Rp. 200/kg.

4.3 Sorting

Preliminary sorting of the produce should remove unmarketable pieces and foreign matters such as plant debris, soil or stones. Unmarketable pieces mean damaged fruit due to overripening, infected fruit and fruit having scabs and dots. At present, such sorting is not done by almost farmers except a few plantation estates. Particularly, small scale farmers are apt to adopt the Tebasan or Ijon system for harvesting of small fruit such as duku and salak. They are loosing opportunity to add value to their produces.

4.4 Grading

The fruit quality standards have been set or are under preparation by the Ministry of Agriculture. Some fruits are classified by weight but some are by diameter. Following are some examples:

Mango (SP-139-1981; Revision in Feb. 1991)

Cultivar	(Unit: gram)			
	Big	Medium	Small	Very small
Arumanis	>400	350 - 400	300 - 349	250-299
Golek	>500	450 - 500	400 - 499	350 - 399
Gedong	>250	200 - 250	150 - 199	100 - 149
Manalagi	>400	350 - 400	300 - 349	250 - 299

Salak (SP-142-1981)

Big size	Medium size	Small size
more than 61 grams	33 - 61 grams	less than 32 grams

Avocado (SP-142-1981)

Big size	Medium size	Small size
451 - 550 grams	351 - 450 grams	250 - 350 grams

Mangosteen (under preparation)

Superior	I	II
>65 mm	55 - 65 mm	<55 mm

Rambutan (under preparation)

Cultivar	Big (number/kg)	Small (number/kg)
Binjai	Max. 20	>20
Lebak Bulus	Max. 35	>35
Rapiah	Max. 30	>30
Simacan	Max. 40	>40

Ambon banana (under preparation)

Specification	Unit	A	B	C
Length of finger	cm	18.1 - 20.0	16.1 - 18.0	14.1 - 16.0
Weight of hand	kg	>3.0	2.5 - 3.0	<2.5
Diameter of fruit	cm	>2.5	>2.5	<2.5

The grading standard of durian by fruit shape is also under preparation. There are 4 categories for 11 types of fruit shape, namely A: Very good shape 5 types; B: Good shape 3 types; C: Less good shape 2 types; and D: Not good shape 3 types. There are grading standards by weight for the A, B and C categories.

According to the survey results, farmers do not grade fruit by weighing except large mango estates. Most farmers only check their fruit by visual inspection and classify it into large size, middle size, and small size. Sometimes, their standard is the circumference of fruit determined by the length of palm and fingers. Dissemination of the governmental specification to small scale farmers is most important for nation wide standardization of fruit.

4.5 Packaging

The standard specification has also been prepared by the Ministry of Agriculture for mangosteen, Ambon banana, rambutan and durian. It is summarised is as follows:

Mangosteen: Fresh mangosteen fruit is packaged with carton boxes or plastic baskets, which are strong, fine, clean and dry, as well as ventilated.

Ambon banana: Fresh yellow Ambon banana fruit is packaged in carton boxes or other packaging materials, which are strong, good and clean. Each box is layered with polyethylene plastic of 0.01 mm thick. Each box is filled with 10 - 13 kg of hands or parts of hands of fresh Ambon banana fruit, or in accordance with the market demand.

Rambutan: Fresh rambutan fruit is presented in bunch or apart and wrapped with paper, plastic net, etc. as well as packaged with bamboo or carton boxes with or without supports, with a net weight of 10 kg at maximum.

Durian: Durian fruit is packaged in accordance with the market demand. European, USA and Canadian markets prefer 2.5 - 3.5 kg durian fruit packaged in carton boxes up to 10 - 12 kg. The Hongkong market selects 2 - 4 kg durian fruit packaged in wood baskets up to 35 - 50 kg, while the Singapore market or local market prefer 2.0 - 5.0 kg durian fruit packaged in wood baskets or wood boxes or unpackaged.

As clearly shown from the above, the Ministry of Agriculture hopes to shift to smaller size packaging instead of traditional packaging. Education of farmers and collectors is indispensable to enable them to familiarize themselves with and adopt the new packaging standard.

For reference, the packaging standards for various fruits set by the Farmers Cooperation in Japan are summarized below:

Hard skin fruit (apple)

No	Volume	Stage	Length	Width
1	15 kg	3	430 mm	360 mm
2	10 kg	2	430 mm	360 mm

Material: Corrugated cardboard

Soft skin fruit (mandarin, orange)

Volume	Length	Width	Depth
15 kg	360 mm	300 mm	250 mm
10 kg	360 mm	300 mm	170 mm

Material: Corrugated cardboard

Soft and small fruit (grape)

No	Volume	Length	Width	Depth
1	4 kg	380 mm	260 mm	90 - 110 mm
2	4 kg	420 mm	270 mm	90 - 110 mm
3	4 kg	455 mm	265 mm	100 - 130 mm
4	4 kg	460 mm	280 mm	90 - 110 mm

Material: Corrugated cardboard

The case of hard skin fruit applies to avocado and mangosteen; soft skin fruit to mango; and soft and small skin fruit to duku, rambutan, and salak.

4.6 Storage

No storage facilities to preserve harvested fruit have ever been seen in villages in Indonesia. Usually, harvested fruit is transported promptly from the field by collectors/traders to the market.

There are some cold storages at Pasar Kranat Jati in Jakarta, Pasar Induk Caringin in Bandung, a fruit store of ASPERTI in Surabaya, a fruit supermarket in Medan, and a fruit wholesaler in

Ujung Pandang. The facilities are utilized mainly for storing imported fruit and some are utilized for preserving fruit for export purpose.

Every fruit has its optimum cold storage temperature at which its shelf life can be extended as shown in the Table C4.1.

Table C4.1 Shelf Life at Optimum Temperature

Fruit	Post-harvest life at optimum temperature (days)	Optimum storage temperature (°C)
Avocado- Mexican	14 - 28	5
- West Indian	14 - 28	10
Banana	7 - 28	14
Durian	42 - 56	4
Duku/Langsar	10 - 15	11
Mango	14 - 25	10 - 12
Passion fruit	14 - 21	12
Rambutan	7 - 21	12

Source: Robert E. Psull, AICAR Proceedings No. 50; Published in July 1993
ISBN 1 86320 101 7

There are no data on mangosteen and salak.

4.7 Transportation

Since most production areas of tropical fruit are located far from urban areas, the cost for transportation cannot be ignored from the viewpoint of marketing. Some examples surveyed in this Study from August to December 1997 are shown below:

North Sumatra

Durian	Dairi - Medan (170 km)
2-ton pickup truck	Rp. 200,000 to 300,000

West Java

Avocado	Bali - Bandung
5-ton truck	Rp. 750,000 (30 hrs)
7-ton truck	Rp. 1,020,000 (40 - 70 hrs)

East Java

Mango	Probolingo - Surabaya	Surabaya - Jakarta	Total
	Rp. 80/kg (Truck)	Rp. 170/kg (Train)	Rp. 250/kg

South Sulawesi

Ferry boat between Mamuju and Balikpapan

	5-ton Truck	10-ton Truck	Pick-up
Fully loaded	Rp. 279,000	Rp. 400,000	Rp. 165,000
Empty	Rp. 236,000	Rp. 305,000	--

Truck

Fruit	Enrekang - Mamuju (370 km)
5-ton truck	Rp. 650,000

The average transportation cost by truck can be estimated at Rp. 1,000/ton.km.

Efforts to minimize the transportation cost are required. For example, the ferry boats coming back from Balikpapan to Mamuju always carry empty trucks. It is desirable to transport some commodities from Kalimantan to South Sulawesi to reduce the transportation cost.

5. FRUIT PROCESSING

Among the nine selected tropical fruits, banana production is the largest and it is already well processed as puree, crispy, fried chip, and dried banana particularly in East Java. Although there are no statistics on quantity at the national level, marquisa is produced in North Sumatra and South Sulawesi. The production quantity is still small, but it is used as raw material for marquisa syrup/pulp and/or juice processing. Durian is processed to dodol when it is in excess in the market. Marquisa and salak are also processed to dodol when they are in excess in the market. A very small quantity of mango is used for juice processing.

Table C5.1 shows the nutrient composition of the selected fruits which were referred to a document published by the Provincial Agricultural Services Office of East Java. The analytical data of marquisa were extracted from a technical bulletin published by FAO.

Table C5.1 Nutrient Composition of Tropical Fruit

	Banana	Mango	Rambutan	Salak	Marquisa
Calories	99	46	69	77	92
Protein (gram)	1.2	0.4	0.9	0.4	0.6 - 1.2
Fat (gram)	(0.2)	(0.2)	(0.1)	0	0.1
CHO (gram)	25.8	11.9	18.1	20.9	8 - 16
Ca (mg)	8	15	16	28	-
P (mg)	28	9	16	18	-
Fe (mg)	0.5	0.2	0.5	4.2	1
Vitamin A (I.U.)	146	1,200	(0)	0	20
Vitamin B1 (mg)	0.08	(0.08)	0	0.04	0.1
Vitamin C (mg)	3	6	58	2	20 - 45
Water (gram)	72.0	82.2	80.5	78.0	75 - 82
BDD (%)	75	65	40	(50)	-

Note: The figures are for 100 grams of fruit.

It is interesting to compare the nutrient composition between the fruits. Banana contains high carbohydrate, phosphorus, and Vitamin A. This means banana puree is a good nutrient as baby food. Mango has a very high content of Vitamin A. This means mango is a good food for patients who are suffering from eye disease and good preventive medicine for it. Rambutan contains a very high level of Vitamin C, and salak contains a rather large quantity of minerals such as Calcium and Iron. Marquisa also has a very high Vitamin C content that is cleared from another source.

Similar analyses should be carried out for avocado, duku, durian, and mangosteen. Such analyses will be of great help to promote domestic consumption of tropical fruit and convince the public that the habit to eat fruit is good for maintaining their health.

When processing tropical fruit, various cautions should be taken so as to avoid decomposition of such useful components. As shown in the table, marquisa contains a lot of Vitamin C. All small-scale home industry factories processing marquisa juice sterilize the product by boiling it at 100°C, while large scale home industry factories, Pyramid Unta in Karo, use Sodium Benzoate as a preserve agent and add sugar up to 62% concentration to avoid microbial decay during marketing. The Vitamin C content in the syrup/juice should be determined through analysis to compare the both processes. Also the flavour, that attracts for its palatability, might be greatly different.

It is recommended to process mango by slicing and drying to produce dried Mango. This is a good food to prevent eye disease. The farm economy and social survey results clarified that many rural inhabitants still suffer from eye disease. Dried mango should be an effective counter-measure for it because it is available throughout the year.

It is difficult to process avocado, duku and mangosteen because of their size and taste. The Food Technology Laboratory of Bogor Agricultural University is conducting an experiment on ready-to-eat salak. This is a trial to preserve peeled salak meat by film wrapping. If this trial is successful, it should be applicable to durian.

As to the location of processing plants, it is generally recommendable to locate them in the production areas if utilities are available, while refining or bottling plants should be installed in

urban areas because of expensive transportation cost in Indonesia. The yield of banana puree is 50% and marquisa syrup is 20% to 25% of raw material used by the processing plant. There is no need to transport fruit skin to urban area.

Processed fruit products are earning a large amount of foreign currency in Indonesia as shown in Table C5.2. In 1995 they earned about US\$45 million. Although this amount was mostly from export of canned pineapple and its syrup, it shows a good potential for fruit juice, except frozen citrus juice which is imported from Brazil, and other processed products such as jam and puree. It is urgently required to get worldwide market information.

Table C5.2 Balance of Processed Fruit Export and Import (1995)

Fruit Products	Export Vol. (ton)	Export Value US\$ 1,000	Import Vol. (ton)	Import Value US\$ 1,000	Balance Vol. (ton)	Balance Value US\$ 1,000
Pineapple in syrup, airtight packed.	89,403.5	46,373.5	10.4	18.4	89,393.1	46,355.1
Fruit jam, puree and paste	0	0	147.6	212.5	- 147.6	- 212.5
Cherry in syrup, airtight packed.	0	0	369.9	234.3	- 369.9	- 234.3
Fruit juice	3,548.2	3,089.5	89.9	79.7	3,458.3	3,009.8
Tomato juice	0	0	1,078.8	815.8	- 1,078.8	- 815.8
Frozen citrus juice	0	0	641.2	1,160.7	- 641.2	- 1,160.7
Other citrus juice	36.8	27.1	867.6	679.9	- 830.8	- 652.8
Other fruit jam	227.2	185.8	364.4	940.2	- 137.2	- 754.4
Others	1,053.1	644.9	1,287.7	1,100.1	- 234.6	- 455.2
Total	94,268.8	50,320.8	4,857.6	5,241.5	89,411.2	45,079.2

Source: Vademekum Pemasaran 1986 - 1996, Pusat Promosi dan Informasi; Tanaman Pangan dan Hortikultura

6. BASIC DEVELOPMENT PLAN

6.1 North Sumatra Province

Major constraints for post-harvest handling and processing of tropical fruit in North Sumatra are: 1) Long distance to the urban market where tropical fruit is consumed; 2) Fluctuation of yearly production is fairly large; and 3) Production of mangosteen and marquisa is still very small.

The reason 1) is due to the fact that the rural market is quite small and only 10% to 30% of fruit produce is consumed in the rural area. Accordingly 70% to 90% of it should be transported to the urban area and the distance from Dairi, Tapanuli Selatan, Tapanuli Tengah and Tapanuli Utara to Medan is quite far. It is 170 km, 380 km, 320 km, and 280 km respectively. The shelf life of durian, mangosteen and salak is not so long and these fruits are easily deteriorated during transportation if they are not properly packaged. It was observed in the urban markets in Jakarta and Bandung that durian transported from Sumatra is easily damaged by cracks resulting from heat during transportation

Small production quantity and its yearly fluctuation are other constraints for mangosteen and marquisa in the Province. These can be attributed to less intensive farming practice by small

scale farmers in the rural area and not to post-harvest handling. But for the development of processed fruit, such as marquisa syrup/juice, a stable supply in quantity and price is prerequisite.

One solution to this constraint is the improvement of the rural fruit/vegetable market. At typical example was seen at Brastagi market. The land space is provided by the local government, but there is no pavement nor roof. The road in the market is muddy and very dirty. A lot of gabages are discarded near stores. It seems not sanitary to handle fruit/vegetable there for human consumption. From the above mentioned reason, the recommended action programs for North Sumatra are as follows:

Table C6.1 Proposed Facilities in North Sumatra

Fruit	District	Area planned (ha)	Facilities recommended
Durian	Dairi	300	Storage, packing house
	Tapanuli Tengah	750	- ditto -
	Tapanuli Utara	500	- ditto -
Mangosteen	Tapanuli Selatan	1,800	Packing house
	Tapanuli Utara	500	- ditto -
Marquisa	Karo	1,000	Packing house
Rambutan	Langkat	500	Packing house for export
Salak	Tapanuli Selatan	15,000	Container for transportation

The packing house will be a simple structure cottage to be built in the rural village with paved flat floor and roof. Simple facilities of sorting, cleaning, grading and packaging shall be installed inside.

At present, no constraints on post-harvest handling of rambutan were observed because the distance to the urban market is very short compared to those in Tapanuli Selatan District, etc.

The provincial government has already made great efforts to promote domestic fruit consumption and it hold the Medan Fair in last April. Similar fairs were also held in Ipo and Penan in Malaysia in cooperation with private sectors. Such efforts should be continued. At the same time, the government should pay attention to residues of pesticides on fruit, particularly on fruit for export to developed countries. This is the trend followed worldwide for ensuring food safety.

6.2 West Java Province

Major constraints to post-harvest handling and processing of tropical fruit in West Java are: 1) the demand always exceeds the supply in the Province, and 2) the yearly production fluctuates largely.

The reason 1) derives from the fact that a huge market, DKI Jakarta, is adjacent to the Province. In fact, most tropical fruit sold at the Kramat Jati wholesale market in Jakarta is transported from West Java. On the other hand, fruit sold at the Induk Caringin wholesale market in Bandung is transported from East Java and Bali. Ordinary distribution and marketing systems are required to stabilize fruit prices. The supply of durian, mango and mangosteen is always not sufficient to meet the demand. Accordingly, proper post-harvest handling is essential to avoid losses during transportation and marketing.

As to the yearly production, it was observed that duku, mango and salak have good harvest every two or three years. This is attributed to poor farm management, mainly in pre-harvest handling and not in post-harvest handling. Statistics on mangosteen before 1995 are not available although there are a lot of very old trees in the production area.

The recommendable action programs for post-harvest handling are summarized in Table C6.2. The reason why farmers need harvesting tools is that most fruit trees are too tall to pick their fruit by hand. This also comes from poor farming knowledge of small scale fruit growing farmers. They do not understand the necessity of pruning and cutting off branches regularly.

Table C6.2 Proposed Facilities in West Java

Commodity	District	Area planned (ha)	Facilities recommended
Avocado	Bandung	500	Packing house, Harvest tools
Duku	Ciamis	500	Packing house, Harvest tools
Durian	Bogor	500	Storage, Harvest tools
Mango	Sumedang	1,000	Packing house, Harvest tools, Cart
Mangosteen	Purwakarta	500	Storage, Packing house
Salak	Tasikmalaya	1,000	Packing house, Harvest tools

Another constraint concerns on the importance of processing. This is particularly important for avocado and mango, because in the peak season of both fruits, they become of no value and farmers do not like to harvest them from trees or simply discard them in the field. Some kinds of processing shall be considered at the provincial level, not at the district level.

In connection with processing, the needs for research and development facilities should be focused on the activity of private sectors. The reason comes from the case of PT. Ultra Jaya in Bandung. The company is manufacturing fruit juice in Tetra pack line with raw materials such as frozen citrus juice and apple juice imported from abroad. The raw materials of similar quality are imported available indigenously, but it does not have any facilities for R&D purpose. The replacement of raw materials with domestic ones is indispensable to maintain the business, in view of the rapid devaluation of the Rupiah in very recent days. Some kind of subsidy from the central/provincial government shall be urgently required to assist the company in installing R&D facilities.

6.3 East Java Province

The major constraints on post-harvest handling and processing of tropical fruit in East Java are almost similar to those in West Java. The production of banana and mango is dominant and is growing steady year by year. The production of duku and durian is still small and no data on the past production of duku are available. A severe fluctuation is seen in salak production .

Mango production has increased rapidly and steadily due to the establishment of large estate companies in Gresik, Pasuruan and Probolinggo in East Java. All estates have their own brand and product specifications are strictly controlled in accordance with manuals for sorting, grading and packaging. Since the quality of fruit is very high and homogeneous, the companies have direct sales contracts with the supermarket in Jakarta or exported their products to Singapore.

Examples of grading manuals are as follows:

PT. Galasari Gunungswadaya: Harvest → Field shed cottage → Packing house → Sorting → Grading by specific gravity → Drying → Packaging

P.T. Sata Harum: Harvest → Sorting → Washing → Heating at 45°C for 3 min. → Drying → Grading by weighing → Packaging

Before packaging, each mango is labeled with a special sticker showing their brand name. The packaging material is carton box with inner partitions and ventilation holes. The packaging size is smaller than that of the traditional container such as bamboo basket and wooden box. The package is 5 kg for gift and 10 kg for supermarket so as to avoid damage during transportation. Such high technology should be disseminated to small scale mango growers nearby.

Although its production is quite small, duku is a very sensitive fruit and when the skin is damaged, the quality of fruit deteriorates very rapidly. Accordingly, special attention is required to be paid to post-harvest handling.

Another constraint for fruit processing in East Java is the shortage of raw material. A typical example is seen in the banana puree processor in Mojokerto. The rate of plant operation is very low due to shortage of raw material. A long term contract system should be applied with farmer producers for smooth operation of the processing factory.

Table C6.3 Proposed Facilities in East Java

Commodity	District	Area planned (ha)	Facilities recommended
Avocado	Lumajang	1,000	Packing house
Banana	Jombang	500	Packing house
	Lumajang	500	Packing house
Duku	Tulungagung	1,000	Packing house
Durian	Jombang	1,150	Packing house for remote area
	Trenggalek	1,000	Packing house for remote area
Mango	Pasuruan	750	Cold storage, Packing house
Salak	Malang	1,700	Processing

The peak season of salak also need some processing because their shelf life is only few days unless they are stored in cold storage.

6.4 South Sulawesi Province

In general, farmers in South Sulawesi never do sorting and grading. These are done by collectors. Since the marketing channel in the Province is not so well developed and the size of market is rather small, collectors are obliged to transport their fruit products to areas outside the Province. This is the major constraints to post-harvest handling of tropical fruit in South Sulawesi. The Provincial Agricultural Services Office desires to install a local distribution centre in the district with the functions of sorting, grading, and packaging. The function of Market Information Service is also desirable. This distribution centre will connect farmers with collectors/traders. In Ujung Pandang, it is also necessary to have a central wholesale market with cold storage facilities for vegetable and fruit.

Table C6.4 Proposed Facilities in South Sulawesi

Commodity	District	Area planned (ha)	Facility recommendable
Avocado	Gowa	500	Local distribution centre
	Soppeng	500	- ditto -
Mango	Bone	500	- ditto -
	Majene	500	- ditto -
	Maros	500	- ditto -
	Sidrap	500	- ditto -
	Wajo	500	- ditto -
Mangosteen	Polewali	500	- ditto -
	Tana Toraja	500	- ditto -
Marquisa	Gowa	1,000	- ditto -
	Tana Toraja	3,000	- ditto -
Rambutan	Baru	700	- ditto -
	Enrekang	500	- ditto -
	Mamuju	2,350	- ditto -
	Pinrang	500	- ditto -

The local distribution centre will be a structure that has a stage with flat paved floor and roof. Both ends of the staged floor are used for unloading fruit products gathered by farmers nearby and for loading/delivery of traded products by collectors/traders who transport them to the urban market or outside the Province. The middle part of the floor is used for sorting, cleaning, grading, and simple packaging durable for transportation. The Market Information Service should be installed additionally in the centre where the products are transported for efficient marketing.

Since the population of each district in South Sulawesi is far smaller than that of the districts in West Java and East Java, the number of such Distribution Centres should be determined carefully.

Table C-1-1 List of Agri-business in North Sumatra

No	Name	Address	
1	PT. Maju Jaya	Jl. Sambas 37, Medan	Marquisa syrup
2	PT. Pintu Besar	Jl. Letjen Hariono, Medan	ibid.
3	PT. Sarang Tawon	Jl. Nyak Makam 24, Medan	ibid.
4	PT. Gunung Kawi	Jl. Sambas 11, Medan	ibid.
5	PT. Putra Brastagi	Jl. Thamrin 75/7-F, Medan	Exporter
6	PT. Arfindo Subur	Jl. Mangkubumi Dalam 15, Medan	ibid.
7	CV. Karya Tani	Jl. Teratai 14-A, Medan	ibid.
8	CV. Ginting Co	Jl. Pemuda Baru 7/8, Medan	ibid.
9	CV. Perintis Tani	Jl. Riau 1-C, Kabanjahe	ibid.
10	CV. Tani Makmur	Jl. Darat 48-B, Kabanjahe	ibid.
11	CV. Dhaksa Putra	Jl. Putri Hijau Baru 31, Medan	ibid.
12	PT. Arinya Karosutama	Jl. Asia 220, Medan	ibid.
13	PT. Tenda Mas Nusantara	Jl. Veteran 18-G, Medan	ibid.
14	PT. Sindung Rianawati	Jl. Perniagaan 127, Medan	ibid.
15	PT. Bibit Unggul Karo Biotek	Jl. Veteran 16-I/48, Medan	ibid.
16	PT. Gunung Lintong	Jl. Pemuda 22, Medan	ibid.
17	PT. Fajar Utama	Jl. Kapten Utah Dendi 40, Kabanjahe	ibid.
18	PT. Bayu Bali Exim	Jl. Udara, Brastagi	ibid.
19	PT. Bibit Baru	Jl. Iskandar Muda 248-C, Medan	ibid.
20	PT. Selektani	ibid.	ibid.
21	PT. Kurnia Wiratama	Jl. Teuku Umar 7/AG, Medan	ibid.

Source: Dinas Pertanian Tanaman Pangan, Sumatera Utara; Sep., 1997

Table C-1-2 List of Agri-business in West Java

No	Name	Location	Activity
1	PT. International Grand	Kab. Lebak	Banana
2	PT. Carcia Paya Ind.	Kab. Sukabumi	Papain & Pectin
3	PT. International Grand	Kab. Cianjur	Banana & Pineapple
4	PT. International Grand	Kab. Garut	ibid.
5	PT. Inti Hortindotama	Kab. Garut	Juice concentrate
6	PT. Ultra Jaya	Kab. Bandung	Juice concentrate
7	PT. Kbun Mas	Kab. Karawang	Durian, Mango
8	PT. Kertosari Gemilan	Jakarta Pusat	Rambutan, Mangosteen, Avocado / Exporter
9	PT. Purnawangi Maju Jaya	Kab. Bandung	Rambutan, Sirsak, Jeruk, Durian / Exporter
10	PT. Teratai Pangan	Kab. Bekasi	Jeruk
11	PT. Inti Hortidotama	Kab. Karawang	Fresh fruit
12	PT. Morelli Makmur	Kab. Subang	Juice concentrate

Source: Dinas Pertanian Tanaman Pangan, Jawa Barat; July, 1996

Table C-1-3 List of Agri-Business in East Java

No	Name	Address	Product
1	Aneka Saos	Jl. Jenggolo 25, Sidoharjo	Tomato sauce
2	Bahagia	Strengganan Dalem, Sby	Tomato and chili sauce
3	Bangka	Jl. Bangka, Malang	Dried banana
4	Banner Processing & HFG	Mojo Arum IV-7, Sby	Fruit jam and jelly
5	Batara Agung Muiia	Kebraon II/21, Karang Pisang, Sby	Tomato and chili sauce
6	Bintang Mas	Pesarkembang 117, Sby	Tomato sauce
7	Cipta Rasa	Mojo III/52, Sby	Tomato sauce
8	Darmo	Tanjungsari, Pacitan	Dried banana
9	Daya Semesta Food Ind.	Margorejo Indah XII/303, Sby	Canned pineapple
10	Delinus	Kedung Kandang, Mojokerto	Tomato sauce
11	Embasa Orima Food Indonesia	Rnugkut Industri III/41, Sby	Tomato and chili sauce
12	Georges Limited	Ngagel Jaya Tengah IV/2, Sby	Fruit syrup
13	Hadi Sanjaya	Genteng Bandar III, Sby	Sirsak syrup
14	Harapan Jaya	Ngagik 70, Sby	Fruit syrup
15	Jaya Pineapple Canary	Plampitan Kalimin 27, Sby	Canned pineapple
16	Levis	Patemon 171, Sby	Tomato sauce
17	New Sumber Rasa	Kedung Cowek 167, Sby	Tomato and papaya sauce
18	PLY7 Mouth	Bengawan 57, Jatim	Pinapple, strawberry jam
19	Rimba Ria	Kedindin Tengah II/6, Jatim	Tomato and chili sauce
20	Roti Kering	Raya Mantup, Lamongan	Banana crispy
21	Sam Hop	Kembang Jepun, Jatim	Tomato and chili sauce
22	Sampurna	Cisdane 16, Sby	Fruit jam and jelly
23	Saritana	Keputran 22, Jatim	Manisan of Mango
24	Ny. Sukarti	Hadiluwit, Pacitan	Dried banana
25	Sumber Alam	Klatak Giri, Banyuwangi	Dried banana
26	Sweet Nice	Taman Ngagel 19, Sby	Pineapple jelly and jam
27	TBK	Ploso I/4a, Jatim	Manisan of Mango
28	Waru Sakti	Raya Dedungan, Sidiarjo	Canned papaya
29	Wen Ning	Lektol. Sumoharjo 76, Mojokerto	Grape juice
30	Horti Nusantara P.T.	Mojokerto	Banana puree

Source: Dinas Pertanian Tanaman Pangan, Jawa Timur, Oct., 1997

Table C-1-4 List of Agri-business in South Sulawesi

No	Name	Address	Activity
1	Bintang Bola	Jl. Korban 40, No.107, U. P.	Marquisa Syrup
2	CV. Karya Kita	Jl. Gunung Merapi 86, U. P.	ibid.
3	Sunny	Jl. Sungai Pareman 21, U. P.	ibid.
4	Electra	Jl. Sungai Tallo 15, U. P.	ibid.
5	Ratu	Jl. Karunrung 5, U. P.	ibid.
6	Surya	Jl. Satando 41, U. P.	ibid.
7	Prima	Jl. Anuang, U. P.	ibid.
8	CV. Binang Malino	Jl. Yos Sudarso 153, U. P.	ibid.
9	PT. Marquisa Segar	Kanreapia, Kab. Gowa	ibid.
10	DHT	Jl. Lembe 76, U. P.	ibid.
11	Torino	Jl. Kesatuan 44, U. P.	ibid.
12	Dei Liang Seng	Jl. Karampete 1, U. P.	ibid.
13	Dunia Baru	Jl. Nusantara 356, U. P.	ibid.
14	Safari	Jl. Bacan 98, U. P.	ibid.
15	Merpati Dua	Jl. UripSumoharjo 2/14, U. P.	ibid.
16	Sentosa	Jl. Abubakar Lambogo 255,	ibid.
17	Bintang Mas	Jl. Nusantara 358, U. P.	ibid.
18	Kuda Terbang	Jl. Somba Opu 194/7, U. P.	ibid.
19	UD. Sulawesi Utama	Jl. Nusantara 334, U. P.	ibid.
20	Agung Jaya	Jl. Baronang 8, U. P.	ibid.
21	Setia	Jl. Kalimantan 136, U. P.	ibid.
22	Bulat Dunia	Jl. Haji Bora 5, U. P.	ibid.
23	Karunrung	Jl. Gunung Latimojong 27,	ibid.
24	Marquisa 43	Jl. KH Wahid Hasyim 43,	ibid.
25	Piala Dunia	Jl. Sungai Pareman 55/27	ibid.
26	Bola Dunia	Kanreapia, Kab. Gowa	ibid.
27	Toraja Marquisa	Makale, Kab. Tator	ibid.
28	Shantung	Makale, Kab. Tator	ibid.
29	UD. Cikoro	KEC. Tompobati, Kab. Gowa	ibid.
30	Spring	Jl. Barawaja 3R/K, U. P.	ibid.

Source: DINas Pertanian Tanaman Pangan, Sulawesi Selatan; 1994