BASIC DESIGN STUDY REPORT
ON
THE CONSTRUCTION PROJECT OF THE SEED BANK
IN
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

DECEMBER 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

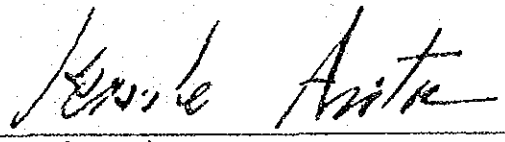
In response to the request of the Government of the Socialist Republic of the Union of Burma, the Government of Japan has decided to conduct a basic design study on the Construction Project of the Seed Bank and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Burma a study team headed by Dr. Masahiro NAKAGAWARA, Chief, Ecological Genetics Laboratory, National Institute of Agro-biological Resources, Ministry of Agriculture, Forestry & Fisheries from July 27 to August 19, 1986.

The team had discussions on the Project with the officials concerned of the Government of the Socialist Republic of the Union of Burma and conducted a field survey in Yezin area. After the team returned to Japan, further studies were made, a draft report was prepared and, for the explanation and discussion of it, a mission headed by Mr. Noriaki NIWA, Official, First Basic Design Study Division, Grant Aid Planning & Survey Department, Japan International Cooperation Agency was sent to Burma from November 5 to November 14, 1986. As a result, the present report has been prepared.

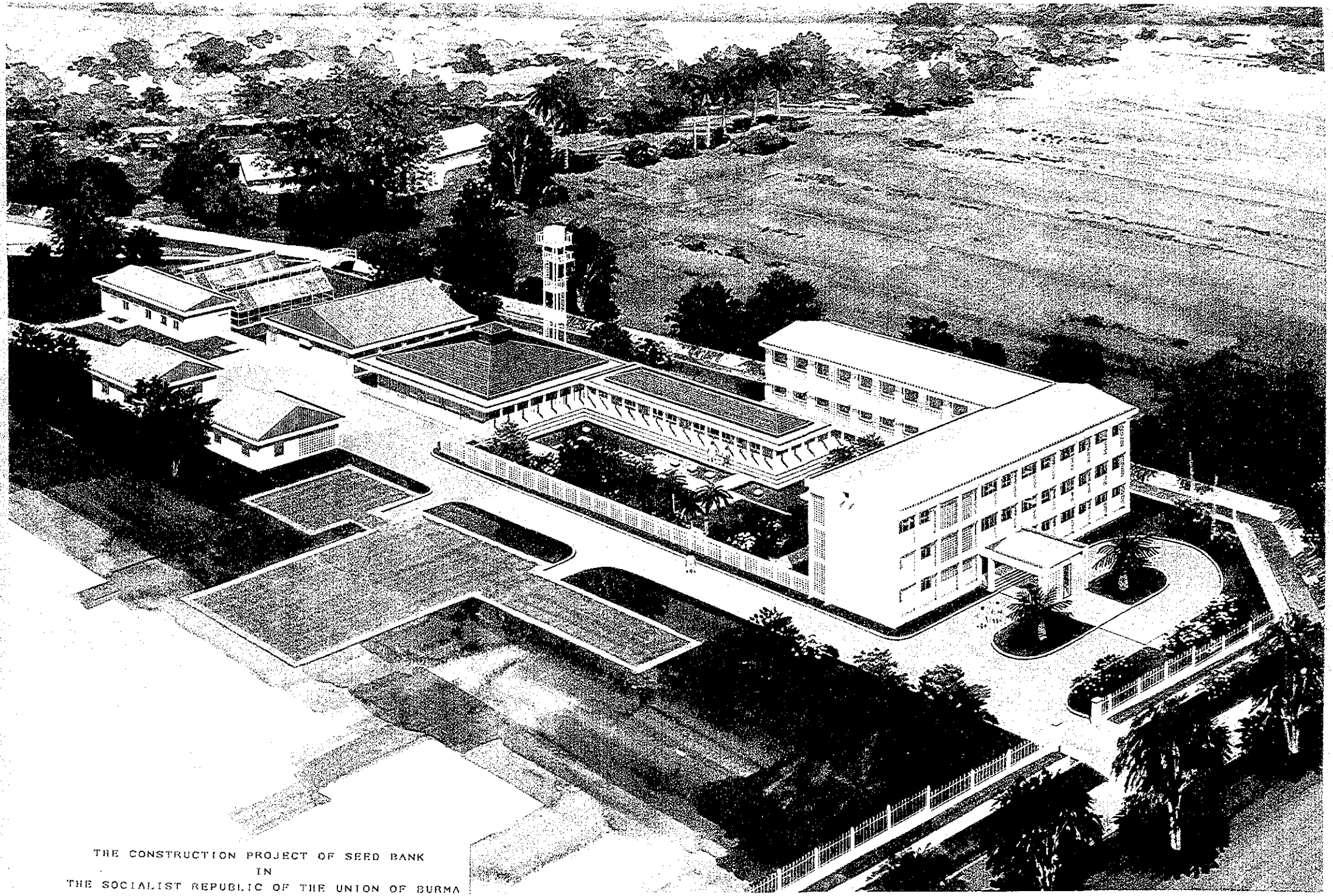
I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Socialist Republic of the Union of Burma for their close cooperation extended to the team.

December, 1986.



Keisuke Arita
President
Japan International Cooperation Agency



THE CONSTRUCTION PROJECT OF SEED BANK
IN
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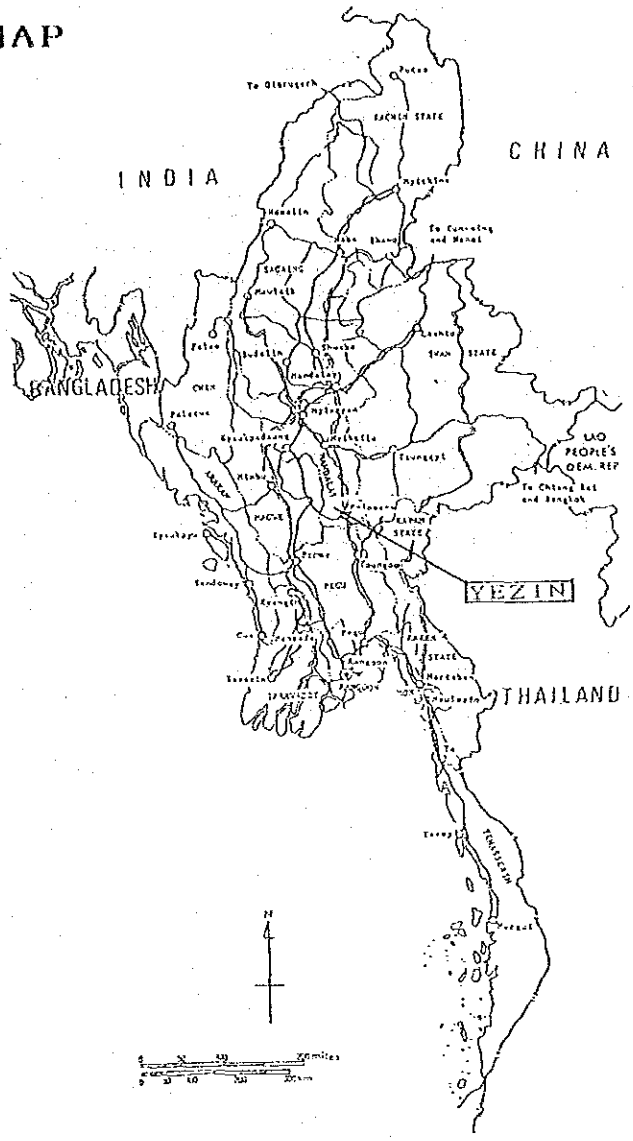
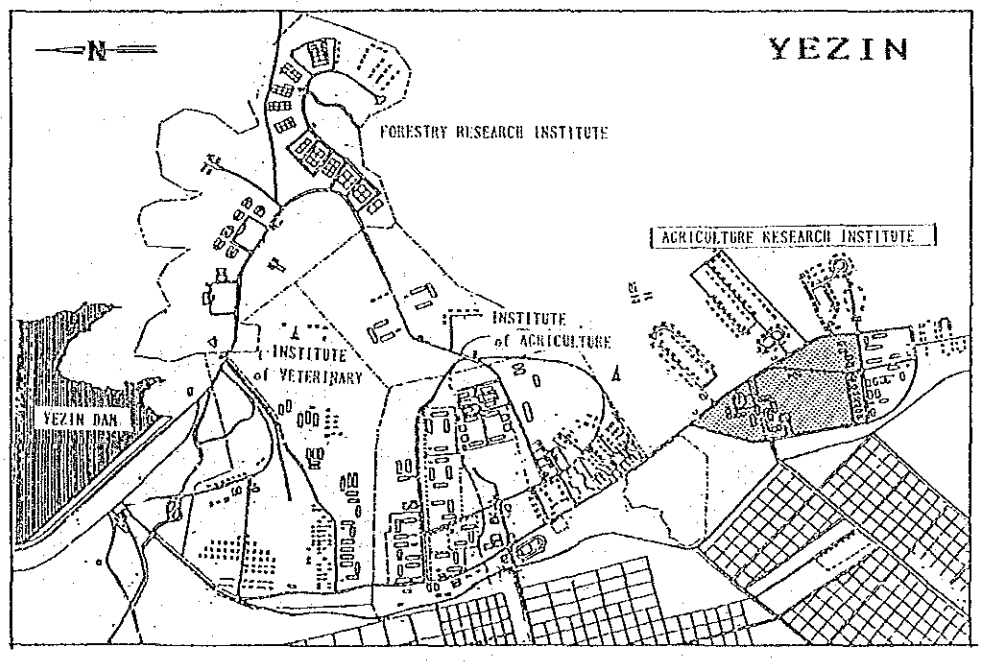
LOCATION MAP





SUMMARY

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Agriculture plays a major role in the economy of the Socialist Republic of the Union of Burma. Since independence the Government of the Socialist Republic of the Union of Burma (hereinafter referred to as the Government of Burma) has been making strenuous effort to enhance agricultural production. The government's program for increased production of rice and other crops in Burma got on the right track in the early 1970s. Especially, after the late 1970s, a remarkable increase in production was brought by the introduction and dissemination of HYV (High Yielding Varieties). This rapid growth in production, however, was accompanied by the decrease in indigenous (local) varieties because they were replaced by HYV in many areas.

This trend became more evident in the early 1980s. The Agricultural Research Institute (ARI) in Yezin, in recognition of the importance of preserving genetic resources of major crops, set about a task to prevent their extinction. Preservation of genetic resources is important because they provide gene base indispensable for the evolution of improved varieties. During the first few years, genetic crop species were maintained and preserved through reproduction in the fields. In the recent years, however, the situation has become more urgent because there is a rapid increase in the number of genetic crop species to be preserved and that they must be promptly collected through exploration. It has therefore become necessary to establish a system to ensure stable and labor-saving preservation of genetic resources. In other words, the preservation method needs to be changed from labor-requiring and often erroneous "line reproduction" to "facility preservation" which enables a long-term artificial preservation of genetic crop species.

In terms of genetic resources, Burma is one of the most prominent countries in the world. It has been revealed that various kinds of crop species such as rice, tea, pulse crop have their nucli of genetic diversities in Burma and its adjacent areas. This indicates that the country abounds in valuable genetic resources with a wide range of diversities.

Under the circumstances described above, the Government of Burma is implementing, as part of its Fifth Four-Year Development Plan, a program to enhance agricultural production. The major components of this program include improved seed production, method cultivation and prevention of pests and diseases; namely, promotion of seed breeding. Particularly important in this connection are collection, preservation and evaluation of genetic resources.

In line with the above policy, the Government of Burma has formulated the Seed Bank Project as one of its top priority projects in the 1986-1990 Five-Year Development Plan, and requested the Japanese government to provide a grant aid for the construction of the facilities and equipment to be installed therein.

As the result of consideration of conceptions, activities of the Seed Bank are as follows:

a) Exploration and collection of seed crop genetic resources originated in Burma and studies related to it.

b) Categorization and evaluation of collected genetic resources and related studies.

c) Studies regarding rejuvenation, multiplication and preservation methods for the genetic resources to be preserved.

d) Preservation of genetic resources in safe conditions for short and medium terms and conducting germination tests.

e) Promotion of effective utilization of genetic resources through systematic data processing, recording and other activities.

f) Conducting quarantine inspection, isolation and sterilization for the introduced exotic species.

g) Serving as a center of national and international exchange of genetic resources and related information.

h) Offering training to the technical staff of related organizations in Burma in the field of genetic resources.

i) Conducting basic study of genetic resources related to the activities described above and establishment of support system.

The Agriculture Corporation under the Ministry of Agriculture and Forests is the executing agency of this project and is responsible for the budgeting, staffing and other measures required. The status of the Seed Bank institution in the organization setups of ARI will be abreast of the 13 divisions ranked directly under the director and function as a national center of genetic resources.

The staff involved in this project will be 60 in total: one(1) project manager, three(3) division chiefs, three(3) assistant chiefs, 13 senior researchers, 13 inspectors and 16 administrative staff. The capacity of the genetic seed storage will be about 50,000 items.

The proposed project site is on the premises of the Agricultural Research Institute in Yezin. Yezin is located 15 km northeast of Pyinmana City, Mandalay Division, 400 km north of Rangoon.

The facilities to be constructed with Japan's grant aid for satisfying the aforementioned functions of the Seed Bank include:

1) Seed Bank and information buildings - - - most important facilities in this project dealing with seed preservation, distribution and data management.

2) Administration, research and training building - - - a facility provided with functions for research, training and administration concerning genetic resources.

3) Net House facilities - - - to be used for isolation and sterilization of introduced genetic resources.

4) Garage facilities - - - to accommodate vehicles used for exploration and collection of genetic resources.

5) Others (Stand-by generator building, etc.)

6) Accommodations for lecturers and researchers.

The facilities and equipment to be provided under the grant aid program are outlined below.

Facility	1st Floor	2nd Floor	3rd Floor	Total
Administration, Training and Research Building	863	825	825	2,513 m²
Information Section	338			338 m²
Seed Bank	563			563 m²
ARI Divisions' Section	473			473 m²
Net House	536			536 m²
Garage and Workshop	144			144 m²
Stand-by Generator Building	144			144 m²
Accommodations	484	202		686 m²
Total	3,545	1,027	825	5,397 m²

Equipment: Seed Bank equipment
Information Section equipment
Laboratory equipment
Training equipment
Laboratory office equipment
Vehicles
Work shop and stand-by generator equipment
Additional facilities equipment

The Agriculture Corporation is in charge of executing the project from planning to the completion of the construction work. The construction will take 21 months after the signing of Exchange of Notes (E/N); six(6) months for detail design and tender-related procedures and 15 months for the construction work.

The cost of Burmese responsibility is estimated to be K750,000 (¥17,355,000), including such undertakings as site preparation, replacement of drain ditches and landscaping. Annual maintenance and administration expenses are estimated to be K1,168,000(Kyat), which is within the budget appropriated by the Government of Burma.

The foundation of the Seed Bank along with establishment of a research system for genetic resources will make it possible for the Burmese researchers to develop new improved varieties on their own and thus contribute to increased agricultural production. In a word, it will form the basis of the future agricultural development in Burma. Furthermore, it may contribute to the worldwide progress in seed breeding as a provider of diverse genetic resources.

In view of the reliable technology and strong determination on the part of the Burmese side, and the project-type technical cooperation intended by the Japanese side, it is anticipated that the project will produce satisfactory results in a relatively short period. In this context it is of great signficance for the project to be implemented under Japanese grant aid.

For the smooth implementation of the construction work, it is desired that the Burmese side provide unstinting cooperation in such matters as site preparation, document procedures, tax exemption and customs clearance for construction materials and equipment. It is also necessary to strengthen the operational system in accordance with the staff program.

The Seed Bank is expected to produce still greater effects through amplified functions when the project-type technical cooperation in the form of expert dispatch, equipment supply and acceptance of trainees is carried out providing assistance regarding operation of the Seed Bank, planning and execution of training programs and research activities.

CONTENTS

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

The Government of Burma has been implementing, in recent years, a program for increased rice production through variety improvement. Due to the dissemination of HYV, however, valuable genetic resources are now faced with a crisis of extinction. To cope with this problem, the government has formulated a Seed Bank Project which aims at enhancing effective breeding through collection, evaluation and preservation of genetic resources of rice and other crop species, and has requested the Japanese Government to extend technical and grant aid cooperation.

The Japan International Cooperation Agency (JICA) sent to Burma a preliminary study team headed by Masahiro Nakagawara, Chief, Ecological Genetics Laboratory, National Institute of Agrobiological Resources, Ministry of Agriculture, Forestry and Fisheries, for 14 days from May 18 to May 30, 1986 for the purpose of conducting a contact survey for the technical cooperation and a preliminary study for the grant aid cooperation.

The preliminary study team, through discussions with the concerned officials of the Government of Burma, agreed upon such basic items as the objectives, contents, proposed site and implementation agency of the project.

Based on the results of the preliminary study, the Government of Japan sent, through JICA, a Basic Design Study Team, with the above Mr. Nakagawara as the team leader for 24 days from July 27 to August 19, 1986. The team conducted a basic design study in connection with the grant aid cooperation for the Seed Bank Construction Project. The list of the study team members and the study schedule are given in the appendix.

The Basic Design Study Team, in due consideration of the preliminary study results, exchanged opinions with concerned officials of the Burmese government regarding the contents and scales of facilities and equipment necessary and appropriate for the implementation of the project. Furthermore, the team conducted field surveys in Yezin and Rangoon. As a result, elaboration was made in various aspects of the project including site alteration.

Minutes of discussions were then signed and exchanged by the representatives of both sides. The contents of the minutes are shown in the appendix.

This Basic Design Study Report has been prepared on the basis of the results of discussions with the Burmese side and analysis of data collected through field surveys. It compiles the background, objectives, most appropriate basic design, implementation system and results of evaluation of the Construction Project of the Seed Bank.

CHAPTER 2 PROJECT BACKGROUND

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2-1 General Conditions

(1) Natural Conditions

Burma is situated between latitudes of 9°58' and 28°31 'N and longitudes of 92°9' and 101°10'E, and covers a total area of 680,000km^2. Mountainous areas extend in the east, west and north, while the Andaman Sea and the Bay of Bengal bound the country on the south.

The Tropic of Cancer runs through about two-thirds of the country dividing it into two climatic regions; the tropical south and the temperate zone. Topographically Burma is comprised of forest-covered mountainous areas, valleys and hilly areas, and plain regions. The north is bounded by mountains which range in elevation 900-1000m. Gradient decreases from north to south and rivers therefore flow in a north-south direction.

There are four major rivers; the Irawadi, Chindwin, Sittang and Salween rivers. The delta formed by the first three rivers comprises the principal cultivated area in Burma. In contrast, there is little cultivation along the Salween River, even in the river valleys. The Irawadi delta extends 80-320km inland. Crisscrossed by a network of rivulets, it is the major rice producing area in Burma.

Limited rainfall of 630-2,000mm falls in the region near the confluence of the Irawadi and Chindwin rivers and a wide variety of crops are grown. This is the only irrigated area in Burma.

The climate is divided into the dry season from mid-October to mid-May and the rainy season for the rest of the year. The coldest period occurs in the middle of the dry season from December to February. Maximum temperatures in central Burma climb to as high as 40-45°C and the temperature in this area rarely falls below 10-15°C throughout the year.

The majority of rainfall is carried by the southwesterly monsoon and maximum annual rainfall occurs in July. The maximum recorded rainfall is for Kachin State at 2,500-5,100mm. Average annual rainfall for the entire country is about 1,000-2,000mm.

(2) Socio-Economic Conditions

Burma is a multi-ethnic country. Burmese constitute the largest single ethnic group comprising 60% of the population. They pursue agriculture primarily in the central and southern part of the country. Other ethnic groups include the Shan in northern Burma, the Karen in the highlands of the south and the Kachin of the northern highlands.

Total population of the country is 37.1 million. Although population growth rate has tapered off somewhat in recent years, it still remains at a high 2% per annum. (See Table 2-1)

Table 2-1 Estimates on Population Growth

Year	Population (1,000)	Annual Growth (%)
1979/80	32,939	2.03
1980/81	33,608	2.02
1981/82	34,287	2.01
1982/83	34,976	2.01
1983/84	35,680	2.01
1984/85	36,392	2.00
1985/86	37,115	1.99

Source: Report to the Pyithu Hluttaw on the Financial, Economic and Social Conditions of the Socialist Republic of the Union of Burma for 1986/87

Birth, mortality and infant mortality rates in 1985 were 28.7, 8.7 and 44.7 persons/1,000 respectively. Average life expectancy in 1983 was 64.7 years.

GDP for 1985/86 is projected at 20.7 billion kyat. Per capita GDP is 557 kyat (approximately US$74), representing a 4.1% increase over the previous year. On a sector wise basis agriculture accounts for 37% of GDP, commerce for 26%, industry for 10%, and transportation for 5%. The labor population in the agricultural sector accounts for 66% of the total national labor force, underscoring the importance of this sector to the national economy.

Burma's trade balance of payments is one of chronic excess importation. In 1984/85, there was a 2 billion kyats surplus of imports over exports. As indicated in the table below, agricultural products account for approximately half of major export items.

Table-2-2 Economic Indicators

Year	GDP		% of GDP Contributed by Agricultural Sector	Trade (Million Kyat)		% of Exports Comprised by Agricultural Products
	Total (Million kyat)	Annual Increase (%)		Export	Import	
1981/82	16,717	-	38	3,453	5,611	57
1982/83	17,654	5.6	38	3,036	6,314	52
1983/84	18,429	4.4	38	3,420	5,197	53
1984/85	19,464	5.6	38	3,195	5,207	44
1985/86	20,675	3.5	37	3,234	4,730	N.A

Source: Report to the Pyithu Hluttaw on the Financial, Economic and Social Conditions of the Socialist Republic of the Union of Burma for 1986/87

N.A. Not analysed.

Rice exports in 1983/84 were 1.31 million tons, and 900,000 tons in 1984/85. Exports of 1.06 million tons are anticipated in 1985/86. Rice consequently constitutes a major component of agricultural exports.

2-2 Agricultural Sector

Burma is traditionally an agricultural nation. The agricultural sector is accordingly one of the key industries supporting the Burmese economy. Under the Fifth Four Year Plan, expansion of agricultural production is a high priority goal.

(1) Land use

Out of a total land area of 680,000 km^2 in Burma, 83,000 km^2 or 12% is cultivated area. For the past 5 years, cultivated area has remained the same with almost no new development of agricultural land.

Projections for 1985/86 indicate that out of 8.42 million ha. of cultivable land, 2.19 million ha. is multi-cropped for a total cropped area of 10.61 million ha. Land use ratio has shown an increasing trend over the past years with an increase in multiple-cropping area (see following table).

Table 2-3 Land Cultivation

Unit(10,000 ha)

Year	Area Sown	Multiple Cropping Area	Net Area Sown	Crop Intensity (%)
1981/82	1,016.7	175.4	841.3	121
1982/83	991.0	168.0	823.0	120
1983/84	1,015.7	188.8	828.9	123
1984/85	1,051.5	215.6	835.9	126
1985/86	1,061.1	218.8	842.3	126

Source: Report to the Pyithu Hluttaw on the Financial, Economic and Social Conditions of the Socialist Republic of the Union of Burma for 1986/87

Rice accounts for the most cultivated area at 4.92 million hectares (47%). Next is sesame at 1.50 million hectares (14%) and peanuts at 650,000 hectares (6%) as shown in Table 2-4. Whereas the expansion of cultivated area for rice has topped out, cropped areas for sesame, beans, maize, wheat, etc. have shown marked increase. Diversification of vegetable production in general is advancing.

The four basic cropping patterns outlined below are currently practised in Burma.

1) Cropping before the monsoon in paddy areas (jute or cotton)

2) Cropping after the paddy harvest (groundnuts, sunflower, and pulse)

3) Double cropping in dryland areas, with or without irrigation depending on the crop (sesame, pulse, corn, etc.)

4) Mixed culture cropping where two crop types with different growing periods are planted in the same field (sesame and chick peas, groundnuts and corn, etc.)

The total area cropped according to the above four methods is 1.9 million hectares, 46% of which employs cropping pattern 3) and 31% of which employs cropping pattern 2). Of the total cultivated area of about 10 million hectares, only 12% is irrigated. Accordingly, expansion of the irrigated area is urgently required.

Table 2-4 Land Utilization for Each Crop

Unit: 1,000 ha

Crops	1981/82	1982/83	1983/84	1984/85 (Provi-sional actual)	1985/86 Provi-sional)
Paddy	5,103	4,882	4,831	4,601	4,887
Wheat	104	111	143	131	140
Maize	154	171	208	229	241
Matpe	87	76	91	92	101
Pedisein	47	42	47	61	74
Butter bean	60	64	79	90	96
Sultapya	50	48	50	41	32
Soya bean	28	29	28	30	28
Gram	215	162	220	199	276
Pesingon	76	70	64	81	83
Other pulses	297	277	297	291	273
Groundnut	598	571	560	647	646
Sesame	1,370	1,377	1,337	1,501	1,484
Sunflower	104	110	140	765	197
Cotton	226	217	227	250	230
Jute	49	68	67	66	61
Rubber	81	80	79	79	78
Sugarcane	110	116	112	129	136
Burmese tobacco	48	43	49	53	52
Virginia tobacco	9	11	10	10	14
Other crops	1,354	1,384	1,515	1,463	1,481
Total	10,167	9,910	10,157	10,515	10,611

(2) Agricultural Production

As shown in the share of land utilization, the primary crop in Burma is rice. Main crops in Burma are i) rice, upland rice, wheat and corn among the cereal grains; ii) groundnuts, sesame and sunflower among the oil crops; iii) jute, cotton and sweet potato among the industrial crops; and chick peas, lima beans, pigeon peas, and green grams among the pulse crops.

One of the major objectives of Burma since its establishment as a socialist nation, has been self-sufficient agricultural production. Production of rice progressed markedly after 1970. This was largely due to the introduction and extension of high yield varieties in the latter half of the 1970s. Increased production occurred not only in rice but also for other crops as well. Rice yield increased in the 1980s, despite a slight decrease in total harvested area, and total volume of unhulled rice increased sharply to twice the production volume for the 1960s (14 million tons). At 3t/ha, unit yield is one of the highest throughout Southeast Asia. The growth trend at present, however, seems to be slowing down. (See Table 2-5)

Table 2-5 Trend of Cultivated Area, Yield and Production of Rice

Year	Cultivated Area		Average Yield		Total Production	
	1,000 ha	Increase Ratio(%)	Ton/ha	Increase Ratio(%)	1,000 ton	Increase Ratio(%)
1960/61	4,216.1	-	1.68	-	6,754	-
1964/65	5,108.8	21.2	1.71	1.8	8,373	24.0
1969/70	4,954.6	-3.0	1.71	-	7,858	-6.2
1974/75	5,177.2	4.5	1.76	2.8	8,448	75
1979/80	5,025.8	-2.9	2.35	33.9	10,283	21.7
1980/81	5,126.2	2.0	2.76	17.3	13,107	27.5
1981/82	5,103.1	-0.5	2.94	6.7	13,923	6.2
1982/83	4,882.2	-4.3	3.15	7.1	14,146	1.6
1983/84	4,831.2	-1.0	3.07	-2.7	14,062	0.6
1984/85	4,601.3	-4.8	3.10	1.1	14,255	1.4

Source: Agriculture Corporation

Sixty-five percent of rice is cultivated in rainfed paddy fields and only about 17% is irrigated. The yield of both rainfed and irrigated paddy increased. In addition, there are some salt affected paddy fields (5%) and deep water paddy fields (10%) and appropriate rice varieties have been introduced to these areas. By cropping period, 45% of total rice production is comprised of the early maturing variety (Kaukyin), 40% is comprised of the medium maturing variety (Kauklat) and 13% of the late maturing variety (Kaukkyi). The early and medium maturing varieties clearly account for the majority of production.

Production amounts for major crops other than rice are indicated in Table 2-6. In recent years wheat, corn, sunflower, etc. have exhibited an increasing trend in production amount.

Table 2-6 Production of Crops (Except Rice)

Unit: 1,000 ton

	1981/82	1982/83	1983/84	1984/85	1985/86 (Provisional)
Wheat	124	130	214	206	234
Maize	206	239	309	303	378
Matpe	60	54	86	78	91
Pedisein	15	18	22	30	41
Butter bean	74	78	95	113	125
Sultapya	29	29	34	29	23
Soy bean	19	20	22	23	22
Gram	155	126	173	138	234
Pesingon	41	34	38	49	53
Ground nut	573	550	532	667	651
Sesame	180	198	207	253	269
Sunflower	71	71	114	141	186
Cotton	96	99	104	126	112
Jute	34	64	55	52	50
Rubber	16	17	16	16	16
Sugarcane	2,736	3,719	3,662	3,767	3,786
Burmese tabacco	47	53	58	63	66
Virginia tabacco	30	36	44	41	68

Source: Report to the Pyithu Hluttaw on the Financial, Economic and Social Conditions of the Socialist Republic of the Union of Burma for 1986/87

(3) Land holding patterns

Under the policies of the Burma Socialist Program Party, all cultivated land is owned by the state, with cultivation rights being granted to the individual farmers who work the land. Average cultivated tracts granted to individual farmers are generally small.

As indicated in the table below, 85% of all farm households cultivate 4 ha. or less and account for 56% of all cultivated land. Twelve percent of all farm households cultivate 4 - 8 ha, and 3% farm 8 - 15 ha.

As discussed above, Burma is a socialist nation in which private ownership of land is not permitted. Crops to be raised on a given tract of land are determined by government policy. Transfer of cultivation rights from one farmer to another is not possible without official permission. Where a farmer has relinquished his cultivation rights to a certain piece of land, transfer of that right to another individual is determined by the Village Land Committee.

Table 2-7 Distribution of Farm Size Holdings in Burma

Size of Holding	No. of Farmers (thousands)	Per Cent of Farmers	Total Hectarage (thousands)	Per Cent of Total
Below 2 ha	2,620	61.1	2,446.8	25.0
2 to 4 ha	1,051	24.5	3,046.2	31.0
4 to 8 ha	503	11.7	2,839.4	29.0
8 to 20 ha	112	2.6	1,231.1	12.6
20 to 40 ha	2	-	53.8	0.5
above 40 ha	1	-	181.3	1.9
Total	4,289	100.0	9,798.6	100.0

Source: Notes on Agriculture in Burma, MAF, January 1984.

2-3 Economic Development Planning

(1) Long-term economic development planning

Economic development in Burma has been pursued with a high degree of reliance on agriculture and agriculture related sectors. This formula comprises the principal element of the New 20 Year Plan announced in 1974. Priorities in the said plan are as follows (in descending order of priority):

1) Agricultural and forestry development and expansion of exports from this sector

2) Development of manufacture of domestic alternatives to imports

3) Development of heavy industry centered on utilization of domestic mineral resources

Phased attainment of the highly privatized agricultural development goals of the NEW 20 Year Plan is the objective of the Four Year Plans.

The Second Four Year Plan (1974/75 - 1977/78) achieved an average economic growth rate of 4.7%, while the Third Four Year Plan achieved a rate of 6.5%. The Fourth Four Year Plan (1982/83 - 85/86) is projected to produce a growth rate of 5.5%, which represents 98.9% of the targeted level under the Plan.

(2) Fifth Four Year Plan (1986/87 - 1989/1990)

Implementation of the Fifth Four Year Plan by the Government of Burma is to commence this year with an objective to achieve the remaining goals of the 20 Year Plan. In the subject Four Year Plan, expansion of agricultural production remains the central component. The GDP goal for the first year of the Plan is 21.9 billion kyat, which represents a 3.6% increase over the previous year. Industries contributing to the GDP have been divided into 13 sectors under the plan, with the agricultural sector targeted for a 2.2% growth in production over the previous year, or a product of 6.05 billion kyat.

Target for each sector is shown below.

Table 2-8 Target for Fifth Four Year Plan

Sectors	Target (Million Kyat)	Annual Increase Rate (%)
(1) Agriculture	6,047.8	2.2
(2) Livestock and Fishery	1,488.7	4.6
(3) Forestry	462.7	2.8
(4) Mining	361.9	5.3
(5) Processing and Manufacturing	2,457.3	5.1
(6) Power	396.0	6.1
(7) Construction	562.0	0
(8) Transportation	1,145.8	6.7
(9) Communications	172.1	13.3
(10) Financial Institutions	845.3	4.9
(11) Social and Administrative	2,285.7	4.1
(12) Rentals and Other Services	1,178.1	3.0
(13) Trade	4,457.9	3.6
	21,861.3	3.6

(3) Agricultural development planning

Specific policies for expansion of agricultural production under the Fifth Four Year Plan are given below:

1) Increase in agricultural production through expansion of intensive agriculture.

2) Expansion of production of industrial crops and development of related industries.

3) Production of crops suited to regional features (meteorology, local industries, etc.)

4) Vitalization of agricultural and production cooperatives and state agricultural production organizations.

5) Production expansion in the livestock husbandry sector

6) Development of new agricultural land

7) Expanded use of agricultural inputs (fertilizers, agro-chemicals, etc.) to increase yield per unit area.

8) Stabilization of agricultural production through irrigation and flood control.

9) Expanded production of improved seeds and vitalization of agricultural research.

These policies aim at increasing rice production as well as other agricultural products as alternatives to rice for export. With the drop in the world price for rice, improvement of Burma's worsening balance of payment status has become an important goal.

In the subject Fifth Four Year Plan, significant increase in agricultural production, centering on rice, is the central component in order to meet domestic needs through population increase as well as to obtain foreign exchange. In order to achieve agricultural production targets, the said plan places major emphasis on agricultural modernization.

In regards to vitalization of agricultural research, the plan sets out the following specific policies as a means of expanding agricultural production:

1) Expanded production of improved varieties
2) Method cultivation
3) Pest control

In order to realize the above, the government is moving forward with specific research and development programs. Plant breeding bears close relevance to this research, and in this context the subject Seed Bank Project has been incorporated within the Government's research and development planning.

2-4 Foreign Assistance Regarding Plant Genetic Resources

In recent years, Burma has actively sought and received assistance from Japan, the U.S., West Germany, Sweden, the World Bank, etc. on various development projects. Among these, projects similar in nature to the subject project are outlined below:

1) Burma Agriculture Research and Development Project (BARD)
Through USAID, the United States implemented the Maize and Oil seed Production Project (MOPP) from 1981 to 1986. Project cost was US$30 million. The project provided for provision of fertilizer and other agricultural inputs, training program and assignment of technical experts, and is contributing to expansion of maize and oil seed production. Subsequent to completion of the aforementioned project, USAID continued with formulation and implementation of the BARD project to further promote expanded production of maize and oil seed. Project cost is US$11.3 million and project components include a training program, construction of facilities and provision of equipment and materials. Project features are seed production and extension of improved varieties for corn and oil seed. In contrast to the subject Seed Bank Project, this project places primary emphasis on expanded seed production and extension at the farm level.

2) Food Crop Development Project (FCDP)
This is a UNDP project being implemented through FAO. Project implementation period is 3 years commencing in July 1984. Project cost is US$950,000. The project focuses on beans and grains, with the principal aim of study and extension of improved varieties and cultivation methods in various regions of the country, as well as training of researchers in seed experimentation and breeding.

3) Burma - IRRI Farming System Project

This project is being implemented under a CIDA grant. Project cost is US$3 million. The project focuses on improved yield through combined cultivation of rice with other crops. Other aims are increased agricultural production efficiency, training of researchers, and assessment of appropriateness of improved varieties developed by IRRI for cultivation in Burma as well as necessary modifications of cultivation methods to realize such. At present, the project covers only personnel costs for dispatch of experts.

4) Seed Development Project

This project is being implemented by the World Bank as a 7 year program beginning in 1978 and focuses on seed production and distribution for rice, cotton, and peanuts. The project also includes study of feasibility for plant breeding farm development, and peanut storage facilities in southern Burma.

In addition to the above, the Seed Development Project - Phase II (World Bank), Oilseed Processing Project (ADB), etc. are also in progress. Such projects are aimed at seed production, extension and research at the farm level. The subject Seed Bank Project places emphasis in contrast on seed storage, and information dissemination and research on stored seeds. The subject project accordingly is not redundant in terms of focus with the projects discussed above.

2-5 Project Background

2-5-1 Background of the Request of the Project

Rice production increased greatly during the latter half of the 1970s under the government agricultural development policy, mainly due to the introduction and extension of high yield varieties. This success was also a result of the Whole Township Extension Program begun in 1975/76 under which agricultural extension workers disseminated appropriate technology and techniques for use of high yield varieties, etc. to the individual farmers.

With the introduction and extension of the high yield varieties in areas which produced traditional local varieties (folk varieties and land varieties) the local varieties have quickly disappeared. This is particularly true of areas under the Whole Township Extension Program where extension workers brought new varieties directly to the farmers. This trend became steadily more pronounced in the early 1980s.

In response, the Agriculture Corporation and Agricultural Research Institute began to turn their attention to the preservation of local varieties of staple crops as a genetic resource to be utilized in future quality improvement programs. At first their efforts were directed mainly at maintaining certain strains in specified fields by yearly rejuvenation.

However, the urgency of this work increased due to the need for increased quality improvement and investigations which revealed that collection of disappearing strains must be accelerated.

Accordingly, establishment of an efficient system for preservation and stabilization of genetic resources became a prime focus. The existing approach which concentrated on maintenance of local strains in existing fields required extensive labor and harbored the risk of losing an entire crop due to adverse weather conditions, etc. It was therefore, essential to place the emphasis on artificial long term preservation through the development of improved storage facilities.

The climate of Burma varies widely depending on elevation and latitude, ranging from tropical and subtropical regions to subartic zones. Rainfall also varies widely from region to region with heavy rainfall in south and central Burma and scanty rainfall in the northern mountainous region.

The area along the border with China is referred to as the origin of rice production and is famed for the variety of wild species found there. Accordingly, wild species and local varieties are expected to be abundantly available in this area and can be preserved as genetic resources.

Many seed species appropriate to specific areas have developed in Burma over centuries of cultivation. Farmers selectively cultivated superior strains and other strains developed through natural variation. Traditionally cultivated crops include folk varieties, land varieties, etc. In this way, local varieties were gradually developed which were specifically suited to a certain area. As these strains have accumulated abundant superior genes, they offer a valuable genetic resource for crop improvement. Recently, however, the extension and mono-culture cultivation of improved varieties in response to population increase has accelerated and as a result, the existing local strains have greatly decreased. If this trend continues unchecked, these local varieties will disappear in the near future.

Allied wild varieties have an important role in the improvement of crop varieties. If these existing wild varieties become extinct due to monoculture practices and expansion of area cultivated for a single variety, the genetic resources required to respond to future variations in crop diseases and insects as well as to changes in the natural environment will no longer be available.

There are many varieties which have not yet even been discovered, as botanical research in this regard is insufficient. The first important step in genetic resource preservation therefore, is urgent implementation of an inventory study of known and potential undiscovered strains, in addition to the study of preservation methods.

Genes are the basic material utilized in plant breeding and therefore information on genetic characteristics should be collected and studied. If plants which contain useful genes are regarded as resources, the awareness of the necessity to preserve such plant species will greatly increase.

Preservation of genetic resources is receiving much greater attention internationally, in such international agencies as FAO, the International Board of Plant and Genetic Resources (IBPGR) and United Nations Environmental Program (UNEP), and in the developed countries of the west. Since the oil crisis, the subject of conservation of world resources has been a vital part of every nation's policy, including preservation of plant resources which are the basis of their food supply. The recombination of genes has recently become possible with the development of biotechnology, and constructive efforts towards preservation and use of domestic plant resources are increasing. Establishment of gene banks is also increasing worldwide. In this context, the government's plan of Burma

to establish systematic preservation of genetic resources is a very timely step.

About 14,000 species (total for all crops) of seeds are being maintained in Burma at present. In addition, the number of varieties introduced by international research agencies is increasing yearly. For this reason, labor and cost for rejuvenation and preservation have been increasing apace, taking precedence over research for seed improvement. Accordingly, the establishment of a long-term genetic resource preservation system is urgently required for continued healthy development of the agriculture sector of Burma.

Within the context of the above discussed background, the Government of Burma has incorporated planning for establishment of a center for plant genetic resources preservation and research. Such facilities would serve as an important component in strategy to expand agricultural production as targetted by the Fifth Four Year Plan. The envisaged facilities would be intended to promote meaningful exchange of information and application of genetic resources not only domestically but at the international level as well.

2-5-2 Present Conditions of Agricultural Research

(1) Research Institutes

The Agriculture Corporation (hereinafter referred to as AC) is comprised of 8 sections, of which the Agricultural Research Institute (ARI), the Applied Research Department (ARD), and the Agricultural Extension Department (AED) are closely involved in agricultural research. (See Fig. 2-1).

1) ARI

The ARI is located in Yezin (about 400 km north of Rangoon). Yezin is situated in central Burma where the northern edge of the alluvial delta joins the hilly upland field area. Accordingly, both lowland paddy and upland dry field cultivation is possible at this site. Yezin is also located at the center of the farm belt and is therefore representative of typical Burmese farmland. The Government of Burma is concentrating numerous agricultural research agencies in Yezin, regarding it as an agricultural research center. In addition to the ARI, such facilities as the Agriculture University, the Forestry Research Institute and the Forestry University are all located here.

The ARI is the center of agricultural research in Burma. Basic research is conducted for each crop variety particularly concerning plant breeding and physiology and ecology, as well as study of such fields as cropping system, improvement of farm implements, pest control, and applied research. Crops cultivated at the ARI range from hybrids to third filial generation, while those below forth filial generation are developed at the central ARD agricultural laboratory where varieties appropriate for each area are selected.

ARI consists of the following 7 crop research divisions and 6 disciplinary divisions, with research content as outlined hereunder.

Crop Divisions

- Rice
- Maize and other cereals
- Oil seed crops
- Fibre crops
- Food legumes
- Sugar crops
- Horticulture

Disciplinary Divisions

- Agronomy
- Botany
- Chemistry
- Entomology
- Plant pathology
- Agricultural Engineering

Research Content

. Germplasm Collection and Evaluation
. Varietal improvement
. Screening for tolerances
. Testing for yield performances and adaptability
. Agro-technique Experiments
. Basic seed production
. Mutation/Tissue Culture
. Micronutrients
. Biofertilizers
. Pests and Diseases
. Cropping Systems
. Small Farm Machinery/Animal drawn implement

ARI is also implementing the following foreign agency-sponsored research projects.

Food Crop Development Project
Burma Agriculture Research and Development Project
Burma-IRRI Farming Systems Project

Its staff consists of 48 Research Officers and 383 Research Assistants.

ARI was established in 1971 at Yezin. Strengthening of the Institute was started in 1974 and completed in 1978, when 7 crop divisions were created in addition to the existing 5 divisions.

The objectives of ARI are to intensify research activities on crops of economic importance and to carry out research programs to establish appropriate cropping systems for different localities.

ARI occupies a total area of 365ha of which 287ha are under cultivation.

2) ARD

The ARD is comprised of 21 central research farms and 20 seed farms. ARD activities are closely coordinated with ARI and include system development and selection of seed strains under fourth filial generation, experiments on appropriateness of seeds for certain areas, and research on cultivation of varieties unique to each area. (See Fig. 2-2 and Table 2-9).

3) AED

The AED operates in close cooperation with the ARI and ARD, and is responsible for extension of various agricultural technology. The effectiveness of its activities is illustrated by the successful extension of high yielding varieties of rice which contributed substantially to unit yield increase in paddy rice.

Fig. 2-1 Organization Chart of the Agriculture Corporation

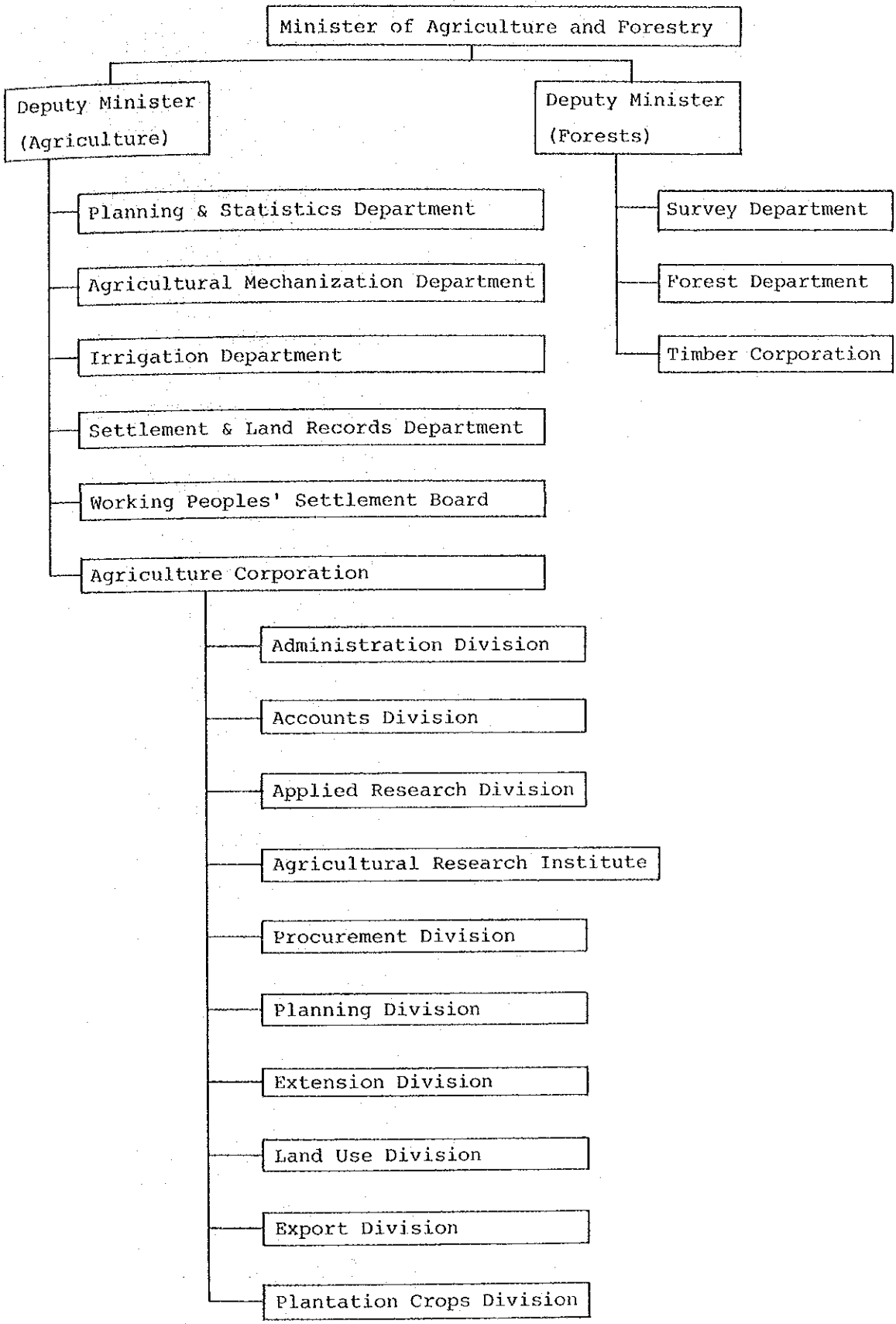


Table 2-9 Research Activities of Central Research Farm and Seed Farm

(1) Central Research Farm

No.	Name	State/Division	Main Crops
1.	Nankwe	Kachin	Sugarcane, Upland Rice
2.	Pa-an	Karen	Rice
3.	Bawkhwe	Chin	Maize, Horticulture
4.	Ranthilo	Chin	Maize, Horticulture
5.	Launglon	Tenasserin	Rice
6.	Laydatpyin	Pegu	Rice, Maize, Groundnut, Long Staple Cotton
7.	Letpadan	Pegu	Rice, Groundnut
8.	Nyaungbintha	Pegu	Sugarcane, Rice
9.	Magwe	Magwe	Groundnut, Sesame
10.	Hlaingdet	Mandalay	Long Staple Cotton, Short Staple Cotton
11.	Kyaukse	Mandalay	Rice, Sesame
12.	Lungyaw	Mandalay	Long Staple Cotton, Rice

Continued

No.	Name	State/Division	Main Crops
13.	Mahlaing	Mandalay	Short Staple Cotton, Pulses, Sesame
14.	Mandalay	Mandalay	Rice, Wheat
15.	Tatkon	Mandalay	Maize, Pulses, Sunflower
16.	Mudon	Mon	Rice
17.	Sittwe	Rakhine	Rice
18.	Hmawbi	Rangoon	Rice
19.	Banyin	Shan	Upland Rice, Maize, Wheat, Soybean
20.	Heho	Shan	Rice, Wheat, Maize, Groundnut, Niger, Soybean
21.	Myaungmya	Irrawaddy	Rice, Jute

(2) Seed Farm

No.	Name	State/Division	Main Crops
1.	Monyin	Kachin	Rice
2.	Chepa	Sagaing	Rice
3.	Gwegon	Sagaing	Rice
4.	Kyemon	Sagaing	Pulses, Sunflower
5.	Zaloke	Sagaing	Wheat
6.	Kadoke	Pegu	Rice, Sunflower, Jute
7.	Paungde	Pegu	Rice
8.	Aunglan	Magwe	Maize, Groundnut, Jute
9.	Kinmuntang	Magwe	Long Staple Cotton, Sesame
10.	Pwintphyu	Magwe	Rice
11.	Maymyo	Mandalay	Wheat, Maize
12.	Meaungkan	Mandalay	Rice
13.	Ahninepon	Mon	Sugarcane
14.	Ava	Mon	Sugarcane
15.	Gyogon	Rangoon	Rice

Continued

No.	Name	State/Division	Main Crops
16.	Thonegwa	Rangoon	Rice
17.	Kyaukme	Shan	Upland rice, Maize
18.	Panthaput	Irrawaddy	Rice, Pulses
19.	Tagontaing	Irrawaddy	Rice
20.	Thayaungchaung	Irrawaddy	Rice, Jute

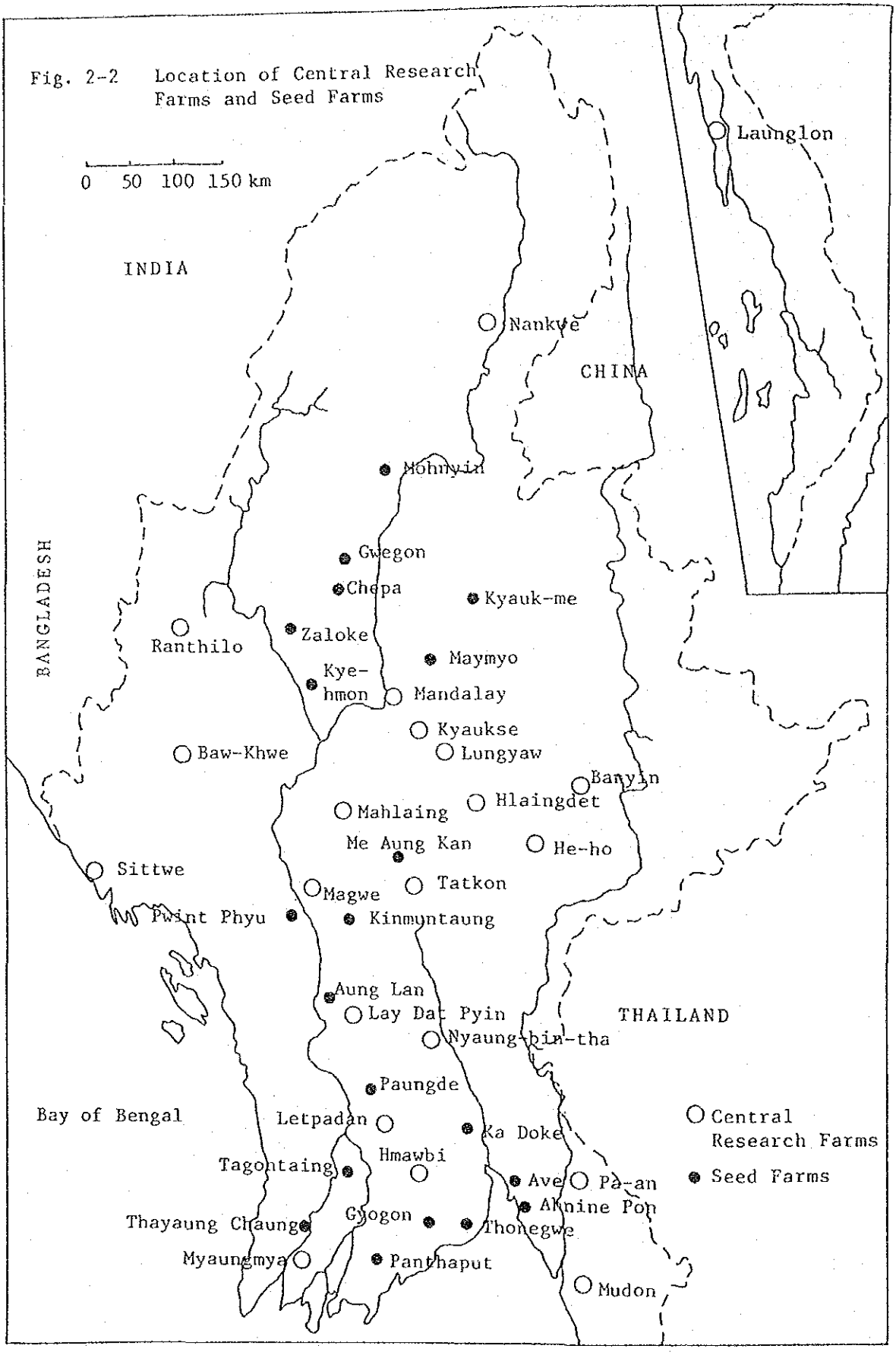


Fig. 2-2 Location of Central Research Farms and Seed Farms
0 50 100 150 km
INDIA
BANGLADESH
CHINA
THAILAND
Bay of Bengal
Launglon
Nankye
Mohnyin
Gwegon
Chepa
Kyauk-me
Ranthilo
Zaloke
Maymyo
Kye-hmon
Mandalay
Kyaukse
Lungyaw
Baw-Khwe
Banyin
Hlaingdet
Mahlaing
Me Aung Kan
He-ho
Sittwe
Magwe
Tatkon
Pwint Phyu
Kinmuntaung
Aung Lan
Lay Dat Pyin
Nyaung-bin-tha
Paungde
Letpadan
Ka Doke
Hmawbi
Tagontaing
Ave
Pa-an
Akhine Pon
Thayaung Chaung
Gyogon
Thonegwe
Myaungmya
Panthaput
Mudon
Central Research Farms
Seed Farms

(2) Plant Genetic Research and Management

Collection and preservation of plant genetic resources is primarily conducted by ARI and ARD. Crop types and their number which are presently preserved by both agencies are as tabulated in Table 2-10. This table shows that the genetic resources preserved by ARI and ARD number as much as 14,000 of which about 60% are rice varieties. Although there is likely some overlap of the varieties preserved between the ARI and ARD making precise estimation difficult at present, the amount of genetic resources preserved in Burma is considered substantial for a developing country.

Seed preservation in the ARI is governed independently by each crop division and therefore there is some discrepancy among the divisions. In some divisions, seeds are stored in bags inserted into tin cans at room temperature, while a few divisions have refrigerated storage. In either case, long term storage over several years is not possible, and seed stocks are replenished yearly from experimental farm cultivation, particularly in the case of rice, in order to maintain each strain. Consequently, the amount of labor and expenditure required for management is considerable, superseding the original purpose of plant breeding and research. Refrigeration units for seed storage are therefore considered essential for adequate preservation of genetic resources in future.

At ARD seeds for distribution to farmers are principally preserved. Seeds are preserved at normal temperature and humidity following packing.

Table 2-10 Collections of Different Crop Varieties at ARI and ARD

Crops	Number of Germplasms	
	ARI	ARD
1. Rice	4,138	4,702
2. Wheat	443	1,830
3. Barley	50	-
4. Rye	55	-
5. Maize	69	31
6. Sorgume	237	53
7. Peanut	29	15
8. Sesame		14
9. Sunflower	209	-
10. Cotton (Long stem cotton)	24	25
Cotton (Short stem cotton)	145	-
11. Jute (Capsularis)	42	-
Jute (Ohtorius)	62	-
12. Black Gram	365	-
13. Chick Pea	211	-
14. Pigeon Pea	90	-
15. Cow Pea	64	-
16. Butter Bean	36	-
17. Sultani	112	-
18. Green Gram	193	-
19. Soy Bean	12	
20. Winged Bean	-	375
21. Other Beans	178	-
22. Sugarcane	2	-
Sub-total	7,452	7,102
Total	14,559	

Source: Agricultural Research Institute and Applied Research Division

(3) Research Subjects

1) Number of Staff and Research Capacity

The number of ARI and ARD research staff is shown in Table 2-11 while the number of ARI staff according to each field is shown in Table 2-12.

Table 2-11 Number of Staff in ARI and ARD

	ARI		ARD	
General Manager	1		1	
Deputy General Manager	15		2	
Manager	15		16	
Assistant Manager	56	Sub-total 87	62	Sub-Total 81
Junior Research Officer	68		-	
Assistant Farm Manager	-		85	
Research Assistant	62		189	
Junior Research Assistant	99	Sub-total 229	405	Sub-total 679
Other Support Staff (including Project Incremental Staff)	1,056		1,642	
Total	1,392		2,402	

Source: Agriculture Corporation

Table 2-12 Number of Research Staff in ARI

Division	Research Officer	Research Assistant	Total
Rice	7	21	28
Maize and other cereals	7	16	23
Oilseed Crops	7	18	25
Fibre Crops	5	17	22
Food Legumes	6	13	19
Sugar Crops	5	14	19
Horticulture	5	11	16
Agronomy	6	24	30
Botany	5	10	15
Chemistry	9	28	37
Entomorogy	6	15	21
Plant Pathology	5	15	20
Administration	14	27	41
Total	87	229	316

Source : Agriculture Corporation

ARI staff with qualifications as junior research assistant and above number 316 persons. However, due to insufficient facilities, almost all researchers are engaged solely in cultivation research centering on field experiments. Field study indicates that although many of the staff have had some training abroad (principally at IRRI), training periods have been of short duration (2 - 6 months). Although staff members have general knowledge of laboratory level research, they have very little practical experience in the same.

2) Research Budget

The ARI and ARD research budget allocations from 1981/82 to 1985/86 are presented in the table below. As can be seen from this table, budget allocation for materials and equipment have decreased in recent years while the budget allocation for maintenance and operation has increased. This trend indicates that the introduction of new research equipment is inhibited as these organizations are being operated on a budget sufficient only for expendable supplies required for regular research activities. The overall research budget allocated to these agencies is judged to be quite low.

Table 2-13 Budget of the Agricultural Research Institute, Yezin and Applied Research Division

Unit: thousand Kyats

	CAPITAL		CURRENT	
	ARI	ARD	ARI	ARD
1981/82	10319.00	17158.34	5841.73	28175.11
1982/83	10446.73	15284.81	6684.16	27225.24
1983/84	6905.37	16957.14	8738.77	29450.19
1984/85	5629.65	20060.87	7938.79	27759.50
1985/86	5137.73	11183.63	11487.52	28318.58

3) Utilization of Research Equipment and Materials by ARI

Research equipment used by each crop division of ARI is generally restricted to basic items such as balances, grain moisture meters, micrometers and threshers. Survey revealed that the majority of this equipment was provided under foreign aid programs while items procured independently by ARI from its own budget are extremely limited. Moreover, a large percentage of equipment had broken down or were missing parts thus rendering them inoperable. This situation has had an adverse effect on research activities.

In some sections preservation of seeds is no longer possible due to malfunction of basic parts for the deep freeze of seed storage units. Laboratory experiments are also inadequate; however, the staff of each crop division expressed high hopes for future development with introduction of the Seed Bank facility.

Major equipment presently used by ARI are as follows:

- Refrigirator
- Grain Moisture Meter
- Seed Dryer
- Microscope
- Incubator
- Balance
- Oil Content Meter
- Oven Dryer
- Sprayer (Manual, Motorized)
- Thresher
- Micrometer
- Crusher
- Sugar Refractometer
- Fibre Bundle Strength Tester
- Seed Storage
- Sealer

2-5-3 Background of the Request

Expansion of agricultural production is a major focus of the Fifth Four Year Plan. Such expansion, however, can not be merely limited to modernization of farming methods through introduction of agricultural inputs such as fertilizer, and increased cultivated area. Rather it must be achieved through effective integration of these activities with development of plant breeding technology at both the local and national levels through cultivation and distribution of superior seeds, extension of high yield varieties, etc. The Government of Burma has therefore incorporated development of agricultural research as one of the main supports of its agricultural expansion policy as outlined in the Fifth Four Year Plan.

Until this time, facilities for preservation of genetic seed resources, which are the key to development of superior seeds, were not included in seed production and distribution projects promoted under foreign assistance. However, with the rapid depletion of genetic seed resources and existing genetic material following the recent extension of high yield varieties and resultant monoculture, the Government of Burma drew up a gene bank development plan and included it as a top priority within its request for grant aid assistance from Japan.

CHAPTER 3 PROJECT OUTLINE

CHAPTER 3 PROJECT OUTLINE

3-1 Objectives of the Project

The Project aims to establish a seed bank facility for collection, preservation and evaluation of plant genetic resources in Burma. This will facilitate effective use of genetic resources, contribute to the development of plant breeding, and strengthen the agricultural production capacity of the country. Moreover, such a facility is essential for the preservation of existing genetic resources in Burma which are already fast disappearing.

In addition to establishment of the seed bank and domestic genetic resources facilities, the Project aims to establish an artificial long-term preservation system, as well as a research system for the as yet underdeveloped plant breeding field. The seed bank will thus be more than simply a research facility for a limited number of researchers; rather it will contribute on an international level by providing genetic information unique to Burma, and will act as the focal point for research and extension of plant breeding technology.

As can be seen by the contents of the request, the number of equipment and facilities required was not concretely defined. Accordingly, the Survey Team formulated an equipment plan and a facility plan in concurrence with the results of the field survey.

3-2 Review of the Contents of the Request

3-2-1 Work Content

The Government of Burma requested the following eight work items as the project plan.

(1) To explore and collect crop genetic resources originated in Burma and to prevent the loss of valuable indigenous varieties.

(2) To characterize and evaluate the assembled genetic materials for use of breeders.

(3) To preserve seed crop genetic resources safely for short-term storage (temperature 150°C, approximate preserved duration 3~5 years) and medium-term storage (temperature 5°C, approximate preserved duration 20~30 years).

(4) To rejuvenate and propagate genetic materials preserved.

(5) To promote effective utilization of the genetic resources in the crop improvement programme through activities such as data recording, processing, retrieval and dissemination.

(6) To develop research technology concerned with genetic resources for seed crop and to train the scientific staff in technology on seed genetic resources.

(7) To test, isolate and sterilize seeds of collected indigenous and exotic varieties under the plant quarantine regulations.

(8) To act as as a center of national and international exchange of the genetic resources and related information.

The Study Team studied the above content and determined to incorporate the following items in the basic design for the project.

(1) Staff requested by the Government of Burma (1 project manager, 3 division chiefs, 3 assistant chiefs, 12 researchers, 24 inspectors, and 14 office workers) was adopted as the basis for the design. However, the staff plan may be revised in accordance with the functions of the project.

(2) The project site will be located adjacent to the south side of the lecture room of the main ARI research building in view of safety, environment, area and ease of communication with ARI.

(3) Lodgings for the lecturers will be located separate from the proposed seed bank site in the residential area. These lodgings will be used by the lecturers for the training program as well as by researchers from other institutions who cooperate in short or long-term research projects.

(4) Medium to long term seed storage facilities (5°C) and short term seed storage facilities (15°C) will be constructed. Rice seeds, which are the main target of the project, can be preserved for 20-30 years at 5°C, and for 3-5 years at 15°C. Thus rejuvenation would need to be undertaken only when necessary. As the running costs would be greatly increased if temperatures below freezing were used, preservation at 5 and 15°C is considered appropriate for the project.

(5) Although some highly advanced equipment was requested during the survey period, these were judged to be inappropriate in terms of operation and maintenance. Accordingly, the study team, on-the basis of present conditions in Yezin, will concentrate on selection of basic equipment and avoid introduction of more advanced equipment.

3-2-2 General Conditions of the Project Site

(1) Site Location

The project site is in the grounds of ARI, which is located in the Yezin District, approximately 410 km north of Rangoon City and approximately 15 km northeast of Pyinmana City in the Mandalay Division. It is situated at lat. 195°51' N. and long. 96°0'7" E.

The Yezin District in central Burma is where the vast alluvial delta area in lower Burma meets the hilly plateau and dry field farming is prevalent. It is also located in the center of the agricultural area of Burma. Thus it can be said that the project site's geographical position is typical of the geography of Burma.

The Government of Burma is currently implementing a program to establish an agricultural research center in the Yezin District where agricultural research institutions concentrate. Thus far an agricultural college, a veterinary college, a forestry research institution and a forestry college, in addition to ARI, have been established in this district.

The northern part of the Yezin District is hilly country and the southern part is low land. ARI is situated in the southern end of the district. In the northern hilly area are the above-mentioned agricultural college and other research facilities, as well as the Yezin Dam built by damming a valley in the northern hills using Burmese funds and resources. The water of the dam is utilized for irrigation.

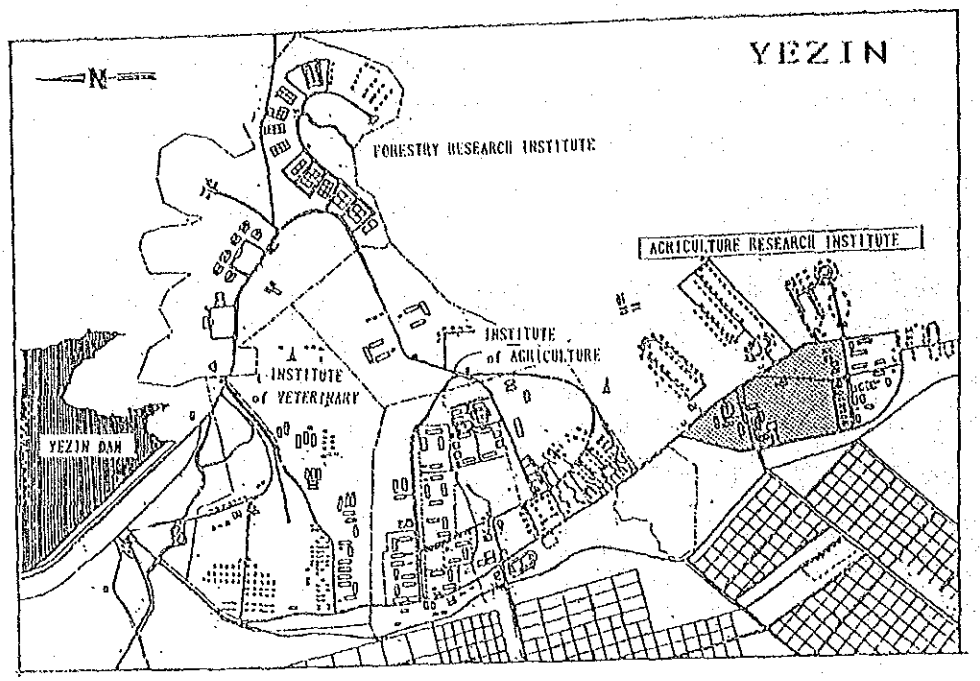


Fig. 3-1 Existing layout of Research Organization in Yezin

(2) Meteorological Conditions

In Burma which has a monsoon climate, the year is divided into the rainy season (late May to October), the cool season (October to February) and the hot season (February to mid May). Sixty-five percent of its total land area belongs to the tropics and 35% to the subtropics.

The Yezin District is situated midway between the central dry area with an average annual precipitation of less than 1,000 mm which is centered around Mandalay, and the southern area with a climate of high temperatures and high humidity. The average yearly precipitation in the district is approximately 1,200 mm, which is less than 50% of the 2,500 mm average yearly precipitation in Rangoon.

Its climatic conditions as measured by ARI (1983-85) are as follows:

1) *Temperature*

Average temperature in the hottest month	38.3°C (April)
(Maximum temperature)	43.0°C (April 17, 1983)
Average temperature in the coolest month	13.8°C (January)
(Minimum temperature)	10.0°C (January 27, 1985)

2) Humidity

Maximum average monthly humidity	85.9% (August)
Minimum average monthly humidity	62.3% (February)

3) Precipitation

Maximum average monthly precipitation	290.6 mm (August)
Maximum daily precipitation	120.9 mm
Minimum average monthly precipitation	0.0 mm (February)
Average yearly precipitation	1,211.2 mm

4) Wind Direction

March to October	South	1.2 - 4.0 m/sec.
November to February	North	0.7 - 1.9 m/sec.

(3) Earthquakes, etc.

In the central part of Burma is a vast default plane along the Sittang River which runs north to south while the western part of Burma is located in the Europe-Asia Earthquake Zone extending from Indonesia to the Himalayas.

It appears that the epicenters of the earthquakes occurring in Burma are concentrated in the Sittan River valley and areas near Mandalay, a big city in the central part of Burma, and the Amadan Sea which is located in the Europe-Asia Earthquake Zone.

The Yezin District in which the project site is located is adjacent to the Sittang River default plane and earthquakes which occur in this district are thought to register a maximum magnitude of 7 on the modified Merical scale. It is necessary, therefore, to plan an aseismatic structural design.

(4) Infrastructure

1) Transportation

The Yezin District is a district on the Rangoon-Mandalay Road (Route 1), one of Burma's trunk roads. It is located approximately 410 km north of Rangoon. Paved roads, about 5 m in width, run throughout the length and breadth of the premises of ARI.

In Piynmana which is approximately 15 km away from ARI is a railroad station where express trains on the Rangoon-Myitkynia line, Burma's trunk railroad line, stop. It is about 7 hours train ride from Rangoon to Piynmana.

2) Electricity

Electric power is supplied by the Taunggyi Power Plant on the Inle Lake. Electric power is led to the premises of ARI by a service line of 11,000V branching from the 33,000V high voltage line of the power plant.

Although the power plant's electric power generating capacity meets the power needs during peak hours, power stoppages and drops in voltage often occur due to lack of a satisfactory power transmission and distribution network.

In the Yezin District the electricity is cut several times a week. At its worst, a power cut lasts for several hours and voltage drops by as much as 30%.

Currently a new power plant is being constructed in Piynmana. It is possible to transmit electricity from the new power plant to the Yezin District. When the new power plant becomes operational, the problems of power stoppage and drops in voltage will be considerably alleviated.

3) Water supply

Underground water is utilized in and around the Project site. The water supply for the Seed Bank Center is also drawn from existing tube wells. Therefore new tube wells will not be needed for the Project.

The water has a relatively high calcium and magnesium content but this will not affect implementation of the Project.

4) Sewerage

There is no sewerage system available in and around the project site. Rainwater and household waste water are discharged into drainage ditches or penetrate into the ground. Sewage is discharged into septic tanks, out of which purifed water penetrates into the ground.

5) Other

There are no municipal gas supply facilities in Burma. Propane gas is not yet in widespread use. Firewood is generally used, and electricity and kerosene are used in some areas as the energy source.

There is no telephone service available in the Yezin District. Some important facilities in the district are equipped with wireless communication devices.

3-2-3 Facilities and Equipment

As there was no official request for specific facilities and materials, the Study Team, in concurrence with the Burmese side drew up a specific plan based on the field survey. The content of the said facilities and equipment plan for the project is as follows:

(1) Facility

- Seed bank
- Administration, information & research laboratory
- Training
- Utilities
- Other facilities related to the Project, if necessary

(2) Equipment

- for Seed Bank section
- for Information section
- for Research laboratory
- for Training facilities
- for Office
- Vehicles
- for Utilities
- Other facilities related to the Project, if necessary

3-2-4 Technical Cooperation

The target of technical cooperation is crop production improvement through collection, preservation, evaluation and utilization of genetic resources to be implemented at the Seed Bank. The Agricultural Corporation is the recipient agency for technical cooperation over a period of four years. The items included in this cooperation are as follows:

(1) To carry out the activities and research works on;
- Method for collection and exploration of seed crop genetic resources;
- Description and documentation of collected materials of each crop;
- Classification, evaluation, rejuvenation and multiplication of seed crop genetic materials;
- Procedures for testing of introduced materials for various crop species, including isolation and purification of genetic materials;
- Techniques for long term preservation including management of seed genetic resources storage facilities;
- Physiology of seeds which are seed bank materials;
- Information system for genetic materials collected, introduced and preserved;
- Collaboration with national and international institutions on plant genetic resources;
- Training scientific staff in the technology on seed genetic resources.

(2) To exchange necessary information, data and research materials for the above subjects.

3-3 General Conditions

3-3-1 Functions and Facilities

The functions and facilities required for the Project are outlined hereunder.

(1) Seed preservation and distribution, information management and publicity work.

Seed preservation and distribution which is the most important function of the Seed Bank, includes receiving, preservation, maintenance and distribution of genetic resources, management and use of passport information, and liaison with the relevant laboratories, while information management and publicity work includes receiving, registration and management of information on genetic resources, structuring of a data base, and preparation, printing and distribution of catalogues and picture books.

Short-term and long and medium-term storage rooms will be low-cost, compact and maintenance-free facilities which have adequate storage capacity and efficient power consumption.

(2) Research and training in the fields of genetic resources and coordination

Research is closely related with the activities of the Seed Bank in promotion of breeding, and comprises three fields, namely research on investigation, collection and introduction methods of genetic resources, research on classification and evaluation methods and propagation and preservation methods.

The purpose of training is to secure human resources to operate project breeding work and to collect genetic resources in Burma, and training is intended for experts who are now working in laboratories and experimental stations. Training will be carried out by using audiovisual materials and laboratory equipment, etc.

(3) Coordination between the Seed Bank and the existing laboratories

The facilities will take charge of selection, coordination and preservation of seeds for the Crop Divisions of the existing laboratories as well as supply of seeds to Seed Bank. The facilities will occupy an important position in ART.

(4) Cultivation in quarantine and detoxification treatment of introduced genetic resources.

This function is related to research on investigation, collection and introduction methods. The Seed Bank will handle cultivation of introduced seeds in quarantine in a net-house for prevention of epidemics, detection of diseases and vermin and creation of sterile seedlings through the growing-point culture method.

(5) Facilities for instructors and researchers

All facilities required for training and research activities to be conducted by the instructors for the training program and cooperative researchers will be provided.

The facilities will be available for both long-term and short-term use by the said instructors, etc.

3-3-2 Activities of the Seed Bank Center

In consideration of existing activities for plant genetic resources preservation, the proposed Project will focus on the improvement of fundamental research activities. The work content is briefly summarized below.

(1) Seed Preservation

This work primarily involves preservation of seed which have been either collected or introduced. Facilities consist of a seed storehouse equipped with machinery required for proper storage and preservation work such as drying, selection, and packing. Activities also include inspection of germination rate of stored seeds and production of plant specimens.

Seeds will be preserved in cold storage at temperatures of 15°C for short-term and 5°C for medium and long-term storage. Freezing capacity was not considered for this facility as it requires a higher maintenance cost and was not requested by the Government of Burma.

Total storage of 50,000 seed types is planned over a 20 year period under the project. However, as an annual maximum of only 2000 seed types are planned for preservation, it will be some time before the cold storage facilities of the Seed Bank will be fully utilized. Accordingly, although the total storage area provided will be for storage of 50,000 seed types, refrigeration cabinets will initially be provided for only one compartment. The other compartment will be utilized as a seed treatment room, and the refrigeration cabinets for this compartment will be installed in accordance with the rate of expansion of stored seeds as judged by the Government of Burma.

(2) Information Management

Information concerning collected genetic resources will be exchanged with domestic and international research agencies. Passport data, seed characteristics and other information will be compiled by card and computer, documented in the form of reports, pamphlets, etc. and exchanged with other research agencies for use in research activities. Exchange of collected resources, etc. will also be carried out to foster breeding activities.

In view of the Seed Bank's function as a center for information exchange and thereby development of plant breeding, etc., the facility will benefit not only Burma but also other rice producing countries.

(3) Research

Research activities will be undertaken in three laboratories. Identification and collection of genetic resources includes isolated cultivation, sterilization, classification, evaluation (composition analysis, evaluation of characteristics), study of storage methods, and propagation and rejuvenation of seeds. The laboratories will be designed to facilitate these as well as related research activities such as tissue culture and plant analysis. The latter research activities were included at the request of the Government of Burma because they are closely related to plant breeding research activities to be conducted at the Seed Bank and will facilitate effective use of the facility.

The functions of the laboratories will be divided as follows one laboratory for exploration, collection and introduction related research; one laboratory for classification and evaluation; and one laboratory for study of propagation and preservation methods.

(4) Training

Instruction in plant breeding technology in Burmese educational institutions, including universities, is insufficient. Accordingly, project management and genetic resource collection personnel will be capable of training seed bank researchers etc. in breeding techniques within Burma.

All new staff as well as technicians with some experience working at existing research laboratories, etc. will be subject to training under the Project. Training methods will include lectures, practical training, field trips and video. Courses will be offered two or three times a year for a period of three months each and each group will number 20 students.

(5) Other

Other activities to be undertaken at the proposed Seed Bank include seed preservation by crop division and operation and management activities. For the former, a division annex will be established. Necessary seed storage and

working space will be provided for separate breeding activities by each crop division of the ARI to facilitate preparatory work for seed storage and research. In this way the connection between the Seed Bank and each ARI crop division will be strengthened and research activities will develop smoothly. As for operation and management, all activities required for operation and management of the Seed Bank will be carried out.

In considering the above work content, the following nine fundamental activities are identified for operation of the project and these are directly related to the outline of the facility and equipment plan.

1) Exploration, Collection and Preservation of Seed Resources
   Plant genetic resources distributed throughout Burma will be identified and collected. This activity will be implemented not only through the Seed Bank but also through various related agencies.

2) Management of Data related to Genetic Resources Collected for Each Crop Variety
   The collection location, conditions and other data will be compiled and stored for all collected genetic resources.

3) Classification, Evaluation, Rejuvenation and Propagation of Genetic Seed Resources
   First evaluation concerning characteristics of classification and second evaluation related to agricultural characteristics and various other properties will be carried out for collected genetic resources. Moreover, rejuvenation and propagation will be undertaken for stored seeds, the germination percentage of which has decreased or the storage volume of which has been depleted.

4) Isolated Cultivation and Sterilization of Each Species of Introduced Genetic Resources
   Genetic resources which are newly introduced will be cultivated in isolation in a net house for purposes of plant quarantine and inspected for disease or pest outbreaks. Production of virus free plants by apical meristem culture will be carried out as necessary.

5) Study of Long-Term Preservation Method

Studies will be conducted to develop long-term preservation methods for recalcitrant and orthodox seeds.

6) Physiological Study of Collected Genetic Resources

Physiological research will be conducted on seed composition, enzyme analysis, etc.

7) Compilation of Information on Collection; Introduction and Preservation of Genetic Resources

Information obtained from the first and second evaluations, etc. will be entered into both a card and a computer system to ensure efficient compilation and filing of information.

8) Information Exchange Between Domestic and International Research Agencies

Information on genetic resources will be collected from both domestic and international research agencies and reports on stored genetic resources offered in return.

9) Training of Research Staff

Training will be offered to research staff in collection, evaluation, preservation, information management, etc. in order to increase the level of expertise.

3-3-3 Research System

The following eight divisions will be established to ensure the smooth implementation of the nine seed bank activities mentioned above.

(1) Seed Bank Section
(2) Information Section
(3) Introduction Laboratory
(4) Evaluation Laboratory
(5) Preservation Method Laboratory
(6) Division Stock
(7) Training Center
(8) Administration Sector

The work content to be performed by each of the above divisions is delineated below.

(1) Seed Bank Section

1) Pretreatment for preservation of genetic resources
   - Selection
   - Drying
   - Weighing
   - Vacuum-packing
   - Seed test (Germination test)

2) Preservation of genetic resources
   - Short-term preservation
     Approximately 500g storage capacity each for distribution
   - Long-term preservation
     Approximately 150g storage capacity each

3) Preparation, preservation and inspection of specimen

4) Distribution of genetic resources

(2) Information Section

1) Acceptance of information on genetic resources as follows:
   - General seed characteristics
   - Special seed characteristics from laboratories
   - Seed characteristics from domestic and international institutes.

2) Registration of information on genetic resources characteristics
   - Preparation of data base
   - Making lists of genetic resources

3) Reference of information on genetic resources

4) Information services on genetic resources
   - Preparation and distribution of information journal
   - Control of distribution of genetic resources information

4) Taste analysis of crops

(5) Preservation Laboratory

1) Propagation and rejuvenation of genetic resources
   - Cultivation
   - Tissue culture

2) Research on long-term preservation method
   - Research on preservation method at low temperatures (0 - -50°C)

3) Research on preservation method of recalcitrant seeds

(6) Divisions Stock

1) Preparation of working collection
   - Selection
   - Drying
   - Screening
   - Weighing
   - Packing

2) Exchange of genetic resources information with Seed Bank Center

3) Temporary preservation of genetic resources for research work of crop divisions in ARI

(7) Training Center

1) Audio-visual training

2) Lectures

3) Experimentation
   - Germination test
   - Evaluation of characteristics

(3) Introduction Laboratory

1) Exploration and collection of genetic resources
   - Exploration and collection survey (3 teams)

2) Processing of collected and introduced genetic resources
   - Selection
   - Drying

3) Introduction and first evaluation
   - Evaluation of morphological characteristics

4) Sterilization (tissue culture)
   - Creation of virus free plants (apical meristem culture)

5) Plant quarantine

6) Isolated cultivation
   - Sterilization of genetic resources
   - Evaluation of morphological characteristics
   - Enzyme analysis of isolated plants by electrophoresis method
   - Temporary preservation of genetic resources

(4) Evaluation Laboratory

1) Classification
   - Classification of crops
   - Morphological classification
   - Physiological classification

2) Evaluation
   - Analysis of plant body. (carbohydrate, fat, protein)
   - Evaluation of plant physiology
   - Physiological evaluation of germination

3) Research of Cultivation Method

4) Field Investigation

(8) Administrative Sector

1) Maintenance and operation of the Seed Bank Center

2) General affairs

The following flow chart shows the working relationship among each of the above facilities.

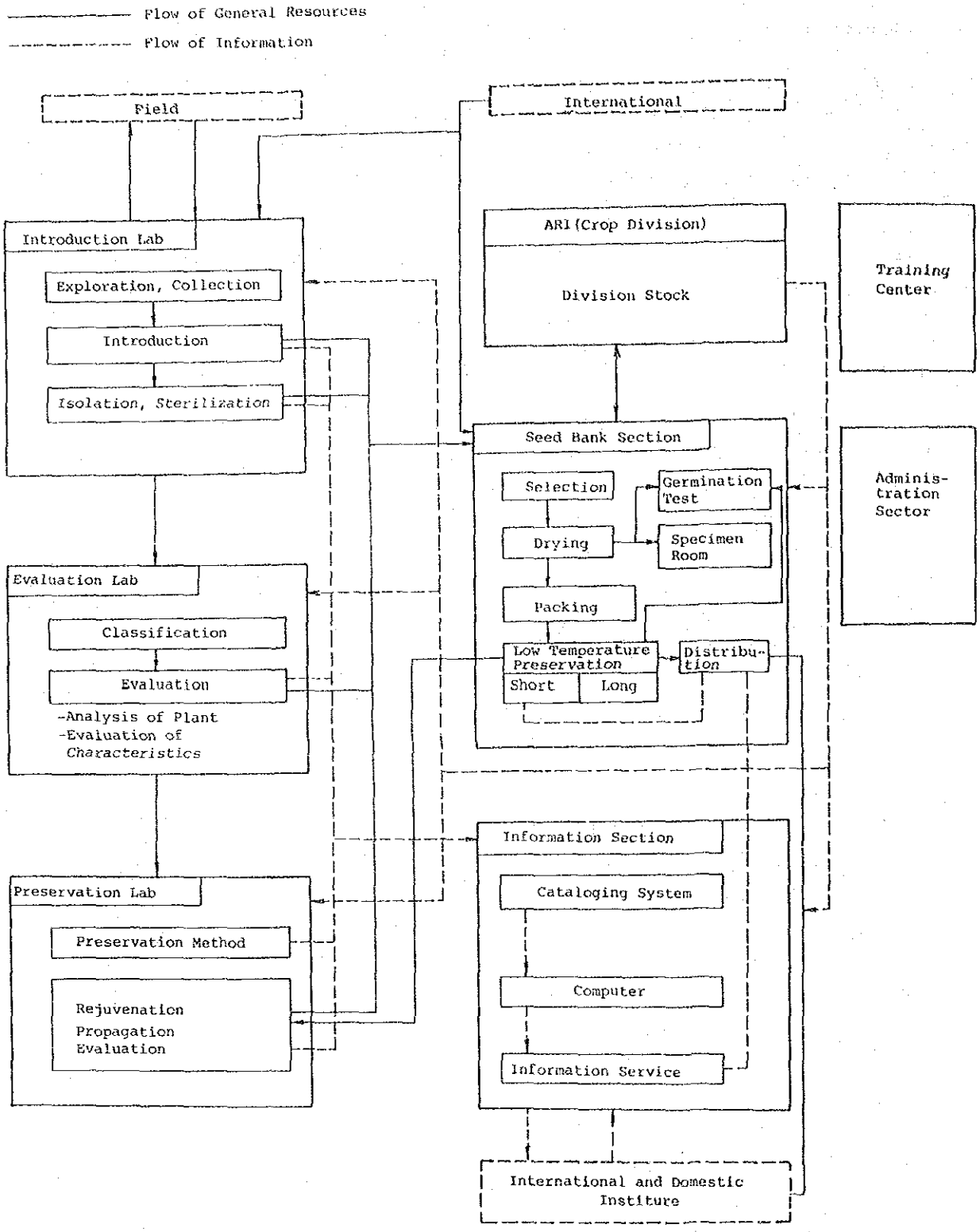


Fig. 3-2 Flow Chart of Genetic Resources and Information

3-4 Project Implementation

3-4-1 Organization

(1) Relevant Organizations

Implementation of the Project is under the jurisdiction of the ARI which is part of the AC. A Project Division will be established in addition to the existing Crop Divisions and Disciplinary Divisions and will be comprised of four sections, one of which is the Seed Bank. An organizational diagram is presented below.

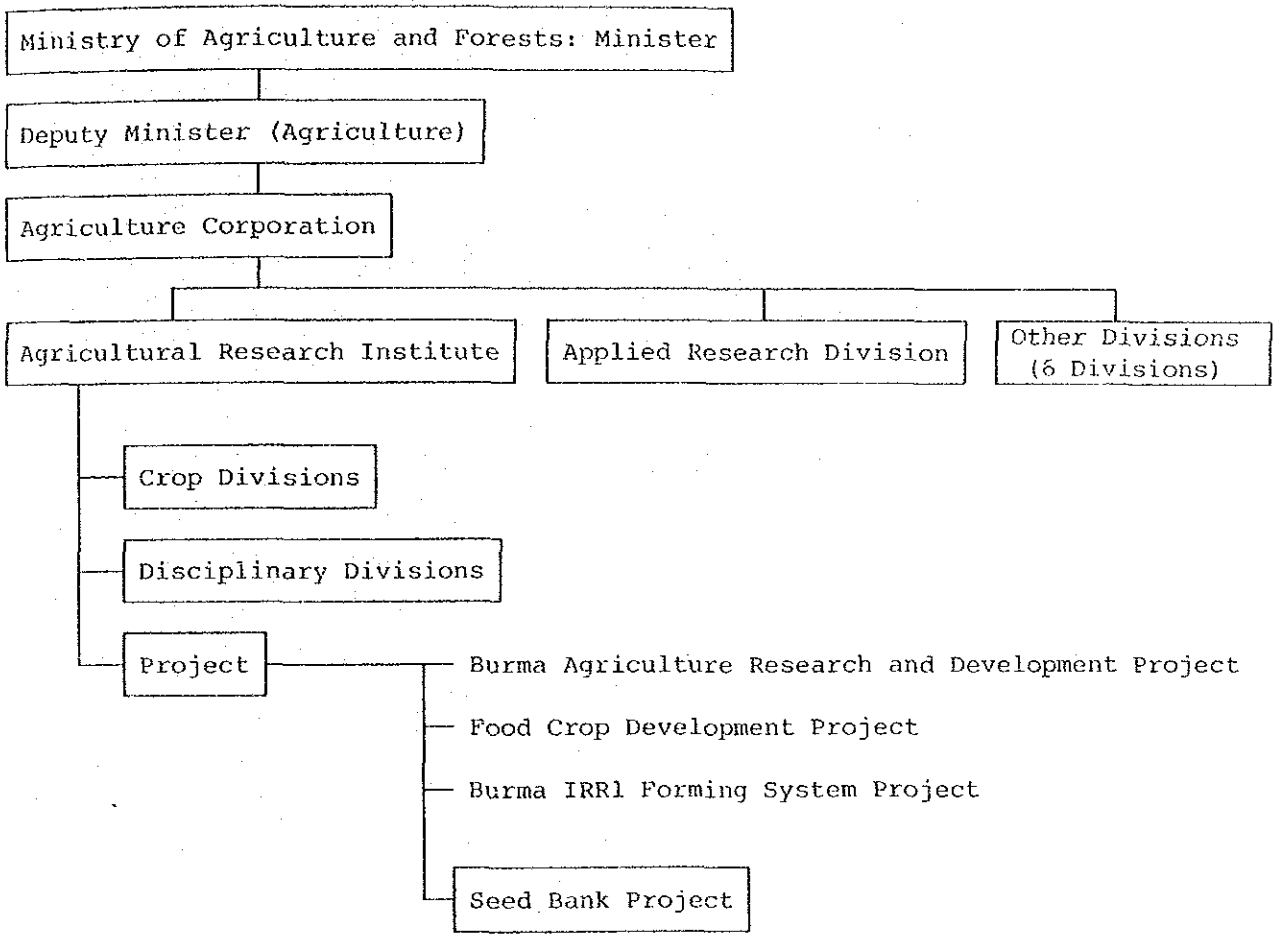
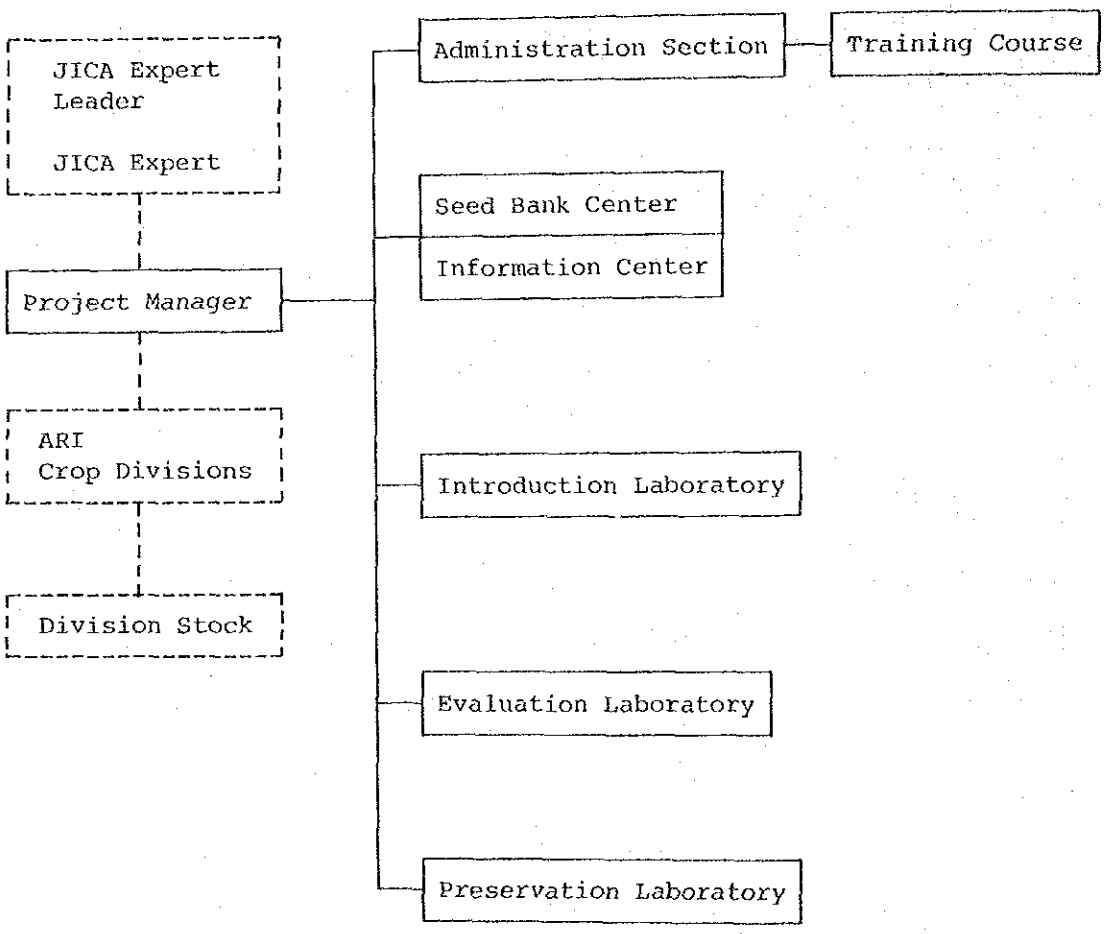


Fig. 3-3 Position of the Seed Bank Center in ARI

(2) Project Organization and Manpower Distribution

The Project will be implemented by a staff of 60 people appointed by the ARI and ARD. Organization within the Project will include 1) a genetic resources preservation center, 2) a genetic resources information management center, 3) an exploration and introduction laboratory, 4) a classification and evaluation laboratory, 5) a propagation laboratory, and 6) a research management section. In addition, a training section will be included within the research management section, while the division's stock will be managed by each crop division within the ARI. An organizational chart is presented below.

Fig. 3-4 Proposed Organization Chart of Seed Bank Center



Personnel required for management of the proposed Project are as outlined in the following table.

Table 3-1 Proposed Staff Layout of the Seed Bank Center

1. Project manager	1
2. (Administration Section)	(11)
Chief administration officer	1
Secretary	2
Typist	1
Administration officer (Librarian)	1
" " (General affairs)	1
" " (Equipment control)	1
" " (Training)	1
Driver	1
Worker	2
3. (Seed Bank Section)	(7)
Chief research officer	1
Research officer	2
Inspector	4
4. (Information Section)	(6)
Chief research officer	1
Research officer	1
Inspector	2
Computer operator	2
5. (Introduction Laboratory)	(13)
Chief research officer	1
Deputy chief research officer	1
Research officer	4
Inspector	4
Driver	3

6. (Evaluation Laboratory)	(11)
Chief research officer	1
Deputy chief research officer	1
Research officer	3
Inspector	6
7. (Preservation Laboratory)	(11)
Chief research officer	1
Deputy chief research officer	1
Research officer	3
Inspector	6
Total	60 persons

(3) Operation and Management System

The Seed Bank will be managed as one division of the ARI; however, at the same time it will also function as the main center for research and seed storage in Burma. The administration and management of the Seed Bank will be coordinated as one division of ARI while an independent office will be included within the Seed Bank for management of activities related to its role as the main national center. The Government of Burma has allotted the following budget for the first and second year of seed bank operation.

Table 3-2 Budget Allocation for the Seed Bank Center

Unit : (1,000 Kyats)

	Yr. I	Yr. II	Total
Capital cost	20,000	29,000	49,000
Pay and allowance	367	370	737
Cost of training	1,390	1,395	2,785
Operating cost	3,902	3,920	7,822
Total	25,659	34,685	60,344

3-4-2 Training System

New and experienced technicians at existing research centers and laboratories will be trained under the Project. Class size will be limited to about 20 per course and each course period will cover about 3 months (13 weeks). As the trainees will already have received basic instruction at university or college, the course content will be concentrated on seed preservation and plant breeding which will be immediately applicable to their work place after completion of the course.

Classes will be centered in the student study room and training room; however, observation and practical training will also be conducted as required in the research laboratory, seed bank, and genetic resource information center.

There are about 1,000 research staff above the rank of Junior Research Assistant presently employed by ARI and ARD. With the project training program, an average of 20 people can be trained and thus significant results are envisioned. The training course is planned to be held three times a year, and although this may occasionally be reduced to twice a year depending on the availability of instructors and conditions of research activities at the Seed Bank, the training system is considered essential for early promotion of plant breeding activities. Materials required for the proposed content of the training program are presented in Appendix 6.

CHAPTER 4 BASIC DESIGN

CHAPTER 4 BASIC DESIGN

Construction of full-scale seed storage facilities in Burma where numerous traditional crop varieties are growing will play an important role not only in Burma but also in other countries, since genetic resources are reducing all over the world.

The Basic Design Study Team has made a detailed study and analysis to fix a basic design for the project based on the discussions with the Government of Burma. This chapter shows the overall scheme and the proposal on the contents and the scope of the facilities.

4-1 Basic Design Policy

The following basic policy was adopted to make the project most effective under the conditions of the project site.

- Facilities taking account of natural conditions

Comfortable living conditions should be secured, which will cope with great climatic change such as torrential downpour in the rainy season and high temperature in summer.

- Facilities taking account of functionality, economy and durability

The facilities of the project should be arranged in due consideration of the natural and smooth relationship among each facility containing ARI's existing facilities. The local materials and construction methods will be positively adopted and the facilities should be of easy maintenance and of good operability as well as durability not requiring special techniques.

- Facilities with reasonable contents and scope

The facilities will be designed with duly reasonable contents and scope for Japanese grant aid from the standpoint of the project implementation system, the contents of research and future prospects.

- Facility design taking account of far-reaching effects and continuance

The facilities will be designed for bringing out the local technical potential, and developing its effect in Burma. The facilities will be designed also for taking charge of long-lasting research on seed preservation in Burma and, further, playing an important part in the activity of genetic resource preservation from the international viewpoint.

- Facilities with agreeable appearance

The facilities will be located on the south of the hillside of ARI grounds, so they will be a symbolic landmark. They should be designed to have a functional sequence with agreeable appearance that matches the environment.

4-2 Site Condition

Four proposed sites had been presented by the Burmese Government at first, and after a discussion between the Burmese Government and the Basic Study Team, the site was decided as in Fig. 4-1 from the four sites according to the following reasons.

1. The area should be large enough for the facilities.
2. The facilities should be located near ARI's existing facilities.
3. The generator should be kept away from the existing facilities in consideration of the noise.
4. The project site cannot be divided into two sites.

The project site is located to the south of the research area where the main buldings, that include laboratories, the hall and so on, exist. It is a grassy place with an incline of one to three meters toward the south. And the site narrows to 34.3 m toward the front road, so it is necessary to do filling and excavation in order to flatten the site and to remove the existing drainage. This is under Burmese responsibility.

The accomodations will be built in a residential area adjoining the project site at Burmese request.

Electric power will be supplied through the power line (11 kV) of the road to the west of the site.

As to water supply, the four wells within the ARI premises have sufficient capacity. Water will be supplied to the Seed Bank by constructing a branch to water-supply facilities near the site.

Rain water will be discharged to the drainage on the south of the site and waste water will be made to permeate the soil after passing through a septic tank. Chemical wastes and organic solvent wastes from the laboratories will be collected separately.

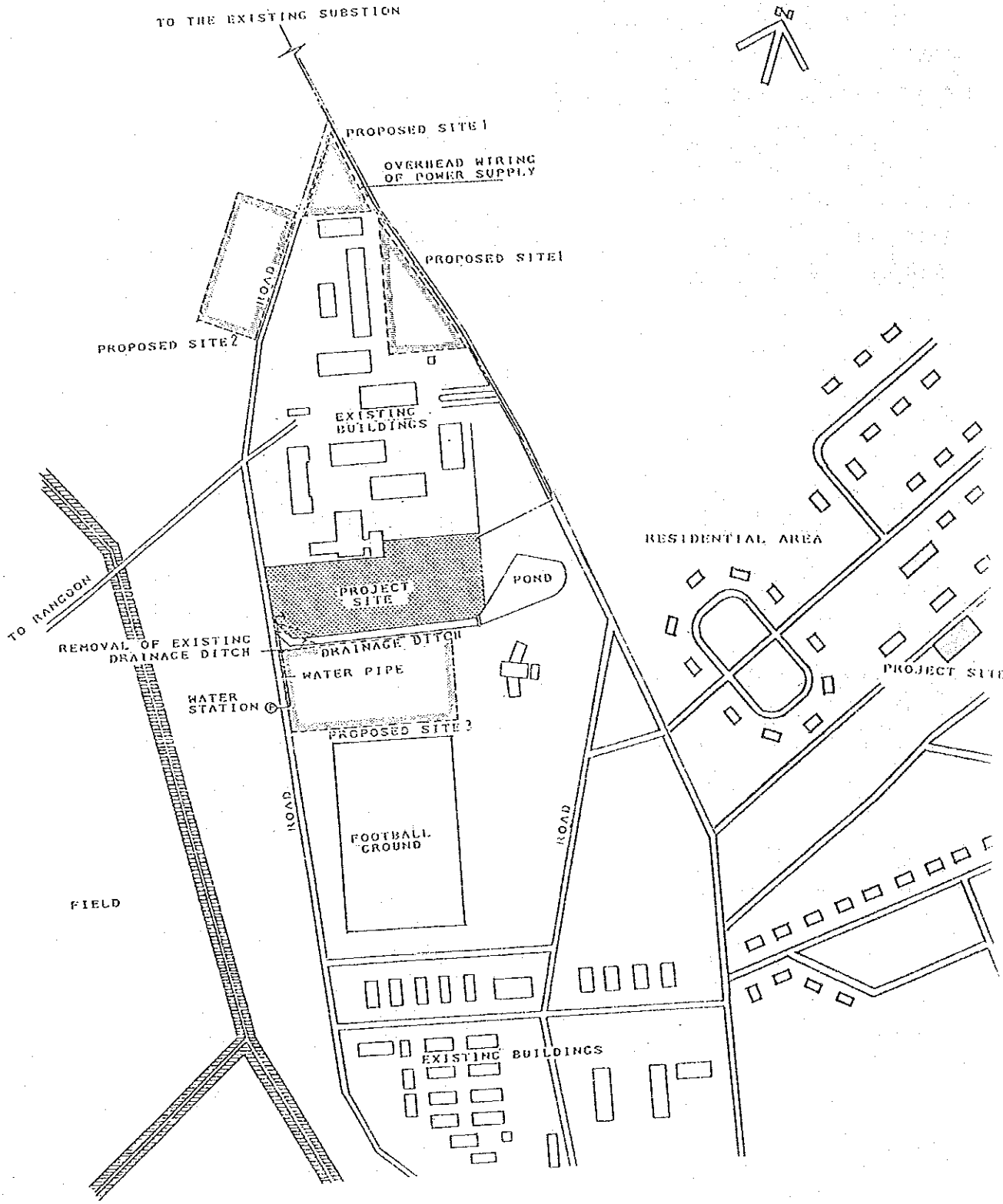


FIG.4-1 SITE MAP