4.8.3 Plan to Develop Soybean Seed Distribution System

(1) Objectives

To establish a proper distribution system to make farmers understand advantages of using quality soybean seeds.

(2) Executive Agency

A government organization or public corporation which is related to production and distribution of soybean seeds in East Java Province.

(3) Actual activities

To promote distribution and extension of quality seeds as follows:

a) To use quality seeds at demonstration farms.
b) To use quality seeds preferably in intensification programmes.
c) To include quality seeds in multiplication projects, such as BIMAS, INMUS etc., as a part of technical package.
d) To provide credit for production on the condition of using quality seeds.
e) To promote sales marketing system, for farmers organization such as KUD, Kelompok Tani.

(4) Planning of the project

It is desirable to implement this plan under extension programmes affiliated with the Major Food Crops Production Programme.

4.8.4 Plan to Reinforce Administrative Functions and Activites of Soyben Seed Multiplication and Distribution

(I) Improvement of BBI Farms

(1) Objectives

To make BBI farm conduct FS production throughout the year, by improving their facilities including irrigation systems.

(2) Executing Agency

DGFCA

(3) Plan Design

BBI Plawija Bedali possesses three farms at Randu Agung - Singosari (12 ha), Bedali-Lawang (8 ha), Ketindan-Lawang (3.5 ha).

They are supposed to prepare equipment to make up for a deficiency against standard equipment lists of BBI (referred to Appendix C-3).

Rangu Agung has already been equipped with irrigation facilities, such as raceways, from outside. Water is basically insufficient in dry season, so cultivation in this season has not been fully carried out. Bedali Farm has not been equipped with such facilities, and cultivation in dry season is impossible. As for water resources, underground water can be drawn up from boring wells (75 - 125 m depth, 5ℓ/second according to local information). It should be planned to establish a reservoir at the Rangu Agung Farm and to take surplus water from the existing raceways, to store as much as water possible.

As for irrigation waterways, both pipe-lines and open waterways (concrete-lining)should be studied from the view-points of water loss and irrigation methods for the farm and from an economical

point of view.

The length of irrigation waterways in proportion to the total area of the farm may be estimated to be 200 - 300 m/ha, since the farm declines as a whole and it is divided into comparatively small sections. As for a reservoir, it will be constructed at the most suitable place on the farm. But, since the soil consists of fine volcanic ash, water may easily leak out of it. So, it is necessary to study the laying of a water-leakage-proof sheet. The outline of the irrigation facilities is as follows.

Table 4.5 Reinforcement Plan for BBI Palawija Bedali

Item	Rangu Agung-Singosari	Bedali-Lawang
Area for irrigation	12 ha	8 ha
Water resources	Deep wells (75 - 125 m) & existing irrigation raceways	Deep wells (75 - 125 m)
Length of waterway	200-300 m/ha x 12 ha= 2,400 - 3,600 m	200 - 300 m/ha x 8 ha= 1,600 - 2,400 m
Reservoir	4 mm/day x 12 ha x 45 days - (pump supply) ≒ 5,000m^3	To be about 2,000m^3, since pumped-up water for five days is stored temporarily

(4) Plan of Equipment and Facilities

As for the equipment which is needed for BBI Bedali, it is basically planned to prepare to make up for a deficiency against the standard equipment which the government has fixed for BBI Palawija. They are shown in the attached Appendix ??. The following are the list of equipment specially requested for the farm.

5 sets	Weeding Machine
3 sets	Seed Planter
2 sets	Mini-type Tractor
2 sets	Large-type Tractor
2 sets	Power Sprayer

1 set	Seed Grader
2 sets	Irrigation Pump
1 lot	Equipment for Training
1 set	Small package type seed refrigerator

(5) Cost Estimation

Irrigation related	¥30,000,000
Equipment	27,400,000
Total	¥57,400,000

(II) Strengtheining of BPSB Inspection Activities

(1) Objective

To strengthening inspection function of BPSB in order to activate their roles in inspection and certification.

(2) Executing agencies

DGFCA and BPSB in project areas

(3) Plan of Design

In order to improve the inspection function of BPSB, the following items are required to be enforced.

a) Improvement in transportation means
b) Fulfillment of inspection tools and equipments
c) Training for inspectors

As for particulars of equipment inventory of BPSB possessions, refer to Appendix D-3.

In assorting necessary equipments, it is necessary to train operation personnel. So equipments have to be introduced by stages depending on capabilities of inspection personnel. The equipments are sorted into three groups here in the order of higher priority.

(Group 1)	
Motorcycles	6 units
Motorcar	1 units
Germination test device	1 sets
Bean scales	2 sets
Infrared moisture testers	2
Electric moisture testers	2
Portable moisture testers	4

Sieve sets	2
Lamped magnifiers	2
Seed analysis boards	5
Seed micrometers	4
Double tube probes	4
(Group 2)	
Screenhouse	1
Electronic scales	2
(Group 3)	
Automatic seed counter	1

(5) Cost estimation

Equipment ---------- ¥39,240,000

(III) Provision of Technical Training

(1) Objective

To improve skills of the people concerned by the training and to progress multiplication and development programme for quality seeds.

(2) Executing Agencies

DGFCA to perform the programme is cooperation with Agency for Agricultural Research and Development (AFRD) and Agency for Agricultural Educaion, Training and Extension.

(3) Details of the training programme

1) Training themes

. Soybean cultivation techniques
Selection of varieties/farm management practices/pests and diseases/ farming practices/improvement of crop rotation/ water management/weed control

. Postharvest processing techniques
Harvesting/threshing/drying/cleaning/processing

. Storage techniques
Rotation of storage conditions to germination ratio

. Seed production techniques
Maintenance of genetic characteristics of a variety/roguing of other varieties/identification of diseased plant

. Test and disease indexing technique
Germination test/analysis and disease indexing/indexing of diseased plants

2) Possible Trainees

The below people who are involved in soybean multiplication and distribution in East Java are intended as possible trainees, who estimatedly add up 120:
Technical staff of BBI farms
BPSB inspectors

SPC employees
Extension workers (PPL)
Representative of seed grower groups

3) Places and frequency

As for training places, classes are to be held at training facilities of Agency for Agricultural Education, Training and Extension in Malan city, and on-the-job training is to be held at a BBI farm at Bedali, of Malan city (BBI to be furnished with postharvest-operation-related equipments, laboratory-related analyzers, and education-related audio-visual devices.)

The number of items of trainings is limited under the present circumstances provided the training is to be held in parallel to soybean cropping. But if soybean cropping were made possible over the year by improving BBI farms, training would be possible at any times during the year.

4) Training instructors

Sources of instructors are as shown below:

. MARIF (Malang Research Institute for Food Crops) and BORIF (Bogor Research Institute for Food Crops)
. Foreign experts on soybean cultivation
. Technical key personnel of private enterprises involved in processing of seeds
. General managers and deputy general managers of BBI and BPSB

Most parts of techniques for soybean multiplication and distribution are similar to those for rice. Though even training schemes for rice seeds are not fully programmed, it is a possible alternative to render training combining some courses with those for rice, and this possibility is worth considering. The techniques for which the training needs to be rendered are:

a. Soybean cultivation techniques
b. Postharvest processing techniques
c. Seed production and processing techniques

Table 4.6 Training Programme for Multiplication and Distribution of Soybean Seed

Class of Soybean Seed	Institute/ Organization	Contents of Training: Technical Areas	Contents of Training: Objectives	Trainees	Lecturers	Training Method	Place	Implementation Schedule (years) 1 2 3 4 5
FS/SS	BBI Palawija	Soybean cropping	Selection of suitable varieties Soil fertility Crop management Crop rotation Pest and disease control Water management Weed control	Field technician of BBI Extension worker (PPL)	Research worker from BORIF/ MARIF Foreign expert	Class lesson by foreign expert Lecturing tour	MARIF/BORIF Provincial BPLPP BBI's fields	//////
	PIU (SPC)	Seed farming	Maintenance of genetic charactristics of variety Inspection of diseased plants and other varieties Rogueing of diseased plants and other varieties	Field technician of BBI Technician for SPC	Research worker from BORIF/ MARIF Foreign expert	Class lesson by foreign expert On the job training	Provincial BPLPP The nearest SPC	////
		Past-harvest works	Harvesting Threshing Drying Cleaning Processing					
		Storage	Study on the relation of the rate of germination and the period of storage Maintenance of germinative viability Ambience control Improvement of packing method are material					
ES	Seed Growers	Soybean cropping Seed farming Postharvest works	ditto	Representative of seed growers' group	Chief & assist. chief of BBI/ BPSB branch	Class lesson On the job training	Provincial BPLPP Demonstration farm	//////
	BPSB	Test analysis	Test of germination analysis Inspection Disease indexing	Inspector of BPSB	Research worker from BORIF/ MARIF Foreign expert	Correspondence course	Central and provincial laboratory of BPSB	////

4.9 Economic Evaluation

(1) Economic analysis

In Indonesia soybean import is under the control of the government (BULOG) and domestic market price of soybean is artificially fixed up at a higher level. Therefore if we want to know the impact of the project to the national economy or to resource allocation it is necessary to revaluate the domestic market price by using international price and to set proper economic price. In this economic analysis we set following economic prices as parameters of economic calculation according to the analysis of past time-series price data.

	Market	Economic price
Farm-gate price of soybean for consumption	500 Rp	312 Rp
Uncertified soybean seed	550 Rp	343 Rp
Material of soybean seed	600 Rp	374 Rp
Certified soybean seed	850 Rp	530 Rp

Economic Benefits of the Project are composed of direct benefit (benefit from seed production) and indirect benefit (benefit from increasing soybean production). Direct benefit can be calculated by multiplining the supply volume of improved seed by economic price of certified soybean seed. For calculating indirect benefit, firstly we multiply the difference between unit yield of improved seed (1,10 ton/ha) and that of local seed (1,00 ton/ha) by planted areas, i.e. calculate the increment by deducting the production volume in case of without project from the production volume in case of with project, secondly multiply the increment by economic price of soybean for consumption, and then the gross benefit can be drawn. Because farmers can use improved seed 5 times through self-picking of seed or JABAL system after buying it, therefore we also add the increment of soybean production after second harvest in calculation of benefit. While because the gross indirect benefit include the additional cost (187 Rp/kg) by introducing improved seed, we calculate the net benefit by deducting it from the gross benefit.

Under those prereguisites mentioned above we conducted economic calculation and got the result of calculation of economic internal rate of returns, i.e. IRR (20.4%) through whole project life of 20 years.

Land use in East Java is very intensive and the potential of expanding planted area of soybean is limited, so it is necessary to adopt the cultivation method that will increase yield per hectare in the future. However, since increase of production that will accompany the increase of unit cost is of no value in an economic sense, increase of production must be consistent with cutting off the unit cost. The fact that 20.4% of IRR can be expected from implementing the Project strongly suggests the possibility to increase soybean production with decreasing unit cost.

Agricultural technology that will increase yield per hectare cannot evade the sharp increase of unit cost in case it exceeds certain limit of the increase of production. In East Java its share in total production of soybean is large, agricultural infrastructures are well constructed and farmers technical level is high, therefore eminent increasing effect of soybean production can be expected in the short run. But considering limiting conditions mentioned above, increase of soybean production must be encouraged in outer territories where there is big potential of expanding planted areas of soybean in the long run.

(2) Analysis of Farm Income

By introducing improved seed (ES), yield per hectare will increase 10%, then increment of soybean per hectare is 100 kg and the gross income is 50,000 Rp (100 kg x 500 Rp/kg). Additional cost per hectare being 15,000 Rp [(850 Rp/kg - 550 Rp/kg) x 50 kg] and deducting additional cost from gross income, then net income per hectare of 35,000 Rp can be expected. In case of not renewing improved seed, using it repeatedly and supposing yield per hectare of ES_1, is 1.07 ton/ha, that of ES_3 is 1.04 ton/ha,

that of ES_2 is 1.02 ton and that of ES_4 is 1.01 ton/ha, then the increment of production per hectare (the increment of net income) of ES_1, is 70 kg (35,000 Rp), that of ES_2 is 40 kg (20,000 Rp), that of ES_3 is 20 kg (10,000 Rp) and that of ES_4 is 10 kg (5,000 Rp)

Supplying volume of project seed reach at annual target volume of 1,000 ton at the sixth year of the project life, project seed from the first generation to the fifth generation spreads to whole project area at the tenth year of the project life, and then expected nominal value of annual increment of whole farm income is 2.1 billion Rp. Discounting total expected nominal value of increment of whole farm income through whole project life of 20 years by discounting factor of 12%, which is equal to lending interest rate of agricultural credit, then the present value of 7,7781 million Rp can be calculated.

(3) Financial analysis

Economic effect of the Project is external and the main benefit belongs to farmers who use improved seed. In other words owner of the Project can only get one part of the benefit and she cannot get enough income judging from the financial point of view. Profitability of the project can be improved by lowering purchasing price of material of soybean seed or by raising selling price of improved seed,but to encourage the production of seed growers and to encourage general farmers buying improved seed those prices must be set properly taking account of movement of the market prices.

The result of this financial analysis can be summarized as follows. Total income can cover current expenditure, small surplus is remained but it can only cover small part of capital expenditure. In other words the income of this project cannot recover the investment of fixed capital and can cover only requisite sum of working capital.

The another important problems how to get working capital which is needed in advance. The largest cost item of working capital

is purchasing fund for material of soybean seed, and the interest that must be paid till recovering proceeds of certified seed is its real financial cost. In the cost items of this financial analysis the interest is disregarded, because procuring method and borrowing conditions of working capital have not yet been ascertained. To cover the interest of the working capital at least 12% (lending rate of agricultural credit) of paying capacity is needed but the residual deducting current expenditure from total income is small, therefore some subsidize for interest is needed in case all working capital is procured by borrowing.

Table 4.7 Flows of Economic Cost and Economic Benefit

Project Year	Economic cost			Economic benefit			Net benefit
	Capital cost	Current cost	Total	Capital cost	Current cost	Total	
1	806,000	18,960	824,960				824,960
2	1,550,000	18,960	1,568,960				1,568,960
3	1,110,000	26,460	1,137,460				1,136,460
4		251,880	251,880	106,000	99,800	205,800	46,080
5		343,920	343,520	318,000	395,440	773,440	869,920
6		555,560	555,560	530,000	842,000	1,372,000	816,440
7		555,560	555,560	530,000	1,171,280	1,701,280	1,145,720
8		555,560	555,560	530,000	1,349,640	1,879,640	1,324,080
9		555,560	555,560	530,000	1,431,960	1,961,960	1,406,401
10		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
11		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
12		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
13		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
14		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
15		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
16		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
17		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
18		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
19		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
20		555,560	555,560	530,000	1,459,400	1,989,400	1,433,840
Total	3,466,000	8,992,780	12,459,180	8,374,000	21,343,520	29,712,520	17,258,340

IRR = 20.4%

Table 4.8 Future Projection of the Increment of Farm Income

	Nominal value (1000 Rp)	Discounting factor (12%)	Present value (1000 Rp)
1	0	0.893	0
2	0	0.797	0
3	0	0.712	0
4	140,000	0.636	39,040
5	560,000	0.567	317,520
6	1,200,000	0.567	608,400
7	1,680,000	0,452	739,360
8	1,940,000	0.403	781,820
9	2,060,000	0.361	743,660
10	2,100,000	0.322	676,200
11	2,100,000	0.287	602,700
12	2,100,000	0.257	539,700
13	2,100,000	0.229	480,900
14	2,100,000	0.205	430,500
15	2,100,000	0.183	384,300
16	2,100,000	0.163	342,300
17	2,100,000	0.146	306,600
18	2,100,000	0.130	273,000
19	2,100,000	0.116	243,600
20	2,100,000	0.104	218,400
Total	30,680,000		7,778,000

Table 4.9 Financial Projection of the Project

Unit: 1000 Rp

Project	Income	Expenciture							
	Total	Capital expenditure			Current expenditure			Total	Net income
		SPC	Storage	Sub-total	SPC	Storage	Sub-total		
1		500,000	306,000	806,000	11,760	7,200	7,200	18,960	824,960
2		1,250,000	200,000	1,550,000	11,760	7,200	7,200	18,960	1,568,960
3		1,000,000	110,000	1,110,000	11,760	14,700	14,700	26,460	1,136,460
4	170,000				211,000	107,880	318,880	318,880	148,880
5	510,000				410,280	69,240	479,520	479,520	30,480
6	850,000				675,960	105,600	781,560	781,560	68,440
7	850,000				675,960	105,600	781,560	781,560	68,440
8	850,000				675,960	105,600	781,560	781,560	68,440
9	850,000				675,960	105,600	781,560	781,560	68,440
10	850,000				675,960	105,600	781,560	781,560	68,440
11	850,000				675,960	105,600	781,560	781,560	68,440
12	850,000				675,960	105,600	781,560	781,560	68,440
13	850,000				675,960	105,600	781,560	781,560	68,440
14	850,000				675,960	105,600	781,560	781,560	68,440
15	850,000				675,960	105,600	781,560	781,560	68,440
16	850,000				675,960	105,600	781,560	781,560	68,440
17	850,000				675,960	105,600	781,560	781,560	68,440
18	850,000				675,960	105,600	781,560	781,560	68,440
19	850,000				675,960	105,600	781,560	781,560	68,440
20	850,000				675,960	105,600	781,560	781,560	68,440
Total	13,480,000	2,750,000	616,000	3,466,000	10,795,960	1,724,220	12,605,140	16,082,180	2,602,180

CHAPTER 5 POTATO PRODUCTION

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5.1 Government Policy of Potato Production

Potato is classified as vegetable in Indonesia. The percentage of the production value of vegetables among all the food crops is small, but it is an important source of vitamins to keep healthy life of Indonesian nationals. Indonesian government has the objectives of the improvement of vegetable production.

a. To improve the nutritional quality of the national diet.
b. To promote export and minimize import.
c. To fill the demand in domestic market which is increasing in quantity as well as in quality.
d. To improve farmers' income.

In the past Indonesian government's endeavours for potato production has been limited only to research activities especially in Lembang Horticulture Research Institute (LEHRI). However it recently decided to take measures for encouraging potato production to cope with increasing demand mainly in urban areas. The Government aims at not only increasing potato production but also developing potato processing industry for the purpose of substituting domestic potato products for imported potato products, i.e. French fried potato and potato chips. In the future production surplus is expected to be exported increasingly to neighbouring countries.

Table 5.1 Production Targets of Potato in REPELITA IV

Item \ Year	1984	1985	1986	1987	1988	Annual growth rate (%)
Area harvested (1000 ha)	26.7	26.8	27.2	27.6	28.0	1.49
Yield per hectare (ton/ha)	7.6	8.0	8.5	8.9	9.4	5.30
Total production (1000 ton)	201.0	215.0	230.0	246.0	263.0	6.91

Source: Kabijaksanaan dan Langkah-Langkah Operasional Rembangunan Pertanian Tanaman Pangan REPELITA IV.

Table 5.2 Target of Intensification Areas of Potato in REPELITA IV

Unit: ha

Province \ Year	1984	1985	1986	1987	1988
Non credit service					
North Sumatra	1,712	1,712	1,622	1,682	1,622
Jambi	1,141	-	-	-	-
West Java	8,000	9,141	8,660	8,660	8,660
Central Java	2,194	2,194	2,079	2,079	2,079
East Java	3,977	3,977	3,768	3,768	3,768
South Sulawesi	2,000	2,000	1,895	1,895	1,895
Sub-total	19,000	19,000	18,000	18,000	18,000
Credit service					
North Sumatra	631	721	811	901	901
Jambi	968	849	720	811	811
West Java	2,400	3,000	3,610	4,000	4,000
Central Java	808	924	1,039	1,155	1,155
East Java	1,465	1,675	1,884	2,093	2,093
South Sulawesi	737	842	948	1,053	1,053
Sub-total	7,000	8,000	9,000	10,000	10,000
Total	26,000	27,000	27,000	28,000	28,000

Source: Kebijaksanaan dan Langkah-Langkah Operasional Rembangunan Pertanian Tanaman Pangan REPELITA IV

5.2 Related Development Projects and Foreign Aids

5.2.1 SAPPRAD Project

(1) Background of the project

Under CIP (International Potato Center)'s regional development scheme, "Southeast Asian Programme for Potato Research And Development", the Indonesian government has been engaged in researches, development and training. The activities are shown in Table 5.3. Financial assistances for this activity are mainly provided by the Australian government.

(2) Present status of technical cooperation

Dr. Michael Potts, an agronomist, has been stationed at LEHRI by CIP since June, 1987. Included within the scope of SAPPRAD are the following:

1) TPS Evaluation of CIP Materials by Mr. Sudjoko Sahat of Lembang.
2) Bacterial wilt and late blight screening of CIP germ plasm also by Mr. Sahat.
3) Marketing study with director Okabe and Mr. Bottema of coport-ESCAP at Bogor.
4) SAPPRAD project on tropical agronomy at mid-elevation areas of West Java, Central Java, East Java and Bali. Work being done by IR. Surachmat Kusumo at Food Crops Research. Center at Bogor.
5) SAPPRAD project on pilot potato farmer production trials in West, East, Central Java and Bali conducted by Dr. Azis Asandhi of Lembang.
6) SAPPRAD project on pilot testing of rapid multiplication technique for seed production at Lembang West Java, Sumberbrantas East Java and Wonosobo Central Java conducted also by Dr. Azis.

Table 5.3 SAPPRAD - INDONESIA Training, Workshops, Field-day 1982 - 1987

	Activities	Date	Venue	Number of Participants
1.	Research method training	Nov.16-20, 1982	Lembang	40 researchers
2.	Potato production workshop	Dec.22-24, 1982	Lembang	60 researchers, extension workers and farmers
3.	Potato workshop	August 8-9, 1983	Lembang	40 researchers
4.	Field day of lowland potato	August 20, 1984	Jambegede	100 extension workers and farmers
5.	Regional tropical potato agronomy course	August 20-30, 1984	Malang	26 researchrs and extension workers
6.	Planning workshop for regional tropical agronomy verification trials	August 29-30, 1984	Surabaya	10 extension workers
7.	Diffused light storage training	March, 1985	Sumberbrantas	12 extension workers and farmers
8.	Field day of lowland potato research	August 27, 1985	Jambegede	SAPPRAD TCM (8 res. workers)
9.	Seminar on research results on potato	August 28, 1985	Lembang	15 research workers
10.	SAPPRAD Technical Com. Meeting	August 29-30, 1985	Lembang	8 research workers
11.	Seminar on socec. of potato production in medium elevation	Dec.13, 1985	Bogor	26 agro-econ. researchers and extension workers
12.	Seminar on mid-elevation potato	Jan.15, 1987	Lembang	34 researchers

(3) The demand and marketing of potatoes in Java (1987/1988)

The main objective of this project is to assess an impact on demand and prices, taking into account expanding of production to mid-lowland areas (300 - 700 m above sea level). Dr. Grata Watson will be stationed at LEHRI by CIP for this study.

1) To estimate costs of production and profitability of mid-lowland potatoes.
2) To analyze consumption and utilization patterns.
3) To analyze relationship between income level, price (income elasticity and price elasticity of demand) and potato consumption in the major urban markets in Java.
4) To study the relation between price and quantity of potatoes in major wholesale markets.
5) To assess export potential of potatoes in the Singaporean market.

(4) Subjects of research cooperation in future

CIP is planning technical cooperation in future with Indonesia in the following fields:

1) Potato and sweet potato improvement - to select parental materials for breeding - Mr. Sahat
2) Research contract on bacterial wilt - Mr. Sahat
3) TPS progeny evaluation and seed production - Mr. Sahat
4) Potato adaptation to warmer climates - with Dr. Potts
5) Socio-economic study - by Dr. Greta Watson of Rockefeller Foundation
6) Postharvest studies with assistance of Dr. Siert Wiersema.
7) SAPPRAD current studies to continue plus additional projects on screening for potato processing varieties and piloting of seed production systems in government farms and farmers fields.

5.2.2 Technical Cooperation by JICA experts

Japanese technical cooperation was commenced by a JICA expert who has been assigned to the country since October, 1985.

Assignee	:	Mr. Akio Suematsu
Assignment period	:	October, 1985 through September, 1986
Speciality	:	Techniques for seed potato multiplication
Assignment place	:	Lembang Horticulture Research Institute

The assigned expert engaged himself in the below activities with respect to the objective field of cooperation, "techniques for seed potato multiplication".

1) Technical guidance for disease indexing
   . Elisa method
   . Latex aggregation
2) Technical development of tissue culture
3) Field study of virus diseases
   . West Java Province
   . Central Java Province
4) Introduction of Japanese local varieties
   5 Japanese varieties were tentatively cultivated and this is still under way presently.
5) Training of disease indexing
   The training was carried out at LEHRI for personnel of PPL and BBI/BBU.

Another expert, Mr. Masanao Hiura, will take over the works of technical cooperation at LEHRI from him since December, 1987.

5.2.3 Other Aids

(1) Financial aid by USAID

With a view to extending economical production of pathogen free potatoes by making farmers directly take up the rapid multiplication method, SUAID has given key farmers financial assistances to buy screen houses for isolating potatoes from aphids which are thought to be a disease carrier.

(2) Research and development by ADB

A multiplication programme for quality seed potatoes was taken up as a priority project in the course of development researches for "Production Promotion Programme for Vegetables" financed by Asian Development Bank, but it has not been brought into implementation yet.

5.3 Actual Conditions of Potato Production

5.3.1 Production Circumstances

Indonesia is thought to have a long history in the cultivation of potatoes. It is said, however, that potato cultivation spread out to all over Java island only after early 1900s.

One experimental farm was established exclusively for potato in Lembang of Margahayu in 1939 and this is the predecessor of the present Lembang Horticulture Research Institute. Potatoes have been used for soup, French-fry or cakes as luxurious food.

The production of potato in Indonesia has been increasing every year, and the harvested area for potato in approximately 30,000 ha, while the production has reached approximately 300,000 tons as of 1985.

Table 5.4 Production of Potato in Indonesia (1981 - 1985)

Year	Harvested Area (Ha)	Production (Ton)	Yield per Unit (Ton/Ha)
1981	26,600	195,400	7.3
1982	21,000	164,800	7.8
1983	30,300	250,000	8.3
1984	31,600	325,600	10.3
1985	30,600	317,700	10.4

Source: Directorate of Horticulture, Ministry of Agriculture

75% of the potatoes have been produced in three Java provinces, followed by North Sumatra. Jambi and South Sulawesi provinces, where the study was conducted this time, account for only 0.7% and 3.0% of the total

natural production respectively. (Refer to Table 5.5)

Table 5.5 Production of Potato in 5 Provinces for the study, 1985

Province	Harvested Area (Ha)	%	production (Ton)	%	Yield per Unit (Ton/Ha)
Jambi	512	1.7	2,210	0.7	4.32
West Java	10,245	33.5	132,674	41.8	12.95
Central Java	4,456	14.6	44,215	13.9	9.92
East Java	6,776	22.1	58,934	18.6	8.70
South Sulawesi	1,362	4.5	9,404	3.0	6.90
Indonesia	30,597	100.0	317,694	100.0	10.38

Source: Directorate of Horticulture, Ministry of Agriculture
Agricultural Office, East Java Province

Potatoes are grown at high and cool lands of 800 - 2,000 m of the altitude as vegetable in Indonesia. The following figures show the major producing areas of potato in the five provinces when the study was conducted.

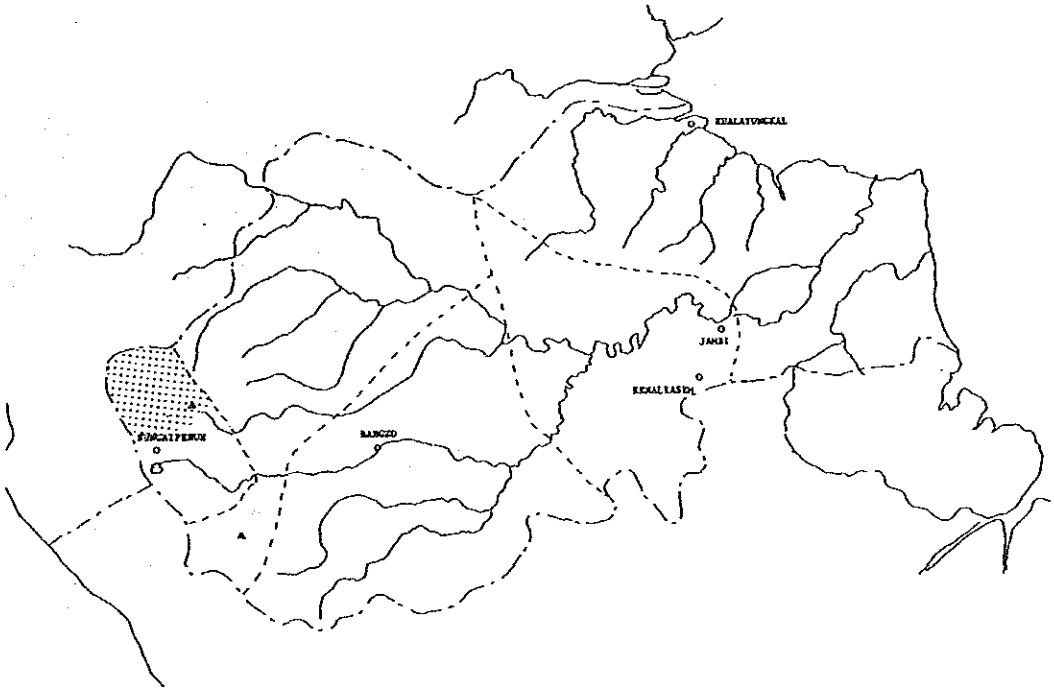


Figure 5.1 Major Producing Areas of Potato in Jambi Province

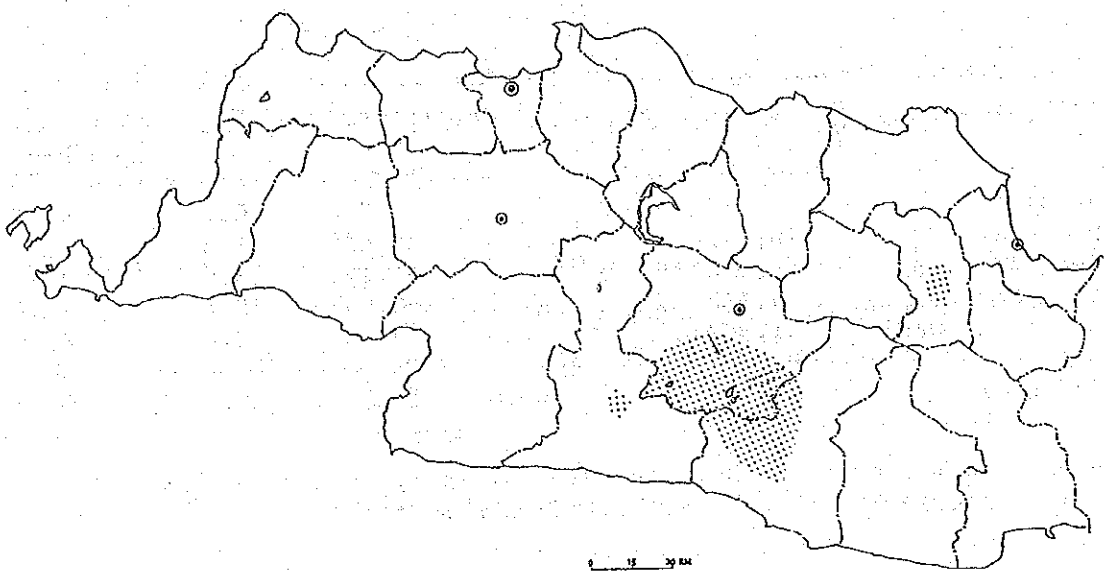


Figure 5.2 Major Producing Areas of Potato in West Java Province

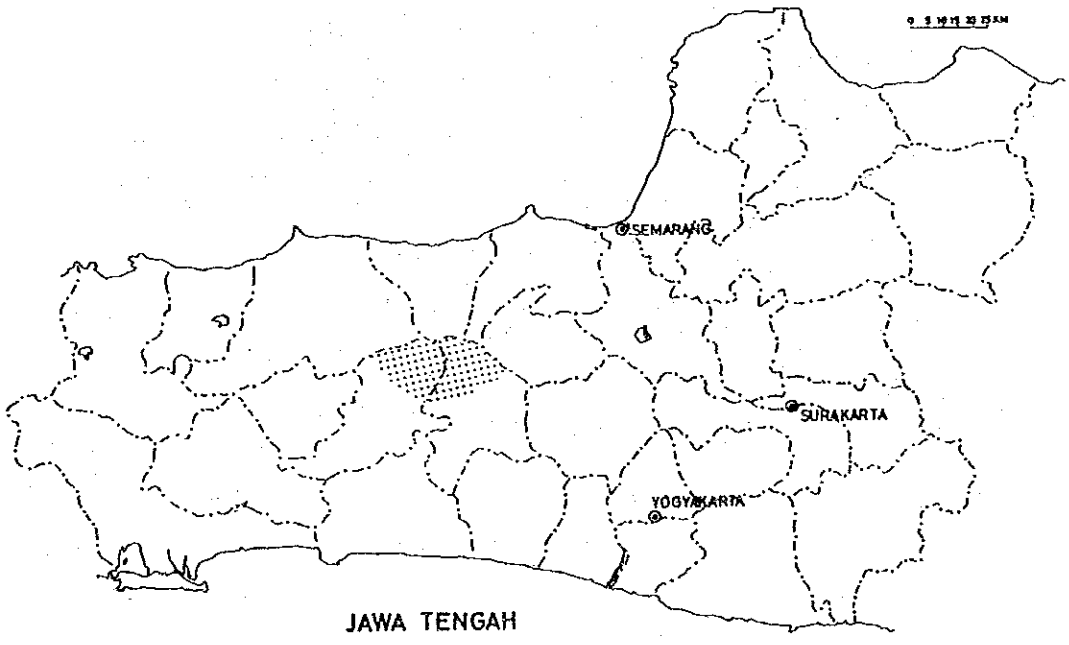


Figure 5.3 Major Producing Areas of Potato in Central Java Province

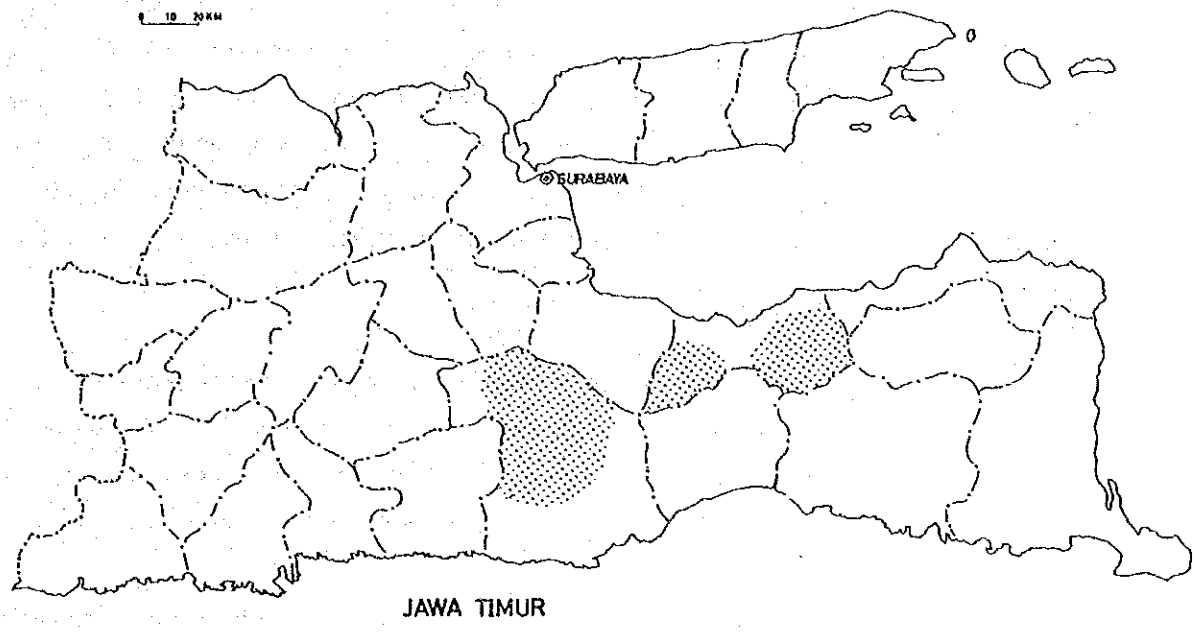


Figure 5.4 Major Producing Areas of Potato in East Java Province

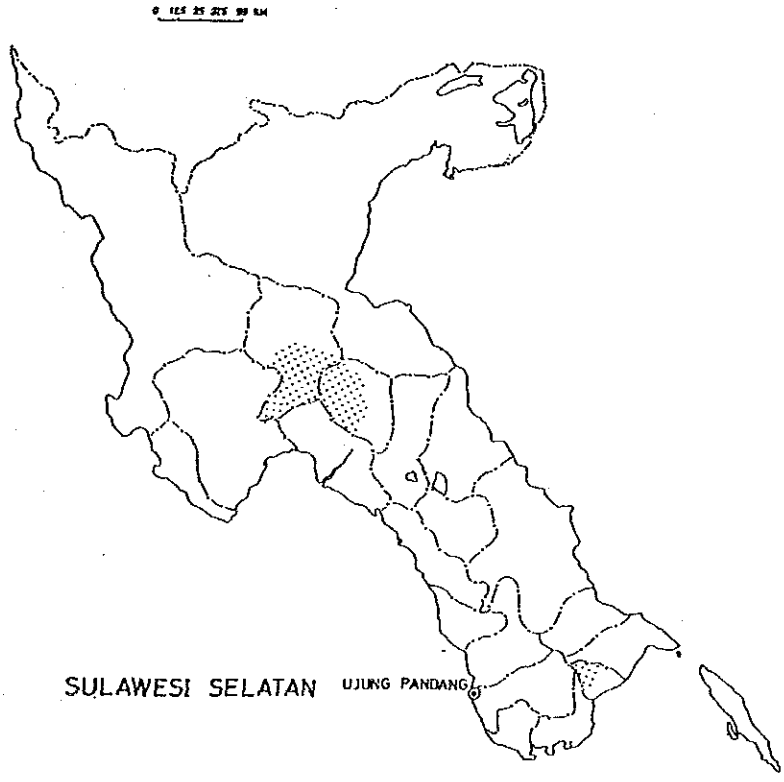


Figure 5.5 Major Producing Areas of Potato in South Sulawesi Province

Though potato is cultivated at high and cool lands, the potato cultivation in tropical zone contains a lot of problems. Yield per unit area in Indonesia is approximately 10 tons, showing a remarkably low figure in comparison with the other major potato producing countries of the world. Techniques of potato production were generally low-levelled and they use seed potatoes of low quality, and these lead to low yield. Quality seed potatoes available for farmers are all expensive imported ones, and there are disorders in distribution channels after they are imported. So, it is impossible for farmers under the present conditions to buy and use such imported seeds.

Therefore, it is an urgent task to constantly supply pathogen-free seed potatoes in order to increase potato production in Indonesia. Besides, it is also necessary to rear the varieties which match each area, to improve cultivation techniques and to improve storing method for seed potatoes.

Since potato cultivation has come to the limit at high lands, several measures have been taken to expand cropping area at mid-elevation (approximately at the altitude of 400 - 800 meters). And so, the production increases in potato in these areas are expected in future.

5.3.2 Cropping Pattern

The following figures show cropping patterns of potato in the five provinces where the study was conducted.

Jambi Province

Cropping Pattern \ Month	Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
I	Potato — Maiz — Potatoe Cabbage

West Java Province

Cropping Pattern \ Month	Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
I	Potato — Potato — Potato
II	Cabbage, Tomato — Potato — Cabbage, Totamato
III	Cabbage — Maize — Potato

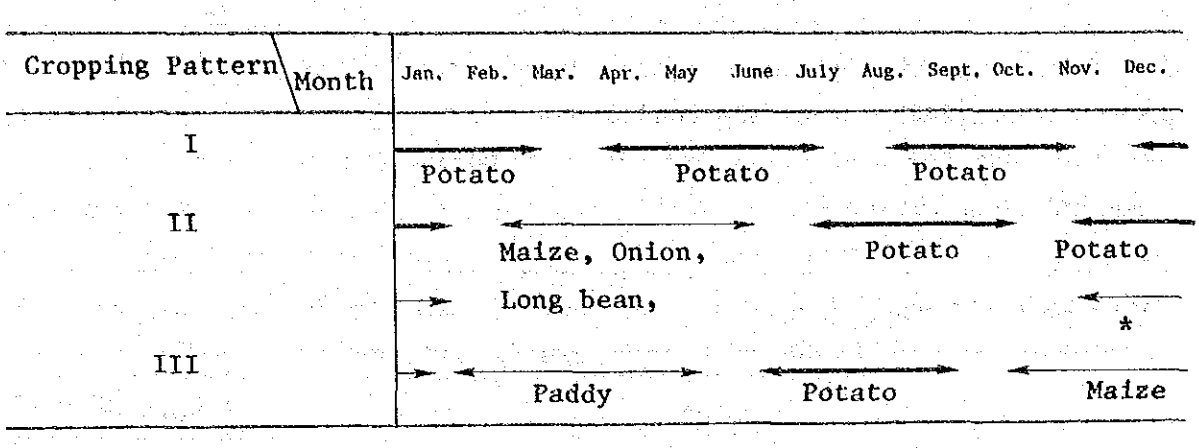
Central Java Province

Cropping Pattern \ Month	Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
I (Potatoes 3 croppings + Cabbage 1 cropping)	Potato (I) — Potato (II)
	Potato (III) — Cabbage — Potato (I)
II	Potato — Cabbage — Potato

East Java Province

Cropping Pattern \ Month	Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
I	Potato — Potato
II	Potato — Cabbage

South Sulawesi Province



* Maize, Onion, Long bean, Cabbage

Figure 5.6 Cropping Pattern of Potato in the Provinces

Potato is classified into a vegetable in Indonesia and they are cultivated in mountainous regions together with other vegetables (cabbage, tomato, spring opinion, pulse, maize). In some farms, they are sometimes grown by mixed cropping with onion or pulse.

The farming scale of most of the potato growers is below 1.0 ha. In Indonesia, it is possible to grow potatoes throughout the year if water conditions permit, and they grow enough to harvest after 100 days of a growing period. Any of the provinces does not have a fixed cropping season for potato, and the farmers grow potatoes in view of rainfall, relation with other rival crops and so on.

The planting has been done in the proportion of approximately 60% in early rainy season (October - November), 30% in late rainy season (March - April) and 10% in dry season (May - June). This is because the producing areas in highlands are less equipped with irrigation facilities. The income from the potato production is generally estimated to be higher in the planting after dry as well as rainy season than in that in early rainy season. The followings are the reasons for that.

(1) Potatoes planted during the dry season and late in the rainy season are of higher yield and of better quality than those planted early in the rainy season.

(2) Since the potatoes planted in early rainy season are easy to be affected by disease, they require higher cost for spraying of chemicals.

(3) Since the total production is small in the crops planted after dry and rainy seasons, the price is higher in comparison with the potatoes planted in early rainy season.

Farmers are less motivated to actively rotate potato and to keep cultivation conditions better with a view to heightening yield. The potato comparatively well bears successive rotation and since the yield would not be decreased even after several years on the condition that management practice be properly applied. However, it is clear that successive rotation causes diseases and invites insects and thus that it deprave both the quantity and quality of harvests. Therefore, it is required to established economical crop rotation systems which match different areas in order to promote production increase in potatoes.

5.3.3 Varieties

The followings are major varieties which have been encouraged to grow at present in Indonesia.

Table 5.6 Varieties of Potatoes

Varieties	Productivity (Ton/Ha)	Growing period (Days)	Skin Colour /meat colour
Desiree	13.7	100	Red/light yellow
Patrones	14.3	100	Yellow/yellow
Donata	17.0	100	Gray/light yellow
Redosa	14.1	100	Gray/broken white
Thung 151	17.1	110	Yellow/yellow
Rapan 104/106	17.0	115	Yellow/yellow
Eigenheimer (Kerinci)	9.1	100	Yellow/yellow
Cosima	28.5	101	Light yellow/yellow
Cipanas	24.9	105	Yellow/yellow
Granola	25.0	100	Yellow/yellow

Source: Directorate of Horticulture, Ministry of Agriculture

The varieties such as Eigenheimer, Provit, Voran or Bevelandes were cultivated before 1960. Eigenheimer is still popular in the name of Kerinci in West Sumatra. Katella, Maritta, Aquilla, Thung and Patrones were introduced in 1960s, and Patrones have been grown in North Sumatra. Since Katella has a good shape and the quality is not easily affected by virus disease, they were grown in a wide range of areas. But this variety is easy affected by late blight.

Consumers prefer oval-shaped potatoes with pale yellow skin, light yellow meat, shallow bud and with a characteristic of hardness in boiling. TD12-8-4 were bred by the crossing of Thung 151C and Desiree, and it is now called Chipanas. This has a high yielding ability with high quality and has a resistance to late blight. Among introduced varieties, Cosima and Chipanas were released at the same time. Granola was introduced recently from West Germany and cultivation has been expanded in North Sumatra, West Java and in other areas, showing the high yielding ability of 30 tons/ha.

The selection of varieties suitable for mid-lands has been conducted at present in collaboration with CIP and some strains highly resistant to heat and bacterial wilt have been found out.

Even though the Study Team intended to know the planted area of potatoes in Indonesia classified by varieties, it was not available, as the statistics have not been compiled yet. According to the investigation results, Granola is grown in many parts of Java Island while Chipanas, Cosima and other varieties are grown together with Granola in Jambi and South Sulawesi.

5.3.4 Farmer's Practices

The following Table shows the farmer's practices for potato production in the five provinces where investigations were conducted.

Table 5.7 Growing Practices for Potato Adopted by Farmers

Operation / Province	Jambi	West Java	Central Java	East Java	South Sulawesi
1. Tilling					
(1) Human Power	o	o	o	o	o
(2) Animal	x	x	x	x	x
(3) Machines	x	x	x	x	x
2. Manuring					
(1) All-over broadcasting	x	x	x	x	x
(2) Application around the plant	o	o	o	o	o
Basic					
Urea(kg/Ha)	125-150	100-180	150-200	-240	100-150
TSP (kg/Ha)	125	100-180	150-200	-240	100-150
KCL (kg/Ha)	100-120	-25	50-80	-80	-
Compost(Ton/Ha)	5-10	10-20	10-30	10-15	10-20
Top-dressing	x	x	x	x	x
3. Seeding(Ton/Ha)	1-1.5	1-1.2	1.2	1-1.5	1.2
Cutting of Seed Potatoes	x	o Not general	x	x	o Not general
4. Planting Density (cm x cm)	60-70 x25	70x 25-35	70x30	60-70 x20-40	30-40 x30-40
5. Chemical Spraying	5-6 times	15-20 times	10-20 times	15 times	2-5 times
(1) Human Power	o	o	o	o	o
(2) Power	x	x	x	x	x
6. Weeding	2-3 times	2 times	2 times	3-4 times	1-2 times
7. Earthing up	1-2 times	1 time	1 time	1 time	1-2 times
8. Storing	Left in the soil	Spread in storages	Packed in bags or wooden boxes, and kept in storages	Packed in bags or wooden boxes, and kept in storages	Packed in bags, and kept under floor
9. Required Labour (Man/Ha)	-	180-280	140-160	190	100-175

Since potatoes are grown in high-lands of a cool climate in Indonesia, the area for one farm is, generally speaking, very small, and so mechanization is difficult to introduce. Therefore, all the operations from plowing to harvest are done intensively by human power. As for fertilizer, area, triple superphosphate and potassium choride are mainly used there, and some farmers use ZA as a nitrogen fertilizer. These kinds of fertilizer are applied around the plant as basic dressing and no farmers apply top-dressing there. For potato cultivation basic dressing is a very important element. Because the increase in manuring greatly influences the yield, the growing period is comparatively short, besides, the manuring effect will be reduced unless fertilizer is absorbed by the flowering time. But, the absorption factor is said to be high when nitrogen fertilizer is applied separately as basic dressing and as top-dressing. According to one example of manuring standards in Central Java Province, the proportion is; urea: 225 kg, triple superphosphate: 300 kg, and pottasium chloride: 100 kg. The manuring amount of the farmers is known to be below the standard in comparison with this example. The manuring amount can not be fixed, it varies depending upon the soil conditions of areas, and individual farmer is supposed to fix it. But, the careful research works on manuring standards including the problem of top-dressing in consideration of locality are necessary and the standard is shown to farmers in order to increase the yield of all the farmers.

Most of seed potatoes which are used by farmers are those selected among generally cultivated potatoes and the renewal rate of seed potatoes is very low. The farmers generally use seed potatoes which are grown by themselves for five-six generations and some farmers use even those of the tenth generation or more than that. The farmers use potatoes weighing 20-50 g as seed potatoes, and the planting density is generally 70 cm x 30 cm. Chemical spray for potato is done more frequently in comparison with other crops and there are even fear for heavy application. Especially, in Java island, it is done 15-20 times per cropping, showing a big gap in comparison with about 5 times per cropping in two provinces of the outer islands. High frequency of chemical spray is seen in the application of fungicides rather than in that of insecticides. While insecticides are sprayed only at the early growing period, fungicides are sprayed after each rain, in an extreme example. According to Suhardi Report, the rate of yield decrease is sometimes 50% or more than that,

when late blight susceptible varieties are grown with no chemical spray. Thus, it is known that the farmers spend a considerable amount of labour as well as money for control of late blight.

It is a general method to store seed potatoes in Central and East Java, and South Sulawesi to pack them in bags or wooden boxes and keep them in storage or under the floor, while advanced farmers in West Java adopt a method of applying NAC powder on seed potatoes, spread them in the dark and cool places and keep them in wooden boxes after sprouting. It is heard that the farmers in Jambi keep seed potatoes under the ground without digging them up and dig them up around one month before planting. In this method, the farmers leave stems and leaves to naturally wither up. But, it increases danger of virus infestation from the viewpoint of seed potato production to leave stems and leaves under such conditions, so different techniques should be introduced separately to seed potato production and food potato production.

5.3.5 Pests and Diseases

(1) Major pests and diseases

The following table shows major pests and diseases of potato in Indonesia.

Table 5.8 Major Pests and Diseases for Potatoes in Indonesia

Category	Scientific Name	Common Name
Insects	Agrotis ipsilon	black cutworm
	Henosepilachna vigintioctopunctata	epilachna beetle
	Heliothis armigena Hbn	bud worm
	Spodoptera exigue	cutworm
	Spodoptera litura F.	cutworm
	Chysodeixis chalcites	looper
	PhtoriMaea operculella	tuber moth
	Myzus persicae	aphid
	Aphis gossypii Glor.	aphid

Category	Scientific Name	Common Name
Insects	Aphis spiraecola Patch	aphid
	Holotrichia javana Brsk	white grub
	Gryllotalpa sp.	mole cricket
Nematodes	Meloidogyne SPP.	root-knot nematodes
Fungi	Phytophthora infestans	late blight
	Alternaria solani	early blight
Bacteria	Pseudomonas solanacearum	bacterial wilt
Virus		PLRV
		PVY
		PVX
		PVS
		PVA
		PVM
		TBRV

It is said that 30% of the total cost for potato production is spent for chemicals to protect plants from pests and diseases. So, it can be easily imagined how large a problem of pests and diseases are for potato production. Comprehensive measures are required to be taken in combination of establishment of crop rotation system, introduction of resistant varieties, production of pathogen-free seed potatoes, elimination of pathogen and chemical spray in proper time in order to reduce these pests and diseases.

The major pests and diseases are late blight, bacterial wilt, virus diseases, aphid, potato tuber moth, root-knot nematodes and mole cricket.

1) Late blight (Phytophthora infestants)

This causes a serious damage. According to Suhardi Report, there exist at least five types of late blight fungus strains in Indonesia. Therefore, it is necessary to select the varieties of biological resistance (field resistance,

general resistance, horizontal resistance), and to cope with this problem by using pathogen-free seed potatoes and by spraying chemicals for withering stems and leaves two weeks before harvest in order to protect potato from late blight infection.

2) Bacterial wilt (Pseudomonas solanacearum)

This causes a serious damage especially to low-altitude regions, and it brings about 10-70% of decrease in yield. The control of this disease is one of the most difficult problems, and chemicals have no effect on this, though they have some effects on comprehensive control measures. There were found several strains of high productivity and resistant to late blight and bacterial wilt among those provided by CIP, and so they may be reared to varieties in the near future. Furthermore, it is also necessary to promote protection system by adopting rotation cropping with paddy, sugarcane and others, and by using clean seeds in combination.

3) Tuber moth (Phthorimaea opercuella)

They infect potatoes in the field and cause the decrease in yield by 20-46%. The damage can be reduced by chemical spray (during standing crop period and storing period) and by taking such measures as to earth up enough soil in order to avoid their oviposition into potatoes, not to leave rubbish and undigged potatoes as they are and to cover harvested potatoes with cheese cloth.

4) Root-knot nematodes (Meloidgyne sp.)

They cause the decrease in yield by 15-45% and fall the quality by 50-80%. They sometimes cause further serious damage in co-existence with bacterial wilt. The control measures to be taken are to introduce resistant varieties, adopt the crop rotation system and spray chemicals.

5) Mole crickets (Gryllotalpa sp.)

Even though they are harmful insects which cause serious damage, the application of chemicals at the planting time brings about effects to some extent.

(2) Analysis of virus disease of potato

The Study Team collected totalling 200 samples of potato leaves, that is, 5 samples from each farm multiplied by 8 farms in each province multiplied by 5 provinces, and analized virus disease of PLRV, PVY, PVX, PVS and PVM by the ELISA method.

While collecting samples, the Team selected 50 plants at random and observed the infected degree as well as symptoms of diseases and recorded them.

The Team also estimated the infection rate of each virus disease and of total basing upon the above-mentioned examination results and observational results. The following Table shows the summary of those results. The reason why the accumulated figure of infection rate of each virus disease is different from the figure of infection rate of the total is because overlapped infection is included in these figures.

Table 5.9 Survey Results of Infection Rate of Virus Disease for Potatoes
Jambi Province (%)

Virus / Farm	PLRV	PVY	PVX	PVS	PVM	Total
J-1	8	0	0	0	0	8
J-2	12	0	0	7	0	18
J-3	5	0	0	12	0	17
J-4	45	0	0	0	0	45
J-5	0	34	0	0	0	34
J-6	23	0	0	0	0	23
J-7	6	0	0	20	0	26
J-8	0	7	0	0	0	7
Average	12.4	5.1	0	4.9	0	22.3

West Java Province (%)

Virus / Farm	PLRV	PVY	PVX	PVS	PVM	Total
WJ-1	0	0	0	7	0	7
WJ-2	15	0	0	4	0	15
WJ-3	20	7	0	20	0	20
WJ-4	4	0	0	8	0	8
WJ-5	4	0	0	3	0	6
WJ-6	2	0	0	0	0	2
WJ-7	18	0	0	9	0	18
WJ-8	0	7	0	40	0	40
Average	7.9	0.9	0	11.4	0	14.5

Central Java Province (%)

Virus / Farm	PLRV	PVY	PVX	PVS	PVM	Total
CJ-1	6	0	0	22	0	22
CJ-2	0	0	0	27	0	27
CJ-3	12	0	0	12	0	12
CJ-4	0	0	0	9	0	9
CJ-5	0	5	0	15	0	15
CJ-6	5	0	0	30	0	30
CJ-7	17	0	0	46	0	50
CJ-8	0	6	0	52	0	52
Average	5	1.4	0	26.7	0	27.1

East Java Province (%)

Virus / Farm	PLRV	PVY	PVX	PVS	PVM	Total
EJ-1	0	0	0	26	0	26
EJ-2	0	0	0	2	0	2
EJ-3	0	0	0	10	0	10
EJ-4	2	0	0	2	0	4
EJ-5	5	0	0	32	0	36
EJ-6	23	0	0	30	0	30
EJ-7	4	0	0	32	2	32
EJ-8	0	0	0	42	4	42
Average	4.3	0	0	22	0	22.8

South Sulawesi Province (%)

Virus / Farm	PLRV	PVY	PVX	PVS	PVM	Total
S-1	14	0	0	2	0	16
S-2	0	0	0	0	0	0
S-3	0	2	0	0	0	2
S-4	12	0	0	12	0	16
S-5	0	100	0	100	0	100
S-6	0	6	0	0	0	6
S-7	0	20	0	6	0	26
S-8	0	0	0	0	0	0
Average	3.3	16.0	0	15.0	0	20.8

Though the infection rate of virus disease largely differs among farms with a range of 0 - 100%, there is not so big a difference among the average of each province. It is estimated around 20% in general.

Among five kinds of virus diseases which were analized, PVS ranked top, followed by PLRV and then by PVY. PVM was found

only in East Java and PVM was not detected among 200 samples. According to A.S. Duriat Report (1975), the virus diseases generally found in Java island are PLRV, PVY and PVS, and so these three virus diseases are considered to have spread widely in Indonesia.

But, according to A.S. Duriat, virus diseases prevailed in those days in Java island in the order of PLRV, PVY and PVS. Though this report differs from what was gained through the present study, it accords with the results in Jambi Province. Probably, since new varieties have been introduced to Java island one after another, there may be change in the spread of virus disease, under the influence of the change of varieties to have resistance to virus disease, in comparison with those days in 1975.

In any way, it is an important subject to study how to prevent infection of virus diseases in order to produce quality seed potatoes and, therefore, it is required to carefully investigate the actual situation of distribution pattern of virus diseases as soon as possible at a national level in order to take effective measures for prevention of virus diseases.

5.3.6 Production Cost

Seed potato plays a decisive role in potato production and the percentage of seed potato cost to the total production cost is very high. High productivity and high profitability can be expected by using virus-free and healthy seed potato but expensive imported seed potato must be purchased to enjoy those advantages. Rich farmers who afford to buy imported seed potato are getting high yield per hectare and big profit, employing many agricultural laborers. On the other hand, poor farmers can use only old seed potato which has been harvested repeatedly from generation to generation, so their seed potato cost is low. But their production is small and their profit is also little. Therefore if healthy seed potato is supplied cheaply to them, their income will increase remarkably.

The feature of cost structure of potato production is as follows. In Java island the percentage of agricultural inputs such as seed potato, fertilizer, pesticide is higher than in the outer territories, and more intensive production is done. But in the recent years West Java Province some problems such as pollution of soil, declining land productivity, etc. are becoming serious, so proper measures must be taken. On the other hand, Krinci in Jambi province is very suitable for potato production but local consumption volume of potato is small and it is very far from the main potato market, Jakarta, therefore high transportation cost must be paid.

Table 5.10 Production Cost of Potato in Five Provinces
(Result of Field Study)

Unit: Rp/ha

Item \ Province	East Java	Central Java	West Java	Jambi	South Sumatra
Seed potato	600,000	1,950,000	600,000	557,500	343,333
Fertilizer	283,625	247,417	753,425	28,400	176,667
Pesticide	86,100	507,833	794,672	4,500	50,633
Labour	186,875	223,958	333,600	713,000	318,333
Others	4,000	4,000	42,000		1,500
Total	1,160,600	2,933,208	2,523,697	1,303,400	890,467
Yield (ton/ha)	15.0	15.0	14.3	15.5	7.3
Unit cost (Rp/kg)	77.4	195.5	176.5	84.1	122.0

5.3.7 Marketing and Processing

(1) Supply and demand

Total production of potato increased from 195,405 tons to 283,318 tons during 1981 - 1985. In 1985 the volume of export is 19,288 tons, that of import is 346 tons, and domestic balance is 264,376 tons supposing seed potato requirement is 1.5 tons/ha, the volume of potato for consumption is 220,336 tons and the volume of seed potato is 43,782 tons. Since 1984 the balance of trade of potato has changed from deficit to surplus and exported potato is mainly transported to Singapore and Malaysia. Domestic potato is not suitable for processing, especially for French fried potato and potato chips, therefore some amount of potato is also imported.

Many Indonesian people have no common customs of eating potatoes. Potato consumption is mostly in urban areas. In 1984 average per capita monthly consumption of potato in urban area is 44 grams, that of rural areas is 20 grams, and that of urban + rural areas is 26 grams. Lower income classes whose monthly per capita expenditure is less than Rp.10,000 only consume below 10 grams of potato. Higher income classes whose monthly per capita expenditure is over Rp.40,000 consume over 100 grams of potato.

The data suggest that price elasticity of potato consumption is very low in spite of high income elasticity of it. Therefore potato consumption will increase only in moderate pace within near future and the increase will mainly depend on the growth rate of urban population or on the changing pattern of life style. Because many Indonesian people belong to lower income classes especially in rural areas and only few people belong to higher income classes who can afford to eat potato, while there is no common custom of eating potato among Indonesian people.

Table 5.11 Balance Sheet of Potato

Unit: ton

Year	Domestic Production	Export	Import		Domestic balance	Domestic consumption	Seed potato	
			For consumption	For seed			Domestic	Imported
1981	195,405	285	545	596	196,261	156,355	39,310	596
1982	164,801	150	565	722	165,938	131,574	33,642	722
1983	249,986	1,892	956	1,300	250,350	204,892	44,158	1,300
1984	371,546	12,295	1,096	360	360,707	311,162	49,185	360
1985	283,318	19,288	88	258	264,376	220,336	43,782	258
1986		14,638	66	442				442

Source: Directorate of Horticulture.

Table 5.12: Statistics of Potato Import in 1986

	Import volume (kg)	C.I.F price (US$)
For consumption		
Singapore	9,844	8,254
Australia	120	47
U.S.A.	53,679	48,738
England	104	82
Holland	696	1,829
France	1,241	2,994
Sub-total	65,684	61,944
For seed		
Australia	15,030	5,260
Canada	125	1,047
France	62,760	35,782
West Germany	364,264	203,685
Austria	60	319
Sub-total	442,239	246,093
Total	507,923	308,037

Source: BIRO PUSAT STATISTIK.

Table 5.13: Average Per Capita Monthly Consumption of Potato by Monthly Per Capita Expenditure of Classes

Unit: (g)

Monthly Per Capita Expenditure	Urban	Rural	Urban + Rural
Less than Rp. 5,000		3	3
Rp. 5,000 - 5,999	5	6	6
Rp. 6,000 - 7,999	3	7	6
Rp. 8,000 - 9,999	8	10	10
Rp. 10,000 - 14,999	12	16	15
Rp. 15,000 - 19,999	26	31	29
Rp. 20,000 - 29,999	50	46	48
Rp. 30,000 - 39,999	72	70	71
Rp. 40,000 - 49,999	100	98	100
Rp. 60,000 - 59,999	114	96	110
Over Rp. 8,000	137	138	137
Average Per Capita	44	20	26

Source: Pengeluaran Untuk Konsumsi Penduduk Indonesia 1984.

(2) Price

Consumer price of potato is very high, comparing with that of rice in Indonesia. Potato can be classified as a kind of luxury food. It is consumed not as a main food but as a vegetable. In Jakarta, the largest market of potato, average consumer price of potato has always exceed over 400 Rp/kg during 1981 - 1986. Judging from data in West Java, monthly change of potato price is very largely fluctuated. From October to February potato price is generally low, but from June to August it keeps very high level.

Table 5.14 Consumer Price of Potato

Unit: Rp/kg

Year	Jakarta	Bandung	Semarang	Surabaya	Ujung Pandang	Jambi
1981	418.8	343.8	314.6	345.8	390.3	347.9
1982	469.0	396.7	303.4	349.3	434.7	308.4
1983	471.6	405.6	363.1	379.5	609.0	333.3
1984	456.5	345.8	325.4	308.3	611.1	345.8
1985	405.1	374.3	309.2	285.1	457.6	306.3
1986	459.5	332.4	332.1	358.0	438.9	370.8

Source: Harga Konsumen Beberapa Barang dan Jasa di Seluruh Ibukota Provinsi Indonesia, Tahun 1981 - 1986.

Table 5.15 Farm-gate and Wholesale Prices of Potato in West Java (1986)

Unit: Rp/kg

Month	Farmgate	Wholesale
January	170	212
February	199	234
March	241	279
April	232	254
May	270	316
June	328	359
July	300	344
August	290	330
September	272	313
October	202	256
November	203	249
December	185	221

Source: Dinas Pertanian Tanaman Pangan, Pemerintah Propinsi Daerah Tingakt I Java Barat

(3) Marketing

Most potatoes are produced in high lands and generally producing areas are far from consuming areas in cities, so marketing channels are very complicated. A typical marketing channel can be shown as follows. Grower - Rural Wholesaler - Main Urban Wholesaler - Secondary Urban Wholesaler - Retailer - Consumer. Potato is transported to producing areas through various steps such as collecting, selecting, transporting, etc. but marketing margin is small because of severe competition among traders.

Mark-up rate is set higher at the last wholesalers level and at retailers level.

Most of potato is consumed in large cities such as Jakarta, Surabaya, Bandung, Padang, etc. West Java supplies its potato mainly to Jakarta and Bandung, Central Java to Jakarta, Bandung and Yogyakarta, East Java to Surabaya, North Sumatra to Medan, and West Sumatra to Padang. In Jambi local people, even potato farmers, consume very small quantity of potatoes, so that most product is transported to Jakarta or other big cities in Sumatra. In South Sulawesi a part of potatoes are transported from Enrekang via Ujung Pandang to Kalimantan, Maruk and Irian Jaya, and some potatoes are brought from Surabaya to Ujung Pandang according to the market price of it. North Sumatra which is the largest potato producing area in Sumatra island has been supplying potato not only for domestic market but also for foreign countries such as Singapore and Malaysia exploiting its geographical advantage.

(4) Processing

In recent years many fast food restaurants have been established in big cities such as Jakarta, Surabaya, Bandung, etc. and the demand for processed potato such as French fried and potato chips is expanding. In the past some frozen processed potato has been imported because domestic potato is not suitable for processing. But now Indonesian Government is encouraging production of new varieties of potato suitable for processing. Recently one potato processing factory (Sweiful Pomy Chips Ag) was constructed in Citeruep, West Java and started tentative operation in 1987.

Two varieties of potato, i.e. Diamond from the Netherlands and Ilan Hardy from New Zealand, were introduced for processing material. Potato for processing material which the factory needs 5 - 10 tons/day is grown in West Java and is supplied by P.T. Titis Samporna.

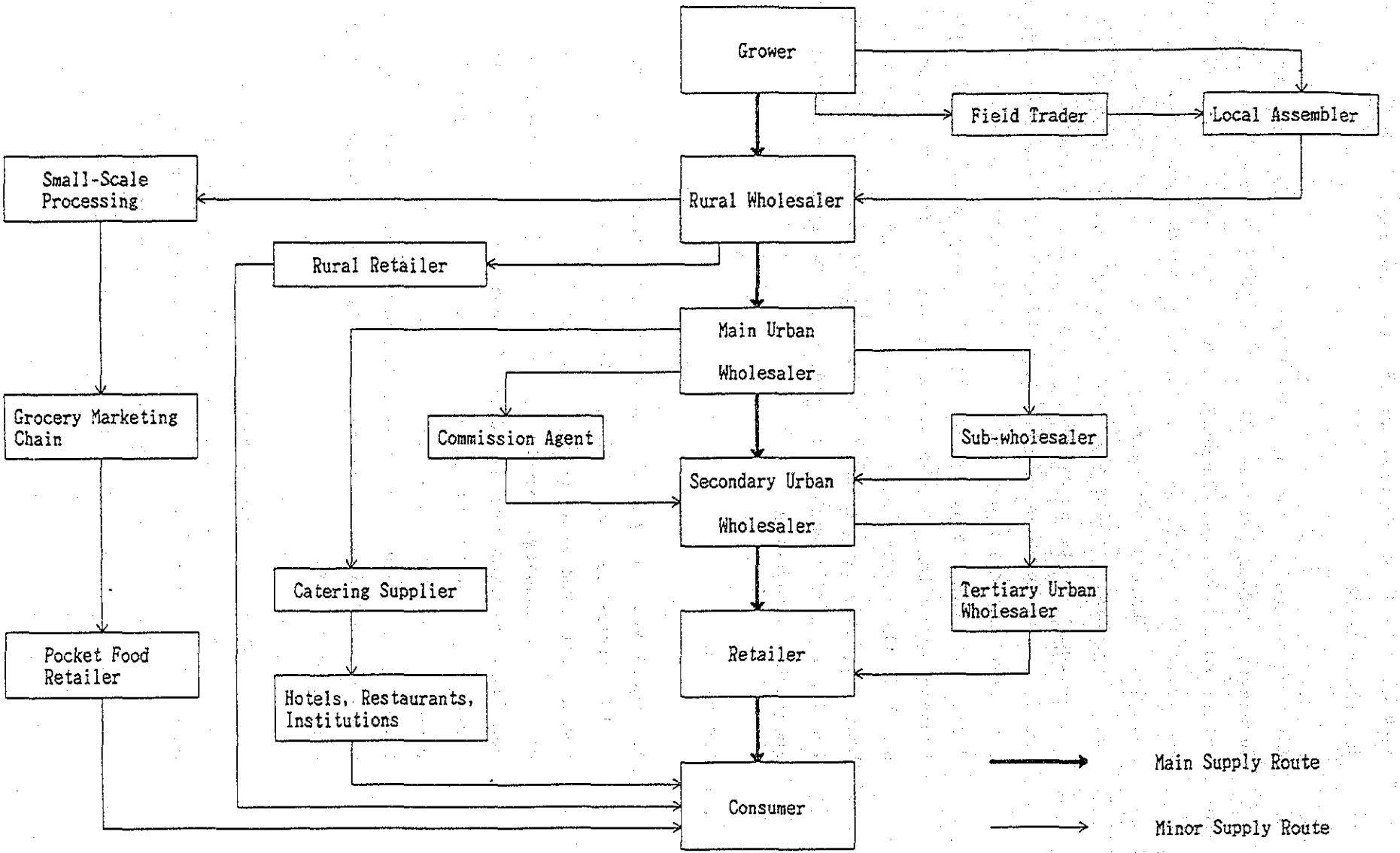


Fig. 5.7 Marketing Channels of Potato in Indonesia

5.4 Multiplication and Distribution of Seed Potato and its Problems

5.4.1 Seed Potato Multiplication

The system to multiply and distribute seed potatoes in Indonesia is the same as that for other crops such as soybean etc.

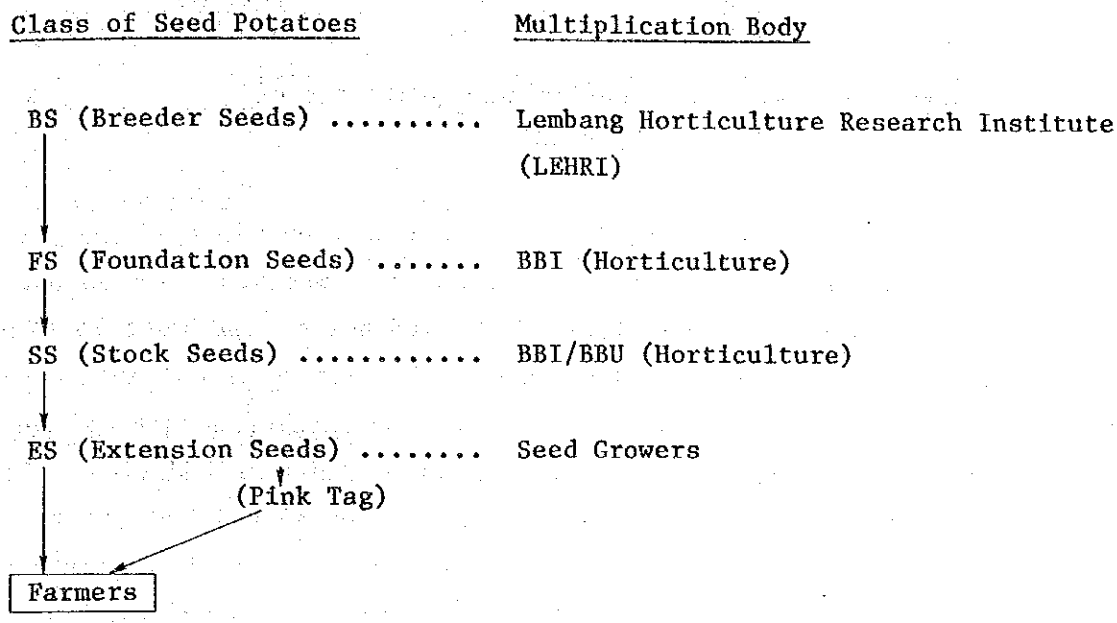


Figure 5.8 Multiplication System for Seed Potato

Even though the concept shown above was defined by the Government, the system to multiply and distribute seed potatoes with the efforts of the Government has not satisfactorily functioned these days. This may be attributed mainly to the following reasons; i.e. it has been only several years since the above-mentioned concept regarding seed potato multiplication started to be implemented by the Government; and the structure of the organization and experience as well as ability of the staff involved in the multiplication are not satisfactory. In addition to them, as the Government has refrained from encouraging this programme due to a shortage of budget, they are poor in progress under the present conditions.

Lembang Horticulture Research Institute (LEHRI) is responsible for production of BS and distributes them to BBI/BBUs. The following Table shows the recent situation of BS production.

Table 5.16 Distribution of BS Seed Potatoes

(kg)

Year	Domestic Production	Import	Total
1982	-	720,394	720,394
1983	5,400	1,299,695	1,305,095
1984	8,895	360,370	369,265
1985	4,424	258,325	262,749
1986	7,879	517,010	524,889

Source: Directorate of Horiculture, Ministry of Agriculture, Indonesia

While BS seed potatoes of 5 - 10 tons are produced every year in Indonesia, a large quantity of seed potatoes are imported from abroad. Imported seed potatoes are deemed as BS in Indonesia and most of the import seed potatoes have been sold to general farmers after multiplied by seed potato growers of the country. Since the sufficient amount of seed potatoes have not been produced in the country and, in addition, the Government has not allotted any budget for the production of BS seed potatoes since 1986/87, imported seed potatoes will hold a further important position in the potato production programmes of Indonesia. But, as the structure to systematically multiply and distribute seed potatoes after import has not been established yet, the quality seed potatoes imported at high costs have not fully displayed their effects.

Though BBI/BBUs are supposed to produce FS and SS, the growing areas for seed potatoes at BBI/BBUs of the country in 1985/86 were 8 ha for FS and 33.5 ha for SS, and they are too small to meet the demand of the country. According to "Horticulture Seed Production Mannual, 1987/88" published by Directorate of Horticulture in March, 1987, the seed potato production is planned only in the following four provinces in the total area of 1.5 ha. Thus, it is difficult under present conditions to expect the production increase in FS as well as SS even in future.

North Sumatra	0.2 ha
West Sumatra	0.1 ha
West Java	0.2 ha
East Java	1.0 ha
Total	1.5 ha

The cultivated area for potatoes was approximately 30,000 ha in Indonesia in 1985 and the seed potatoes of each class required for this area are estimated to be BS: 51 tons, FS: 338 tons, SS: 2,250 tons and ES: 15,000 tons.

Table 5.17 Estimated Amount of Required Seed Potatoes, 1985

(kg)

	BS	FS	SS	ES
Required Amount (A)	50,625	337,500	2,250,000	15,000,000
Supplied Amount (B) 1985/86	262,749 (domestic production; 4,424)	50,800	253,550	3,101,592
(B)/(A) (%)	519 (8.7)	15.1	11.3	20.7

Conditions: 1) Required amount of seed potatoes: 1.5 tons/ha
2) Yield of seed potatoes: 10 tons/ha
3) Renewal rate of seed potatoes: Once in three cropping seasons

Source of Supplied Amount: Directorate of Horticulture, Ministry of Agriculture, Indonesia

Even though the total amount of BS including the imported seed potatoes exceeds as much as five times of the required amount, the supplied amount of FS, SS and ES is far below the required amount as a result, because the seed multiplication has not been systematically carried out.

5.4.2 Producing Techniques for Seed Potatoes

(1) Multiplication techniques for basic seeds

As for the multiplication of basic seeds of potato, it is thought to be a new technology to culture clean seeds by the shoot apex culture method and to rapidly multiply valuable material in a short period by the rapid multiplication method.

This field has been considerably reinforced even in Indonesia under the aid in capital from USAID as well as that in techniques from CIP.

1) Tissue culture

There are already clean room, culture room and screen-houses to keep aphids off and so on, and the multiplication of seed potatoes has been already carried out on a practical level by skilled experts.

It is possible to collect the first young seedlings about two months after picking the top of selected tuber sprouts under a germ-free condition and culturing them, and then about 30 young seedlings are harvested in every six weeks after that.

2) Screen house

Cut stems from small plants which were cultured under a germ-free condition are utilized as mother plants for multiplication in screen houses which are devised to keep off aphids.

The mother plants are grown at the density of 5 x 5 cm on the compound of steamsterilized sand and compost (1:1). The stem cuttings picked from mother plants are transplanted at simple net houses and utilized to produce tuberlets. Then, there will be a harvest of 3 - 5 kg/m^2 in about eighty days.

3) Isolated farm for multiplication

The tuberlets produced in net houses germinated in diffused light storages in 2.5 - 3 months and transplanted in isolated farms in Sumberbrantas or Wonosobo tablelands. According to the experimental results, there was a harvest of 14 tons/ha at the density of 70 x 25 cm in Lembang. The produced seed potatoes are multiplied once more and then distributed as Breeder Seeds.

(2) Multiplication up to Extension Seeds

As for the production of basic seeds (Breeder Seeds), as was mentioned already, there remains fear for cleanliness of seed potatoes produced in isolated farms for multiplication, but it can be said that the implementation system has been by and large established.

But, as many experts pointed out so far, the multiplication of seed potatoes after FS is a key problem to be solved for the extension of quality seed potatoes, and the amount of seed potatoes after FS, as was mentioned before, is far below the demand at present.

This is probably because the multiplication system for seed potatoes has not been established yet and so the multiplication has hardly been carried out through steps such as BS - FS - SS - ES. Especially, in the case of imported seed potatoes, even though they are positioned as BS, most of them are multiplied by domestic seed potato growers and then sold to general farmers without secured guarantee of quality.

Even though these farmers who multiply imported seed potatoes have played an important role in the multiplication and distribution programmes for seed potatoes in Indonesia, it seems that no special guidance has been provided to them by the Government. They have taken no special measures such as isolating farms or roguing infected plants, and there is nearly no difference in measures to be taken between the field for general crops and those for seed potatoes. As for harvested seed potatoes, those of suitable size are sorted for seed potatoes in the same way as those which general farmers grow their own seed potatoes, and other ones are sold for food. They have almost no custom of cutting seed potatoes and the ideal size of the seed potato is said to be the size as large as a chicken egg, and so, the potatoes of around 20 - 50 g are selected for seed potatoes.

As can be judged from the above description, the techniques and knowledges of the farmers who have grown seed potatoes are extremely insufficient to produce seed potatoes. The Table 5.17 shows the amounts of ES which were produced by registered seed potato growers in agricultural offices of each province. It can be easily imagined that a considerable amount of potatoes unsuitable for seed potatoes have been mixed among them.

FS and SS have been produced on a provincial level at BBI/BBUs, but most of these FS and SS are far below the required conditions both in quality and quantity. The followings are considered to be the reasons for that.

1) BBI/BBUs do not have their isolated farms in the regions suitable for seed potato production.
2) The staff are not adequately trained and experienced on the production of quality seed potatoes.
3) The systematic structure for multiplication and distribution of seed potatoes have not been established. The high classed seed potatoes such as FS and SS are sometimes distributed directly to general farmers in many regions.
4) Shortage of budget.

The average yields per unit of seed potatoes at BBI/BBUs in the whole country were 6.4 tons/ha in the case of FS and 7.6 tons/ha in that of SS in 1985/86. Since it is a top priority in the seed potato production to produce clean seed potatoes with high physiological viability, high yield can not be necessarily expected. Still, the above-mentioned figures are too low, and this proves the low level of producing skills at BBI/BBUs.

5.4.3 System and Organization for Multiplication and Distribution of Seed Potatoes

The present structure for multiplication and distribution of seed potatoes and related organizations in Indonesia are shown in the Figure 5.9. The outline of major related organizations are described as follows.

(1) National Seed Board

The seed policies in Indonesia have been largely improved with the Seed I Project of IBRD (1971 - 78) as a turning point, and the National Seed Board was established as a part of the activities.

This Board has placed its headquarters at the Directorate General of Food Crops Agriculture, the Ministry of Agriculture, an it is an advisory body for the Ministry when it decides seed policies.

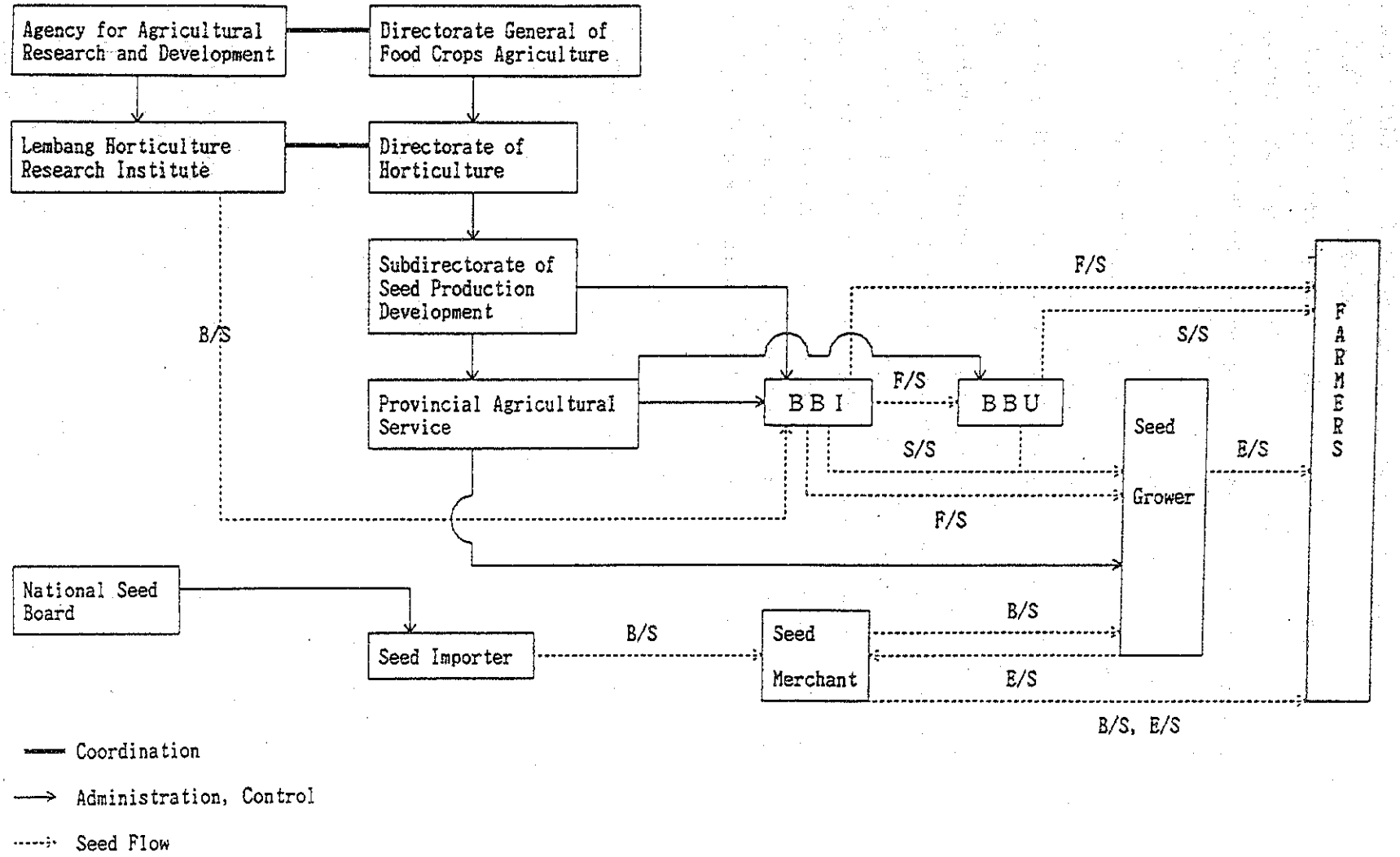


Fig. 5.9 Ortanization Structure for Seed Potato Multiplication and Distribution

It is needed, in relation to seed production, to gain the approval from this Board when new varieties are bred/introduced and released. The Committee has two committees; i.e. "Variety Evaluation and Release" Committee which is concerned with the introduction and release of new varieties, and "Guidance, Control and Certification" Committee which is concerned with seed production and marketing.

(2) Directorate of Horticulture, Ministry of Agriculture

This is one directorate of the Directorate General of Food Crops Agriculture of the Ministry of Agriculture and used to be a subdirectorate of Directorate Food Crop Production Development of the above-mentioned Directorate General before. This was raised to the status of Directorate of Horticulture in 1983. This Directorate has charge of the administrative affairs of the Central Government regarding horticultural crops and ornamental plants, and the production as well as distribution of seed potatoes on the central level, and budget have been also planned here.

The following is the structural chart of the Directorate of Horiculture.

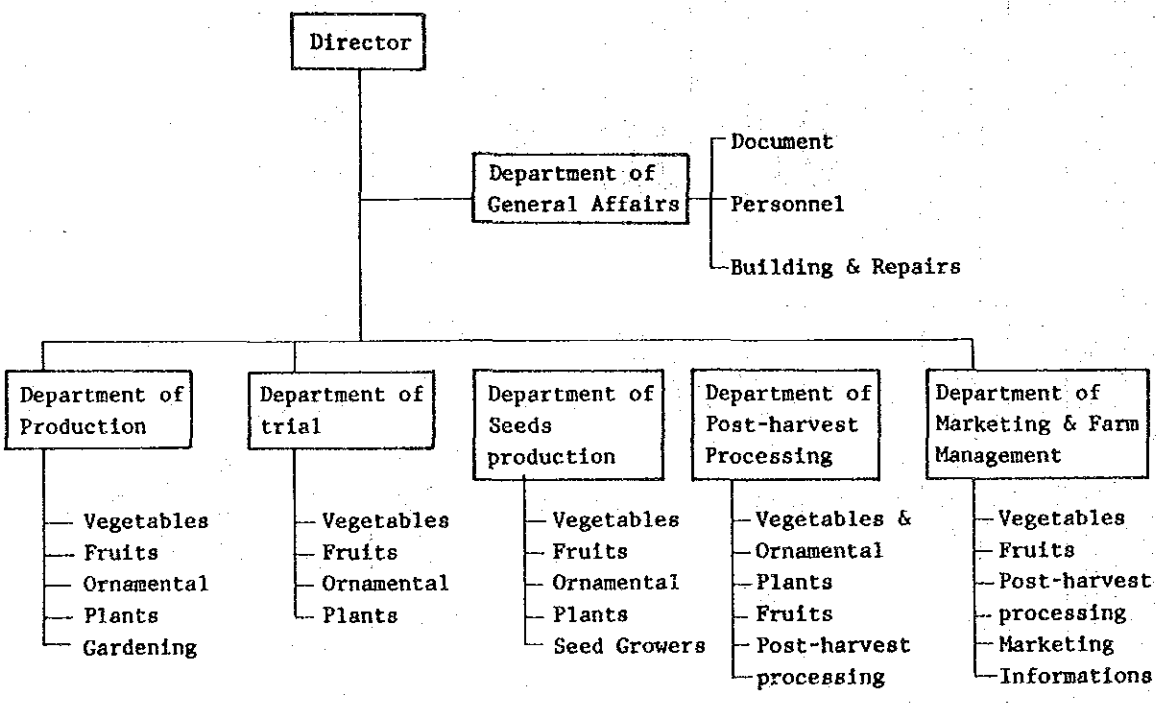


Figure 5.10 Structure of Directorate of Horticulture

(3) Lembang Horticulture Research Institute

This is one of the two horticulture research institutes in the country and has conducted experimental and research works on vegetables and ornamental plants. This Institute is located in Bangdon in West Java Province, which is a major producing area of vegetables in Indonesia, and it is positioned as the highest authority for vegetable breeding and other research works. The Institute has placed emphasis on the research of the following seven priority vegetables, potatoes, tomatoes, cabbage, beans, pepper, onions, and garlics.

In the field of multiplication and distribution of seed potatoes, this Institute has charge of producing BS seed potatoes and distributing them to BBI/BBUs, and it has produced tuberlets, which are used as the mother plant for BS, by the tissue culture technique and multiplied BS seed potatoes by using them. Actually, however, no budget has been alloted for BS production since 1986/87, and so, it is said that BS seed potatoes are not produced under the distribution programmes for seed potatoes of the Government, apart from those for experiment and research works.

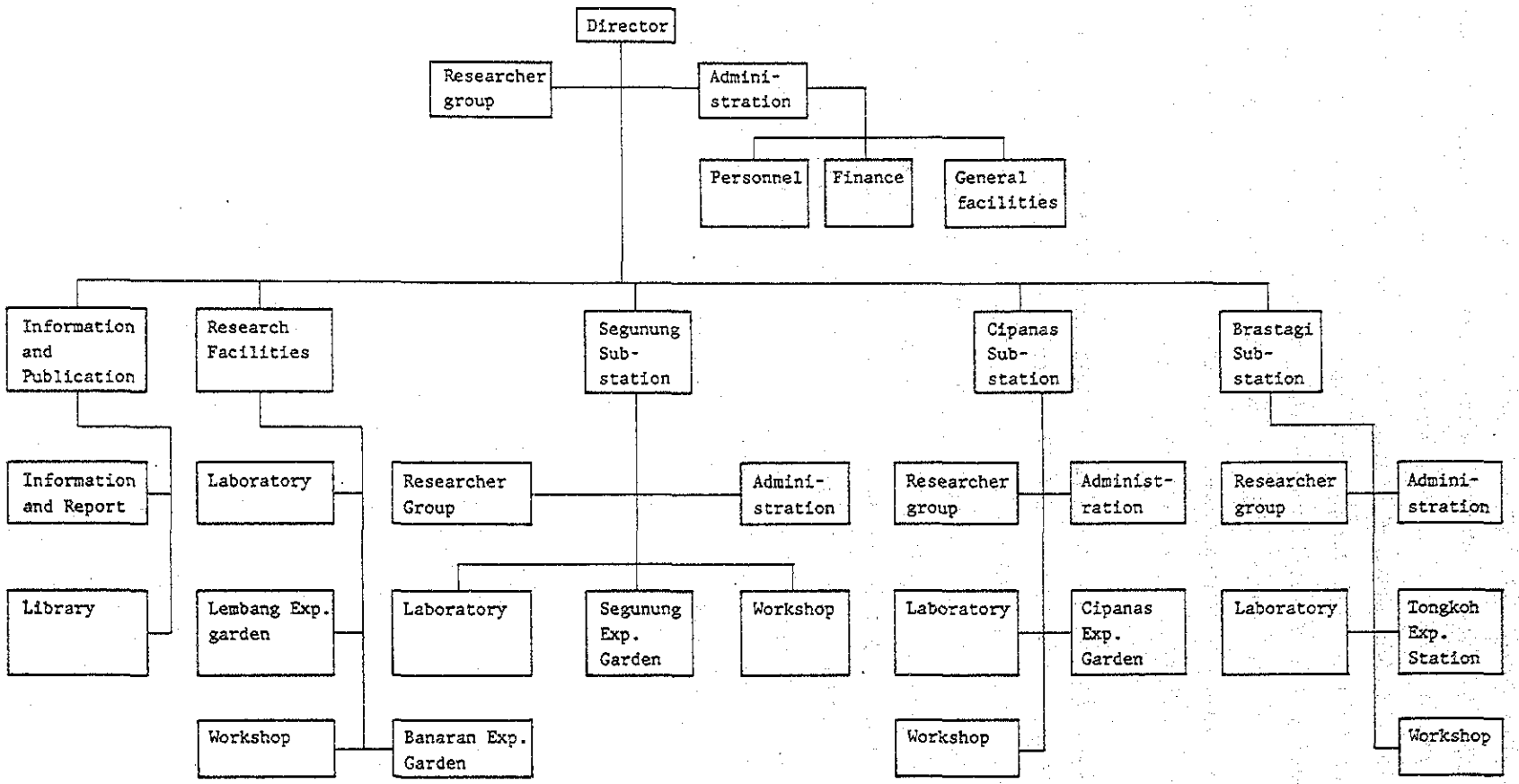


Figure 5.11 Organization Chart of Lembang Horticulture Research Institute

(4) BBI/BBUs

One BBI and several BBUs are located for horticultural crops in each province (Refer to Appendix C-2). The main role of these BBI and BBU is to multiply FS and SS, but in the case of seed potato, BBI/BBUs have not satisfactorily produced them both in quality and in quantity, as was mentioned already. The budget for seed potato production at BBI has been on the downturn recently, and this is one of the element to hinder satisfactory activities.

Table 5.18 Budget for Seed Potato Production Provided by the Central Government

Year	Cropping Area (ha)	Budget (xRp 1,000)
1985/86	41.5	49,776.5
1986/87	11.8	14,385
1987/88	0.8	1,010

Source: Directorate of Horticulture, Ministry of Agriculture

(5) Seed potato importers

Indonesia has imported a large quantity of seed potatoes from abroad every year and they have been all dealt by private importers. Most of them have offices in Jakarta, import seed potatoes from West European countries such as West Germany, Netherland and so on, with the approval of the National Seed Board and sell them to seed merchants.

Table 5.19 Imports of Seed Potatoes

Year \ Sources of Import	France	West Germany	Holland	Others	Total
1982	-	486,000	142,269	92,125	720,394
1983	-	653,994	314,490	331,211	1,299,695
1984	-	286,260	34,630	39,480	360,370
1985	-	243,125	15,040	160	258,325
1986	162,760	150,000	203,000	1,250	517,010

Source: Directorate of Horticulture, Ministry of Agriculture

(6) Seed merchants

They have shops in major producing areas such as Bandong etc., and sell imported seed potatoes which they bought from importers to seed growers or general farmers. They also sell the seed potatoes which are multiplied by seed growers.

(7) Seed growers

Generally speaking, they multiply imported seed potatoes and sell them to seed merchants or general farmers. Some of them are registered in the agricultural office of the province and it is said that they have produced ES. Though they have played an important role in the field of multiplication and distribution of seed potatoes in Indonesia, their techniques and knowledges are too insufficient to produce seed potatoes.

5.4.4 Quarantine and Inspection System

Quarantines are very important to protect plants from pests and diseases. Particularly, in the case of seed potato production, as potatoes are vegetatively propagated crops and many kinds of diseases are transmitted by seed potatoes, quarantine of the plants is an indispensable operation.

The quarantines of plants are normally conducted at the ports when they are imported or exported but, the domestic quarantine inspection mainly at the potato field is also very important in order to produce quality seed potatoes.

(1) Import quarantine services

Agricultural Quarantine Office has had charge of the quarantine services for agricultural products to be imported as well as exported including seeds and those which are transported between islands, and potatoes are also included in their services.

The Agricultural Quarantine Office has located its headquarter in Jakarta and has local offices in Medan, Palembang, Jakarta, Surabaya and Ujungpandang.

A large number of seaports are scattered, in Indonesia which is a vast island country and each local office has several subordinate offices to cover all of these seaports. The total number of the offices add up to 39, and their list is shown in Appendix E-1.

All of the seed potatoes are unloaded at Jakarta, and it is said that other local offices have had charge only of quarantine services for those which are transported between islands including those for food. As it is, however, their achievement of quarantines for potatoes is extremely low. It was also said that quarantine services have not been provided for imported food potatoes, since they have been all imported after processed.

The Agricultural Quarantine Office conducts quarantine services on the following pests and diseases. The ordinances in relation to plant quarantine are shown in the Appendix E-2 - E-5.

Table 5.20 Pests and Diseases of Potatoes Controlled by Agricultural Quarantine Office in Indonesia

Scientific Name	General Name
	Andes potao latent virus
	Potato X-virus
	Potato Y-virus
	Potato T-virus
	Potato spirdle tuber
Corynebacterium sepedonicum	Bacterial ring rot
Polyscytalum pustulans	Skin spot
Ditylenchus destructor	Potato rot nematode
Globodera pallida	Golden nematode
Globodera rostochiensis	Potato cyst nematode
Leptionotarsa decemlineata	Colorado potato beetle

Source: The Decree of the Minister of Agriculture, October 15, 1984

(2) Domestic quarantine inspection

BPSB has had charge of domestic quarantine services for seed potatoes and the inspection standards are shown in table 5.21. As for BS, Lembang Horticulture Research Institute has conducted independent inspection on them.

Table 5.21 Inspection Standards for Seed Potatoes by BPSB

a. Field Inspection Standards

Factor	FS	SS	ES	Pink Tag
1. Isolation (m)	350	350	350	350
2. Other variety and off type (Max.)	0.0%	0.5%	1.0%	2.0%
3. Disease (Max.)				
- Phytopthora infestans	1.0%	3.0%	5.0%	8.0%
- Wilt disease	1.0%	2.0%	3.0%	2.0%
- Black leg	0.5%	0.5%	1.0%	5.0%
- Ring rot	0.0%	0.0%	0.1%	0.5%
- Nematodes	0.5%	1.0%	1.0%	3.0%
- Virus (LR, X, Y)	0.5%	0.5%	1.0%	2.0%

b. Laboratory Standards
Laboratory inspection put emphasis on the seed health and objective diseases and the standards are in accordance with the field inspection standards.

Source: BPSB

BPSB is supposed to conduct inspections at least four times at fields (before planting, 30 days after planting, 45 days after planting and 60 - 70 days after planting) and once at laboratories to certify seed potatoes, basing upon the above-mentioned standards. The seed potato certification manual of BPSB is shown in Appendix D-20.

Even though the guidelines for standards and certification have been prescribed already, the inspection and certification system of seeds of BPSB has not been applied to seed potatoes yet. BPSB has not had enough ability to conduct inspections for seed potatoes.

As can be judged from the above description almost no inspection has been conducted for seed potatoes under the present situations, and most of the produced and distributed FS, SS, and ES at present have not been certified by the third party in the quality. BPSB has fully understood the importance of inspection for seed potatoes. But, actually, the present inspection system for seeds was applied to paddy seeds only in 1971 and to the secondary food crops such as the soybean in 1984. Therefore, it is all the BPSB can do to try to improve its inspection ability for paddy and secondary food crops, and it is beyond its capacity to inspect seed potatoes at present.

Still, it is especially important and indispensable to establish an inspection system for seed potatoes in order to reinforce the production system of quality seed potatoes and also, it is required to progress the inspection skills of the staff related to seed potatoes and to fulfill the inspection equipments as soon as possible.

Even though the inspection standards are prescribed, as was mentioned before, they are widely apart from the present situations in Indonesia. For example, it is impossible to detach farms for seed potatoes more than 350 m from farms for potato cultivation in Java island which is a major producing area of potato. It seems also impossible to follow the standards on disease, taking into consideration the present

inspection system and seed grower's level.

It is certainly indispensable to prescribe standards for production of quality seed potatoes, and advanced producing countries of potatoes have actually prescribed similar but much stricter standards and produced seed potatoes. But, the standards, when they ignore the actual situation, turn out a dead letter, however ideal they may be. Even though the standards need be preserved as it is right now, a practical inspection means compatible with the reality is much more desirable, and this can be only realized by separately tightening controls of farmers step by step against target diseases one by one and by gradually getting the standards to fit in the reality, not by strengthening the control at a stroke.

5.4.5 Facilities for Multiplication and Distribution of Seed Potatoes

In Indonesia there are few well-developed facilities for multiplication and distribution of seed potatoes. Most of the seed potatoes are sorted by hand according to the size (20 - 50 g/potato) after harvested at general farms (up to the third or fourth generations). Therefore, the exclusive farms for seed potatoes do not exist actually in this country.

Even at BBI/BBU, 60 - 80% of the harvest are used as seed potatoes, and damaged potatoes as well as extremely small or large ones are used for food.

(1) Facilities for multiplication of seed potatoes

They can be divided into two types according to their ownership, that is, governmental and non-governmental facilities. Governmental facilities are LEHRI and BBI/BBU, and as for non-governmental ones, there exist no organizations such as companies or firms, but they are owned by potato growing farmers. In other expression, seed potatoes have not been multiplied as well as distributed totally systematically under the present conditions in the country.

1) Lembang Horticultural Research Institute (LEHRI)

This Institute, which is located in West Java Province, is the starting point for the multiplication and distribution of seed potatoes and their activities are based on the techniques of meristem tissue culture. Though the role and function of LEHRI concerning the multiplication of seed potatoes is to supply B/S seed potatoes to BBI/BBU on the basis of the multiplication and distribution policies of the Government, LEHRI has also distributed a part of seed potatoes to potato producing farmers for demonstrative experimentations.

The output of Pre-B/S Tuberlets (about 10 - 20 g/pc.) which were produced by the technique of meristem tissue culture at LEHRI in 1986 is reported to be approximately 20,000. They are sent to its subsidiary isolated farm in Sumber Brantas, East Java, and used for the production of B/S. Table 5.22 shows the conditions of locations for both LEHRI and its subsidiary isolated farm.

Table 5.22 Conditions of Location for LEHRI and Its Subsidiary Isolated Farm

	HQ. LEHRI	Isolated field
Location	Lembang, 5 km from Lembang (West Java)	Sumber Brantas, 30 km from Batu (East Java)
Area	50 ha	30 ha
Elevation f.s.l.	1,250 m	2,000 - 2,300 m
Temperature ranges	15 - 25°C	
Relative humidity	80 - 98%	
Precipitation	1,385 mm/year	

Source: Collected data by the Study Team

LEHRI possesses the facilities for tissue culture for the production increase in pathogen-free seed potatoes of high quality. It received the provision of equipments, buildings and technical cooperation (including the training in the Philippines) from USAID during the period from 1983 - 1986.

Several equipments were also provided by JICA as experts' carried equipments and they have been utilized even now. The existing equipments of LEHRI for seed potato multiplication are shown below.

Tissue culture laboratory room (4 x 5 m)

Screen house (230 m^2), glass roofing with 100 trays (1.2 x 0.75 m)

Net house (90 m^2 x 2)

Storage cum working room (270 m^2) with natural ventilation through net on side-wall

Agri. Machines

Tractor (80 hp. 30 hp) x 3 sets
Hand tractor x 2 sets
Large trailer x 1 set

Irrigation system, pumped up to the reservoir from stream, then distribute to the plots through pipe

Cold storage room (6 x 3 x 3 m) (refrigerator not in order now)

Preparation room

Autoclave x 1 set, fine balance x 1 set,
refrigerator x 1 set, vacume cleaner x 1 set,
PH meter x 1 set, isotemp lab oven x 1 set,
heating and drying heraus x 1 set,
laminar airflow cabinet x 1 set,
microscope x 3 sets, de-humidifier x 1 set,
heater x 1 set

Incubation room

Shaker x 3 sets

Motor diesel generator x 1 set

Virology laboratory

Shaker x 1 set, magnetic mixer x 1 set,
stereoscopic microscope x 1 set,
PH meter x 1 set, homogenizer x 1 set,
Elisa reader x 1 set (out of order),
refrigerator x 1 set

2) Multiplication facilities for seed potatoes at BBI/BBU

BBI/BBU are positioned as the multiplication of seed potatoes (equivalent to FS or SS). Actually, however, potato culture is possible only under a cool climate. Therefore, it is difficult to grow potatoes unless they are located at highlands of more than 1,000 m of altitude.

The scale of seed potato production at BBI/BBU in the five provinces for the study is very small as is shown in Table 5.23.

Table 5.23 BBI/BBU Producing Seed Potatoes

Name of BBI/BBU	Province	Production of Seed Potatoes (ton) 1984	1985	1986
-	Jambi	-	-	-
BBU Marino	S. Sulawesi	n.a.	n.a.	n.a.
-	East Java	-	-	-
BBU Kledung	Central Java	n.a.	n.a.	10.36
BBU Margahayu	West Java	5.7	6.0	12.6

Source: Collected data by the Study Team

As for the facilities which are owned by the above-mentioned BBI/BBU, there is no facilities which deserve special mention except self-made simple storages with storing shelves which have been established within the existing buildings. Though the storing shelves are designed with the

consideration on ventilation and diffused light storage, it is difficult to keep the perfect storing conditions. Thus, it is necessary under the actual conditions to eliminate damaged potatoes while they are in store or just before planting.

The Government of Japan provided equipments to BBI horticulture in 14 provinces under the aid programme of KR-2 in the past, as first and second years. Besides, it has also already provided the equipments for potato multiplication and for processing of agricultural crops including those for tissue culture to BBI horticulture in six provinces where potato cultivation is viable, which are all shown in Tables 5.24 and 5.25.

As those for the third year, the equipments for potatoes which were requested additionally for BBI horticulture have been under consideration at present.

Table 5.24 Equipments for BBI/BBU Horiculture
KR-2 V (1985/1986)

No.	Province	Equipment	Unit	Landed Port
1.	D.I. Aceh	- Hand tractor	1	Belawan
		- Sprinkler irrigation	1	
2.	Bengkulu	- Four wheel tractor	1	Jakarta
		- Hand tractor	1	
		- Sprinkler irrigation	1	
3.	Riau	- Four wheel tractor	1	Belawan
		- Hand tractor	1	
4.	D.I. Yogyakarta	- Four wheel tractor	1	Jakarta
		- Hand tractor	1	
		- Sprinkler irrigation	1	
5.	Sumatera Selatan	- Hand tractor	1	Jakarta
		- Sprinkler irrigation	1	
		- Four wheel tractor	1	
6.	Lampung	- Hand tractor	1	Jakarta
		- Sprinkler irrigation	1	

No.	Province	Equipment	Unit	Land Port
7.	Sulawesi Utara	- Four wheel tractor	1	Ujung Pandang
		- Hand tractor	1	
		- Sprinkler irrigation	1	
		- Motor duster	1	
		- Hand refractometer	1	
8.	Sulawesi Tengah	- Four wheel tractor	1	Ujung Pandang
		- Hand tractor	1	
		- Sprinkler irrigation	1	
9.	Sulawesi Tenggara	- Four wheel tractor	1	Ujung Pandang
		- Hand tractor	1	
		- Sprinkler irrigation	1	
10.	Kalimantan Timur	- Four wheel tractor	1	Surabaya/Jakarta
		- Motor duster	1	
		- Hand tractor	1	
		- Hand refractometer	1	
11.	Kalimantan Selatan	- Four wheel tractor	1	Surabaya/Jakarta
		- Sprinkler irrigation	1	
12.	Bali	- Hand tractor	1	Surabaya
		- Sprinkler irrigation	1	
13.	Kalimantan Barat	- Four wheel tractor	1	Surabaya/Jakarta
		- Sprinkler irrigation	1	
14.	Jakarta	- Hand tractor	1	Tanjung Priok
		- Pipe House	12	
		- Spare parts	1	

Source: Directorate of Horticulture, DGFCA

Table 5.25 Strengthening of Staple Food, Seed and Processing Center Equipment

Under KR-2 VI (1986/1987)

No.	Equipment	Unit	Province						
			North Sumatra	West Sumatra	West Java	Central Java	East Java	South Sulawesi	Jakarta
1.	Motor duster	24	2	2	2	2	2	2	12
2.	Potato digger	24	2	2	2	2	2	2	12
3.	Grader/Sorter	8	1	1	1	1	1	1	2
4.	Drum Seed treater	12	2	2	2	2	2	2	-
5.	Four wheel tractor	12	1	1	1	1	1	1	6
6.	Hand tractor	12	1	1	1	1	1	1	6
7.	Sprinkler irrigation	12	1	1	1	1	1	1	6
8.	Vegetable cutter	6	-	-	-	-	-	1	5
9.	Hardness tester	18	1	1	1	1	1	1	12
10.	Hand refracto meter	18	1	1	1	1	1	1	12
11.	Top loading balance	6	1	1	1	1	1	1	-
12.	Cabinet drier	12	2	2	2	2	2	2	-
13.	Plastic heat sealer	12	1	1	1	1	1	1	6
14.	Poly pack	6	1	-	1	1	1	-	2
15.	Strecher	6	1	1	1	1	1	1	-
16.	Cold container	6	1	1	1	1	1	1	-
17.	Aluminium foil sealer	6	1	-	1	1	-	-	3
18.	Generator	6	1	-	1	-	1	1	2
19.	Pipe house	27	4	4	4	4	4	4	3

Note : Locations: North Sumatera: Balai Benih Induk Hortikultura Kuta Gadung, Kab. Tanah Karo
West Sumatera : BBI Hortikultura Unit Dataran Tinggi Surian, Kab. Solok
West Java : BBI Hortikultura Pasir Banteng, Kab. Sumedang
Central Java : BBI Hortikultura Salaman, Kab. Megelang
East Java : BBI Hortikultura Unit Dataran Tinggi Nongko Jajar, Kab. Pasuruan
South Sulawesi : BBI Hortikultura Malino, Kab. Goa
Jakarta : Direktorat Jenderal Pertanian Tanaman Pangan.

Source: Directorate of Horticulture, Mnistry of Agriculture

Actually, however, the equipments provided in the past have not been fully utilized and some equipments have been left unpacked among them. There are stated such reasons that the buildings which should be constructed by the recipient body have not been completed or that there are no operators or technicians but there lie basic problems of the management and the shortage of budget (for reconstructing & extending of buildings, electric wiring, installing & transporting).

As an example, the vegetable processing equipments (including potatoes) have been provided to 3 BBIs/BBUs (Passir Bangteng, Passar Mingu, Bonto Bonto) under KR-2. But, taking into consideration the fact that the basic role and function of BBI/BBU is to multiply seeds, it is still too early to introduce vegetable processing facilities to them at this stage. It is also estimated under the present situations of Indonesia that it may take a great deal of time to put the machines in working order in case only machines are provided. Therefore, it is required to implement thorough investigations by both the providing side and the receiving side before materializing equipment providing plans. Otherwise, the same things shall be repeated.

3) Facilities of seed potato producing farmers

The exclusive seed potato farmers do not exist in this country, as was stated already, but, three advanced farmers out of twenty farmers who completed the training on potato tissue culture conducted at LEHRI received assistance in the fields of techniques and equipments from LEHRI/USAID/ADB and have been implementing joint demonstrative researches on the multiplications by the method of tissue culture.

Their facility consists of a wooden box for transplanting of cuttings (60 x 60 x 20 cmH) and a net room (200 m^2). They have adopted the rapid multiplication method by the cuttings using BS (tuberlets) distributed by LEHRI. The produced seed potatoes are distributed to dealers or farmers near by, but the output has been still extremely limited at present.

Among general farmers who produce potatoes, those who produce seed potatoes are seen more or less in Pangalengan, West Java.

Their farming scale is generally large, and they have used seed potatoes of younger generations in expectation of increase in yield per unit and thus supplied the harvest to neighbouring farmers of a small scale as seed potatoes after sorting.

Sorting operation is done all by hand according to sizes and seed potatoes are kept in their own storages during the period of dormancy. Figure 5.12 shows an example of control and processing procedures for seed potatoes of a large-scaled and advanced farmer.

Processing flow of seed potatoes by a seed grower in Pengalengan

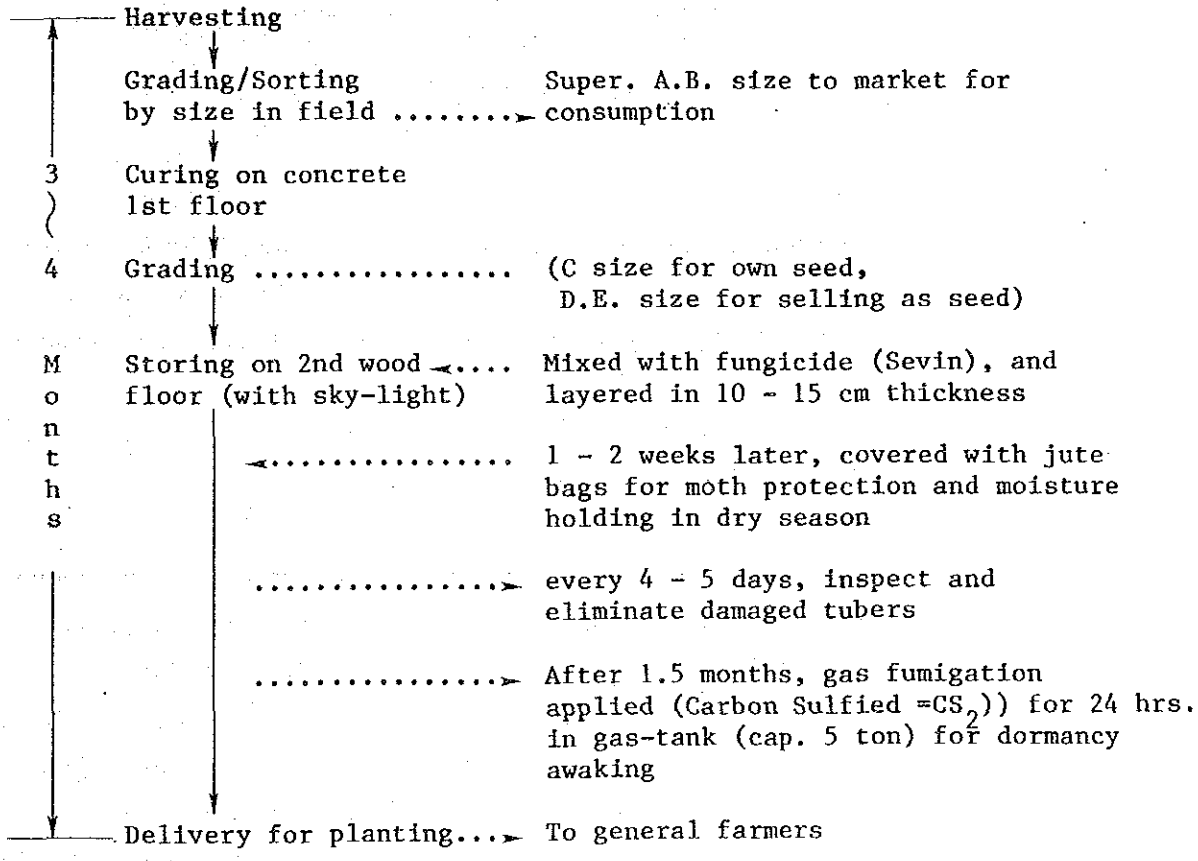


Figure 5.12 Example of Processing Procedures for Seed Potatoes by a Large Scaled Farmer

The followings are the details of the facility of the farmer mentioned in the above Figure.

Building	:	Wooden, or with iron frame and blocks
Workshop	:	Downstair room below 2 - 4 storied storage Mortared floor
Storing place	:	Upper floor of the above-mentioned storage, wooden floor. To collect light.
Capacity	:	300 tons/500 m^2 (0.6 tons/m^2)
Fumigation tank	:	Steel gastank of 5 tons of capacity. The receiver of the cover should be designed to reach inside of a water ditch in order to seal air. To install this in the second story of the storage for easy transportation.

(2) Facilities for distribution of seed potatoes

1) Storage for distribution of seed potatoes

There do not exist any special facilities for the distribution of seed potatoes at present. It is basically needed to keep imported seed potatoes in cold storage, but it is not well known what kind of facilities the importers have owned.

2) Diffused Light Storage (DLS)

Simple DLSs have been experimentally introduced to advanced farmers in Palengalengan and Ciwidey in West Java, Wonosobo in Central Java and in Sumber Brantas in East Java Province, and they were reconstructed facilities by changing the former walls into air-permeable ones such as iron-net, nylon, plastic, glassfiber or glass. Tables 5.26 and 5.27 show the experimental results of DLS. According to these tables, it can be seen that DLS is definitely a superior method.

Table 5.26 Comparison of Storing Methods of Seed Potatoes between Diffused Light Method and Storage in Dark Room (1982/1983)

	Pangalengan		Cisurupan	
	Diffused Light	Dark Room	Diffused Light	Dark Room
Exhastion (%)	24.25	36.20	35.03	39.20
Rottenness (%)	9.51	13.77	10.89	16.24
Sprout Length (cm)	2.20	9.20	2.00	8.30

Notes: Season : Rainy season
Period : 150 days

Source: 5 years SAPPRAD in Indonesia, SAPPRAD and AARD, 1987

Table 5.27 Comparison of Storing Methods of Seed Potatoes between Diffused Light Method and Storage in Dark Room both in Rainy and Dry Seasons

	Rainy Season (April - August)		Dry Season (September - January)	
	Diffused Light	Dark Room	Diffused Light	Dark Room
Sprout Lenght (cm)	2.1	8.7	1.8	7.9
No. of Sprouts/Tuber	3.6	5.0	3.5	5.5
Exhaustion (%)	24.7	28.4	23.6	29.1
Rottenness (%)	9.5	11.2	10.1	13.3
Yield (ton/ha)	25.0	21.4	28.7	22.4

Notes) Experimental Site : Ciwidey, the altitude 1,080 m
Period : 150 days

Source: 5 years SAPPRAD in Indonesia, SAPPRAD and AARD, 1987

3) Grading/sorting of potatoes

The standards for potato grading have not been prescribed on the national level yet in Indonesia, but, potatoes are graded traditionally according to the sizes to some extent and dealt with difference in prices in the market. Table 5.28 shows the results the Study Team observed at the sites.

Table 5.28 General Classified Sizes of Marketed Potatoes for Food

Size	Wonosobo (Central Java) Hearing at Market	Pangalengan (West Java) Example of a Large-Scaled Seed Potato Grower
Super	2 - 3 tubers/kg	4 tubers/ 1.0 kg
A	4 - 5	6 tubers/ 0.98 kg
B	6 - 7	8 tubers/ 0.96 kg
C[1)]	8 - 10	17 tubers/ 1.3 kg
D	-	42 tubers/ 1.14 kg

Note: As for those below C, they are sometimes called in such a way as C_1, C_2, C_3 etc.

Source : Collected data by the Study Team

The above table indicates a tendency to some extent, but they have not been standardized yet. As for the usage classified by sizes, the seed potatoes of Size D are judged suitable for seed potatoes while those of other sizes are marketed for food. As for sorting operation, brokers do it in many cases while a large-scaled farmers do by themselves at their farms at the harvesting time. The operation depends on human power and no tool as well as machines have not been used for this operation.

As for tuber sizes of seed potatoes, Table 5.29 shall be referred to.

Table 5.29 Shows the Classification of Seed Potatoes by Sizes

Class	Explanation by BBU Kledung	BPSB Inspection Manual
1	More than 70 g/tuber	60 - 80 g, or more than 56 m/m in diameter
2	50 - 70 g/tuber	45 - 60 g or 45 - 55 m/m in diameter
3	40 - 50 g/tuber	30 - 45 g or 35 - 44 m/m in diameter
4	25 - 40 g/tuber	
5	Below 25 g/tuber	

5.4.6 Problems in Multiplication and Distribution of Seed Potatoes and Their Countermeasures

The problems in multiplication and distribution of seed potatoes are analyzed according to each stage of production, processing, storage and distribution, and the outline is summarized in brief in Table 5.30 "Problems in multiplication and distribution of seed potatoes and their counter measures".

The outline of the improvement to be taken is shown in the following chart.

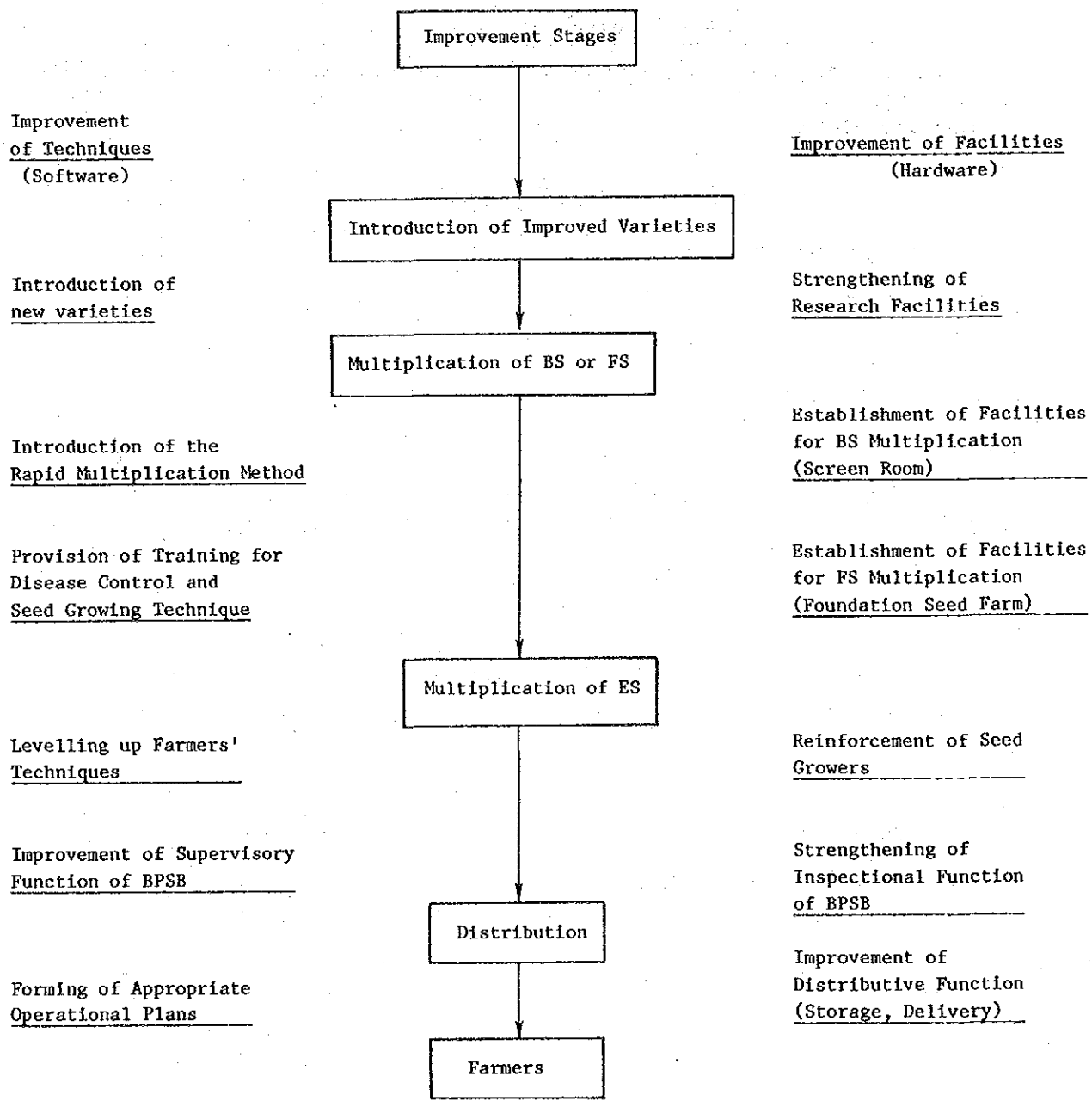


Table 5.30 Problems in Multiplication and Distribution of Seed Potatoes and Countermeasures

Stage	Problems	Concrete Examples of Problems	Improvement Plans	Concrete Measures for Improvement
1. Farmers	Virus-infested seed potatoes have been used.	° Low production ° Prevalence of Virus Disease ° Decrease in quality	Production of pathogen free seed potatoes	- To introduce rapid multiplication method. - To establish isolated seed farms for multiplication of FS - To eliminate virus-infected plants - To reinforce inspection operations at seed potato farms
	The price of seed potatoes is high.	° Occurrence rate of disease becomes high since seed potatoes are not renewed often. ° Multiplication of potatoes is very small.	Production and distribution of low-priced seed potatoes	- To increase yield per unit area - To introduce effective techniques for seed potato multiplication - To simplify distributive route for seed potato - To produce seed potatoes in isolated areas from aphids
	No suitable storage is available.	° Seed potatoes can not be kept safe. ° They are uneven in physiological age.	Improvement and extension of seed potato storing method	- To guide on economical storing methods for seed potatoes - To run storages jointly

Stage	Problems	Concrete Examples of Problems	Improvement Plans	Concrete Measures for Improvement
	Environments of potato cultivation are not suitable due to dense population of aphids.	° Chemicals should be applied very often. ° Soil becomes contaminated by the chemicals	Decrease in Pest Control frequency	- To cultivate under isolated conditions from aphides - To establish an appropriate crop-rotation system - To use pathogen free seed potatoes - To introduce and grow disease-resisting varieties
2. Seed Growers	FS and SS is insufficient in the quantity and their quality is poor.	° Shortage of the elite seed potatoes for multiplication ° Reliance upon imported seed potatoes	Efficient multiplication system for seed potato	- To secure supply of BS and FS - To improve techniques of BBI staff, together with facilities - To organize seed potato growers and provide technical guidance to them
	Techniques for seed potato production are still on a low level.	° Shortage of improved seed potatoes ° Low quality of seed potatoes ° Prevalence of disease	Promotion of Seed Growers of technical high level	- To register seed potato producing farmers and distribute quality seeds to them preferentially - To give guidance to seed potato producing farmers on the basic techniques required for seed potato production, elimination of diseased plants as well as those of alien varieties - To reinforce inspection services by stages, taking into consideration the technical level of seed potato producing farmers

Stage	Problems	Concrete Examples of Problems	Improvement Plans	Concrete Measures for Improvement
	Methods to store seed potatoes are inappropriate.	° There is no way to keep seed potatoes safe for a long time in the tropical areas ° They are uneven in physiological age.	Improvement of storing techniques for seed potatoes	- To build storing house for seed potatoes equipped with quality control function at producing areas.
3. Lembang Horti-culture Research Institute	Shortage of equipment and facilities for research	° Research facilities are insufficient to conduct basic research on potato production. ° The system for the multiplication of clean seed potatoes has not been well functioned yet.	Strengthening and fulfillment of LEHRI	- To fulfill necessary equipment and facilities and strengthen their research works
4. BBI/BBU (Horti-culture)	BBI's locations are not suitable for potato production.	° Prevalence of disease and harmful insects ° Production cost is high. ° Decrease in quality and insufficiency in quantity of seed potatoes	Establishment of BBI Unit at isolated area	- To establish farms for seed potatoes - To introduce new techniques for effective multiplication of seed potatoes - To provide equipments and facilities for multiplication of seed potatoes

Stage	Problems	Concrete Examples of Problems	Improvement Plans	Concrete Measures for Improvement
	Shortage of Irrigation Facilities	° Inefficient land use. ° Cropping seasons are not stable. ° Yield per unit area	Provision of irrigation facilities	- To provide irrigation facilities to make potato production possible throughout the year
	Techniques are insufficient.	° Low quality of seed potatoes	Training for technical staff	- To conduct on-the-job training - To carry out basic researches - To compile the manual of production skills for seed potatoes
	Shortage of budget	° It is difficult to maintain stable production of seed potatoes.	Improvement of financial management	- To introduce the capital revolving management system
5. BPSB	Inspection equipments are insufficient.	° Effective inspections are impossible to be conducted. ° It is impossible to conduct accurate and fair inspection.	Fulfillment of inspection equipments	- To fulfill analytical equipments especially for virus-disease - To arrange transportation facility for inspectors
	Inspectors' knowledge and ability are insufficient.	° It is difficult to conduct accurate and fair inspection.	Strengthening of inspection methods	- To train and educate inspectors - To compile inspection manuals - To carry out comprehensive studies on the actual conditions of virus and other disease for whole are of production in the country, and decide on which the priority should be placed, and improve by stages

5.4.7 Demand Forecasting of Improved Seed Potato

During 1985 - 2000 total planted area will increase from 20,360 ha to 36,642 ha, yield per hectare from 9.65 tons to 21.07 tons, and total production from 283,318 tons to 771,870 tons. Supposing the seed potato requirement per hectare is 1.5 tons, total seed potato requirement will increase from 44,060 tons in 1985 to 54,963 tons in 2000. In this demand forecasting ES requirement is set at one third of total seed potato requirement.

Table 5.31 Long Term Demand Projection of Improved Seed Potato in Indonesia

	Total planted area (ha)	Yield per hectare (ton/ha)	Total production (ton)	Total seed potato requirement (ton)	ES requirement (ton)
1985	29,360	9.65	283,318	44,040	14,680
1986	29,788	10.17	302,886	44,682	14,894
1987	30,232	10.71	323,817	45,348	14,116
1988	30,682	11.28	346,194	46,025	15,342
1989	31,140	11.89	370,115	46,710	15,570
1990	31,605	12.52	395,689	47,408	15,803
1991	32,075	13.19	423,034	48,113	16,038
1992	32,553	13.89	452,268	48,830	16,277
1993	33,037	14.64	483,518	49,556	16,519
1994	33,531	15.42	516,929	50,297	16,766
1995	34,029	16.24	552,650	52,044	17,348
1996	34,537	17.11	590,838	51,806	17,269
1997	35,052	18.02	631,667	52,578	17,526
1998	35,572	18.98	675,315	53,358	17,786
1999	36,104	20.00	721,980	54,156	18,052
2000	36,642	21.07	771,870	54,963	18,321

Source: Directorate of Horiculture, Ministry of Agriculture

Table 5.32 Seed Requirement in 5 Provinces (1)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Planted area (ha)										
Jambi	512	519	527	535	543	551	559	567	576	584
West Java	10,245	10,397	10,552	10,709	10,869	11,031	11,195	11,362	11,531	11,703
Central Java	4,456	4,522	4,589	4,658	4,727	4,798	4,869	4,942	5,015	5,090
East Java	5,539	5,621	5,705	5,790	5,876	5,964	6,053	6,143	6,234	6,327
South Sulawesi	1,362	1,382	1,402	1,423	1,445	1,466	1,488	1,510	1,523	1,555
Seed requirement (ton)										
Jambi	768	778	791	803	815	827	839	851	864	1,296
West Java	15,368	15,596	15,828	16,064	16,304	16,547	16,793	17,043	16,297	17,555
Central Java	6,684	6,783	6,884	6,987	7,091	7,197	7,304	7,413	7,523	7,635
East Java	8,309	8,432	8,558	8,685	8,814	8,946	9,080	9,215	9,351	9,491
South Sulawesi	2,043	2,073	2,103	2,135	2,168	2,199	2,232	2,265	2,300	3,450
ES requirement (ton)										
Jambi	256	259	264	268	272	276	280	284	288	432
West Java	5,123	5,199	5,276	5,355	5,435	5,516	5,598	5,681	5,766	5,852
Central Java	2,228	2,261	2,295	2,329	2,364	2,399	2,435	2,471	2,508	2,545
East Java	2,770	2,811	2,853	2,895	2,938	2,982	3,027	3,072	3,117	3,163
South Sulawesi	681	691	701	712	723	733	744	755	767	1,150

Source: Directorate of Horticulture, Ministry of Agriculture

Seed Requirement in 5 Provinces (2)

	1995	1996	1997	1998	1999	2000
Planted area (ha)						
Jambi	593	602	611	620	629	639
West Java	11,878	12,055	12,234	12,416	12,601	12,789
Central Java	5,166	5,243	5,321	5,400	5,481	5,562
East Java	6,421	6,517	6,614	6,713	6,813	6,914
South Sulawesi	1,579	1,602	1,626	1,650	1,675	1,700
Seed requirement (ton)						
Jambi	890	903	917	930	1,395	959
West Java	17,817	18,083	18,351	18,624	18,902	19,184
Central Java	7,749	7,865	7,982	8,100	8,222	8,343
East Java	9,632	9,776	9,921	10,070	10,220	10,371
South Sulawesi	2,368	2,403	2,439	2,475	3,713	2,550
ES requirement (ton)						
Jambi	297	301	306	310	465	320
West Java	5,939	6,028	6,117	6,208	6,301	6,395
Central Java	2,583	2,622	2,661	2,700	2,741	2,781
East Java	3,211	3,259	3,307	3,357	3,407	3,457
South Sulawesi	790	801	813	825	1,238	850

Source: Directorate of Horticulture, Ministry of Agriculture

CHAPTER 6 DEVELOPMENT PLAN FOR MULTIPLICATION AND DISTRIBUTION OF QUALITY SEED POTATOES

CHAPTER 6 DEVELOPMENT PLAN FOR MULTIPLICATION AND DISTRIBUTION OF QUALITY SEED POTATOES

6.1 Basic Concepts for Development and Planning

On the basis of the results of the studies on the present status regarding multiplication and distribution of seed potatoes in Indonesia, the principal ideas for the improvement are proposed in the followings.

(1) To introduce varieties suitable for agro-ecological conditions of each producing area.

(2) To produce and supply pathogen free Foundation Seeds by the efforts of the government farms.

(3) To organize seed grower groups of a high technical level who produce Extension Seed of good quality.

(4) To introduce the rapid multiplication method in order to further improvement of the way of multiplication.

(5) To reinforce BPSB activities to ensure the production and supply of high quality seed potatoes.

(6) To introduce new technologies which are well adapted to the potato producing areas in collaboration with national and international research institutions.

6.2 Areas to Be Improved

Listed below are the areas in which the improvement is required for development of multiplication and distribution system of quality seed potatoes based on the principal ideas above mentioned.

(1) Requirements for seed potatoes

- Varieties to be multiplied must be well adapted to each of the producing areas.
- Seed potatoes must be free from pests and diseases.
- Seed potatoes must be of appropriate physiological age.

(2) Multiplication of seed potato

- Multiplication of basic seeds (BS - FS) by government farms
- Multiplication by means of private seed growers (SS - ES)

(3) Inspection and certification of seed potatoes

(4) Personnel training on necessary techniques and knowledges

6.3 Items to Be Improved

The items to be improved, which were described in Chapter 5, are classified as follows.

Improvement 1. Introduction of varieties of high-yield.
Improvement 2. Introduction of varieties suitable for growing conditions of each producing area.
Improvement 3. Introduction of varieties for mid-elevation areas to expand growing area.
Improvement 4. Introduction of varieties resistant to diseases and pests.
Improvement 5. Maintenance of seed purity on the genetic characteristics in each procedure of the multiplications.
Improvement 6. Application of new method of multiplication by meristem culture.
Improvement 7. Imports of pathogen free seeds and distribution.
Improvement 8. Control of virus transmission.
Improvement 9. Elimination of diseased plants from fields by thorough inspection.
Improvement 10. Multiplication by direct using tuberlets for commercial seed.
Improvement 11. Improvement of crop rotation system.

Improvement 12. Setting up BBI Units in highland areas which are appropriate for multiplication of seed potatoes.

Improvement 13. Introduction of new techniques, such as Rapid Multiplication Method.

Improvement 14. Improvement of facilities of BBI farms.

Improvement 15. Environmental sanitization around the seed farm.

Improvement 16. Stable supply of pathogen free extension seeds.

Improvement 17. Organization of seed growers to acquire high level techniques cooperatively.

Improvement 18. Encouraging potato growers for efficient farming by providing of farm machineries.

Improvement 19. Introduction of a by-contract system to ensure the production of ES.

Improvement 20. Provision of credit for production of quality seed.

Improvement 21. Provision of seed potato storehouses for seed growers.

Improvement 22. Study on the cutting seed method for increasing number of seed.

Improvement 23. Provision of guidance to seed growers on improved potato growing techniques.

Improvement 24. Removal of other varieties at field inspection.

Improvement 25. Upgradation of techniques of disease indexing and roguing of diseased plants.

Improvement 26. Provision of vehicles and necessary instruments for BPSB inspectors.

Improvement 27. Training for personnel on new techniques and knowledge.

6.4 Evaluation of the Items to Be Improved

The Team evaluated the 27 improvement items, which were described in the previous section, taking into consideration the scale of the effects on this project, and technical, economic and institutional difficulties in case each improvement is implemented and various constraints, and then referred to the practical plans for the implementation of the project.

The following are the criteria used for the evaluation, and the results of evaluation are shown in Table 6.1.

(1) Contribution to the quality of seed

a) Increase in productivity
b) Improvement of disease infestation

(2) Improvement in seed multiplication process

a) Maintenance of the intrinsic characteristics of a variety
b) Effect on multiplication in terms of quantity

(3) Promotion of seed distribution and marketing

a) Scope of marketing promotion
b) Contribution to stabilization of seed price
c) Reduction of costs

(4) Difficulties in application of techniques for multiplication

(5) Increase in farmers' income

a) Increase in average yield per unit area
b) Reduction of production costs

(6) Quality and scope of seed growing techniques

a) Quality of applicable techniques
b) Transfer of seed growing techniques

(7) Relationship with other governmental development programmes

a) Position of potatoes in agricultural development programmes
b) Relationship with vegetable development programmes

(8) Relationship with foreign assistance in developing potato programmes

Table 6.1 Analysis on Effects of Improvement and Study on Constraint Factors

Item to be improved	Facters to be Considered	Problems and Constraints
Improvement 1. Introduction of varieties of high-yield. Improvement 2. Introduction of varieties suitable for growing conditions of every producing area. Improvement 3. Introduction of varieties for mid-elevation areas to expand growing area. Improvement 4. Introduction of varieties resistant to disease and pests. Improvement 5. Maintenance of seed purity on the genetic characteristics in each procedure of multiplication.	o Germ plasms, progenies of promising crosses and promising varieties would be provided by CIP and others o The transfer of new techniques by SAPPRAD is expected. o Development and introduction of new varieties will greatly contribute to the production increase of potatoes.	o LEHRI will take charge of activities for research and development. But, LEHRI is not well equipped for this purpose. o On-farm research activities are limited due to poor facilities and short of budget. o Activities for multiplication of quality seed (FS) are not satisfactory at all BBI's. o Budget has been curtailed very sharply.
Improvement 6. Application of new method of multiplication by meristem culture. Improvement 7. Imports of pathogen free seeds and distribution. Improvement 8. Control of virus transmission. Improvement 9. Elimination of diseased plants from fields by thorough inspection. Improvement 10. Multiplication by direct use of tuberlets for commercial seeds. Improvement 11. Improvement of the crop rotation system.	o Pathogen free potato is the most effective countermeasure for increase in the production.	o Quarantine and inspection system is not functioning. o Actual conditions of diseases and pests are not known in detail at a national level.
Improvement 12. Setting up BBI Units in highland areas which are appropriate for multiplication of seed potatoes. Improvement 13. Introduction of new techniques, such as Rapid Multiplication Method. Improvement 14. Improvement of facilities of BBI farms. Improvement 15. Environmental sanitization around seed farm.	o Introduction of new multiplication will decrease the price of seed potatoes. o Rapid multiplication method is applicable to BBI Units.	o It is difficult to secure the location which is completely isolated from aphids. o Water source is a constraint to BBI irrigation. o Present BBIs are situated mostly at mid-elevation areas where seed potato production is efficient.

Item to be improved	Facters to be Considered	Problems and Constraints
Improvement 16. Stable supply of pathogen free extension seeds. Improvement 17. Organization of seed growers to acquire high level techniques cooperatively. Improvement 18. Encouraging potato growers for efficient farming by provision of farm machineries. Improvement 19. Introduction of a by-contract system to ensure the production of ES. Improvement 20. Provision of credits for production of quality seed. Improvement 21. Provision of seed potato storehouse for seed growers. Improvement 22. Study on the cutting seed method for increasing number of seed. Improvement 23. Provision of guidance to seed growers on improved potato growing techniques.	o Organization of seed grower groups will enable efficient and stable multiplication of ES. o Improvement in operation will lead to the economical farming. o Extension of storage techniques will enable adjustment of potato marketing.	o It seems difficult to organize seed growers' groups. Friction with social customs will be anticipated. o There exist competing vegetables in selection of crop. o Market price of potatoes is not stable. o Guidance in production skills for seed potatoes, as well as extension activities are not conducted satisfactory.
Improvement 24. Removal of other varieties at field inspection. Improvement 25. Upgradation of techniques of disease indexing and rouguing of diseased plants. Improvement 26. Provision of vehicles and necessary instruments for BPSB inspectors.	o Establishment of inspection system will secure production and distribution of pathogen free seed. o Since inspection and certification system are imperative in successful seed potato program, strengthning of BPSB will be of very importance.	o Practically no technicians and no-instrument for potato inspection. o Vehicles are not available for field inspection.
Improvement 27. Training for personnel on new techniques and knowledge.	o Training is very effective for the transfer of techniques and information.	o Very few training courses have been given so far.

6.5 Planning

6.5.1 Introduction of the Rapid Multiplication Method

The Team plans to incorporate the Rapid Multiplication Method into seed potato production system in the following way, based on the results of field study on multiplication and distribution of seed potatoes in Indonesia.

(1) LEHRI will bear the responsibility of introduction and development of new varieties by obtaining germ plasms, promising progenies of crosses and/or promising varieties from CIP and other institutions.

(2) LEHRI will also take charge of developing new technologies and transferring the results to farmers, in good cooperation with SAPPRAD (Southeast Program for Potato Research, one of the CIP regional networks).

(3) LEHRI is exected to provide basic material for multiplication, producing virus-free plants by meristem culture.

(4) LEHRI will produce rooted stem cuttings in the aphid proof screen-houses (stem cutting of BS).

(5) BBI unit, Pangalengan, will receive rooted stem cuttings grown in LEHRI, transplant them in screen-house beds and produce tuberlets. These will be pathogen free BS, and they are distributed to Foundation Seed Farms which will be established in leading potato producing provinces in future.

(6) Foundation Seed Farms will take charge of actively raising stem cuttings by using BS tuberlets as mother plants, rooting them in the screen-houses, transplanting them in isolated fields and then producing seed tubers of FS class.

(7) The farm is expected to have the land area of at least 30 ha, growing isolation plants, several meters wide, to keep aphids off the seed potato field. As for neighbouring farmers, it is desired that they will grow only SS or ES, using FS potatoes of good quality, and as a result, the sanitary environment will be secured.

(8) Seed growers are expected to take necessary training courses on modern techniques, as well as guidances from experts regularly, and their seed fields must be inspected by BPSB, and thus seed quality will be guaranteed.

(9) Seed growers are expected to organize an unit, so as to improve the managing system in connection with the transmission of information, improvement of farming and facilities and so on. Collective management will help growers attain the goal to produce quality seed potatoes.

(10) Since quarantine of seed potatoes and certification systems are essential in successful seed potato program, involvement of BPSB in this respect will be of tremendous importance.

6.5.2 Improvement Plans

The improvement plans which were studied in 6.2, 6.3 and 6.4 can be rearranged as follows.

(1) Introduction of promissing varieties

Improvement 1, 2, 3, 4, 5, 6, 7

To introduce varieties adapted to the growing conditions of each producing area in Indonesia, inducing pathogen-free plants for further multiplication.

(2) Application of the rapid multiplication method

Improvement 8, 9, 10, 11, 12, 13, 14, 15, 16

To apply the effective rapid multiplication method in aphid-proof screen-houses and in isolated fields, utilizing the basic seeds conveyed from LEHRI. The hygienic multiplication system will commence this way.

(3) Multiplication in seed growers' farms

Improvement 17, 18, 19, 20, 21, 22, 23

The seed potatoes multiplied in the isolation will be further multiplied in the farms of seed growers with high level techniques and managing ability. Extention workers will advise growers how to spray and rogue diseased plants and etc. BPSB will inspect the fields to determine the eligibility for the certified seed.

(4) Strengthening of administrative measures needed for multiplication and distribution of the quality seeds

Improvement 23, 24, 25, 26, 27

The following are urgent and important administrative measures to be taken for multiplication of quality seeds of potatoes.

a) To rogue diseased plants, as well as foreign varieties, by reinforcing inspection services of BPSB.
b) To upgrade the techniques and growing knowledge through training of personnel concerned.

6.5.3 Priority Plans

Regarding multiplication and distribution of seed potatoes in Indonesia, improvement plans were described and classified in the previous section. The priority plans are proposed in this section to develop an appropriate system of the multiplication of quality seed potatoes.

(1) Plan to establish a multiplication system of basic seeds

(2) Plan to organize seed grower groups

(3) Plan to reinforce administrative functions and activities for multiplication and distribution of high quality seed of potato

1) Strengthening of BPSB inspection activities
2) Provision of technical training

The above projects are separate from but supplemental to each other and applicable to each province to make a step forward in modernization of multiplication and distribution of high quality seeds of potato.

The Study Team contemplates that it is a better measure of implementing a project in a selected province which has more proper conditions for implementation, to progress the project as a pilot project, and then to extend project operation into the other provinces.

In addition, among the above priority project, the improvement plan of BPSB inspection functions and the plan of personnel training are the ones which are operable separately from the other projects. Yet even these projects would not make remarkable effects and would be hardly cost-effective if these were carried out alone. Hence it is more practical to gradually implement these projects in view of outcomes of the pilot project in West Java Province.

6.5.4 Selection of a Province to Implement a Pilot Project

The Team selected West Java Province out of five subject provinces to implement the above improvement plans as a Pilot Project System. The reasons for the selection of West Java are shown in the Table 6.2 and the following are primary reasons to be specifically noted.

(1) The production of potatoes in West Java province is the largest, accounting for approximately 35% of the total production of the country, and as a result the demand for seed is strong.

(2) Since LEHRI is located near Pangalengan, West Java, which is the proposed site of a planned BBI Unit, both research and multiplication programmes will get along in close cooperation

with each other.

(3) Increased potato production resulting from the introduction of improved techniques will be easily marketed in nearby cities such as Banding, Jakarta and others.

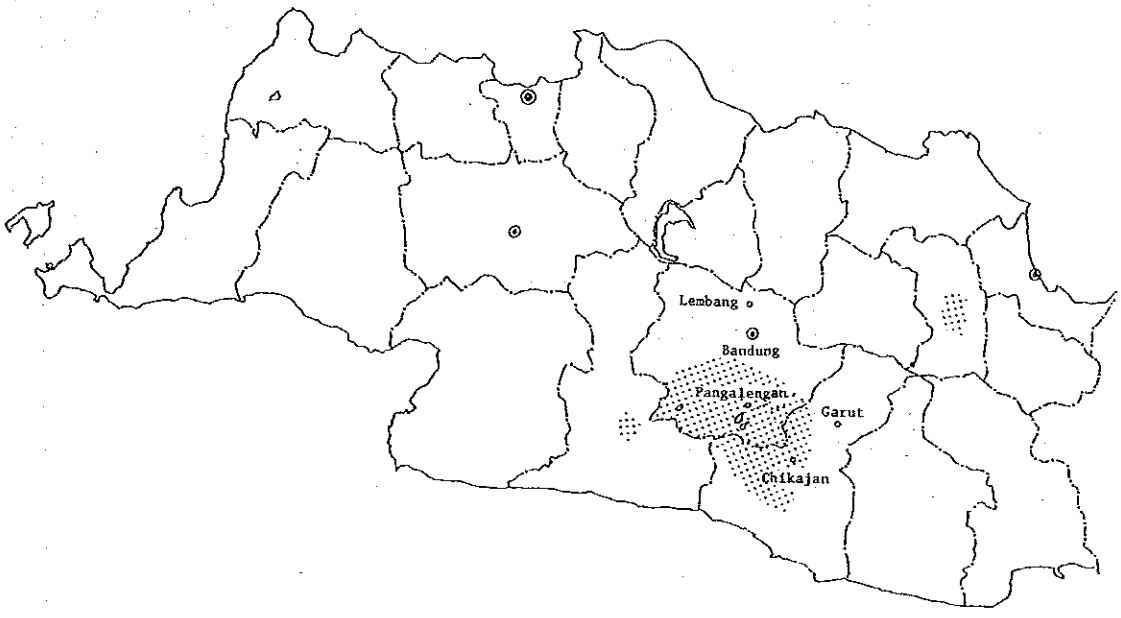


Figure 6.1 Major Potato Production Area in West Java Province

Table 6.2 Factors in Selection of A Province for Seed Potato Multiplication

Items	JAMBI	SOUTH SULAWESI	EAST JAVA	CENTRAL JAVA	WEST JAVA
1. Yield per hectare	*	*	**	***	***
2. Soil Fertility	***	**	***	***	***
3. Virus Transmission by Insects	*	**	*	**	*
4. Farmers' Technical Level	**	*	***	***	***
5. Soil-borne diseases	**	**	***	***	***
6. Marketing of Potato	-	-	**	**	***
7. Land Conservation	**	*	*	*	***
8. Research and Training	-	-	*	*	***
9. Isolation Possiblity	**	**	*	**	*

* ---------- ** ---------- **
Increasing intensity Suitability

6.6 Outlines of Pilot Project Implemented in West Java

The four plans finally proposed for promotion of multiplication and distribution of quality seeds in West Java are detailed as follows regarding their operational procedures. These four plans are mutually complementary to each other and expected to make a step forward in the rationalization and modernization of seed industry in Indonesia.

(1) Estimation of Demand for Seed Potatoes in West Java

12,000 ha x 1.5 tons = 18,000 tons

(Areas under potato farming in West Java) (Seed requirement per ha) (Potential for seed demand in West Java)

18,000 tons x 1/3 = 6,000 tons

(Renewal) rate, every three seasons) (Seed demand)

(2) Project Area

Kab. Bandung, West Java

- o Lembang
  Location of LEHRI
- o Pangalengan
  Proposed location of the Foundation Seed Farm and also location of seed growers who produce about 6,000 tons of Extension Seed.

(3) Proposed Project to be implemented

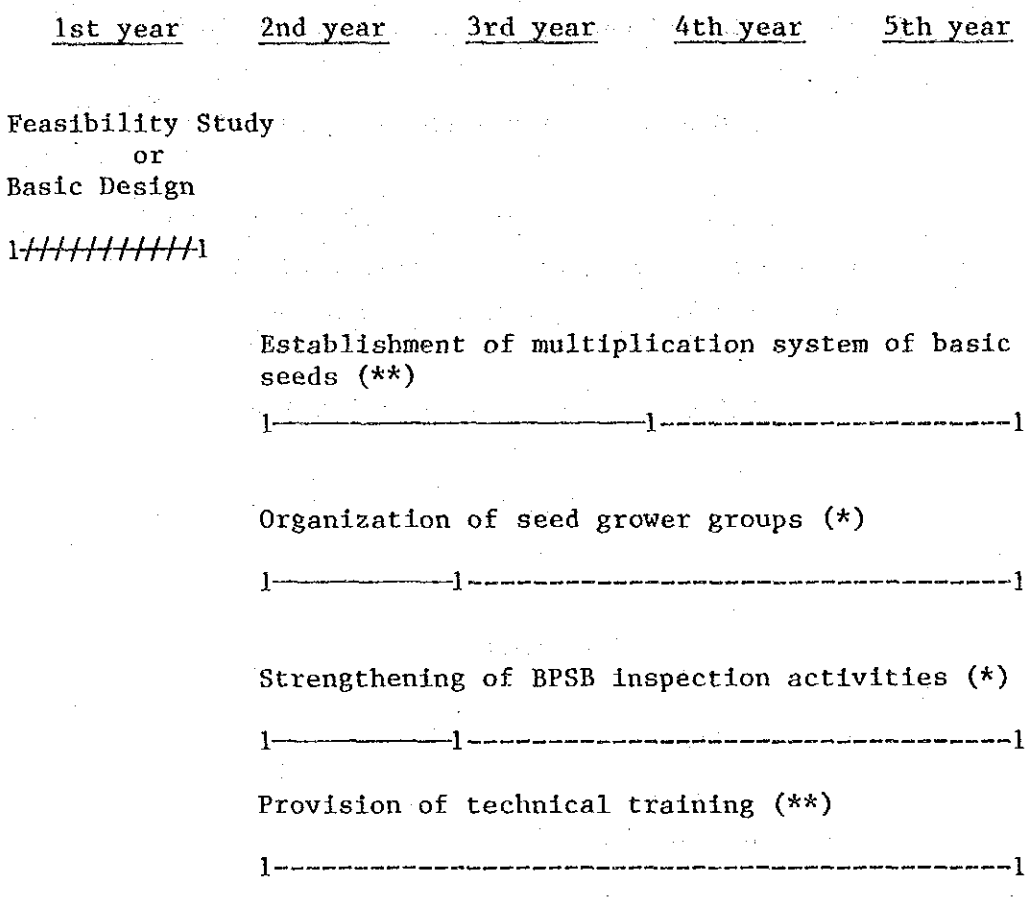
A. Establishment of a multiplication system of basic seeds
B. Organization of seed grower groups

C. Reinforcement of administrative functions and activities for multiplication and distribution of quality potato seeds

1) Strengthening of BPSB inspection activities

2) Provision of technical training

(4) Schedule for Project Implementation and its technical cooperation



(5) Technical Cooperation

During the period of project implemention, technical cooperations are required as follows;

* Long-term assignment;

Expert of potato farming (1)
Plant pathologist/Quarantine (1)
Expert of seed multiplication (1)

* Short-term assignment;

Ecologist of insect (1)
Expert of potato storage (1)
Expert of irrigation/water management (1)
Expert of soil/fertilizer (1)

(6) Project Structure

The chart shown in next page diagrams work flows among the relating organizations involved in the plan for multiplication and distribution of quality potato seeds.

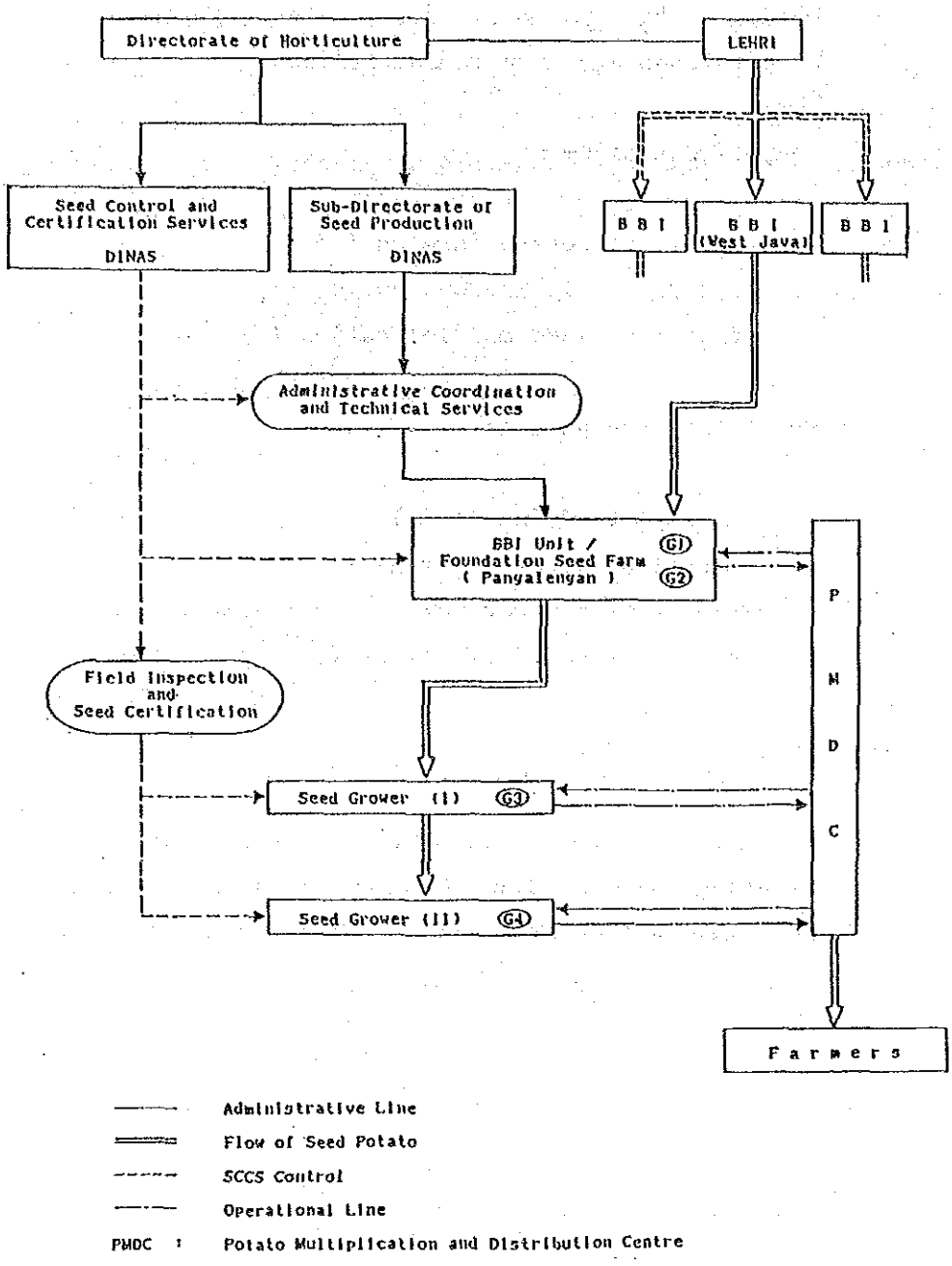


Figure 6.2 Project Structure Chart

(7) Role of PMDC

The "basic seeds" as mentioned in "plan to establish a multiplication system of basic seeds" refers to G1 (BS) and G2 (FS). In this plan, multiplication of these basic seeds are to be undertaken by "Foundation Seed Farm" to be established anew.

For the moment, this farm will be controlled by the government as a BBI Unit for the production of FS.

Subsequent works for multiplication of G3(SS) and G4 (ES) to be undertaken by a public enterprise, which is intended to introduce private sectors to activate seed production industry. This public enterprise is provisionally named Potato Multiplication and Distribution Center (PMDC).

The reasons for intending participation of private sectors in this plan are as follows:

1) Total quantity of annual supply of ES to West Java Province is estimatedly about 6,000 tons. Participation of private sectors is indispensable for production, storage and distribution of such large quantity of seeds in a wide area in line with seasonal requirement.
2) One Foundation Seed Farm requires no less than about 30 ha. Only public enterprises can be expected to be a possible supplier of such a wide stretch of land.
3) Cultivation of upland vegetables such as cabbage, carrot, and onion has to be fitted in as a part of the rotation system of potato. Management of Foundation Seed Farms should be performed economically and cost-effectively in view of such a rotation system.

The linkage of the public enterprise (PMDC) and the government seed farm (BBI Unit) can be explained as below:

1) In a short-run prospect, Foundation Seed Farm that is a government potato seed farm acting as a BBI Unit, will have exclusive responsibility of FS production, and subsequent works for multiplication of SS and ES will be undertaken by PMDC which is formed by merging private sectors for the purpose of activating seed production industry.
2) In a long-run prospect, probably first 5 years, PMDC will have charge of management of the Foundation Seed Farm in addition to duties of supplying ES, thus PMDC will be involved in the thorough processes of multiplication and distribution of every class of potato seeds.

3) More definitely, PMDC acts as a coordinating agency to control seed growers of G3 and G4 in a short run programme, but in a long run programme it is intended to take charge of the full processes up to multiplication of G1 through G4 as indicated Figure 6.3 "Operational Function of PMDC".

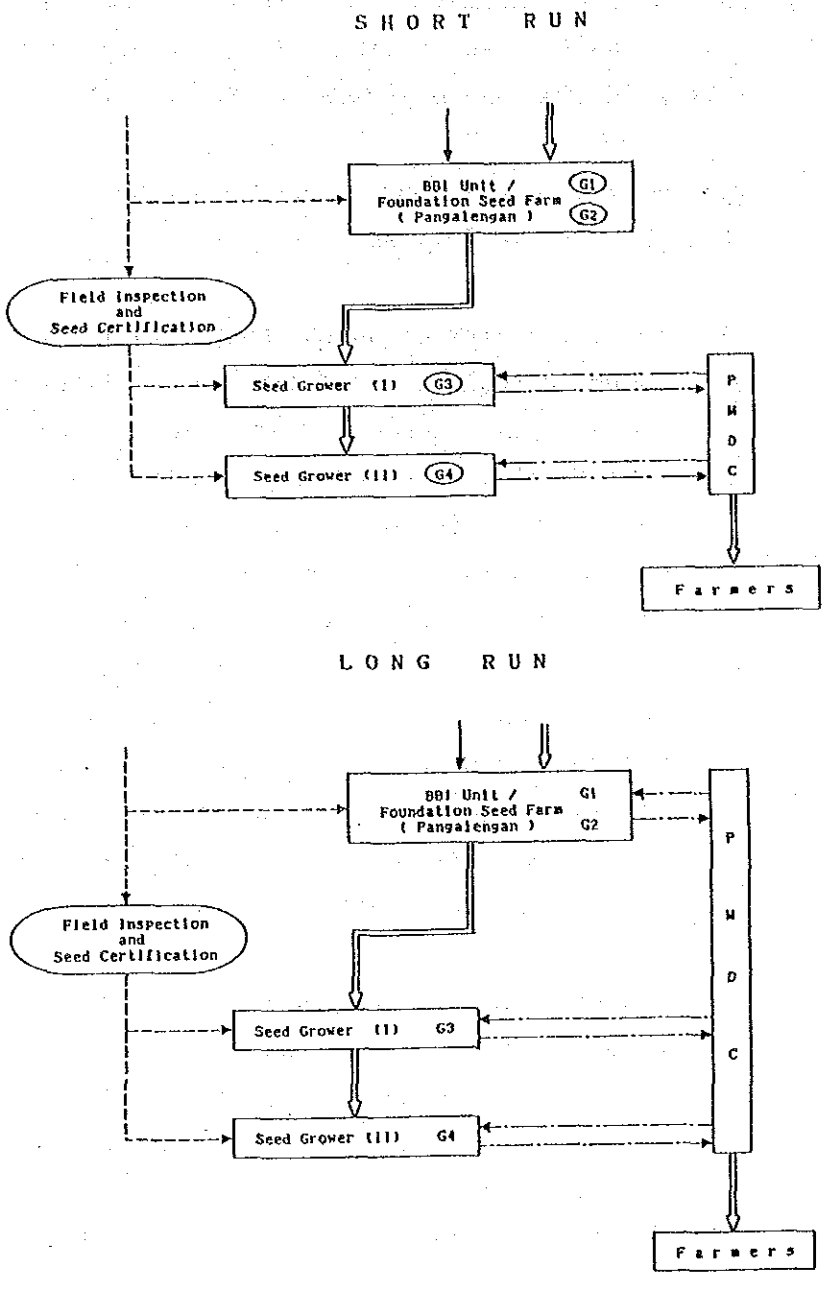


Figure 6.3 Operational Functions of PMDC

6.6.1 Plan to Establish a Multiplication System of Basic Seeds

(1) Objectives

Supply of pathogen free seeds of improved varieties is inevitable to heighten potato production. For this purpose, the following two tasks should be properly achieved;

1) to produce pathogen free basic seeds (BS.FS) by applying new techniques such as disease indexing and meristem tissue culture, etc.,
2) to establish a system to produce foundation seeds in a short period in a large mass by means of the rapid multiplication method.

The purpose of this plan is to prepare the system and to efficiently and effectively accomplish the above two tasks.

(2) Executing Agency

Directorate of Horticulture in cooperation with Lembang Horticulture Research Institute

(3) Scope of the programme

Technical assistance shall be supplied to LEHRI in combination with assistance for improving research equipments and facilities.

Meanwhile, as for BBI Unit, facilities necessary for a potato seed farm such as an isolated farm, irrigation facilities, and various buildings shall be amplified, and production and distribution of BS and FS shall be commissioned. BS stands for tuberlets produced in greenhouses. Seedlings are multiplied from these BS in screen-houses.

(4) Implementation of the plan.

A. Strengthening of LEHRI's Research Activities

1) Concept about reinforcement of LEHRI in connection with equipment and facilities

a) LEHRI is the only research institute in Indonesia for horticultural crops (excluding fruit) including potato, and it has been conducting research works on introduction, selection and multiplication of varieties, adapted to Indonesian conditions.

b) LEHRI is the starting point for multiplication of seed potatoes for all over the country.

c) LEHRI has already received equipment for tissue culture and others from USAID and JICA, so it is capable of producing basic seeds to some extent.

d) Though LEHRI produced seed potatoes equivalent to BS by the rapid multiplication method in 1986, it meets only a small portion of the national demand.

e) Most demand for seeds has been met by means of importation of seed potatoes, but it is urgent to encourage the domestic seed potato production as quickly as possible.

f) It is necessary to reinforce LEHRI in order to promote the development and introduction of varieties matching Indonesian conditions and to produce domestic seed potatoes (BS) effectively.

g) LEHRI will be responsible for cleaning varieties to be multiplied by meristem culture and multiplication of basic seed materials. Rooted stem cuttings will be sent to BBI from LEHRI for further multiplication.

2) Equipments and evaluation required

Required equipments are enumarated in the following Table 6.3.

3) Cost Estimation

Building	¥ 28,000,000
Equipment	143,000,000
Total	¥171,000,000

Table 6.3 Equipment necessary for LEHRI and their Evaluation

Equipment and Facilities necessary for LEHRI				Existing Equipment and Facilities		Evaluation
1. Laboratory						
a. Preparation Room	1	@81 m^2	81 m^2	Preparation Room (13 types)	m^2	
b. Clean Room	1	@19 m^2	19 m^2	approx. 10	m^2	Though it seems necessary to equip
c. Culture Room	1	@34 m^2	34 m^2	3 x 4 12	m^2	the laboratory with a number of
d. Preparation Room inuring	1	@24 m^2	24 m^2	Incubation Room	m^2	instruments, further study will be needed regarding its scope and the
e. Inuring Room	1	@73 m^2	73 m^2			type of equipment. (Independent
f. Inuring Glass Shielded Room	2	@73 m^2	146 m^2			rooms may not be necessary for d.e.)
g. Inspection Room	1	@15 m^2	15 m^2	Virology Lab. (7 types)	m^2	
h. Electron Micro-scope Room	1	@39 m^2	39 m^2			
2. Additional Screen House + Glass House for Indexing						
Screen House			350 m^2		230 m^2	200 m^2
Glass House			100 m^2			100 m^2
- 5 mm thickness of glass						
- Ventilation fan						These should be considered as
- Cultivating facilities (bench system)						necessary equipment at the stage of
- Movable cart						giving specifications.
- Pots						These should further be studied as
- Irrigation system						necessary equipment.

Equipment and Facilities necessary for LEHRI			Existing Equipment and Facilities		Evaluation
3. Net Houses - 40 net houses - Irrigation system	@500 m^2	20,000 m^2	@90 m^2 x 2 ridge	180 m^2	500 m^2
4. Storing Facilities - 10 x 20 m - Including grader			Cum-working facilities	270 m^2	To repair the existing cold storages. To adopt manual selection.
5. Processing Pilot Plant: - Grate dumper, hopper, destoner - Diverter, measuring hopper, peeler - Inspection Conveyor - Feeding unit - Slicer - Drum washer, washing conveyor, washing tank - Rinsing tank, Rinsing conveyor, squeezing roller - Fryer - Chip conveyor, salter, ship shoot					It is necessary to study whether they are indispensable equipment for research and multiplication. (It is required to study the actual examples of equipment of the same type already provided to BBI). Though this is one of the major breeding objectives, a large scale plant will not be prerequisitive for this purpose. It shall be satisfactory to arrange a laboratory as wide as 100 m^2 equipped with some devices and tools.

Equipment and Facilities necessary for LEHRI		Existing Equipment and Facilities	Evaluation
6. Training Center			
- Lecture Room	70 m^2		There have already been training facilities of Agency for Agriculture, Education, Training and Extension (BPLPP) at Rayu Ambon in the vicinity of LEHRI. The training can be carried out at the facilities which accommodate 3 class of 25 trainees each.
- Laboratory	56 m^2		
- Instructor's Room	25 m^2		
- Assistant instructor's Room	15 m^2	Training courses were held in small scale (for twenty persons) in the past.	
- Administration Room	15 m^2		
- Dispensary	12 m^2		
- Kitchen	18 m^2		
- Toilet	33 m^2		
- Trainees resting lobby	131 m^2		
	375 m^2		
7. Truck for transporting rooted stem cuttings			2 (equipped with air-conditioner)
8. Agri. machines		Tractor x3, Hand tractor x3, Trailer x1, Generator x1, Irrigation x1	Machineries for field operation are difficult to be considered in this project.

B. Establishment of Foundation Seed Farm

1) Implementation site

a) To establish Potato Multiplication and Distribution Center in Pangalengan, Bandung, West Java Province. Since Pangalongen is not very far from LEHRI (about 50 km), enhanced research activities on potatoes and strengthened multiplication facilities for basic seed potatoes at LEHRI are easily accessible to the center. And already potato seed growers are existing there. All this will be advantageous to systematize the production procedure of seed potatoes.

b) Land area of approximately 30 ha will be needed for the center. West Java provincial government is willing to provide necessary land out of 117 ha, which has been managed by PD Mamin, the provincial beverage corporation.

c) The land area totaling 117 ha, is presently being rented to army-related association, farmer groups, and individual farmers. But the rent period for the army-related association will expire in March, 1988, and it has already shown its intention to return it to the Corporation.

d) Chances seem less that aphids inhabit the area heavily at the altitude of almost 1,200 m a.s.e., and so it will be desirable for the production of relatively virus-free seeds. The land consists of fine volcanic ash soil of rich fertility. The season in which the Team conducted observation was mid dry season (the end of August), and so some of the fields were fallow and some were under vegetables (potatoes, cabbages).

e) As for the establishment of infrastructure, the site is equipped with electric power through power circuitry and a transformer installed near the site. An unpaved road runs about 2.5 km (about 6 m, wide), through a tea garden from the end of the paved road. As for water

resource, there is a well for cattle in the site, though not used at present. The water level of the well was found about 50 meters deep by survey but its discharge is not certain.

Furthermore, the end of a small dam for hydraulic power plant, PLN (electric corporation) was reaching the site, while there was no water at that time. It is also prohibited to take water from this dam. Therefore, it will be necessary to conduct a study on water resources for irrigation prior to the construction of the Multiplication and Distribution Center.

2) Plan for facilities

a) Scale

Total area approximately 30 ha

Multiplication field 13.5 ha = 4.5 ha x 3 crops/year
Buildings: (as are shown below) Total 3,225 m^2
Isolation plants (Standard 350 m), farm road, reservoir, water channel 15 ha

Construction work to equip farm

Earthing up, levelling of the ground, farm road, reservoir and irrigation channel (Inter-ridge irrigation system), irrigation facilities, boring of artesian well or reservoir.

Buildings

Screenhouses (equipped with irrigation facilities)	1,000 m^2
Office, Cold Storage (-5°C)	175
Laboratory	100
Farm Tools (with workshop)	
Farm equipment storage (for agricultural chemicals, fertilizer, bags, cages)	200
Office	250
Workroom, preparation, temporary storage	
Curing, Disinfection	300
Storage (DLS 1 t/m^2x3 mH, 50 t)	50
Compost Storage	100
Spare Generator fuel deposit	25
Pump Room	25
Staff Dormitory (5)	1,000
Total	3,225 m^2

Equipment

Farm equipment	
Tiller (equipped with rotary, furrowing, and digger)	5 units
Tractor (equipped with a conveyor)	1
Tools (hoe, hook etc.)	1 set
Simple Sorter	1 units
Pump	Decision by future survey
Chemical sprayer (manual, power-driven)	
Chemical Mixer (Chemical tub, water transporter)	20 units
Tractor mount type sprayer (600ℓ)	1 unit

Repair Tool	1 set
Clod Sterilizer	
Soil sterilizer	
(Chloropicrin 50% (250 ℓ/ha) or steam sterilizer)	Decision by future survey
Inspection tool	1 set
Microscope	
PH meter	
Elisa reader, reagent	
Others	
Vehicle	
Truck, Jeep	2 units

3) Cost Estimation

Building	¥147,000,000
Equipment	19,100,000
Farm related	222,000,000
Total	¥388,100,000

Remarks:

1) Operational cost is referred to at the section of economic analysis.
2) Land rent is not included.

Table 6.4 One Example of Multiplication Plan of Seed Potatoes

Generation		G-1	G-2		
Organization	LEHRI	Foundation Seed Farm (Pangalengan)	Foundation Seed Farm (Pangalengan)		
Facility	Screen house SC-1	Screen house SC-2	Screen house SC-3	Screen house SC-4	Multiplication farm F
Area	8.5 m^2 (25.2 m^2) Whole country	76.0 m^2 (228.0 m^2) whole country	304 m^2	450 m^2	13.5 ha
Target Yield	Rooted seedlings 5,063	Tuberlets 20,250	Mother plant 20,250	Rooted seedlings 810,000	Seed potatoes 35 t
Actual Area Yield/Unit Production Frequency	8.5 m^2 2 = 4.3 m^2 400 seedlings/m (5 x 5 cm), 3 times/year	76 m^2 2 = 38 m^2 44.4 seedlings/m (15 x 15 cm), 3 time/year Tuberlets 4/seedling	304 m^2 2 = 152 m^2 44.4 seedlings/m (15 x 15 cm) 3 times/year	Seedlings 40/plant 3 x 3 times/year 400 seedlings/m^2 Including walkway 200 seedlings/m^2 400 seedlings x 20, 250 plants 3 3 400 x 2 = 450 m^2	60,000 seedlings/ha Seed potatoes 10 t/ha

Generation	G-3	G-4	
People Concerned	Seed producer (I)	Seed producer (II)	General producer
Area	90 ha	600 ha	4,000 ha
Target Yield	900 t	6,000 t	
Required Amount of Seeds Total Yield Standard Amount of Seeds	135 t (1.5 t/ha) 15 t/ha 10 t/ha	900 t (1.5 t/ha) 15 t/ha 10 t/ha	6,000 t (1.5 t/ha) Cropping area is 12,000 ha, but 1/3 will be renewed.

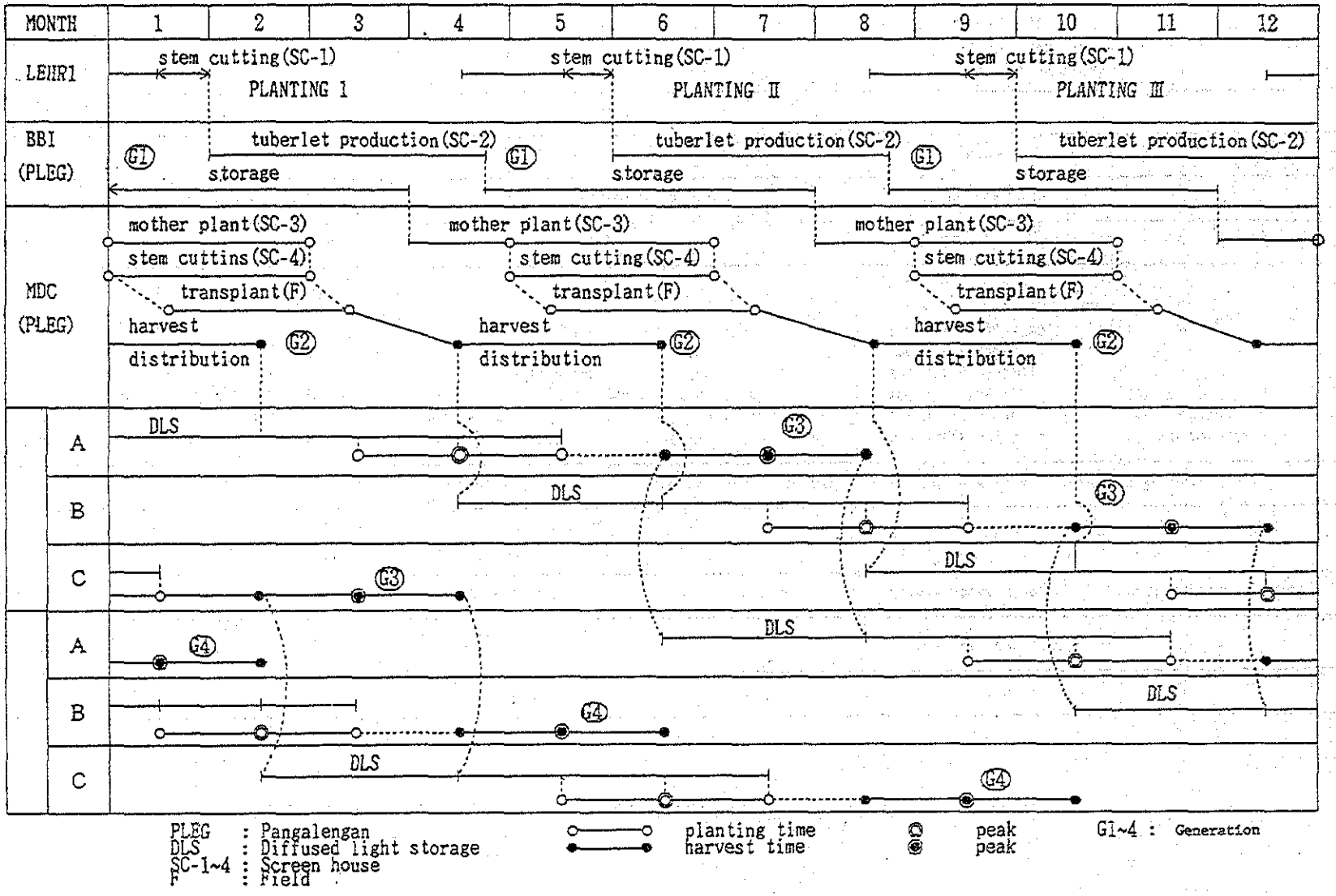


Figure 6.4 Process of Potato Seed Multiplication

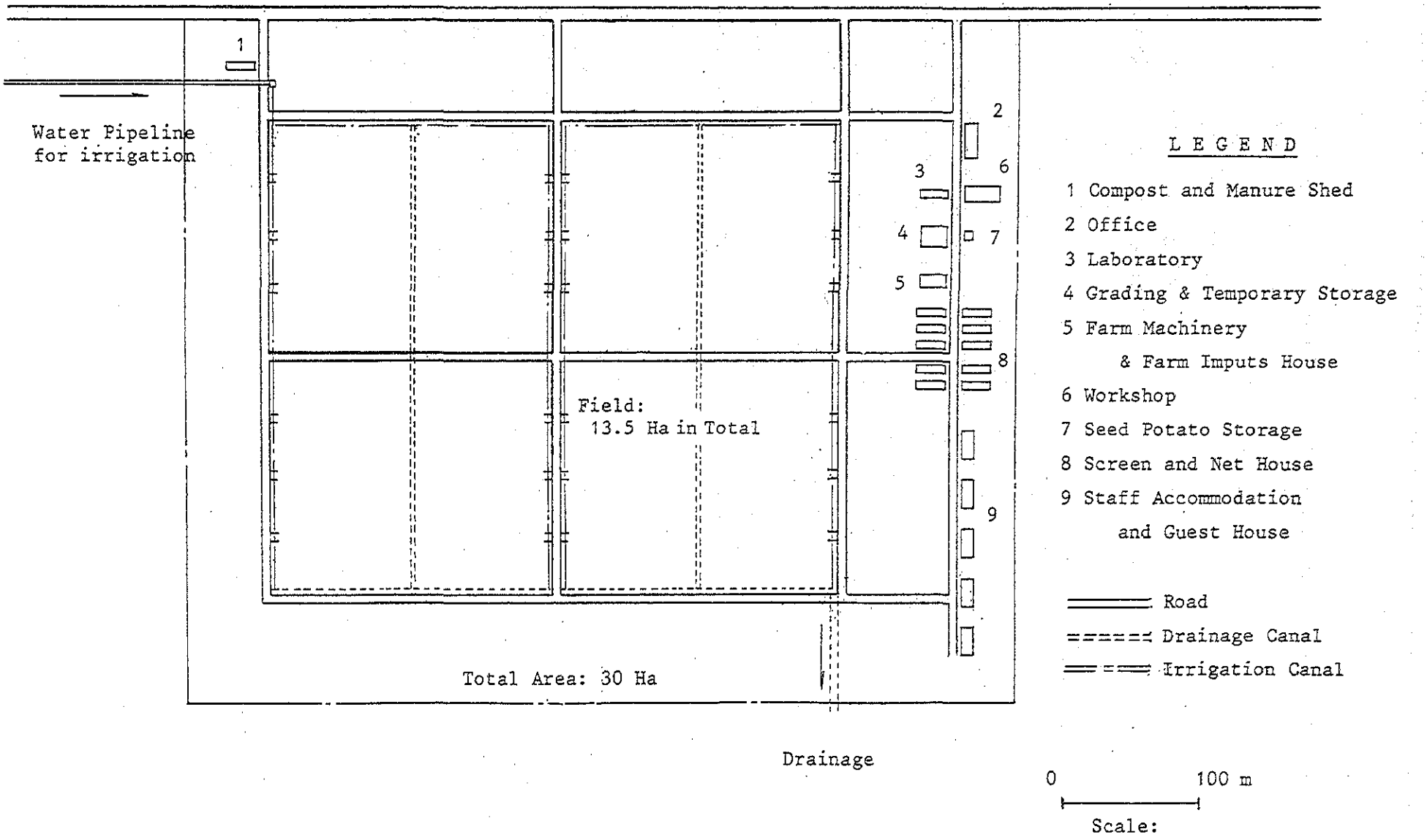


Figure 6.5 Layout Plan of Seed Potato Multiplication Farm of PMDC

6.6.2 Organization of Seed Grower Groups

(1) Objectives

To promote a stable supply of pathogen free seed potatoes (ES) of improved varieties by providing seed grower groups with advanced techniques

(2) Executing Agency

Central or local organization of the Government, or public corporation which are involved in production or distribution of potatoes in West Java Province.

(3) Actual activities

To streamline farming system by organizing seed grower groups with approximately 10 ha, in the potato producing area, by an initiative of the Executing Agency.

1) Cooperative Pest-control

As for pest-control, higher effect will be practiced by conducting the operation at the same time over as wide area as possible. Since it is customary to spray chemicals every 3 - 7 days during the growing period of the potato, it is necessary to cope with the labour intensification under the present conditions. Therefore, it will be effective to provide pest-control equipment as well as to secure water resources, in order to solve the problem by conducting pest-control in groups. Generally speaking, shoulder sprayers of semi-automatic type will be most suitable for this area, while power sprayers are more effective in flat land areas.

2) Cooperative in storage

Seed potatoes have to be stored for considerable time preventing deterioration of potatoes. The building consists of several stories and the ground story is used as a

workshop. Potatoes should be kept in containers and on shelves. Furthermore, these buildings may be utilized by a group of farmers as a meeting place for the community.

Storage is not very popular among farmers and occasionally physiologically inferior seed potatoes are used. Therefore, the improvement of storage is of primary importance.

The diffused light storage (DLS) is considered suitable for this purpose, since it can keep seed potatoes in good conditions as long as five months seed potatoes thus stored favor us with improved yield.

The experiment in the Central Java Province proved that seed potatoes stored in DLS exhibit sturdy and short sprouts at the following planting time. DLS is found practical for farmers to keep quality seed potatoes easily.

Since it can make use of locally available materials for the construction. DLS has an advantage over an expensive dark cold storage which requires an air-conditioner.

It has storing capacity of 1 t to 100 t. Farmers can easily build a small scale DLS on their own.

The principle of DLS is to keep seed potatoes inside a well-ventilated room under diffused light conditions. DLS also avoids the waste of energy in seed potatoes by inhibiting the growth of sprouts and resultantly encourages early growth, and as a result, contributes to yield increase.

3) Development of cooperative irrigation system

Since suitable area for potato production is extremely limited, it will be beneficial to make utmost use of the land by growing crops throughout the year. One of the biggest problems is a supply of supplementary water in rainy season as well as irrigation water in dry season. So an irrigation facility will have to be established for a group of fields (about 10 ha). Water resources are to be chosen from deep wells, rivers or reservoirs depending on the location.

Facilities and equipments for one group of potato growing farmers are shown in the following Table 6.5, based on the

above-mentioned study.

(4) Scope of the project

This project aims to rationalize the farming of nearly 60 groups of potato seed growers on the basis of seed growing programme. The appropriate unit of a seed growers' group will be approximately 10 ha as wide as considering the fact that expected potato seed fields in West Java cover about 600 ha.

(5) Cost Estimation

a. Investment costs for one unit of seed growers (10 ha)

Storage	¥ 5,000,000
Machineries and Equipment	3,900,000
Irrigation	4,800,000
Total	¥13,700,000

b. Total cost for all seed growers in West Java

¥13,700,000 x 60 groups = ¥822,00,000

Table 6.5 Equipments and Facilities for One Group (10 ha) of Seed Potato Growers

Purpose	Equipments & Facilities	Specifications & Design Requirements	Quantity
Grouping for pest control works	Semi-automatic sprayer	$\frac{10.0\ \text{ha}}{0.5\ \text{ha/sprayer/day}}$	20
	Powered sprayer	$\frac{4.0\ \text{ha}}{2.0\ \text{ha/sprayer/day}}$ (4 - 5 hr)	2
Collaboration in storage works	Storehouse with containers and shelves	Seed potato 1.5 t/ha x 10.0 ha = 15.0 t, $\frac{15.0\ \text{t}}{100.0\ \text{kg/m}^2}$ x 1/3(3 floors) = 50.0 m^2	
	Workshop	90.0t ÷ 0.5 t/m^2 = 180.0 m^2	250 m^2
	Meeting room	20.0 m^2/20 people	
	Machinery storehouse	130.0 m^2	
Public irrigation	Boring well, surface-water, reservoir	$\frac{10.0\ \text{ha}}{5.0\ \text{ha/well}}$, multistage pump, reservoir, channel (1 km/10 ha)	2
		4.0 mm/day x 60 days x 10.0 ha	24,000.0 m^2

6.6.3 Reinforcement of Administrative Functions and Activities for Multiplication and Distribution of Quality Potato Seeds

(I) Strengthening of BPSB inspection activities

1) Objectives

To strengthen BPSB's inspection and certification functions in order to ensure the production of pathogen free seed potatoes and to support the fair trade of potato seeds.

2) Executing Agency

DGFCA

3) Necessary equipment for inspection

a) transportation
b) inspection tools
c) laboratory

The details are shown below.

Motor bicycle	12 units
Automobile	3 units
Screen house (150 m^2)	2 sets
Insect rearing box	10
Pyrostat	1
Refrigerator	1
Water distiller	1
Micro pipette	2
Super centrifuge separator	1
Glass needle, pestle	50 sets
ELISA Kit	1 set
Photometer	1
Glass uteusils	1 set

4) Cost Estimation

Equipment ¥82,000,000

(II) Provision of Technical Training

1) Objectives

To improve skills of the people concerned by the training and to facilitate development of multiplication and distribution programme for quality seed potatoes

2) Executing agencies

Directorate of Horticulture, Directorate General of Food Crop Agriculture, to perform the programme in cooperation with Lembang Horticulture Research Institute and Agency for Agricultural Education, Training and Extension.

3) Details of the training programme

a) Training themes:

Training themes of each technical field are shown in Table 6.6.

b) Training method:

Each run of the training programme is to be done with some of the below courses combined:

. Group-training-in-classroom method

It is more efficient if knowledge and skills of trainees are equable.

. Training tour system

To set up small-scale model farms in potato producing areas and to make instructors circuit the farms to train.

. Correspondence training

To prepare technical mannuals for each space training subject and mail them regularly. This is effective for many trainees such as key farmers etc.

. Overseas training

Backbone technical staffers need to be trained overseas, but this is limited to a small number of people who have their own study tasks.

c) Objective personnel

Advanced course:

Researchers of LEHRI and government officials of positions equivalent to the manager of BBI & BPSB.

Presumptive some 30 university graduates are eligible.

Intermediate course:

Workers and inspectors of BBI and BPSB, and PPL stationed in potato production areas. Presumptive some 120 people are eligible, who are graduates of agricultural high schools or equivalent.

Fundamental course:

Seed Growers, Key Farmers.

Representatives of each seed grower group are to attend the training. If requested by other farmers, key farmers are allowed to participate. As a great number of people are eligible, invitation to participate shall be publicly anounced depending on the theme of the training.

d) Training instructors:

In principle, the farmer groups shall be instructed by those who have finished intermediate course, and intermediate trainees shall be instructed by those who have finished advanced course. Advanced trainees shall be instructed by foreign experts or specialists of international institutes.

e) Places:

In principle, training shall be given at training centers of Agency for Agricultural Education, Training and Extension.

f) Frequency of training and the unit of trainees:

This matter is to be settled in future on the basis of adjustment of problems in implementing the training, especially of financial problems.

Incidentally, Indonesian people have an accordant view that the advanced course training should be promptly started so as for this training programme to be operated efficiently and effectively, and that urgent reinforcement of activities in the below fields are particularly required.

. Potato Variety Improvement
. Potato Farming
. Integrated Pest & Disease Management/Disease Indexing

. Rapid Multiplication Techniques and Management/Meristem Tissue Culture

	1st	2nd	3rd	4th	5th	(year)
Potato Variety Improvement	x	x	x	x	x	
Potato Farming	x	x	x	x	x	
Integrated Pest & Disease Management/ Disease Index	x	x	x	x		
Rapid Multiplication Techniques and Management/Meristem Tissue Culture	x	x	x			
Potato Storage	x	x	x			

Table 6.6 Training Programme for Multiplication and Distribution of Seed Potatoes

Class of Seed potatoes	Institute/ Organization	Contents of Training		Trainees	Instructors	Training Method	Place	Implementation Schedule (years)				
		Technical Areas	Objectives					1	2	3	4	5
	LEHRI	Introduction of the rapid multiplication method	Selection of suitable varieties to Indonesian agro-ecological conditions Meristem tissue culture Indexing of diseases Maintenance and propagation of parent material in vitro	Research workers (graduate) Chief of BPSB's branch Chief of BBI	Experts from international institutes Foreign experts	Training abroad Lesson by foreign expert	Institute abroad LEHRI					
BS/FS (G1/G2)	BBI	Implementation of the rapid multiplication method Crop production and management	Management of cuttings and tuberlet production Pest control Harvesting and grading Introduction of up-land irrigation system Isolation from aphids Extermination of nematoda and other harmful insects	Staff of BBI/BPSB Extension worker (PPL)	Experts mentioned above LEHRI research workers	Class lesson Lecturing tour	Provincial BPLPP BBI's fields Demonstration farm					
		Storage for seed potato	Principle of DLS storage Physiological conditions in storage Storage management Pests and diseases in storage									
SS/ES (G3/G4)	Seed grower groups	Seed farming Storage techniques for seed potato	ditto	Inspector of BPSB Seed growers Key farmers	LEHRI research workers Staff of BPSB Staff of BBI	Class lesson Lecturing tour Correspondence course	Provincial BPLPP Demonstration farm					
	BPSB	Inspection and quarantine techniques	Scope of inspection Standards Inspection manuals Specifications and grade of seed potato	Staff of BPSB	Experts mentioned above LEHRI research worker	Class lesson Lecturing tour	BPSB's branch BBI's field Demonstration farm					

6.7 Economic Evaluation

6.7.1 Economic Analysis

Indonesia is importing seed potatoes and potatoes for consumption, and at the same time exporting potatoes for consumption. There is no retrictions for potato trade. Furthermore internal distant transportation in the country is also popular and the response of producers to price change in the potato producing areas is very sensitive. Therefore it can be concluded that the difference between potato price and international price is small.

Economic benefits of the Project are composed of direct benefits (benefits from seed production) and indirect benefit (benefit from increasing potato production). Direct benefit (1) can be calculated by multiplying the production volume of seed potato (G-2) by the economic price (1500Rp/kg). Direct benefit (2) can be calculated by multiplying the production volume of seed potatoes (G-3, G-4) by the economic prices (1000Rp/kg, 750Rp/kg). For calculating indirect benefit, firstly we multiply the difference between unit yield of improved seed potato (15 tons/ha) and that of local Seed Potato (10 tons/ha) by planted area, then multiply the increment by economic price of potato for consumption (240 Rp/kg), and then the gross benefit can be drawn. Because farmers can use improved seed potato 3 times through self-multiplication after buying it, therefore we also add the increment of potato production after second harvest in calculation of benefit. Meanwhile, because the gross benefit includes the additional cost (350Rp/kg) by introducing improved seed potato, we calculate the net benefit by deducting it from the gross benefit.

Economic costs of the Project are composed of the cost of BBI Unit and that of seed potato growers. BBI Unit pays capital expenditure of 1,565 million Rp to construct a screen-house, an isolated seed farm, etc. at the first and the second years of the project life, and then a certain level of current expenditure is needed annually. There are two types of seed potato growers of which one type produces seed potato (G-3) and another type produces seed potato (G-4) and both of them are organized as one unit

of farmers' group composed of 10 ha of farmland.

Each unit of farmers group, equipped with farm machinery (39 million Rp), irrigation facilities (48 million Rp) and storage (50 million Rp), produces seed potato. 3 units of seed growers (I) are organized in the third year of the project and 6 units in the fourth year of the project. 20 units of seed growers (II) are organized in the third year of the project and 40 units at the fourth year of the project. BBI Unit starts to supply seed potato (G-2) from the third year of the project life, and seed growers (I) (II) start to supply seed potato (G-3, G-4) from the fourth year of the project life.

The increasing effect of potato production by implementing the Project is remarkable and the nominal economic benefit at the eighth year of the project life, when project seed potato spreads all over the project area, is almost the same with the total nominal capital expenditure. But because economic cost and economic benefit at different project years cannot be compared directly, we conduct discounting calculation by using discounting fact of 12% which is equal to the lending rate of agricultural credit, and then net present value of 42,517.5 million Rp is calculated. This fact means that the Project is very profitable and is enough feasible.

Supposing that the farm-gate price keeps at the level of 240Rp/kg, large increase of farm income can be expected. But the increasing effect of potato production by implementing the Project is very large, on the other hand, price elasticity of potato to consumption is small, therefore in case the supply capacity exceeds the potato demand, sharp drop of potato price may happen.

The economic impact of the price drop will spread not only to project area but also to all potato producing areas through market mechanism, and all potato grower may suffer from serious economic losses. Therefore, in the process of implementing the project well-balanced increase of production is needed according to the accurate forecasting on future potato demand.

6.7.2 Analysis of Farm Income

By introducing improved seed potato (ES), yield per hectare will increase by 50%, then increment of potato per hectare is 5 tons and the gross income is 1,200,000Rp (5,000 kg x 240Rp/kg). Additional cost per hectare being 525,000Rp [(750Rp/kg-400Rp/kg) x 1,500 kg] and deducting additional cost from gross income, then net income per hectare of 675,000 Rp can be expected. In case that improved seed potato renewed is not, using it repeatedly and supposing that yield per hectare of ES_1 is 13.5 ton/ha, and that that of ES_2 is 1.3 tons/ha, then the increment of production per hectare (the increment of net income) of ES_1 is 3.5 tons (840,000Rp), and that of ES_2 is 2 ton (480,000Rp). Net profit from ES_1 exceeds that from ES because ES_1 does not need additional cost.

Supplying volume of project seed potato reaches at annual target volume of 6,000 ton at the fifth year of the project life, project seed from the first generation to the third generation spread to whole project area at the eighth year of the project life, and then expected nominal value of annual increment of whole farm income is 7.98 billion Rp. Discounting total expected nominal value of increment of whole farm income through whole project life of 20 years by discounting factor of 12%, which is equal to lending interest rate of agricultural credit, then the present value of 28,665.4 million Rp can be calculated.

6.7.3 Financial Analysis

By implementing the Project large economic effect and income effect can be expected but the main benefit exists in the form of increasing effect of potato production. In the other words, seed growers and consumption potato farmers will enjoy large advantage economically and financially. But for BBI Unit the supply volume of seed potatoes (G-2) is small comparing with the capital investment, therefore the income can cover only the current expenditure and the capital expenditure can not be recovered. But expected NPV of the project is very large and it can be concluded that it is worth implementing although it needs some financial sacrifice.

Table 6.7 Flows of Economic Cost and Economic Benefit

Unit: 1000 Rp

Project year	Economic cost			Economic benefit	Net benefit	NPV (Discounting factor=12%)
	Capital expenditure	Current expenditure	Total			
1	200,000	20,160	220,160		220,160	196,603
2	1,365,000	20,160	1,385,160		1,385,160	1,103,973
3	3,151,000	535,230	3,686,230	67,500	3,618,730	2,576,536
4	6,302,000	535,230	6,837,230	1,405,000	5,432,230	3,454,898
5		535,230	535,230	4,710,080	4,174,850	2,367,140
6		535,230	535,230	7,630,080	7,094,850	3,597,089
7		535,230	535,230	10,510,080	9,974,850	4,508,632
8		535,230	535,230	11,790,000	11,254,770	4,535,672
9		535,230	535,230	11,790,000	11,254,770	4,062,972
10		535,230	535,230	11,790,000	11,254,770	3,624,036
11		535,230	535,230	11,790,000	11,254,770	3,230,119
12		535,230	535,230	11,790,000	11,254,770	2,892,476
13		535,230	535,230	11,790,000	11,254,770	2,597,342
14		535,230	535,230	11,790,000	11,254,770	2,307,228
15		535,230	535,230	11,790,000	11,254,770	2,059,623
16		535,230	535,230	11,790,000	11,254,770	1,834,528
17		535,230	535,230	11,790,000	11,254,770	1,643,196
18		535,230	535,230	11,790,000	11,254,770	1,463,120
19		535,230	535,230	11,790,000	11,254,770	1,305,588
20		535,230	535,230	11,790,000	11,254,770	1,170,496
Total	11,018,000	9,674,460	20,692,460	177,592,740	156,900,280	35,867,247

NPV = 42,517.5 million Rp

Table 6.8 Future Projection of the Increment of Farm Income

Project year	Nominal value (1000Rp)	Discounting factor (12%)	NPV (1000Rp)
1		0.893	
2		0.797	
3		0.712	
4		0.636	
5	900,080	0.567	510,345
6	3,820,080	0.507	1,936,781
7	6,700,080	0.452	3,028,436
8	7,980,000	0.403	3,215,940
9	7,980,000	0.361	2,880,780
10	7,980,000	0.322	2,569,560
11	7,980,000	0.287	2,290,260
12	7,980,000	0.257	2,050,860
13	7,980,000	0.229	1,827,420
14	7,980,000	0.205	1,635,900
15	7,980,000	0.183	1,460,340
16	7,980,000	0.163	1,300,740
17	7,980,000	0.146	1,165,080
18	7,980,000	0.130	1,037,400
19	7,980,000	0.116	925,680
20	7,980,000	0.104	829,920
Total	115,160,240		28,665,442

Table 6.9 Financial Projection of BBI Unit

Unit: 1000 Rp

Project year	Income total	Expenditure			Balance
		Capital expenditure	Current expenditure	Total	
1		200,000	20,160	220,160	220,160
2		1,365,000	20,160	1,385,160	1,385,160
3	67,500		186,930	187,930	127,930
4	202,500		187,930	187,930	14,570
5	202,500		187,930	187,930	14,570
6	202,500		187,930	187,930	14,570
7	202,500		187,930	187,930	14,570
8	202,500		187,930	187,930	14,570
9	202,500		187,930	187,930	14,570
10	202,500		187,930	187,930	14,570
11	202,500		187,930	187,930	14,570
12	202,500		187,930	187,930	14,570
13	202,500		187,930	187,930	14,570
14	202,500		187,930	187,930	14,570
15	202,500		187,930	187,930	14,570
16	202,500		187,930	187,930	14,570
17	202,500		187,930	187,930	14,570
18	202,500		187,930	187,930	14,570
19	202,500		187,930	187,930	14,570
20	202,500		187,930	187,930	14,570
Total	3,510,000	1,565,000	3,423,060	4,988,060	1,485,560

CHAPTER 7 RECOMMENDATIONS

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The following are recommended by the Study Team for promoting smooth and effective implementation of the proposed projects for multiplication and distribution of quality seeds of soybean and potato.

1. It is clearly understandable in this study that the quality seed is a key element and has an important role as a forerunner in production increase of both crops.

   Considering the urgent necessity, the projects should get started as soon as possible by taking necessary processes and further studies to clarify the following fields:

   (1) Potato

      1) Foundation seed farm
         . Isolation from aphids
         . Resource of irrigation water
         . Soil-borne diseases
         . Enhancement of cooperation with seed growers
      2) Roles and functions
         Organizational and operational linkage is made among the below organizations:
         o LEHRI
         o BBI Unit
         o PMDC
         o BUMN
         o Private sector

   (2) Soybean

      1) Detailed practical approaches to organize seed grower groups,
      2) Detailed plan to set up seed processing centers,
      3) Studies on the practical marketing system of soybean seeds
      4) Roles and functions of the related organizations.

2. The proposed projects are designed to play an initiating role in the achievement of effective multiplication and distribution of quality seeds. Therefore, constructive leadership of the Government is indispensable at the initial stage of the project preparation for the undermentioned:

   o Organization and staffing
   o Financial arrangements
   o Administrative coordination
   o Land preparation

   Consideration should also be given to the spontaneous participation of the private sector.

3. Lack of willingness to use quality seeds on the part of farmers is a factor hampering effective development of the seed projects. Such negative factors should be gradually improved.

   Six plans are proposed as the priority projects for soybean seeds. These are supplemental to each other, however, there are technical difficulties in implementating these at a time. In this background, the Study Team contemplate that full marketing research is necessary to grasp exact demand, and in addition to this, that possible demand for quality seeds is to be exploited. It is recommendable to include quality seeds in production enhancement projects such as BIMAS or INMUS and to adopt them as a part of the extension programme.

4. This plan for multiplication and distribution of quality seeds is only one of the pillars of the production enhancement projects for both crops. Broad-ranging plans should be accomplished, such as strengthening of crop protection, providing a proper system of irrigation, improving postharvest treatment and processing, providing regional application trial and demonstration of agriculture technology, and expansion of agricultural mechanization as successfully implemented in the case of rice.