

JAPAN INTERNATIONAL COOPERATION AGENCY
CAMBODIA
MINISTRY OF AGRICULTURE

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR REHABILITATION
OF
THE TOUL SAMRONG AGRICULTURAL TECHNICAL
CENTER, BATTAMBANG
IN
CAMBODIA

APRIL, 1993

SANYU CONSULTANTS INC.

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JAPAN INTERNATIONAL
COOPERATION AGENCY

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CENTER,
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BASIC DESIGN REPORT

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PREFACE

In response to a request from the Supreme National Council of Cambodia, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation of the Toul Samrong Agricultural Technical Center, Battambang in Cambodia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Cambodia a study team headed by Mr. Shoji Shimbo, Managing Director, Grant Aid Study and Design Department, JICA and constituted by members of Sanyu Consultants Inc., from October 26 to November 19, 1992.

The team held discussions with the officials concerned of Cambodia, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Cambodia in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the Project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of Cambodia for their close cooperation extended to the teams.

April, 1993



Kensuke Yanagiya

President

Japan International Cooperation Agency

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

April, 1993

Letter of Transmittal


We are pleased to submit to you the basic design study report on the Project for Rehabilitation of the Toul Samrong Agricultural Technical Center, Battambang in Cambodia.

This study has been made by Sanyu Consultants Inc., based on a contract with JICA, from October 21, 1992 to April 23, 1993. Throughout the study, we have taken into full consideration the present situation in the Cambodia, and have planned the most appropriate Project in the scheme of Japan's grant aid.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Agriculture, Forestry and Fishery. We also wish to express our deep gratitude to the officials concerned of the Ministry of Agriculture and Embassy of Japan in Cambodia for their close cooperation and assistance during our study.

Finally, we hope that this report will be effectively used for the promotion of the Project.

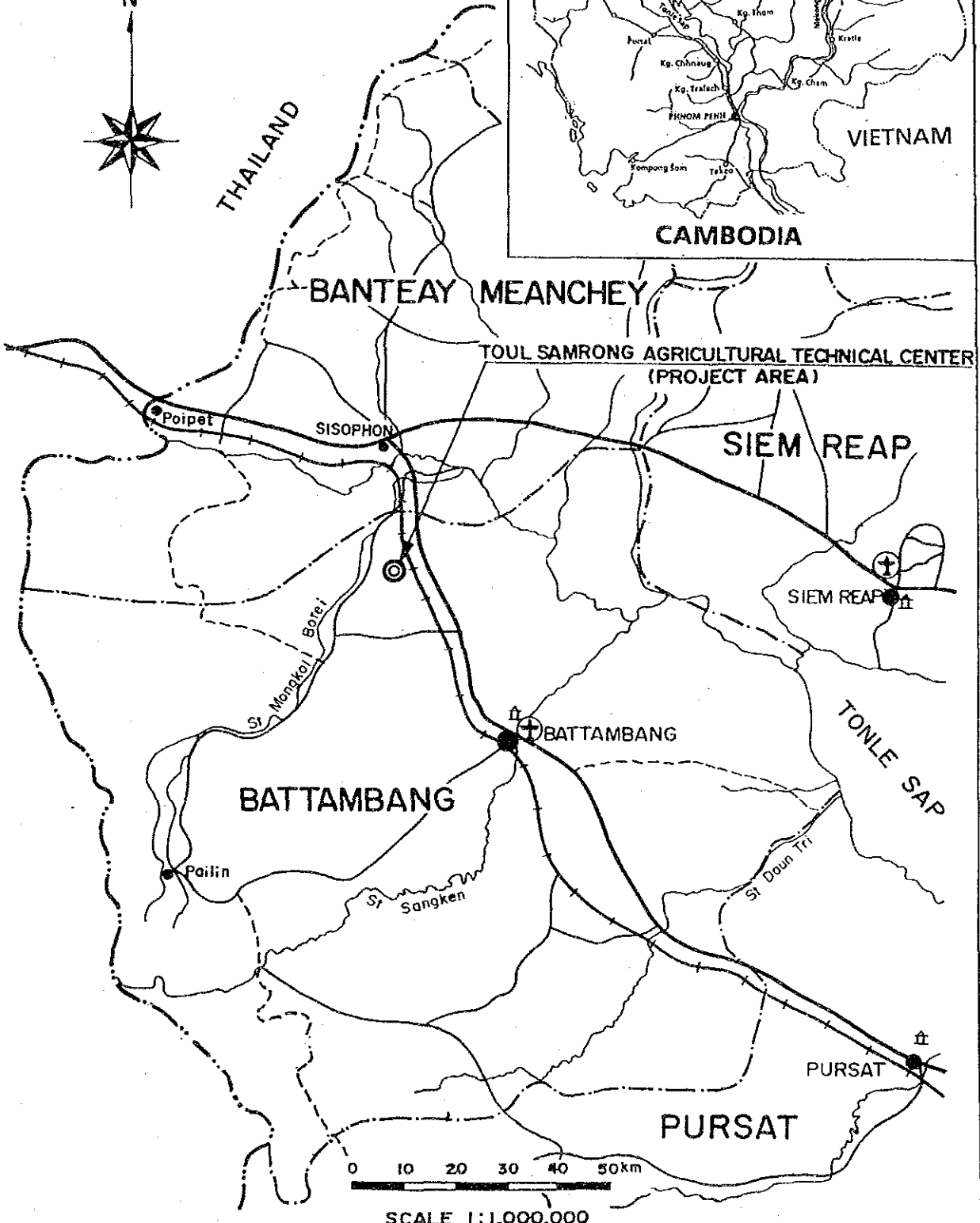
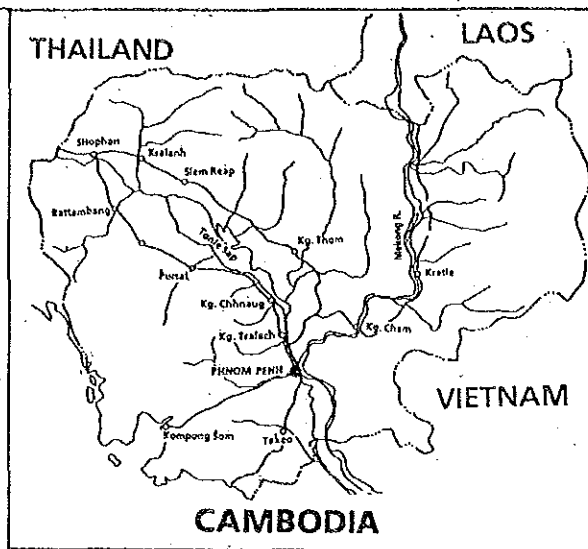
Very truly yours,



Yasunori Hasegawa

Project Manager
Basic Design Study Team on the Project for
Rehabilitation of the Toul Samrong
Agricultural Technical Center, Battambang
Sanyu Consultants Inc.

LOCATION MAP OF THE TOUL SAMRONG AGRICULTURAL TECHNICAL CENTER, BATTAMBANG





Front View of the Center



Official Signing of the Minutes
of Discussion



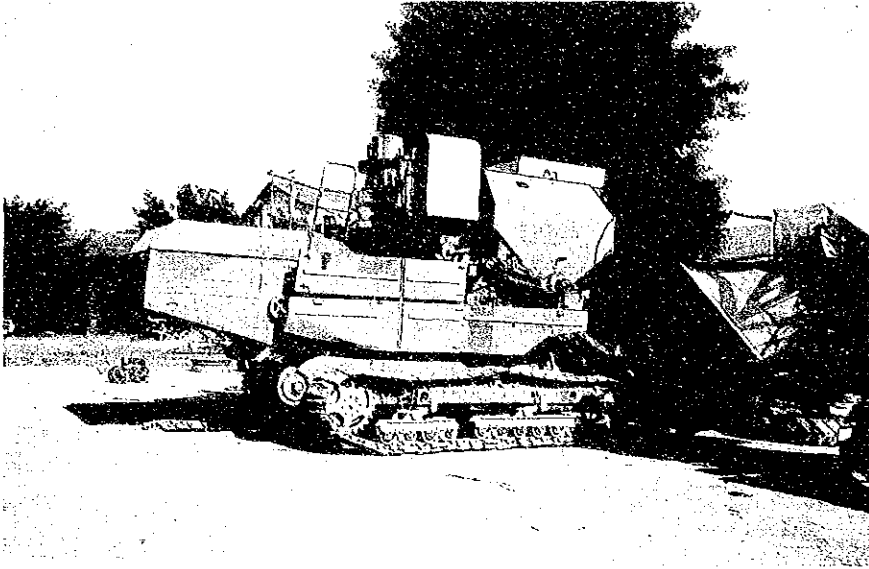
Diversion Work to Main Farm Ditch in the Center Farm



Seed Production Farm with Main Farm Road and Main Farm Ditch (Dual Purpose Canal)



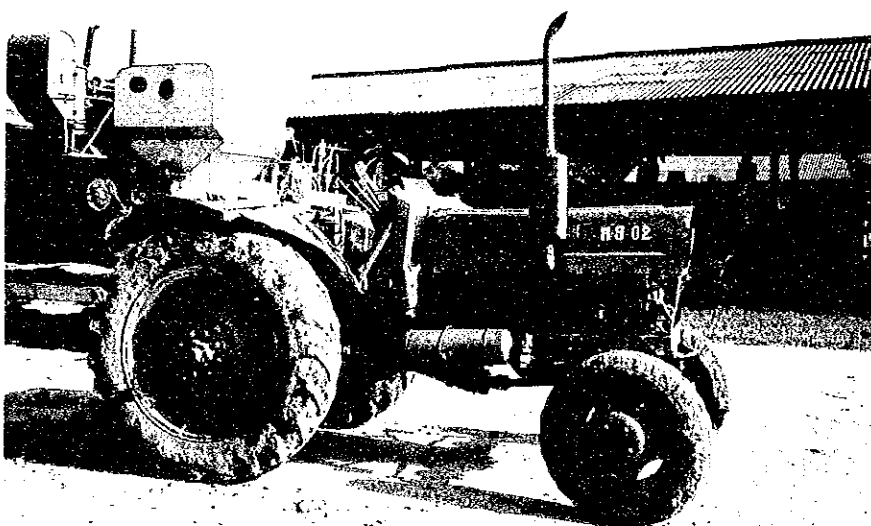
Experimental Plots



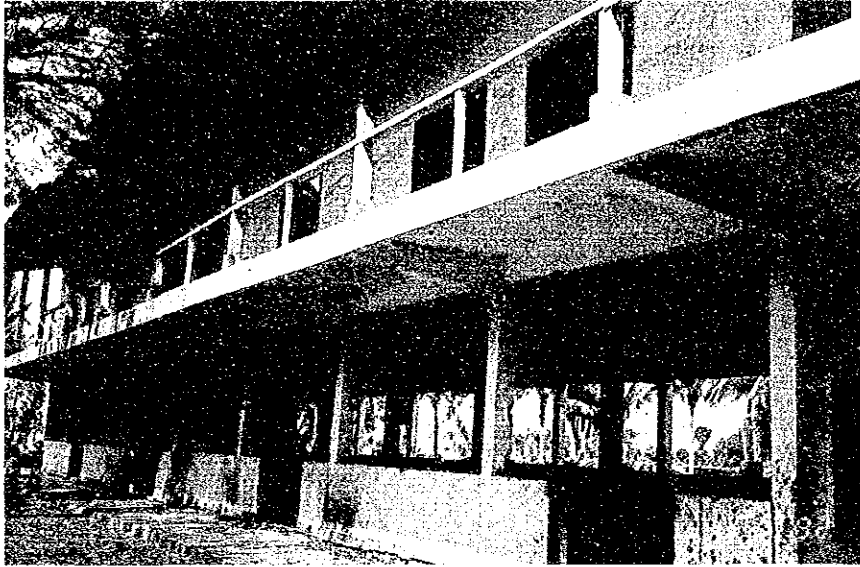
**Combine Harvester Made in
the Former USSR
(Almost out of Life)**



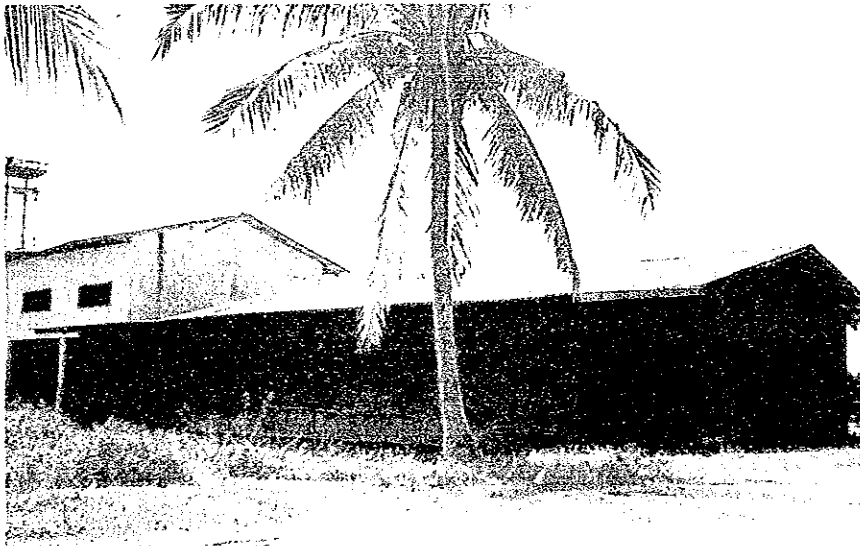
**Repair of the Combine Harvester
(Short in Spare Parts and
Workshop Equipment)**



**Four Wheel Tractor on Operation
(Almost Out of Life)**



Main Building



**Workshop
(Severely Damaged by Termites)**



**Intake from Bovel Irrigation Canal
to the Center Farm**

SUMMARY

SUMMARY

In October 1991, the Paris Peace Agreement was signed in France by the Four Parties of Cambodia and other 19 countries concerned. The signing of the Agreement has brought an end to the 13-year Cambodian civil war. After the war, the Cambodian people have started to reconstruct the damages brought about by the war and focused on the development of the national economy. The civil war and Cambodia's isolation from international circles had pushed back the country's economic development.

Cambodia has a total population of 8.8 million in 1991. With an average population growth rate of 2.8 percent per year, the per capita gross domestic product (GDP) was about US\$180 in 1991, which is among the lowest level in the world. The share of the agriculture-fisheries sector in GDP was 46.9 percent including 40.6 percent of agriculture production. This fact shows that agriculture is the mainstay of the national economy. The working population in the agriculture-fisheries sector increased by about 85 percent in 1991.

In 1967, Cambodia produced about 2.45 million tons of rice. In 1969, about 0.5 million tons (paddy weight basis), was exported which is equivalent to about 44 percent of the total exports of the country. The civil war, however, brought a drastic decrease in rice production by 0.56 million ton in 1979. In 1991, the country earned a rice production of 2.4 million tons.

The rice shortage in 1991 was recorded at about 170,000 tons. The shortage in the rice supply was attributed to the low yield per hectare and rapid population increase. The rice cropping areas in the same year were only 70 percent of that in 1967, which suggests that about 630,000 ha of the paddy fields were devastated during the civil war. The increase in rice productivity will not only improve rice cultivation, but also encourage other agricultural activities leading to revitalization of Cambodian agriculture as a whole. The Ministry of Agriculture of Cambodia has taken up rice production increases as a measure for economic rehabilitation of the country so as to revive rice exportation at a level before the civil war.

In order to attain Cambodia's rice production target, Cambodia shall require quick food aid while dealing with their own food crisis. Cambodia should also accelerate the consolidation of agro-infrastructure such as irrigation and drainage facilities and achieve stable rice production through increased yield per hectare. Rice production increase shall also be achieved through better agricultural inputs like quality seeds, fertilizers, agri-chemicals, farming machines, etc. Especially supply of quality seeds is indispensable, where strengthening in production and distribution of quality seeds is a pressing need.

The Ministry of Planning has designated the year 1995 as a development target year for economic reconstruction of the country and launched the Socio-Economic Rehabilitation and Development Programme for 1991-1995, which includes the following development goals:

- (1) To regain the national economic status to the level of 1968-1969.
- (2) To rehabilitate or construct major agro-related facilities for consolidation of socio-agro infrastructures.
- (3) To expedite development of the national economy so as to ensure a better link with the world economy; and,
- (4) To actively introduce foreign capital and enterprise.

Under the Programme, agricultural sector is accorded the highest priority in order to supply sufficient food and nutrient to nation. The Programme is aimed at expansion of production and stabilization of major staple foods especially rice. There are several agricultural development projects formulated to realize the above Programme. The Rehabilitation Project of the Toul Samrong Agricultural Technical Center is one of the projects that is given the highest priority.

The paddy seeds to be produced in the Toul Samrong Agricultural Technical Center (hereinafter called "the Center") are used for upgrading genetic features and quality of the paddy, unit yield increase, eliminating unfavorable varieties etc. in the Northwest region which consists of five provinces, including Battambang province. The supply of the paddy seed by the Center is inadequate due to the lack of facilities and equipment from the

destruction of the Center, although 287 tons of seed paddy for distribution was produced in 1991.

The total area of the region consisting of five provinces is about 62,700 square kilometers. The total population in 1992 was about 1,850,000 of which about 86 percent of the population, 1,560,000 lived in the rural areas. The total rice cultivation area in the Northwest region is about 440,000 ha, which accounts for about 26 percent of the nation's cultivated area. Consequently, the Northwest region is one of the largest rice growing regions in the country. There are many types of weedy varieties in the paddy fields of this region. The presence of these regressed weed varieties resulted to low unit yield and low quality of rice. The local varieties have been cultivated by traditional extensive farming works with wet season cropping.

Although the Northwest region has high potential for the development of irrigated agriculture, development in the region is lagging behind other regions of the country.

There are at present 340,000 refugees temporally settling in the Northwest region bordering Thailand, and about 79 percent wish to return and settle down in the Northwest region, where a large part of the total war-devastated paddy fields (630,000 ha) are uncultivated. Under these circumstances, the agriculture development, especially the development of rice cultivation, is vital to this region, where strengthening of quality seed production is required.

Toward this end, the Ministry of Planning of Cambodia has formulated the rehabilitation project of the Center, the largest national seed farm in the Northwest region. The Supreme National Council (SNC) has requested the Japanese government to extend grant-aid cooperation for the implementation of the project.

In response to this request, JICA dispatched a preliminary study mission to the field from June 30, 1992 to July 24, 1992 to carry out a study and confirm the details of the request by identifying the executing agencies of the Cambodian side, and determining the possibility of the project being implemented under grant-aid cooperation. Finally, JICA decided to execute

the Basic Design Study of the project based on results of the preliminary study team. According to the aforementioned conclusion of the preliminary study, JICA dispatched the Basic Design Study Team to the field for 25 days from October 26, 1992 to November 19, 1992 in order to conduct a project field survey on the details of the cooperation, the scale of the project, and others etc. Then, the Team made an analysis of the records and data so far collected. The Basic Design Report was prepared in Japan after the Draft Report Explanation Team was dispatched to Cambodia from March 29, 1993 to April 7, 1993. As a result, the Team concluded that the project would greatly contribute to the improvement of the local farmers' living standard through upgrading the yields and quality of rice with use of quality seeds.

The Toul Samrong Agricultural Technical Center was established in 1965 under a Japanese grant-aid scheme so that rice cultivation techniques could be firmly established and extended to the local farmers. Since 1964, many Japanese experts have been dispatched to Cambodia to be engaged in technical cooperation for the establishment of rice cultivation techniques. However, in June 1970, civil war broke out and Japanese technical cooperation was interrupted and the Center ceased operating. During the civil war, the major facilities of the Center were destroyed and the equipment also disappeared. The Agronomy Department utilized the Center as the national rice seed production farm and received aid from the former USSR (presently Russia) for a few years after the war.

Some of the experts who obtained relevant know-how on paddy seed production during Japanese technical cooperation period, survived in the civil war, and have been carrying out various improvements on rice production including the multiplication of quality paddy seeds. The facilities and equipment supplied by the former USSR are not at present in operation due to non-availability of necessary spare parts or worn-out.

Together with the rehabilitation of these facilities, the Agronomy Department has formulated a plan for production of quality paddy seed taking the northwest region as its main objective area. Operation and maintenance of the Center for the seed production plan can be carried out successfully by staff of the Agronomy Department. For the successful strengthening of seed production, the following objectives are required: (1)

to improve the seed farm (2) to improve rice cultivation for seeds (3) to improve post-harvesting works, (4) to introduce seed processing, and (5) to apply seed testing. In addition, rehabilitation and construction of some buildings together with other related building facilities; consolidation of building lots and farm plots; provision of farming and seed processing machines; seed testing equipment and others, shall be carried out.

The field surveys and analyses made by the Team suggest that a development plan shall cover quality control and the production increase of seed paddy, all of which are currently needed. The results of the analyses of the request for a grant-aid project are shown below:

(1) Buildings and Building Lots

The main building of the Center has been damaged and only the inside of the reinforced concrete (RC) structures remains. The total renovation of the main building will facilitate seed on quality control, seed testing, and laboratory work on quality seeds. Workshop, seed processing house, warehouse, meeting room, and dormitory shall be newly constructed because all the existing facilities are either damaged or worn-out.

Since infrastructure facilities such as water supply, sewerage, sanitation, electric supply, on-farm roads, and seed drying yards are damaged, reconstruction of these facilities is essential.

(2) Seed Production Farm

The current unit yield of seed paddy per ha of the Center is only 1.5 tons on an average, due primarily to lack of irrigation water and poor irrigation conveyance facilities. About half of the seed paddy production farms had been suffering from submergence damage. The existing canal system is used for dual purposes of irrigation and drainage which pose a great problem to on-farm water management.

The traditional extensive paddy cultivation (direct sowing method) will not be changed to rice transplanting-type cultivation in the existing paddy fields. Elimination of weedy varieties will not also be conducted under the

present conditions. The operation efficiency of farming machines and farm works will not be reduced in the present farm roads and large size farm plots. Consequently, the rehabilitation of the existing farms will enable the growing of a wide variety of quality paddy varieties together with the improvement in seed quality.

(3) Farming Machines and Seed Testing Equipment/Materials

Most of the existing farming machines are not operational and the necessary spare parts are also not available at present.

Foreign matters can be found in the harvested paddy seeds and seed processing equipment or devices will be necessary to separate quality seeds from such matter. A strict quality check and testing of paddy seeds will make the processed seeds be effectively utilized. The quality check and testing equipment and tools for quality paddy seed production are not available at present.

According to the above study results, the details of the proposed rehabilitation plan are as follows:

(1) Rehabilitation of the Related Buildings and Facilities

The present activities shall be maintained for a nation-wide variety performance test. And the quality and quantity of the seed paddy to be produced shall remain at a level suitable to the present conditions. The seeds to be produced under this manner should be distributed directly to local farmers in the northwest region through the provincial government staff or to be distributed in the same manner after further multiplication in the provincial government farms.

The proposed project has a staffing plan including 85 staff members to cover the activities in producing about 600 tons of seed paddy per annum. The following buildings and facilities will be required for the successful executing the project.

Buildings

Rehabilitation of the main building	1,496 sq.m.
Workshop construction	250 sq.m.
Seed processing house construction	220 sq.m.
Warehouse construction	525 sq.m.
Meeting room construction	195 sq.m.
Dormitory construction	355 sq.m.

Other facilities related to the buildings

Elevated water tank and pump	1 lot
Water distribution system	1 lot
Generator and power distribution lines	1 lot
Sewerage and sanitation facilities	1 lot

(2) Rehabilitation of Building Lots

Rehabilitation of the above buildings will require the following building lots:

Rehabilitation of roads in building lots	7,000 sq.m.
Drainage ditches	900 m.
Construction of seed drying yard	3,600 sq.m.
Rehabilitation of seed drying yard	3,600 sq.m.

(3) Rehabilitation of the Farms

The cultivated area consists of one ha for an experimental field, 8 ha for foundation seed fields and 200 ha for seed production fields or a total of 209 ha. Out of this total area, 103 ha will be cultivated for transplanting paddy cropping, and 106 ha for direct sowing paddy cropping. For this purpose, the following rehabilitation works shall be carried out to ensure a stable seed production:

Feeder canal rehabilitation	4,122 m.
Irrigation canal rehabilitation and construction	16,598 m.
Drainage canal rehabilitation and construction	16,058 m.

Farm road and construction	20,665 m.
Arrangement rehabilitation of farm plot shape	103 ha.

(4) Procurement of Equipment and Materials

The Plan for operation and maintenance of the Center after its rehabilitation will be made to meet the present capacity in staff and costs available at present. Thus, the procurement plan for equipment will be prepared taking into consideration the minimum operation and maintenance costs for the equipment and materials, which can be controlled and managed by the government staff concerned. The following equipment and materials will be selected for the Plan;

Farm machinery	1 lot
Thresher and seed processing machinery	1 lot
Laboratory equipment for seed testing	1 lot
Workshop machinery and equipment	1 lot
Office equipment	1 lot
Vehicles	1 lot
Supporting equipment for use in the center	1 lot
Cabinet articles	1 lot

The following will be the undertakings by the Government of Cambodia and the Government of Japan:

By Government of Cambodia

- Exemption of tax, duty, levy, etc. for imported equipment and materials for the project
- Exemption of taxes for Japanese staff members and other businessmen engaged in the project
- Bearing of the necessary fees and charge for banking services for foreign exchange transactions for import works
- Recruitment of staffs for O/M of the project facilities and budgetary support for their works.

By Government of Japan

- Rehabilitation or construction of a main building, a workshop, a seed processing house, a warehouse, a meeting room, and a dormitory
- Rehabilitation and consolidation of building lots and farm plots
- Procurement of equipment and materials for the project
- Detailed design, tendering, and supervision for the above construction works, and design and tendering for procurement of equipment and materials

The executing body for the project will be the Ministry of Agriculture, Cambodia, which will establish a committee for the project. The Committee will consist of Vice-Minister, Directors of the Planning Department, and the Agronomy Department. The Committee will assign the Agronomy Department to implement the project, including the recruitment of staff and personnel required for the project within the Department, or from other departments, if necessary.

The project implementation will require about twelve (12) months from the date of the contract.

The seed production at the Center is expected to increase approximately from the present 319 tons to 567 tons and the seed quality will be upgraded to the level suitable to the present conditions. Furthermore, the seed paddy will be distributed to the local farmers cultivating a total of 479,000 ha, mainly in the Northwest region so as to generate an increase in rice production as well as obtaining high quality rice production.

The farmers to be benefited by the project are estimated to be 1,817,000 persons including 1,587,000 of the original inhabitants and 230,000 of resettled refugees. The project is considered viable and can be taken up as a grant-aid project by the government of Japan.

Based on the results of the basic design study of the project, the following recommendations are given to the Cambodian side:

1. For the implementation of the Project under the Grant Aid Program by the government of Japan, security in the Project area should be maintained.

2. The rehabilitation of the Center is focused on immediate improvement of seed production qualitatively as well as quantitatively, taking into account the operation and maintenance services of the project facilities and equipment/materials by the Cambodian side. Facilities and equipment to be procured under this project should be well operated and maintained by the Cambodian side at all times.

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ABBREVIATION AND GLOSSARY

ADB	Asian Development Bank
CARRDI	Cambodian Rice Research and Development Institute.
CCAM	Central Company of Agricultural Materials
CDAI	Chumear Daung Agricultural Institute
CIRP	Cambodia-IRRI Rice Project
DOA	Department of Agronomy
DOH	Department of Hydrology
FAO	Food and Agricultural Organization of the UN
GDP	Gross Domestic Product
IBRD	International Bank for Reconstruction and Development
IMFI	International Monetary Fund
IRRI	International Rice Research Institute
MOA	Ministry of Agriculture
NGO	Non-Governmental Organization
O & M	Operation and Maintenance
OXFAM	Oxford Committee for Famine Relief
SNC	Supreme National Council of Cambodia
UNDP	United Nations Development Programme
UNTAC	United Nations Transitional Authority in Cambodia
UNHCR	United Nations High Commissioner for Refugees

CONVERSION FACTORS

(As of November, 1992)

Riel	US \$ 0.00020
US \$	2,000 Riel = 126.45 Yen
Baht	4.98 Yen

Unit

km	kilometer
KVA	kilovolt Ampere
kwh	kilowatt-hour
ton	metric ton

CHAPTER 1. INTRODUCTION

CHAPTER 1. INTRODUCTION

In October, 1991, the Paris Peace Agreement for Cambodia was signed in Paris by the Four Parties of Cambodia and 19 other associated nations, which marked an end to the civil war lasted for 13 years. At present, the war-devasted areas has been under reconstruction and development in line with the direction decided in the Socio-Economic Rehabilitation and Development Programme 1991-1995. The Programme has adopted the following targets;

- (1) The national economy shall be restored to the level of 1968 to 1969.
- (2) Rehabilitation and construction of the major facilities will be implemented for socio-agro infrastructures.
- (3) The national economy shall be conducted to ensure tight links with the world economy.
- (4) Foreign investments and enterprises shall be introduced as vigorously as possible.

The Programme has allotted the highest priority to the agriculture sector compared to various sectors like, industry, transportation, tourism, telecommunication, and others. The agricultural sector occupies the largest project amounts in the national development budget for five years from 1991 to 1995.

Under the circumstances, the Cambodia has requested the Government of Japan to extend grant aid for rehabilitation of the Toul Samrong Agricultural Technical Center, which was established by grant aid from the Government of Japan in 1965.

In response to the request, the Japan International Cooperation Agency (JICA) dispatched the Preliminary Study Team to Cambodia for 25 days from June 30 to July 24, 1992, so that the Team could study the background, purposes, present condition of the Center and scope of necessary rehabilitation work. The scope of work was confirmed with minutes exchanged by both representatives of JICA and the Ministry of Agriculture, Cambodia.

According to the above results, the Government of Japan decided to conduct the basic design study for the grant aid, and JICA sent the Field Survey Team for the basic design (B/D), with Mr. Shoji Shimbo, Managing Director of the Grant Aid Study and Design of JICA as the team leader from October 26 to November 19, 1992.

The objectives of the Team were to conduct a field survey and to make contact with the people belonging to the various authorities concerned so as to reconfirm the background to the rehabilitation, capacity of operation and maintenance, and others to look for the scale and components of the scope of work under the grant aid agreement.

CHAPTER 2. BACKGROUND OF THE PROJECT

CHAPTER 2. BACKGROUND OF THE PROJECT

2.1 Present Status of Agriculture in Cambodia

2.1.1 General

Crop production occupies about 63 percent, the largest share, in production of agriculture, forestry and fisheries in Cambodia. (Refer to Table 2-1)

TABLE 2-1 GROSS DOMESTIC PRODUCT BY SECTOR

(Unit : %)

Sector	1987	1988	1989	1990	1991
1. Agriculture, Forestry, Fisheries	51.4	44.0	45.8	45.4	46.9
Crops + Rubber	27.8	27.8	28.9	26.4	29.4
- Rice	(18.0)	(17.7)	(19.0)	(17.9)	(17.7)
- Other crops	(9.8)	(10.1)	(9.9)	(8.5)	(11.7)
Animal Husbandry	17.1	10.4	11.9	12.6	11.2
Fisheries	4.5	4.1	3.8	5.1	4.8
Forestry	2.0	1.6	1.2	1.4	1.5
2. Mining and Manufacturing	15.3	16.9	16.7	16.3	15.6
3. All others	33.4	39.1	37.5	38.3	37.5
Total	100.0	100.0	100.0	100.0	100.0

Source : World Bank

Rice production in 1991 accounted for about 60 percent of the crop production in supplying the staple food to the nation as well as playing a vital role in the Cambodian national economy. Major crops next to rice are rubber and maize, which have been cropped in 62,000 ha and 46,000 ha respectively, and mungbean, vegetables, tobacco, soybean, sesame, cassava, and others follow the above. They have cropped areas of more than 10,000 ha but not exceeding 25,000 ha in extent. (Refer to Table 5-1 in Appendix)

Although there are about 4.5 million ha of total cultivable land accounting for about 28 percent of the national land area, the currently cropped land area is only about 2.8 million ha for the period 1990-91. Two or more crops per year were carried out on only 50,000 ha of the currently cropped land.

Rice production in the period from 1990-91 is presumed to fall short of the national demand by 170,000 tons, while the World Food Programme suggested that the shortage of rice production in Cambodia would be 150,000 tons in 1992. (refer to Table 5-3 in rice on the basis of paddy)

2. 1. 2 Paddy Rice Production

In 1967, paddy was cropped on land of about 2.51 million ha, with about 2.46 million tons of rice, on the basis of paddy, being produced. In 1969, about 500,000 tons of paddy were exported, which accounted for about 44 percent of the total amount of the exports of that year. The civil war devastation in the 1979, however, resulted in terrible decrease in cropping acreage by 770,000 ha and in production by 560,000 tons. While in the 1980s, rapid increase in production was observed and in 1991-1992, the cropping areas reached about 1.88 million ha and the production 2.4 million tons.

The cropping areas, however, were restored to only 75 percent of the former 2.51 million ha of 1967, which suggests that the rice production in Cambodia has not been recovered to its level of before the civil war. The paddy cropping, occupying about 92 percent of the total crop cultivation areas in the country, has played a vitally important role in farming for the majority of local people.

Development of irrigation and drainage has lagged remarkably throughout the country, where almost the only supplementary irrigation in the wet season is currently practiced for paddy rice. On the other hand, the civil war has prevented the existing irrigation facilities from practicing successful operation and maintenance services, so that the irrigated areas total only 360,000 ha, about 19 percent of the total potential paddy cropping areas. Consequently, paddy cropping in Cambodia is fully dependent upon the wet season cultivation, which is the best use of the natural conditions. The paddy cropping in the country can be classified as shown in the Table 2-2.

TABLE 2-2 PADDY CROPPING CLASSIFICATION BY ENVIRONMENTAL CONDITIONS AND BY PADDY VARIETIES

Environment/Type	Variety	Harvested Area (1991) (⁰⁰⁰ ha)
<u>Wet Season</u>		
1. Rainfed Lowland (Including Supplementary Irrigated)		
① Shallow water (less than 0.1 m usually)	IR (IRRI) & Early	286
② Moderate deep water (0.1 to 0.3 m)	Medium	512
③ Lower deep water	Late	671
<u>Sub-total</u>		<u>1,469</u>
2. Deep Water (More than 0.5 m)	Later and Floating rice	73
3. Upland	Upland rice	29
<u>Total</u>		<u>1,571</u>
<u>Dry Season</u>		
	IR & Early	147
<u>Grand Total</u>		<u>1,718</u>

Source : Planning Department Ministry of Agriculture and Cambodia-IRRI Rice Project

Supplementary irrigation water for paddy rice has been given to a part of about 94 percent in the wet season, but most of the rainfed area of paddy relies on natural water supply. Such environmental conditions for paddy rice as water depth, rainfall, etc. largely vary according to paddy fields resulting in unstable cultivation of paddy. The paddy rice varieties are decided according to the maximum water depth that the local farmers can realistically expect. That is; the flatland with shallow water can be planted with early maturing varieties, and land with moderate water depth planted with medium maturing varieties, and land with deeper water are planted with late maturing varieties.

Mainly in irrigable paddy fields with shallow water, the early maturing varieties including IRRI varieties (IR varieties) have been introduced recently to be cropped under comparatively intensive cropping techniques for improved harvest per unit area. Regrettably, however, the areas cropped

with these varieties are less than 20 percent of the total wet season paddy cropped area.

Most of the wet season paddy rice currently cropped is medium or late maturing varieties and grown in the lowland areas with moderate water depths or deeper water. Mainly local varieties have been adopted for the wet season.

In certain paddy fields, such environmental conditions vary year by year as little rainfall or floods in the early growth period, or conversely, heavy flood often damages the crops. Due to the above fact, the average paddy yield is about 1.3 tons/ha, which remains the lowest in the world.

The reasons for such unstable and poor paddy production in Cambodia derive from the following factors.

- ① Damage resulting from drought, flood, etc.
- ② Inadequate farm inputs are supplied
- ③ Production technology remains at a low level.

Drought and flood damage can be prevented by realization of irrigation/drainage projects and flood control projects. Such countermeasures will however be unrealistic in view of the socioeconomic conditions of Cambodia at the present time. Under the circumstances, stable and sufficient supply of farm inputs and improving the production technology should be indispensable. Particularly, a successful supply of quality seed paddy is considered as the most important.

In general, seed replacement with quality ones would enable the yield to increase by about 10 percent, and at the same time, variety improvement in seed renewal should be able to raise the rice market prices by about 10 percent as well as through upgrading the quality of rice according to the Department of Agriculture.

Smooth and adequate distribution of good quality seeds will bring out an increase in the amount of rice to be supplied, by way of raising the

efficiency of farm inputs such as fertilizers and will also save rice milling loss as much as possible.

2.1.3 Seed Production and Quality Control

At present, there is no high-quality seed production or quality control system available in Cambodia. It is difficult to supply such high quality seeds to local farmers. Although the Ministry of Agriculture has been working for procurement and distribution of the paddy rice seed, the seed quality is not guaranteed as the level of technique is low. The quantity procured and distributed was about 4,000 tons in 1991, which covers only 2.0 percent of that year's cropping area. As a matter of fact, the present supply of the seed is not satisfactory both in quantity and quality. (refer to Table 5-8 in Appendix)

The following show the actual conditions of paddy rice seed production and distribution services rendered by the Ministry of Agriculture.

a) Source of Seeds for Distribution

There are three sources of seed supply available as follows;

① National Seed Farms

The Department of Agriculture operates three rice seed farms including the Toul Samrong Agriculture Technology Center. The seed produced in these farms totals about 540 tons. This amount accounts for about 11 percent of the total amount that the Ministry of Agriculture distributes throughout the country. The unit yield of seed production in these farms is as low as the local farmers production and yet, the quality control for the seed production is poor, not good enough to guarantee the quality of seed.

TABLE 2-3 PRODUCTION OF PADDY SEEDS IN NATIONAL SEED FARM (1990)

Farm	Area (ha)	Production (ton)	Location
1. Kop Srov	76	99	Phnom Penh Municipality
2. Toul Krasang	100	120	Kandal Province
3. Toul Samrong	210	317	Battambang Province
Total	386	536	

Source : Agronomy Department

② Provincial Government Seed Farms

There are six seed farms set up by provincial governments throughout the nation, the farming areas of which are about 10 ha on an average.

③ Rural Development Centers

The Ministry of Agriculture operates six Rural Development Centers. One seed farm has about 100 to 200 ha in cropped areas as set down by the guideline of the Rural Development Center by the farmers. The product of paddy is one of the source for seed procurement by the Ministry.

b) Seed Production and Distribution System

The seed production and distribution system adopted by the Ministry of Agriculture is follows;

① Seed Collection and Distribution System

The Planning Department of the Ministry of Agriculture will make an annual plan for seed distribution based on the seed requirement report submitted by the Provincial Agricultural Services.

② Procurement and Distribution System

The Provincial Agricultural Services have collected the seed from the aforesaid three sources. On the other hand, the Ministry of Agriculture also collects seed from the National Farms and Rural Development Center through the Central Company of Agricultural Materials (CCAM). The CCAM stores the seed in warehouses under the control of the Ministry of Agriculture, and distributes to the provincial governments with necessary amount through the CCAM. The local governments distribute the seed to individual farmers through their provincial offices.

c) Seed Distribution and its Problems

The procurement and distribution of seed under the plan of the Ministry of Agriculture in 1991 were recorded as follows;

Agency	Amount in 1991
- Procurement and Distribution by AIC	1,000 ton
- Procurement and Distribution by Provincial Agricultural Services	3,000 ton
Total	4,000 ton

The seeds supplied by the Ministry of Agriculture, including the seeds produced by the national seed farms cannot be highly rated as they are produced without adequate production technology, quality control or processing for quality seeds. Only a visual check or soaking the seeds in water is employed when the seeds are collected because no quality check or testing equipment or tools are available. Besides quality control for seeds, the poor production conditions at seed farms is another reason why low quality seeds are produced at the seed farms.

2.2 Outline of the Related Development Plans

2.2.1 National Development Plan

The Socio-Economic Rehabilitation and Development Programme 1991-1995 states the production targets for national staple foods such as rice, industrial crops for manufacturing, export products, etc.. As for rice, the production shall be increased from 2.95 million tons in 1991 to 4.0 million tons in 1995 along with a unit area yield increase from 1.45 tons/ha to 1.60 tons/ha.

For accomplishing the above targets the programme has the basic plan for agricultural development as shown below with five main items as important considerations.

- ① The agricultural administration organization shall be consolidated so that the specific and technological administration guidance and control can be executed successfully from the central government to the provincial governments.
- ② The major rice growing provinces shall provide experimental rice research facilities so as to develop and extend rice varieties to fully meet the local conditions.
- ③ The experimental research organization shall be established for major industrial crops and other important crops as well.
- ④ Irrigation development shall be promoted so as to extend the irrigated fields up to 450,000 ha.
- ⑤ Development and preservation shall be carried out intensively for increasing export of sea fish and fresh water fish together with techniques and promotion of fish culture.

With such basic plans established, some projects have been taken up for their materialization, and these projects have been classified into two groups by their agency; they are the projects to be started before 1993 and the other

after 1994. The following seven (7) projects are those with higher priority to commence in urgent requirement before 1993.

- ① Rehabilitation of the Toul Samrong Agricultural Technical Center in Battambang.
- ② Establishing a successful supply of agricultural inputs such as farm chemicals fertilizers.
- ③ Rehabilitation of small and medium-scale dams and irrigation facilities.
- ④ Supply of medicines and materials for prevention of animal diseases.
- ⑤ Supply of various agricultural equipment and devices such as meteorological equipment and irrigation equipment, including tractors with spare parts, large or medium-size pump units.
- ⑥ Modernization of Rubber Cultivation Center by introduction of the latest type of equipment and devices.
- ⑦ Possible expansion of agricultural land areas and establishment of production plans for production increases.

2. 2. 2 Regional Development Plan

At Present in Cambodia, there has been no regional development plan formulated which is consistent with the national development plan. Development has lagged behind in the northwest region of the country, which consists of five provinces including Battambang province where the Toul Samrong Agricultural Technical Center is located. This region, however, is deemed promising in future for agricultural development of rich potential.

The agricultural development of this region will play a vitally important role in securing an adequate food and nutrient supply to the nation as the primary target in the above national development plan, and will be accelerated with higher priority from now on.

Realization of this regional agricultural development requires agricultural productivity to be greatly raised by consolidation of the agricultural infrastructure such as irrigation facilities in medium-and long-term programmes. The areas to be benefited by irrigation projects in this region total about 52,000 ha, approximately 52 percent of the national total of projects listed in nation-wide major irrigation plans. When all of these projects are realized, the total irrigable areas will occupy about 30 percent of the paddy rice cropping areas in the region, constituting enormous progress in consolidation of the infrastructure of paddy rice cultivation.

The short-term improvement plans, however, for paddy rice cropping will require the distribution of quality paddy seeds, which can be achieved without infrastructure.

2.3 History and Details of Request

For the reconstruction of Cambodia, development of rice cultivation is taken up as urgent matters in the Rehabilitation and Development Programme 1991-1995 so that the problem of shortage of rice can be solved and farm production can be increased as soon as possible.

The Supreme National Council of Cambodia has requested the government of Japan to give grant aid for the rehabilitation of the Toul Samrong Agricultural Technical Center in Battambang, which was built in 1956 under a Japanese grant aid for establishing mass paddy harvesting technology. However, it was destroyed during the civil war.

JICA, in response to the above request, dispatched the preliminary study team to the field in 1992. The study concluded that the proposed

project is to try to strengthen the paddy rice seed production increase now underway without dispatching Japanese experts to the site. The scale and size of the facilities will be limited to the range that the Cambodian Authorities concerned can manage and control.

The details of the grant aid which have been agreed to between representatives of JICA and the Ministry of Agriculture of Cambodia are as follows:

(1) Rehabilitation and/or Construction of Buildings

- Main building (office, laboratory, etc.)
- Workshop
- Building for seed processing
- Building for guests and trainees
- Warehouse

(2) Improvement of Infrastructure

- Building Lots
- Seed Farm

(3) Procurement of Machinery and Equipment

- Farming machinery
- Thresher and seed processing machines
- Laboratory equipment for seed testing
- Workshop machines and equipment
- Office equipment
- Equipment for dissemination
- Vehicles

2.4 The Project Area

2.4.1 Location of the Project Area

The Toul Samrong Agricultural Technical Center located in Battambang is in Battambang Province. In the northwest region which consists of five (5) provinces such as Battambang, Pursat, Siem Reap, Banteay Meanchey, Preah Vihear provinces. The Battambang city, the provincial capital, which is the second largest city of Cambodia, is located about 250 km far from the capital, Phnom Penh. The province is connected with Phnom Penh by National Road No. 5 and the railway. About a one hour flight from Phnom Pehn airport to Battambang airport is available twice a week. Traffic is possible from the neighbouring country, Thailand, through Sisophon.

2.4.2 Economic Conditions

The total area of the northwest region with its five provinces is about 62.7 thousand sq.km, and the total population in 1990 was about 185,000. The population density of the region at 29.5 persons per sq.km is considerably lower than that of the overall country at 47.1 persons per sq.km. About 86 percent of the total population, 156,000 persons, live in the rural areas. Consequently, the region is one of the largest rice growing regions in the country and has surplus rice. The overflow rice to the capital areas is well know as Battambang rice. However the major economic activity in the region is in the agricultural sector, forestry and fisheries. Specifically, rice production is the mainstay of the region. Battambang city is the center for local administration as well as marketing in the region.

According to the data of the United Nations High Commissioner for Refugees (UNHCR) there have been about 340,000 war refugees temporarily settled in the northwest areas neighboring Thailand, about 79 percent of whom wish to return to settle down in this northwest region, where a large part of 630,000 ha are left uncultivated as the war devastated paddy fields. A settlement project for refugees has started in the region.

2.4.3 Natural Conditions

(1) Geographic Conditions

The topography of the northwest region consists of plains which are located in the vicinity of the Tonle Sap lake, and the mountainous land of the Dangrek mountain range which forms the international border with Thailand, and Cardamones and Elephant mountain ranges which are located along the coast of the Gulf of Thailand. The plains occupy two areas, namely a very flat part with slopes of only about 1/6,000, and a gentle slope on undulating land with a slope of about 1/2,000, located in the upper part of the national road. The Tonle Sap lake extends the water surface through flood water, flowing from the Mekong River. Flood water brings fertile soils to paddy cultivated areas around the lake and in the surrounding areas.

Inundation by flood water facilitates breeding space for freshwater fish. After mid October, the current of the Tonle Sap is in the reverse direction and the lake surface is reduced from more than 10,000 sq.km to about 3,000 sq.km.

(2) Meteorological Conditions

The rainy season usually starts in May to June and ends in October to November. The dry season is divided into two periods, a comparatively low temperature period of January and February, and a higher temperature period in March to April.

a) Temperature and Relative Humidity

The annual average mean temperature is 27.4°C, the annual average mean maximum temperature is 31.0°C in April and the annual average mean minimum temperature is 21.4°C in December were observed at the Battambang Meteorological Station. The average monthly mean maximum temperature is recorded 39.2°C in April and the minimum is 15.5°C in December. The climate is thus suitable for paddy cultivation.

The mean relative humidity of 78.9% is comparatively high, however this decreases to 70% in March. In the rainy season, weather conditions with higher temperature and higher humidity, sometimes above 80% are recorded throughout the rainy season.

b) Wind and Hours of Sunshine

The mean wind speed is as low as 1.5 m/sec and typhoons occur very rarely. In June, the monthly mean wind speed increases slightly to 2.0 m/sec.

The average wind direction is easterly in dry season and southwesterly during the rainy season. At the end of the rainy season, the direction changes to a northeastern one. The annual mean daily sunshine hours are observed as 7.2 hrs. The monthly mean sunshine hours during the dry season is 8 to 9.5 hrs/day, while in rainy season 5 to 6 hrs/day.

c) Evaporation

The average annual mean evaporation rate is 3.8 mm/day. During the rainy season the rate is less than 3.0 mm/day and in the dry season 4.0 to 5.4 mm/day. The total annual evaporation depth is 1,379 mm.

d) Rainfall

The average annual rainfall is recorded at 1,300 mm. During the dry season from December to April, the monthly mean rainfall is less than 100 mm, while during the rainy season from May to November, the monthly rainfall is more than 100 mm. The beginning and ending of both seasons varies year by year. In 1985, monthly rainfall exceeds 40 mm from January, while in 1986 and 1987 the beginning of the dry season occurred in June. And there are many cases such as in 1992, the end of the rainy season is over by October. Irrigation in the rainy season is essential to perform the

rice transplanting and to the growing period as well as to gain a stable rice production.

During the observation period from 1981 to 1992, the extreme maximum daily rainfall was recorded at 138.2 mm on November 5, 1990.

(3) Hydrological Conditions

a) River and Canal

There are many rivers providing water resources in this region. The water source for the Technical Center is the Mongkol Borei river with a catchment area of 2,850 sq.km (at Bovel village). The discharge of the river fluctuates between 0.8 cu.m/sec in drought periods and 159.6 cu.m/sec in flood periods, which is equivalent to 0.28 to 56 lit/sec/sq.km. The maximum discharge is calculated at about 200 times as big as the minimum discharge. A main irrigation canal and five branch irrigation canals have been in operation to supply water from the Bovel river to the irrigation area of about 30,000 ha in rainy season. Only 200 to 400 ha of paddy field in dry season is irrigated, including this Technical Center.

b) Tonle Sap Lake

The major rivers of this area all flow into the Toule Sap Lake. Due to lack of water level records of the lake, it is rather difficult to understand the an influence of the lake water on farm land. According to information from interviews in the field, high water levels flooded in 1946 and 1969 covering the railway and reaching the Technical Center. In other years, there has been flood damage from the lake. Based on the farmer's information, ordinary high water level in the rainy season is about 9.0 m, the lake water does not affect the Center.

(4) Soil

Soils which exist in the lake side areas near the national road, are classified as Lacustrine Alluvials. The areas with these soils are submerged by part of the Lake during flooding in the rainy season. The soil consists of dark brown clay with patches of dark red, neutral plastic clay with occasionally sandy clay or sandy loam strata. Acidity of top-soil ranges between 6 and 7 and of subsoil between 5.5 and 7.2. The crop has been mainly cultivated as floating rice during the rainy season. In the dry season, the land is either fallow or, sometimes, cultivated with vegetables or beans. If irrigation water could be applied during the dry season, these soils are suitable for cash-crop cultivation. The phosphate content is low.

Soils which extend in areas on the mountainside from the national road are classified into Brown Hydromorphics composed of colluvial materials of mixed basic and acid sources. These soils constitute the richest rice producing soils of Cambodia. They are described as sandy clay loam to clay soils with a surface horizon of a variable thickness averaging 25 cm. The pH values of 6 to 8. The soil characteristics of the subsoils are almost the same as the top soils. The rice in these soils are mainly wetland in the lake side. The average yield of rice ranges from 0.8 to 1.0 ton/ha, in the southern part of the lake side area. In the mountain side, the yield is recorded from 1.2 to 2.0 ton/ha. When using improved rice varieties, given proper fertilizer application, irrigation and farming practices, the future potential yield is estimated at 3.5 ton/ha of paddy on the average.

(5) Land Arrangement

The Agricultural Technical Center is located in a part of the paddy field which has a gentle slope of 1:2,000 in the Mongkol Borei river basin located 8 km west from the Center. This paddy field is a part of the Bovel irrigation project which covers about 30,000 ha, receiving its water from the Monkol Borei river. The Bovel irrigation project is one of six (6) proposed irrigation projects for main paddy rice production areas in Battambang province under the irrigation development plan of the Provincial Agricultural Services. In this irrigation plan, the existing Bovel irrigation system will be rehabilitated in

the future. At present, the provincial irrigation department still maintains for dredging work on mud soil deposited in the canals.

An area of 300 ha at the Center is divided into two parts of 209 ha for experiment and seed production paddy field and 91 ha for building and others lots. The details of land arrangement is made in Table 2-4.

TABLE 2-4 LAND ARRANGEMENTS FOR THE CENTER

Land Arrangement	Area
- Experimental Lot	1 ha
- Foundation Seed lot	8
- Seed Production Lot	200
Sub-total	209
- Building and Feeder Canals	91
Total	300 ha

2. 4. 4 Social Conditions

Besides National Road No. 5 from Phnom Penh to Sisophon, National Road No.6 serves for transportation from Compong Cham to Poipet in the northwest region, with the junction of two roads at Sisophon. A few feeder roads are being developed without almost no network, linking between the national roads and feeder roads. Those roads, including the national roads, have not been well functioning due to the inadequate operation and maintenance services, are interrupted at many points. No functioning electric power distribution or telephone systems are available except for some small-scale ones in Battambang city. The supply of electricity and water is limited to some parts of the urban area.

2.4.5 Present Status of the Toul Samrong Agricultural Technical Center

(1) Building

a) The Building Lot

The building lot is a rectangular piece of land covering an area of about 6.3 ha approximately 210 m long from north to south and approximately 300 m wide from west to east, located around 220 m from National Road No. 5. There are three reservoirs for daily use. The first is 50 m wide and located to the north of the lot. The lot at present is divided into two areas by a road running through the middle of the plot from west to east. Operational facilities are spread across the southern part and residential facilities in the northern part. Problems of the site as a building lot are described out below.

There are many ponds at the site, which were once borrow pits for filling materials of reclaiming building plot. The bearing power of those reclaimed lands is still low even 30 years after the completion of building construction.

The building lot is surrounded by banks of about 50 cm, with two openings for access road. Inside the banks there is a circular road surrounding the plot, however, the road is not paved and soil is sticky clay, therefore the surface of the road turns to mud when it rains, which makes vehicle traffic difficult. The center road running across the site from west to east is a gravel paved road, but its width is not enough, and in addition to damage from settlement, drainage of the road surface is bad causing traffic difficulty during the rainy season. Access roads to existing buildings are also not paved and have the same problems. Broken collection facilities and drainage facilities of existing buildings also make road drainage poor.

Foundation work for a solar seed drying yard, which is located in the southern center of the site, is inappropriate. Concrete, placed in the

form of plate without reinforcement bars causes cracks and non-uniform settlement, which, in turn, result in malfunctioning.

Ponds at the site are used for collecting rainwater, however, there is no connection to the drainage facilities, consequently water overflows in the case of heavy rain which causes damage to buildings by inundation in the past.

b) Building

Almost all the 23 buildings in Center are still in existence. These buildings are classified into operational facilities of the center (11 buildings), residential facilities (9 buildings) and electricity distribution facilities (generator room). In the case of the buildings structures, they are made of non-reinforced concrete and have structural defects in their foundation and floors. Structural cracks due to non-uniform settlement have occurred, but when the building is two-storied such defects are minimal. Buildings using wooden materials suffer seriously from termites and leaking. No buildings are intact from the civil war and their electrical, plumbing equipment and even sanitary equipment are missing. The problems of rehabilitation for the main building, the guest house and others are summarized as below, and refer to Basic Design Drawing No.1.

- i) Main Building : Existing Building No. 1 (Requested Building A)
- Structure : RC, two stories, wooden truss, asbestos cement roofing
- Area : Ground floor : 680 sq.m, 1st floor : 822 sq.m
Total : 1,502 sq.m

RC structures are considered to be strong enough for extensive restoration, because there are no structural defects of the main structures of beams and building columns. Non-uniform settlement occurs frequently in and above the ground floor of the main building and cracks are found in the concrete floor. Lateral cracks on walls caused by settlement of the floor can be found and damage from

caused by settlement of the floor can be found and damage from shell bursts can be seen on columns in the ground floor. All the doors are gone. On the first floor, handrails for stairs and corridors and their piers, beams and cross beams have been removed or are seriously suffering from termites and leakage, as are the wooden truss roofs.

- ii) Guesthouse : Existing Building No. 13 (2 buildings)
 - Structure : RC, one story, wooden truss, asbestos cement roofing
 - Area : 196 sq.m, terrace 60 sq.m

It seems impossible to restore and to rehabilitate the existing guest house. There is no connection between its foundation for RC structure and beams under the ground and several longitudinal flaws caused by settlement of foundation for columns exist at the connecting parts of the foundation and erected wall. Lateral flaws in the upper part of the opening are conceivably caused by defects in the beams under the ground and settlement of floor. Wood work in the hut is seriously damaged by termites and the same situation is progressing in another house. Wooden fittings, facilities for electricity, for plumbing and for sanitation have been removed with only pipes in the concrete still intact.

- iii) Lodge Type D: Existing building No. 16 (Requested building E)
 - Structure: Oddment materials
 - Area : 384 sq.m

It is impossible to rehabilitate the building because it is severely damage by termites and leaks of rain through the roof.

The present conditions of the generator room, a workshop, a cow house, a compost house, etc. of the building need to be dismantled and newly built structures are required:

- i) Generator Room : Existing building No. 8 (Requested building D)
Structure : RC, one story, wooden truss, asbestos cement roofing
Area : Ground floor 102 sq.m

It seems impossible to restore or rehabilitate the existing generator room. A structural flaw penetrates connection parts of RC columns located in the northeast corner and beams to the foundation. Second and third cracks are also found in the same place. These cracks are conceivably caused by settlement of foundations for the column. All the electrical facilities at the outset were taken away during the civil war.

- ii) Workshop : Existing building No. 3 (Requested building B)
Structure : One story wooden house, asbestos cement roofing
Area : 200 sq.m

It seems impossible to restore or rehabilitate the existing workshop. In addition to the damage caused by termites, the workshop is damaged by rainwater leakage and should be demolished.

Existing buildings No. 9, No. 10, the cow house and the compost house are to be demolished and there is no problem for them to be relocated to other places.

(2) Facilities Related to the Building

a) Water Supply Facilities

When the Agricultural Technical Center was established in 1965, the test well was drilled to obtain drinking water but no suitable aquifer was found. The drinking water was supplied from the O Nhor river by installing 1,500 m of pipeline along the national road. A lateral irrigation canal of the Bovel Irrigation Project was extended to the agricultural Technical Center. Hence the drinking water was supplied from the lateral irrigation canal.

From September 1992, Dutch soldiers have been staying in the Center. They drilled a well down to 60 m, however they could get no water from the well. They therefore carried water from 7 km to the north by tank lorry.

OXFAM constructed a well besides the O Nhor river and about 250 families obtain water from the well. But the center is not allowed to drill a well in this area.

b) Electricity

Electric power supply had not yet been achieved by 1992, and the power supply line will not be extended to the Center in the near future. Therefore an independent power generator should be installed.

c) Sewerage

Sewerage water should be treated through a local decomposition tank to be released outside the drainage channel.

(3) Facilities in the Experimental Farm

Facilities in the experimental farm consists of five (5) types of works, such as a feeder canal from the water source to the fields, farm roads, irrigation canals, drainage canals, and farm plots.

a) Feeder Canal

The feeder canal, about 4 km long, was constructed in 1986 by the Center. The canal is located to the southeast from the southern most edge of the farm, and is connected to Branch canal No.4 of the Bovel Irrigation System. The canal has such dual functions as an irrigation water supply to the farm, and a drainage function to drain excess water from outside farmland on the west side of the canal.

The canal sides slopes were damaged by slidden because of lack of less maintenance. The canal has an operation and maintenance (O & M) road of 6 to 7 m width on the left bank and with 3 to 5 m width on the right bank. Due to unpaved gravel roads, no traffic is possible in the rainy season and operation and maintenance works are rather difficult.

Especially, for gate operation work of the intake facility of the canal, the operator(s) have to reach the gate site on foot. Due to lack of maintenance, the check structure on the Branch canal and the intake facility of the feeder canal were damaged in many sections and were not functional. In three places, the dike of the feeder canal has been illegally cut off by farmers to intake water for farmland located to the south of the canal.

Irrigation water to the farm lands is supplied by the Mongkol Borei river. Since runoff water in the dry season is very low, and only 200 to 400 ha is irrigated, out of about 30,000 ha. According to the committee which is in charge of water distribution, there is a difficulty in getting domestic water for people from groundwater sources. Domestic water supply is given the highest priority, above that of an irrigation water supply. On farmland around the Center, therefore, only rice cultivation in the wet season is carried out once a year.

Even if irrigation water supply is available for the farm during the dry season, agricultural products are damaged by birds, rats and insects because there is no vegetation around the farmland during the dry season. There is also no farmers' demand for rice seed during the dry season cultivation, at present, because of the above-mentioned damages.

There is a farm pond at the Center, which is scaled at 120 m width, 130 m length with a water surface area of about 1.0 ha. The pond was constructed about 20 years ago in order to irrigate about 1.0 to 2.0 ha of rice fields during the dry season. However, this has been little effect, so far.

b) Farm Road

The farm is enclosed by four main farm roads. Another main farm road goes through the farm. Another four (4) farm roads were constructed across the farm. The main roads have the width of 6-7 m and 5 m, of which traffics during the rainy season is not possible. The central main farm road is connected to the O & M road of the feeder canal and plays an important role in transporting daily goods for the people. However, during the wet season, people are forced to walk due to muddy road surface caused by rainfall. Only manual transportation is, therefore, possible. Since the facilities under the farm road are destroyed, vehicles cannot pass on the road throughout the whole year.

c) Drainage Canal

Floodwater of about 20 cm depth originates from neighboring farm lands during the rainy season, is overflowing the road surface and flowing into the Center due to the low elevation of the main farm roads. The inundation annually damages about 80 to 100 ha of farmland. This is one of reasons that the rice yield is so low at the Center.

At present, there are no facilities to artificially drain excess water from the farm. In the 1970s, in the lower part of the farm, several pump sets with diameters of about 200 mm were operated for more than 15 to 30 days in order to drain excess water and to minimize the inundation damage to crops.

d) Irrigation Canal

Three main irrigation canals constructed along the main farm roads, have dual purposes such as irrigation and drainage. On-farm water management is, at present, rather difficult, because on-farm facilities are not yet constructed. A plot to plot irrigation system is at present employed at the farms. Since fertilizer supplied by the

Center will flow down or out from fields due to the plot to plot irrigation practice, effective fertilization cannot be expected. That is another reason for the low yield at the Center.

When supplying irrigation water to a field, the water level in the canal should remain higher than that of the fields surface. At this time, simultaneous drainage from neighboring fields is rather difficult due to the higher water level in the canal caused by the dual purpose of the canal system. Such high water levels will invite higher groundwater level which will impede root growing. This is another reason for the lower yield of rice. In the future, this kind of irrigation and drainage system will not be suitable for the production of good quality seed. The canals' embankments were damaged in many places due to poor maintenance.

e) Farm Plots

The number of farm plots are 88, separated by roads, canals and farm paddy dikes . The plot scale ranges from 0.8 to 7.0 ha and 2.5 ha is the average, which is rather wider and is suitable for farm mechanization. However, as the farm does not have a sufficient density of irrigation and drainage ditches and farm roads, water management is ineffective. The appurtenant structures of these canals are not suitable for adequate water management.

(4) Equipment

Most of the existing equipment of the Center had been supplied by the former Soviet Union. However, these were already obsolete and can be no longer used. Also, there are some new machines in the Center supplied by the country, but they are not being used due to the non-availability of personnel (technicians) and spare parts from current Russia. Therefore, the reuse of these equipment is quite difficult, as shown as follows;

a) Administration Equipment

The Khmer typewriter is being used for decade and has reached its life. The mimeograph machine is not used due to the operational

difficulty. The generators are abandoned because the engineers from the former Soviet Union had been withdrawn.

b) Vehicles

Although there are four (4) vehicles made in the Soviet, they are almost scrapped except the mini bus due to the problems on the spare parts. Only two (2) motorcycles are working.

c) Agricultural Machinery

Most of the agricultural machinery have already worn out. However, seed grader, precleaner and trencher are not applicable under the conditions of the Center. Also, large irrigation pump, rotary, manure spreader and disc plow are abandoned due to the lack of the spare parts, unsuitable designation, and soil condition, respectively.

d) Construction Machinery

All of construction machinery have been provided by the Soviet and used. Specially, the bulldozer have been used frequently that three (3) of six (6) units have been scrapped. Also, crane truck is abandoned due to lack of the parts. While three (3) bulldozer, except shovel parts and motor grader are being used for the road maintenance.

e) Workshop Equipment

The workshop equipment, consist of simple tools and such high-grade machinery as lathe, miller, drilling press, injection pump tester, provided by the Soviet. As a technical transfer was provided inadequately, these high-grade machinery become abandoned. Although some general workshop tools are used frequently, most of them are worn out or missing. This causes poor operation and maintenance in the farm machinery and other equipment

2.4.6 Agriculture, Seed Multiplication, Processing and Distribution

(1) General Conditions

In five provinces of the northwest, paddy rice cultivation has been practiced in the fields of about 479,000 ha, approximately 96 percent of the total areas of crop farming. Rice cultivation is the main crop for local farmers and occupies about 26 percent of the national total the same as the rice yield of the national share. Nearly 98 percent of the paddy fields of the region have been cropped during the wet season, while a few have been cropped in the dry season. Consequently, the system of double cropping in one year is very rare in the northwest region. (Refer to Figure 2-1 & Table 5-6 in Appendix)

The varieties in the low land in the wet season are the medium and late maturing varieties, and the paddy farming of the region is characterized by a large acreage cropped with late maturing varieties. (Refer to Table 2-5)

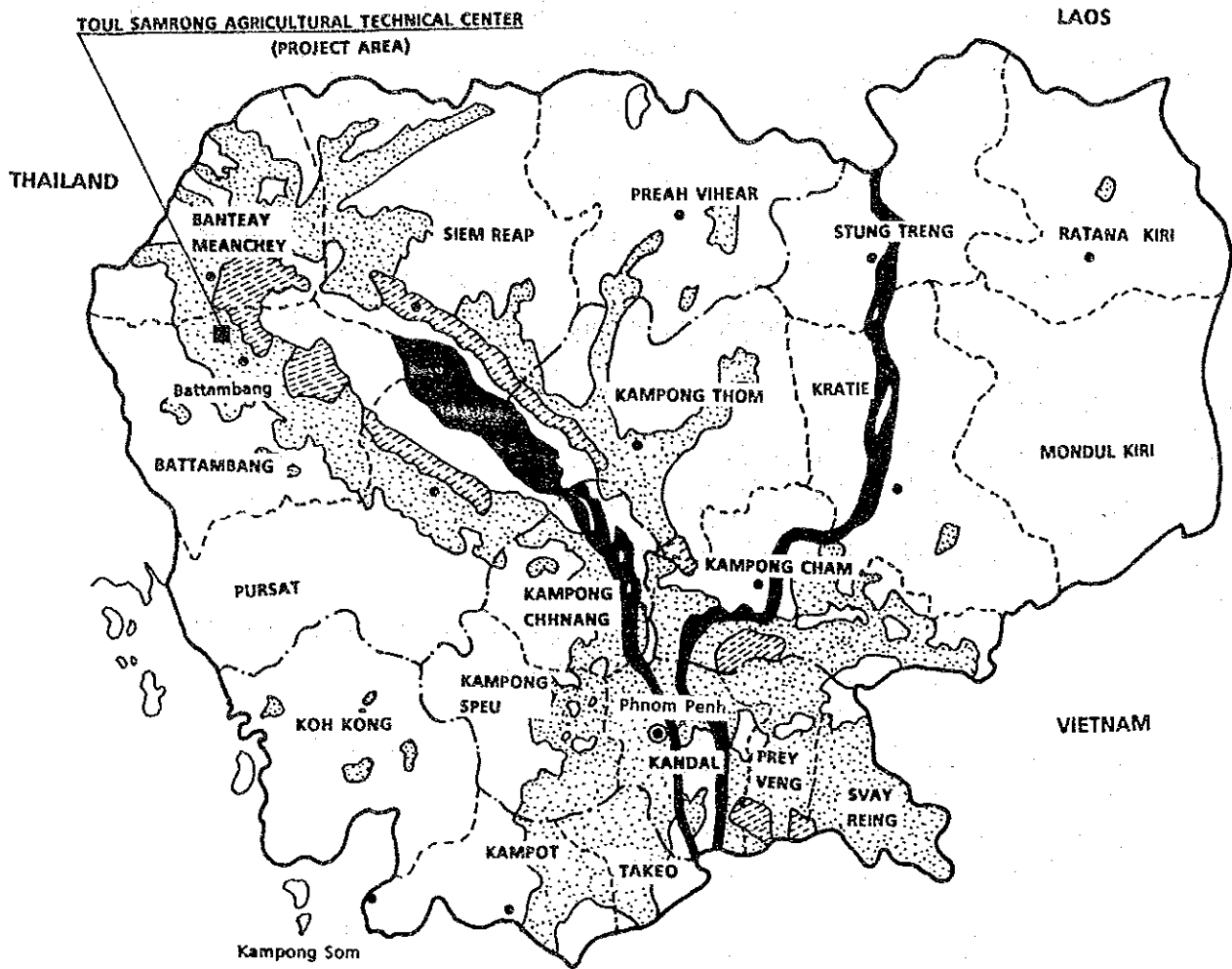
TABLE 2-5 PADDY HARVESTED AREA AND UNIT YIELD IN THE NORTHWEST REGION OF CAMBODIA

Crop Variety	Northwest		National Level	
	Harvested Area (%)	Unit Yield (ton/ha)	Harvested Area (%)	Unit Yield (ton/ha)
Wet Season (Total)	98.2	1.4	91.4	1.3
- IR & Early	9.3	1.4	16.6	1.3
- Medium	23.1	1.4	30.3	1.3
- Late	57.5	1.5	38.5	1.5
- Upland	1.1	1.3	1.7	1.3
- Floating	7.2	1.3	4.3	1.2
Dry Season	1.8	1.4	8.6	2.5
Total	100.0	1.4	100.0	1.4






Source : Department of Agriculture (Refer to Table 5-6 in Appendix)

Most of the late and medium maturing varieties are cropped by completely traditional, extensive farming methods with direct sowing. The paddy yield of the region is at the same level as the national average although the soils are of more highly fertility.

FIGURE 2-1 MAJOR RICE AREAS IN CAMBODIA



LEGEND

-  Ricefield Lowland
-  Floating Rice Area
-  Boundary of Region in National Seed Production Plan
-  Boundary of Province
-  Capital of Province

Source : Cambodia-IRRI Rice Project

There are many fields which have weedy rice plants due to their being mixed with exotic varieties. Currently, rice is being grown in many traditional varieties, although with few seeds supplies. A few seeds, supplied from the Center, are in being replaced. These seeds of improved varieties are distributed under the governmental seed distribution programme.

(2) Production and Distribution of Paddy Seeds

The amount of paddy seed to have been procured and distributed through the Northwest Provincial Agriculture Service Office in 1991 was about 1,100 tons as shown below, which occupied only about two percent to the local sowing quantity 48,000 tons.

TABLE 2-6 QUANTITY OF SEEDS PROCURED AND DISTRIBUTED IN THE NORTHWEST REGION (1991)

Variety	Quantity (ton)	Remarks
IR Varieties	400	IR42, IR 5
Late	700	Toul Samrong II and others
Total	1,100	

Source : Ministry of Agriculture (Refer to Table 5-10)

There are three sources of supply for seed paddy, the Center; Provincial seed farms, and the Ministry of Agriculture, which collect seeds for distribution.

The IR variety is grown as supplemental rice in case of rice shortages before the main wet season crop harvesting with a cropping area of 0.2 to 0.3 ha per household in the rather shallow water fields around the local farmers' residences. There is a late maturing variety of Toul Samrong II which has been developed recently at the Center. That variety is the representative one to be grown in medium depth water fields throughout the country, and plays an important role as the major variety for seed production at not only the Center but also the other two national seed farms.

(3) Seed Production at the Center

The seed production farms at the Center consist of 200 ha of production farms and 9 ha of foundation seed farms including an experimental farm of 1 ha. The varieties applied in the production farms are 80 percent of the late maturing varieties together with 20 percent of IR, which are cropped with traditional direct sowing methods in the dry paddy fields. The average yield at the production farm is about 1.5 tons per ha, which is nearly the same as the average yield in the northwest region. The problems found in this seed production are shown as follows. (Refer to Table 5-10 and Figure 5-2 in Appendix)

- ① In seed production by traditional direct sowing in the dry field the rice plants are so thickly mixed up with seeds that the elimination of foreign/weedy plants is not easy, and their yield, is low.
- ② There have been frequently occurring low yields due to irrigation water shortages, poor harvest due to flood damages in over about 50 percent of the fields. A lot of labor is required for paddy reseeded after flooding.
- ③ Extensive farming is unavoidably practiced due to low density of irrigation ditches and dual purpose canal. And, in addition to the above, the larger size of farm lots and lower farm road density are considered the reasons causing the extensive low productivity farming.

The quantity and receivers of the paddy seed produced in the Center in 1991 are as follows.

Almost all paddy seed produced in the Center is distributed to the local farmers through the Provincial Government Agricultural Services Offices. The remaining seeds is distributed to other regions after being gathered at the central depot in Phnom Phen by Ministry of Agriculture as shown below.

TABLE 2-7 PRODUCTION AND DISTRIBUTION OF SEEDS BY THE TOUL SAMRONG
AGRICULTURAL TECHNICAL CENTER (1991)

Descriptions	Quantity
	(ton)
Production	<u>320</u>
Distribution	
- Battambang Agricultural Service	126
- Banteay Meanchey Agricultural Service	62
- Ministry of Agriculture	99
Subtotal	<u>287</u>
Seeds for next cropping	23
Post Harvest Loss	10

Source : Toul Samrong Agricultural Technical Center

CHAPTER 3. OUTLINE OF THE PROJECT

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3.1 Objectives

More than 85 percent of the total population of Cambodia are engaged in agriculture, most of which is rice growing. Rice production is dominant not only in the farm economy but also in the national economy. The paddy yield of the country, however, is as low as 1.3 tons/ha, the lowest in the world. As a result, about 170,000 tons of rice (milled rice basis) were in short supply in 1991. The rehabilitation of the Center is given an important role with the highest priority and urgency in the Socio-Economic Rehabilitation and Development Programme for 1991 - 1995. This has come from the fact that an improvement in rice production can serve to resolve food shortages and stabilization of the life of local farmers.

Throwing limited time and investment into improvement of rice production, it is necessary to make stable supply of agro-inputs including quality paddy seeds for improvement of rice production.

A stable supply of quality seeds primarily requires the multiplication of quality paddy seeds suited to local conditions. The Center in Battambang has been operated and managed along with the said purpose, but the functions of the Center have been so depleted by turmoil from the civil war that the production of quality seeds has faced difficulty. Under such circumstances, the Ministry of Agriculture of Cambodia planned to rehabilitate the Toul Samrong Agricultural Technical Center in Battambang, the largest national paddy seed farm in the country, and this project has been taken up for the rehabilitation of the necessary buildings and facilities, improvement of seed farms, procurement of equipment and materials for production.

3.2 Study and Examination on Requests

3.2.1 Justification and Necessity of the Project

In the northwest region where the Center is located, rice cultivation has been practiced in fields of about 479,000 ha, which amounts to about 26 percent of the total paddy cropping fields of the country. And, most of the paddy fields left uncropped because civil war deterioration are concentrated in this region. The restoration of such war-devastated paddy fields will serve to accelerate the settlement programme of the civil war refugees. Rice cultivation with its long-lasting traditional varieties in the region has resulted in inferior genetic features in paddy plants with weedy strains intermingled. And it is important to disseminate quality paddy seeds to the local farmers for improvement of rice cultivation, but it is also regrettable that quality paddy seeds are in such extremely short supply.

The quality paddy seed demand can be estimated at about 8,000 tons per year ($479,000 \text{ ha} \times 80\% \times 1/4 \times 80 \text{ kg/ha}$) for 80 percent of the existing paddy fields and seed renewal in this area, every four years. Present seed supply by the Center is only 1/40 below the estimated demand, which is extremely little. The demand will increase much more when the necessary amount of seed for retuning refugees is added. Rice cultivation with quality seeds will not only increase the yield per unit area and milling yield, but will also serve as an extension for such quality strains of rice.

In Cambodia, there has been inadequate technology on post harvesting, seed processing, storage, field checks, and seed testing for the successful production of quality seeds. Japanese technical cooperation, however, had enabled the transfer of various rice cultivation technologies from the highest level to the Center. Together with such transferred technology, other foreign technology and know-how will be adopted for upgrading the current level of improvement technology. Some experts who had worked in the Center together with the Japanese experts before the civil war have survived through the war and will be engaged in operation and/or administration of the Center. Besides, there are some officials working in the Ministry of

Agriculture, who had received training at the Center and are now in responsible positions for the promotion works of this project.

The features of soils, meteorology, hydrology, etc. observed at the Center can represent the rice cultivation environment in the northwest region, giving the right conditions to produce healthy seeds as well. In addition, the Center is located in the middle of the northeast region, playing a vital role as the largest national seed farm. The rice cultivation in the northwest region, as mentioned before, has such a large development potential that the demand for quality paddy seeds is expected to increase more and more. In this respect, rehabilitation of the Center is considered justifiable and feasible from both the viewpoint of economy and technology.

At first, the requested facilities/equipment by the Cambodia for this grant aid were for breeding, seed production, and processing including dispatch of the necessary Japanese experts to the Center for this purpose. These requests were also to cover the whole seed production project.

However, it is planned to rehabilitate the Center in view that the operation and maintenance of the facilities can be made within a range of the human and financial resources under the limitation from war damage, aiming at qualitative and quantitative improvement paddy seed production which has been urgently required at present.

The Ministry of Agriculture has undertaken the Cambodia-IRRI Rice Project under assistance of the International Rice Research Institutes (IRRI), in which a national rice research organization is proposed for establishment. There is also a proposal that the Center should be one of the four major national rice research institutes. According to the above plan, a project of the Cambodia Rice Research and Development Institutes (CARRDI) has been started as one of the central rice research institutes.

3.2.2 Implementation Plan and Operation/Maintenance Plan

(1) Organization of Operation and Maintenance (O/M) Body

The O/M work at the Center has been currently carried out by 80 staff members of 6 Divisions under the Agronomy Department. Out of 80 personnel, the main staffs consists of 12 members including the Director, and the other main staff of Administration Division, Laboratory Division, and Extension Division are graduates majoring in agriculture in any university, college, or high school. (Refer to Figure 3-1)

A new plan has been prepared for an organization with five Divisions under one Director and one Deputy Director. An Administration Division consists of 2 sections and a Laboratory Division consists of three sections. The new organization requires an increase in staff members of five persons i.e., a Deputy Director, a Division Chief for Administration, each head of Seed Quality Control Laboratory, Varietal Performance Laboratory, and Seed Protection Laboratory.

The above staff increase is deemed reasonable and essential because more scientific and intensive seed production, seed quality control, maintenance of breeder's, seed processing, are required together with an increase in buildings and facilities. (Refer to Table 3-1 & Figure 3-2)

The individual responsibility of the above staff is shown as follows;

Director:

To formulate the O/M plan of the Center, to manage seed production, processing, storage distribution, and others under the Vice-Director of the Agronomy Department. The present Director of the Center, who is a graduate from Prek Leap agriculture school's three-year course and is experienced with seed production works since the Japanese technical cooperation before the civil war, is to be assigned to this position.

**TABLE 3-1 TRANSFER OF PERSONNEL WITH THE PROJECT FOR REHABILITATION OF
THE TOUL SAMRONG AGRICULTURAL CENTER**

Division/Section	Person in Charge	Present	Plan	Balance
1. Director		1	1	0
2. Deputy Director		-	1	+ 1
3. Administration	Chief	-	1	+ 1
(1) General Services and Personnel	Section Head	1	1	0
	Typist	1	1	0
	Personnel Service	1	1	0
	Kindergarten Teacher	2	2	0
	Guard	5	5	0
(2) Planning & Account	Section Head	1	1	0
	Clerk	1	1	0
4. Laboratory	Chief	1	1	0
(1) Seed Quality Lab.	Section Head and Technician	-	2	+ 2
(2) Varietal Performance Lab.	Section Head and Technician	3	3	0
	Farm Worker	10	10	0
(3) Seed Protection Lab.	Section Head	-	1	+ 1
5. Seed Production	Chief	1	1	0
	Technologist	1	1	0
	Farm Worker	31	31	0
6. Machinery & Repair	Chief	1	1	0
	Technologist	1	1	0
	Mechanic	3	3	0
	Operator	14	14	0
7. Extension	Chief	1	1	0
Total		80	85	+ 5

Note : The present organization consists of six sections, namely section of General Service and Personnel, Planning and Account, Research, Seed Production, Machinery and repair and Extension.

FIGURE 3-1 PRESENT ORGANIZATION CHART OF THE TOUL SAMRONG AGRICULTURAL TECHNICAL CENTER

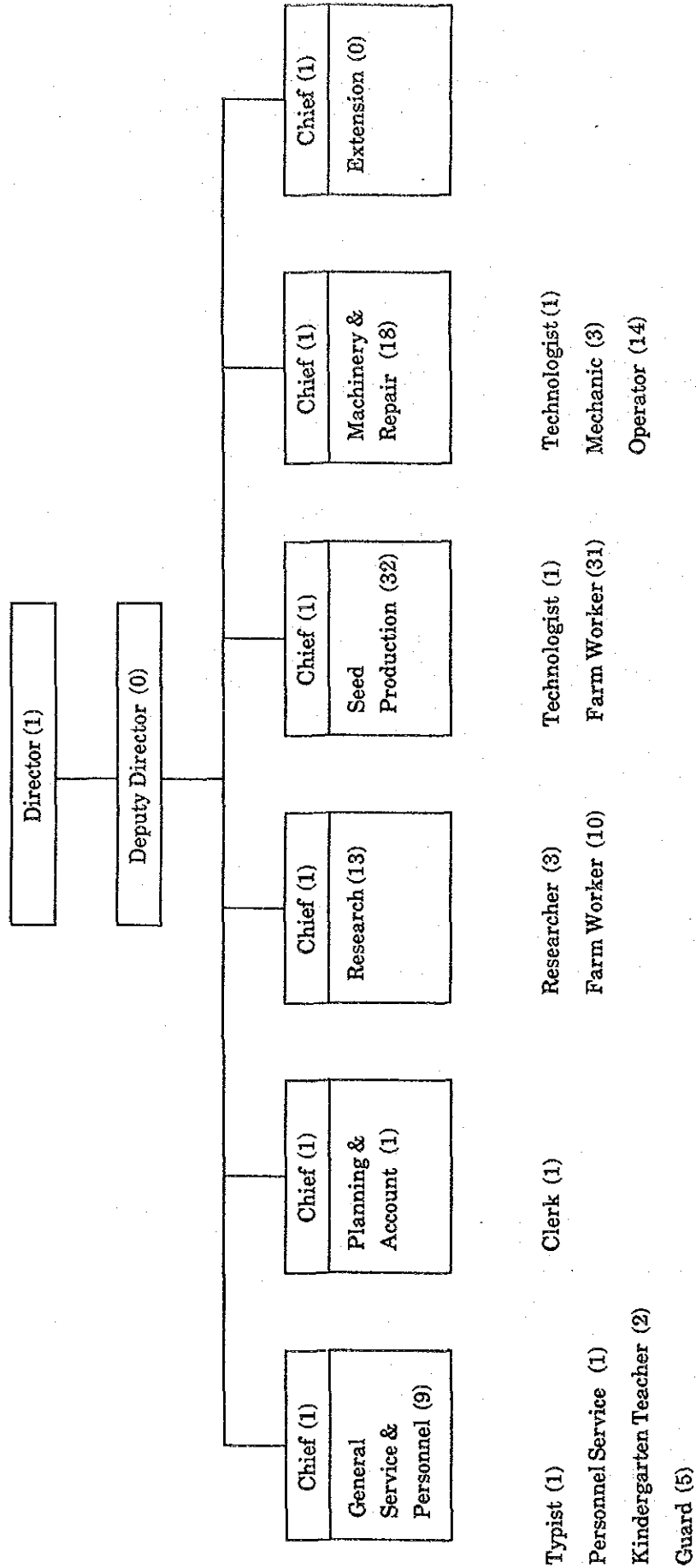
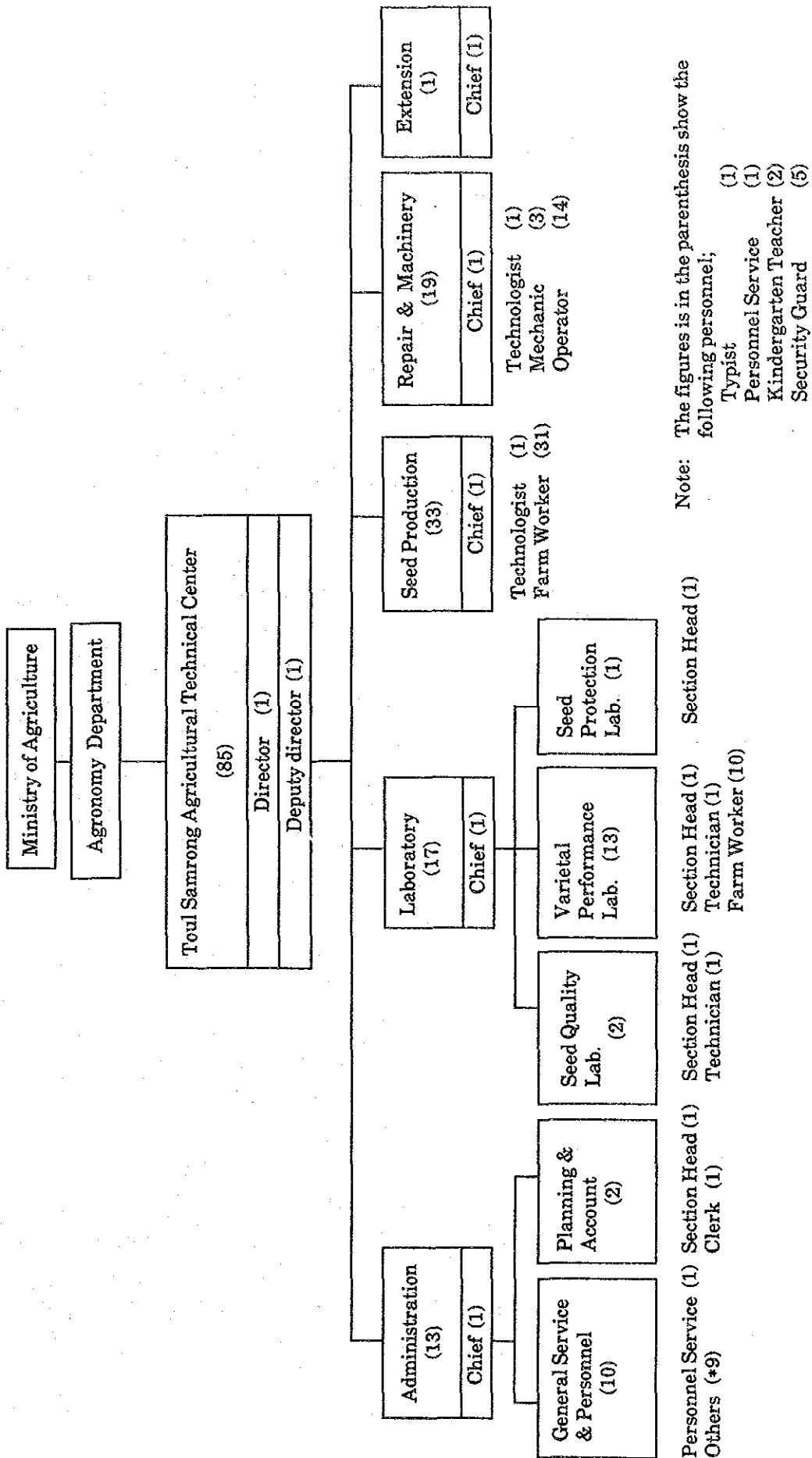


FIGURE 3-2 PROPOSED ORGANIZATION CHART OF THE TOUL SAMRONG AGRICULTURAL TECHNICAL CENTER



- **Deputy Director:** To assist the Director to carry out O/M of the Center.
- **Administration Division:** To carry out accounting and labor-control for effective O/M of the Center, and to manage the proposed two sections after rehabilitation of the Center. A Division chief will be newly recruited but the other staff are already in place.
- **Laboratory Division:** To carry out management work in the three laboratories with respective heads and three technicians; Seed Quality Control Laboratory shall conduct tests for maintaining quality of seeds as well as improving the seed quality, and the Variety Performance Laboratory shall carry out field checking of varietal performance. The Seed Protection Laboratory shall carry field checking of pest occurrence during seed production. The present research division has two graduates of agriculture colleges as well as two graduates of agriculture high schools. One of the college graduates will be assigned to the division chief, while the other one will be the head of the Seed Quality Laboratory. And three new staff will be recruited.
- **Machinery · Repair Division:** To carry out O/M of the farming machinery including those for seed production, together with O/M of the workshop, the existing Machinery and Repair division will be attached to the new division.

- Seed Production Division: To produce foundation seeds and seeds distributed to the local farmers together with their storage control and dispatching; the present staffs will remain in place.
- Extension Division: To be responsible for dissemination of seeds of quality varieties, the present staffs shall stay unmoved in the division.

(2) Financial Scale and Capability of the Executing Body

The running budget of the Center in 1991 was 55,674,000 Riels (1992 constant price), which amounted to 14 percent of the total amount of budget of the Agronomy Department (394,100,000 Rls, 1992 constant price). About 36 percent of this budget was for direct salary of personnel. The annual budget of the Department and the Center is decided by the Ministry of Finance. In addition to the allocated budget, the Agronomy Department can make the final budget by adding the income from sales of seeds, seedlings, etc. (Refer to Table 3-2 & Table 5-9 in Appendix)

TABLE 3-2 BUDGET OF THE TOUL SAMRONG AGRICULTURAL TECHNICAL CENTER
(1989 - 1992)

(Unit: Thousand Riel, 1992 Constant Price)

Item	1989	1990	1991	1992
1. Budget				
(1) Salary	8,145	10,785	19,484	30,492
(2) Fuel	2,367	2,273	8,060	8,360
(3) Seeds	1,550	1,477	2,141	7,581
(4) Fertilizers & Pesticides	4,949	13,381	9,195	8,428
(5) Repair & Spare Parts	1,233	5,780	8,910	1,572
(6) Labor Harvesting	2,178	2,459	7,884	10,000
<u>Total</u>	<u>20,422</u>	<u>36,155</u>	<u>55,674</u>	<u>61,807</u>
2. Sales of seeds				
Quantity (kg)	N.A	N.A	185,440	287,986
Amount (Riel)	N.A	N.A	21,038	39,270

Note : The budget includes the income from sales of various materials in previous year.
Source : Department of Finance, and Agronomy Department, Ministry of Agriculture.

In considering the present budgeting system for the Center, the future budget is expected to include an additional amount resulting from sales income from increasing volume of seeds.

As mentioned below, the amount of seeds to be increased through the project is estimated at 248 tons, which will result in an income increase. On the other hand, the amount of O/M cost to be increased with project will be about US\$16,700 as shown below.

- O/M cost of building	300 US\$
- Fuel and oil cost of generator	14,900 US\$
- Fuel and oil cost of drainage pump	1,500 US\$
<u>Total</u>	<u>16,700 US\$</u>

Since five staff members will be newly deployed with the project, the necessary direct salary for them shall be increased in the budget. The Ministry of Agriculture intends to make a special budget for the project by taking into consideration the fact that the project cannot only serve for improvement of the rice cultivation in the northwest region.

3. 2. 3 Examination/Review on Similar Natured Projects and Relations with the Other Projects Assisted by International Aid Institution

For the following projects, international organizations/agencies together with foreign agencies have extended aid and cooperation to the related projects to seed multiplication, research, and extension on rice cultivation.

(1) Cambodia - IRRI Rice Project

The International Rice Research Institutes (IRRI) have been carried out the Cambodia-IRRI Rice Project with the aid of the Australian government for strengthening of rice research and transfer of rice cultivation technology. This project, after implementation of the first stage (1987 - 1990), advanced to the second stage (1990 - 1992). In the project's training program long-term training has been conducted at the IRRI, the Philippines, in taking the staff of the the Agronomy Department as trainees, on the other hand, the Project is carrying out various studies on paddy varieties at national and provincial experimental farms throughout Cambodia.

As one of the Cambodia-IRRI Rice Projects, the Cambodian Rice Research Development and Institute (CARRDI) has been started at Khum Pratah Rang about 15 km west of Phnom Penh.

Regarding the seed projects, the National Seed Multiplication, Processing, and Distribution Project is proposed in the above project, where the Center is given a position to produce foundation seeds and certified seeds for the northwest region. But, the project has not been promoted yet.

(2) Rural development Center Project

The five Rural Development Centers have been operated under the administration of the Agronomy Department, Ministry of Agriculture, and comprehensive rural development including extension of agriculture technology has been executed in the designated rural development areas, having technical and financial aids from various NGOs.

One of the supply sources of paddy seeds which the Ministry of Agriculture has procured through the Central Company of Agricultural Materials (CCAM) is paddy seed produced by farmers in the service area of the Project.

The Ministry of Agriculture will develop and expand the organization and functions of the Rural Development Center so it can carry out more comprehensive development of the rural areas, providing such Rural Development Centers in every province.

3. 2. 4 Examination on Project Components

The Toul Samrong Agriculture Technical Center Project consists of the following five major components.

- ① Improvement of seed farm
- ② Improvement of cultivation
- ③ Improvement of post-harvesting processes
- ④ Seed processing
- ⑤ Seed quality control

The relationship between the above components and the necessary facilities/materials is shown in Table 3-3 and detailed below.

(1) Improvement of Seed Farms

Seeds are produced according to the following three steps in three years.

- Breeder's stock (first year) The origin of the seeds, which shall be produced at the first step under very strict control
- Foundation stock (second year) The seeds produced primarily from the breeder's stock with characteristic features and attributes of the first generation.
- Seeds for production use (third year) The seeds taken from the foundation seeds to be sown in the farmers' fields.

The Center has two kinds of breeder's stock, one is produced originally in the Center and the other is introduced from the outside. The present breeder's stock produced in the Center are mostly of traditional improved varieties. The seeds of these varieties are multiplied by the extensive cultivation method of traditional direct-sowing, which are major seeds produced in the Center. Such traditional cultivation results in unfavorable seed quality due to the difficulty in control of varieties mixture, abnormally shaped plants induced from abnormal genetic change, weeds, and so on. Improvement of the traditional cultivation will fundamentally require improvement of fields conditions including irrigation and drainage improvement.

(2) Improvement of Cultivation

With improvement of farms, quality seed production in great quantity will require healthy seedling growth, deep plowing, improvement of land

TABLE 3-3 ANALYSIS ON THE REQUESTED FACILITIES/EQUIPMENT AND RELATIONS TO PROJECT COMPONENTS

Requested Facilities/Equipment	Project Component				
	1 Improvement of Seed Farm	2 Improvement of Cultivation	3 Improvement of Post Harvest	4 Seed Processing	5 Seed Testing
1. Rehabilitation and /or construction of Building/Facilities - Main building (Office, laboratory, etc.) - Workshop - Seed processing house - Warehouse - Meeting room - Dormitory		○			○
2. Improvement of infrastructure - Building lots - Seed farm	○	○	○	○	○
2. Improvement of infrastructure - Building lots - Seed farm	○	○	○	○	○
3. Procurement of machinery and equipment - Farming machines - Thresher and seed processing machines - Laboratory equipment for seed testing - Workshop machines and equipment - Office equipment - Vehicles - Cabinet Articles	○	○	○	○	○

Note : The marks of circle show the direct relation to each component

preparation, adoption of transplanting methods, and also more thorough control of insects, diseases and weeds, and more intensive on-farm water management, and so forth. Time-worn farming machines should be replaced together with the introduction of suitable machines.

(3) Improvement of Post Harvesting Processes

Necessary facilities (seed drying yard and storages, etc.) and equipment, shall be provided for minimizing seed damage by threshing, insects, mold, rodents, etc. for successful post harvesting.

(4) Seed Processing

Since, there are foreign matters such as weed seeds, sterile paddy, damaged paddy, etc. mixed in quality seeds, which should be eliminated from the pure quality seeds. In the first phase, simple-type seed processing equipment will be provided to meet the present technical level in the country for a stable supply of quality paddy seeds.

(5) Seed Quality Control

Only simple seed tests and inspection shall be made for each kind of breeder's stock, and foundation seeds for production-use seeds. The equipment for seed-testing shall be installed for this purpose.

In the field of seed production, it is difficult to eliminate the mixture of abnormal and irregular-shaped rice plants, and also such elimination will require much labor. Therefore, strict selection of quality seeds is essential in both the stages of breeder's stock and foundation seeds. And this will require the provision of a variety of equipment and materials for effective selection of seeds.

3. 2. 5 Examination on Requested Facilities and Equipment

The Project aims at seed production taking up quality control and production increase of seeds to satisfy the required quality urgently. As mentioned in the above, estimated amount of seed production increase by establishing the project is 248 tons, which can be considered not a tremendous increase. As a basic policy, it is consequently necessary for the Project, to carry out a detail design of facilities and equipments, taking into account the minimization of the operation and maintenance costs. (For further details, refer to the Chapter of "Basic Design").

The type and functions of the requested facilities and equipments are shown below.

(1) Buildings

a) Main Building

Main building will be used for operation and management of the Center, tests necessary for the production of good quality seeds and seed quality control, and for dissemination of quality seeds. The existing main building requires rehabilitation to meet these purposes.

b) Workshop

The workshop is indispensable for repair of machineries such as farm machines for cultivation and other machines to be introduced for seed production. The existing workshop cannot be rehabilitated; a new one, therefore, must be constructed after breaking up and removal of the old one.

c) Seed Processing House

Paddy seeds are treated by a seed-processing machine which removes impurities to obtain processed seeds of consistent quality. For seed-processing, a new building must be constructed.

d) Warehouse

In order to maintain the quality of processed seeds and to store them until distribution, a warehouse must be newly constructed.

e) Meeting Room

Presently, the seeds produced here are distributed not only to the northwest region but also to other regions. When the Project is completed, the Center will become the biggest seeds producing organization in Cambodia and the importance of the activities of the Center will be furthermore increased.

The Agronomy Department, CARRDI, Chamcar Daung Agricultural University and other related organizations will take part in the management and direction of the operation of the Center. The Center is to distribute the production seeds mainly to five provinces, therefore, it is necessary for the Center to hold meetings with concerned officials of those states on determination of varieties to be disseminated and on methodology for dissemination of seeds. For those issues, officials concerned will visit and attend meetings at this Center. The existing transportation to the Center is not convenient, so a Meeting Room is indispensable for visitors to stay for these meetings. Accommodation capacity of the Meeting Room is determined at 8 persons excluding the staff of the Center, considering their staying period for meetings to be held at this Center.

- Attendants	: Agronomy Department	2
of the meeting	: CARRDI	1
	: Officials from 5 states	5
	: Center side	2
	<u>Total</u>	<u>10</u>

f) Dormitory

There is no seed production farm which is able to supply quality paddy seeds in Cambodia. Therefore, it is planned that each two staff members of seed production from the following nine farms, two other national seed farms, six provincial seed farms, and a rice research station (CARRDI) will receive on-the-job training on seed production technology. A total of 18 attendants will stay in the Center for a long period. So a dormitory is indispensable for long-term visitors, and a dormitory shall be constructed newly.

(2) Facilities Related to Building

There is a necessity of rehabilitation / development of the following facilities related to the above buildings.

a) Water Supply Facilities

For the operation and management of the Center, water supply is indispensable for domestic use, spraying of pesticides, washing farm machines, and laboratory use. The existing water supply facilities cannot be rehabilitated, therefore, new ones shall be developed.

c) Electricity Generation

Electricity generation is indispensable for the light of the buildings as well as for operation of supplied equipment. Since the power supply line in Battambang city will not be extended to the Center in the near future and the existing electricity generation facilities cannot be rehabilitated, new ones must be installed.

d) Drainage / Sewerage Facilities

The facilities to drain the sewerage water and rainwater of the buildings are indispensable, the existing drainage / sewerage facilities cannot be rehabilitated, so new ones shall be constructed.

(3) Farm Facilities

The requested farm facilities consist of a feeder canal, farm roads, irrigation and drainage canals, and paddy fields. Improvement of these facilities is indispensable for the basic strengthening of seed production.

a) Feeder Canal

The feeder canal brings the irrigation water to the Center's farm. Since the function of the canal is reduced due to the damage to canals, rehabilitation is required.

b) Farm Roads

Farm mechanization is necessary for the crop management of seed production. For the effective use of farm machines, the rehabilitation of farm roads is indispensable.

c) Irrigation Canals

Presently, the canal system in the Center's farm has the dual purpose of irrigation and drainage. The seed's low yield and its low quality are also caused by the inadequate water management within the canal system. For the solution of this problem, the improvement of the irrigation canals is indispensable.

d) Paddy Fields

The large plot size and the unfavorable leveling condition of the existing paddy fields hamper the improvement of seed production. Thus, rehabilitation of the paddy fields is indispensable with respect to the size and land leveling.