JAPAN INTERNATIONAL COOPERATION AGENCY

THE KINGDOM OF THAILAND
CHIANG MAI UNIVERSITY

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR THE IMPROVEMENT OF FACILITIES AND EQUIPMENT FOR THE HIGHLAND AGRICULTURAL DEVELOPMENT AND TRAINING CENTER IN THE KINGDOM OF THAILAND

JULY, 1992

SANYU CONSULTANTS INC.

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PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a basic design study on the Project for the Improvement of Facilities and Equipment for the Highland Agricultural Development and Training Center and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand a study team headed by Mr. Masashi Kono, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs and constituted by members of Sanyu Consultants Inc., from January 27 to February 20, 1992.

The team held discussions with the officials concerned of the Government of Thailand, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission headed by Mr. Teruaki Kamada, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs and constituted by members of Sanyu Consultants Inc., was sent to Thailand 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 the Government of the Kingdom of Thailand for their close cooperation extended to the teams.

July, 1992

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

July, 1992

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

Letter of Transmittal

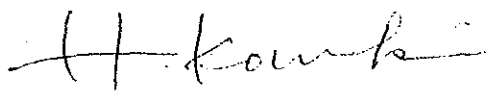
We are pleased to submit to you the basic design study report on the Project for the Improvement of Facilities and Equipment for the Highland Agricultural Development and Training Center in the Kingdom of Thailand.

This study has been made by Sanyu Consultants Inc., based on a contract with JICA, from January 20, 1992 to July 10, 1992. Throughout the study, we have taken into full consideration of the present situation in the Kingdom of Thailand, 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, the Ministry of Agriculture, Forestry and Fishery and Embassy of Thailand in Japan. We also wish to express our deep gratitude to the officials concerned of Chiang Mai University, Japan International Cooperation Agency Thailand Office and Embassy of Japan in Thailand for their close cooperation and assistance during our study.

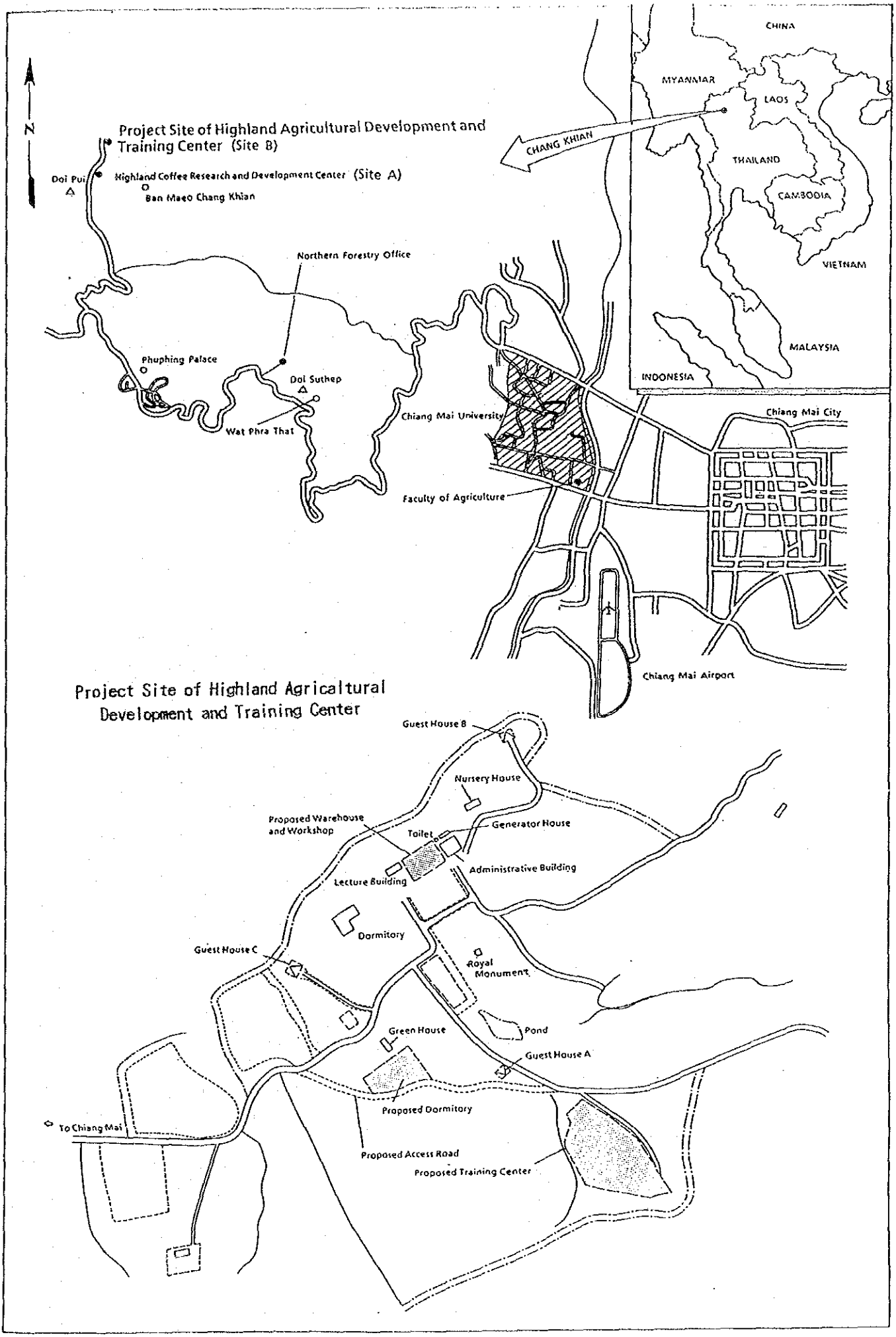
At last, we hope that this report will be effectively used for the promotion of the project.

Very truly yours,



Team leader, Hirokazu Kouriki
Basic design study team on
the Project for the Improvement
of Facilities and Equipment for
the Highland Agricultural
Development and Training Center
Sanyu Consultants Inc.

PROJECT SITE LOCATION MAP



SUMMARY

In Thailand, 63% or about 35 million of the total population earn their living still on agriculture despite the remarkable growth of the urban industry in the 1980's. Agricultural sector has recorded 16% of GDP in 1990/1991, and also created more employment opportunities. Toward this end, the agriculture in Thailand plays a significant role in sustaining the economic and social development of the country.

Under the Sixth National Economic and Social Development Plan (1987-1991), the Government emphasized to develop agriculture in regions and to attain 2.9% of annual growth rate in the agricultural sector.

During the Sixth Plan, 5.7% of annual growth in the agricultural sector, 6.8% of annual growth in income per farmer and 20.3% of annual growth of export amount have been achieved. However, the agricultural sector failed to cope with the development of urban industry. Disparities existed between farmers and non-farmers, urban and rural, as well as the advanced and poor farming areas. Therefore, prevention of forestry destruction, and conservation of natural resources and environment are vital issues under the Seventh National Economic and Social Development Plan (1992-1996).

More importantly, following are agricultural development targets under the Seventh Plan :

1. To maintain 3.4% of annual growth in agricultural sector,
2. To increase the income of farm household, as well as to protect and support farmers to obtain an equitable price of production and sale of farm products.

3. To improve the quality of farmers' livelihood from the view points of education, health and public sanitation; and,

4. To develop and conserve the natural resources towards a well-balanced nature.

The highland area in Northern Thailand covers 12 provinces; namely, Chiang Mai, Chiang Rai, Lamphun, Tak, Payao, Phrae, Mae Hong Son, Loei, Petchabun, Phitsanulok, Nan and Udon Thani. However, the slow-paced development in the area is hindering the accomplishment of the above-mentioned targets of agricultural development under the Seventh Plan due to meteorological, geological and social problems.

In the above provinces, there are nine minority tribes (so-called hilltribes) who are living differently from majority Thai people in terms of language, custom and lifestyle. Reportedly, these hilltribes accounted for approximately 554,000 persons or 1% of the country's population and mainly divided into two groups according to their geographical distributions. Firstly, in the low hill over 600 meters in altitude, Karen (49% of hilltribes population), H'tin (5%), Lua (1%) and Khamu (1%) tirbes depend their livelihood on cultivation of stable food based on mode of shifting and also paddy wherever possible. Secondly, in the high mountain over 1,000 meters in altitude, Meo (15%), Lahu (11%), Yao (7%) Akha (6%) and Lisu (5%) tribes depend their livelihood on cultivation of staple food based on "slush-and-burn" shifting and opium poppy as cash crop. In view of this farming system, they are forced to emigrate to many places continuously.

The Government plans to provide education in Thai language as well as educate them as Thai national. Furthermore, the Government urgently needs to take the countermeasures for the following problems. These are

insufficiency in food due to 3% increment ratio of regional population, insanitary subsistence due to undeveloped water supply facilities, shortage of educational facilities and teachers, poor roads accessibility to villages, environmental destruction such as forestry area reduction (about 2% annually) and soil erosion due to illegal logging and "slush-and-burn" shifting cultivation, and opium poppy production.

Under the direction of His Majesty King, the Royal Project was launched in order to cope with the above problems. The project calls for establishment of six experiment stations and twenty-eight extension stations for highland agriculture, improvement of social infrastructure such as road, irrigation and water supply, and development of regional socioeconomy, i.e, providing education and medical services, organizing rice band and farmers group, and improving postharvest system in food processing, packing, transporting and marketing. Relative to the Royal Project, the OECD countries and United Nations are assisting the Government in the destruction of narcotic production.

Through the effort of the related agencies and countries, the effects in stabilizing their livelihood, such as increase of food self-sufficiency ratio, establishment of cash income opportunity by production of vegetable, flower, fruit, coffee and tea, decline of disease ratio and diffusion of education, have been obtained in the project sites.

However, there are presently shortage of staff in transferring technology as well as their technical know-how. This is mainly due to inadequate equipment and facilities in training institutions and centers. Chiang Mai University has significant role in research of comprehensive highland agriculture and training of agricultural extension staff, however, the university has no capability to meet with demand of the

projects. Therefore, improvement of the facility and equipment is urgently required.

Taking into account the above situation and the results of the study on "Replaced Crops Promotion Projects in Northern Thailand" by JICA study team, the Government of the Kingdom of Thailand requested the Government of Japan to assist in the improvement of the Highland Agricultural Development and Training Center through Grant Aid.

In response to this request, the Government of Japan, through JICA, conducted a basic design on the project under the Grant Aid, and JICA then dispatched a basic design team to Thailand from January 27 to February 20, 1992. The team held various discussions with Thai officials, conducted a field survey and evaluated the appropriateness of the Project as a Japanese Grant Aid. The team completed the home office works in Japan and JICA sent draft explanation team to Thailand from June 7 to 18, 1992, and finally prepared the present report.

The objective of the Project is to train intensively the extension officers and farmers on highland agriculture. The training program shall be executed by lecturers and assistant lecturers in rooms and farm of the Center with support of Faculty of Agriculture, Chiang Mai University and shall consist of three courses; namely, "Agricultural Production Course" comprising Vegetable, Fruits, Upland Rice, Field Crop and Flower Cultivation; "Agricultural Discipline Course" comprising Highland Farming System, Plant Protection, Soil Conservation, Environmental Observation and Meteorological Observation; and "Other Course" comprising seminars / workshop on Highland Condition, Highland Agricultural development, Narcotics Crop Control and Prevention, Highland Community Development and

Forestry Community Development. Furthermore, the mobile training also shall be executed to transfer agricultural technology to farmers directly.

In order to execute the training program, construction of training facilities and provision of training equipment shall be required. The details are following :

1. Building and Civil Works

(1)	Training building	1 blg., floor area approx. 1,000m^2
(2)	Dormitory	1 blg., floor area approx. 660m^2
(3)	Workshop building	1 blg., floor area approx. 430m^2
(4)	Access road in the site	approx. 300m
(5)	Sprinkling facility for demonstration farm	available of sprinkling approx. 0.64 ha
(6)	Rehabilitation of control pond ..	7.0 m (L) x 7.0 m (W) x 1.0 m (D)
(7)	Rehabilitation of greenhouse	1 house, approx. 90m^2

2. Equipment

(1)	Equipment for training	1 lot
	Audio visual, copying machine, typewriter, etc.	
(2)	Equipment for demonstration farm	1 lot
	Hand tractor, 4-wheel tractor, sprayer, etc.	
(3)	Equipment for road maintenance	1 lot
	Bulldozer, dump truck, hydraulic excavator	
(4)	Equipment for transportation	1 lot
	Station wagon, pick-up truck, microbus, motor cycle	
(5)	Equipment for highland agriculturaldevelopment	1 lot
	Balance, meteorological equipment, microscope, etc.	

Considering the schedule and volume of works, and climatic, geographical and social conditions at the site, the implementation period of the Project will take twelve (12) months including procurement of materials and equipment after its construction contract.

Upon completion of the Project, Chiang Mai University shall be responsible for the management of the Center, in cooperation with Office of Narcotics Control Board (ONCB) of the Office of the Prime Minister.

According to the program schedule, the extension officers and advanced farmers will complete the training by the following periods : 452 persons in the first year (1994), 521 persons in the second year (1995), 565 persons in the third year (1996), 604 persons in the fourth year (1997) and 643 persons in the fifth year (1998) throughout the execution of this Project. The total number of farmers to be transferred with new technology through extension activities by the extension officers would be 25,969, 55,900, 88,258, 124,103, and 163,355 in 1995, 1996, 1997, 1998 and 1999, respectively.

It is also expected that the agricultural economy of the hilltribes people would be improved and stabilized, and new village structure without poppy cultivation would be constructed by introducing new farming technology. Also, through the transfer of new farming technology by enhancing the extension activities, the campaign for preventing forestry destruction from traditional shifting cultivation would be smoothly accelerated. The development of this Project has been accorded the highest priority by the Government under the Seventh Five-Year National Economic and Social Development Plan to conserve forestry resources and to protect environmental destruction. Furthermore, the Project will also contribute to the improvement of living standard and the stabilization of

livelihood of hilltribe people living not only in Thailand but also in neighboring countries such as Myanmar, Laos, Vietnam, China and etc. Thus the Project, when completed, will serve a regional center for highland agriculture in Southeast Asia, since extension officers from the said Asian countries will be invited.

Based on the field study and further analysis made in Japan, the Project, when fully developed, would bring direct and indirect effects. The Government of the Kingdom of Thailand is prepared to provide the required manpower and budget for implementation of the Project. Under the above conditions, the Project is, therefore, considered suitable for a Grant-Aid Assistance from the Government of Japan.

In addition, it is recommended that the following matters should be resolved by the Government of the Kingdom of Thailand for efficient implementation and operation of the Project :

(1) The improvement work of unpaved access road from Chiang Mai City to the Site should be completed before the commencement of the construction works.

(2) The required manpower and budget for the implementation, and annual operation and maintenance of the Project should be ensured.

(3) As stated above, a manager and two (2) assistant managers are planned to be assigned at the Center, who are all concurrently holding posts at Chiang Mai University. It is requested that at least one (1) of the two (2) assistant managers be relieved from his post at the University and assigned as a special staff for the operation and maintenance of the Center.

CONTENTS

Page

Page

CHAPTER 1 INTRODUCTION

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The Government of Japan, based on the international cooperation for narcotics eradication agreed at Houston Summit held in July, 1990, decided to conduct project formation study. Subsequently, JICA then dispatched to Thailand a project formation study team headed by Mr. Koichi Aiboshi, Deputy Director, Policy Division, Economic Cooperation Bureau, the Ministry of Foreign Affairs for "Project for Crop Replacement Promotion in Northern Thailand" for a period from November 27 to December 26, 1990 and carried out the field survey, collection of related information and data, and discussion and investigation with Thai officials concerned.

In response to the above, the Government of the Kingdom of Thailand requested the Government of Japan for a Grant Aid assistance in procurement of the facilities and equipment required for the Establishment of Highland Agricultural Research and Training Center, which plans to terminate the shifting cultivation by minor hilltribes, to preserve forestry resources and to conserve environmental condition, and to promote stabilization of their livelihood through promotion of replaced crops of poppy.

Based on the request of the Government of the Kingdom of Thailand, the Government of Japan decided to conduct the basic design study of this project under Grant Aid and in this regard, JICA dispatched to Thailand a basic design study team headed by Mr. Masashi Kono, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, for 25 days from January 27 to February 29, 1992. The members and itinerary of study team and officials concerned in the study are attached in the Appendixes.

Subsequently, the basic design study team fully discussed and exchanged views on the project with the officials concerned of Thailand, as well as the contents and the scale of the necessary and appropriate facilities and equipment for the project. The team also explained the Japanese Grant Aid system, grasped the contents requested for the project and operation and maintenance plan, collected the direct and related data, and visited the project site. The matters discussed are contained in the Minutes of Discussions, which is attached in the Appendixes.

After their return to Japan, the study team carried out basic design of facilities and materials necessary for the implementation of the project, selected the equipment, operation and maintenance plan and so forth through analyzing the data, and compiled the draft final report of the basic design study.

JICA dispatched an explanation team to Thailand to explain the draft final report of the basic design study for a period of 7 days from June 7 to June 13, 1992. The contents are described in the Minutes of Discussions, the copy of which is attached in the Appendixes.

This report summarized the objectives and contents of the project as well as the result of basic design, implementation organization and project evaluation based on the basic design study conducted by the team.

CHAPTER2 BACKGROUND OF THE PROJECT

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2-1 National Economic and Social Development Plan

2-1-1 Target of Agricultural Development on Sixth and Seventh Plan

Under the Sixth National Economic and Social Development Plan (1987-1991), the Government emphasized to develop agriculture in regions and to attain 2.9% of annual growth rate in the agricultural sector.

During the Sixth Plan, 5.7% of annual growth in the agricultural sector, 6.8% of annual growth in income per farmer and 20.3% of annual growth of export amount have been achieved. However, the agricultural sector failed to cope with the development of urban industry. Disparities existed between farmers and non-farmers, urban and rural, as well as the advanced and poor farming areas. Therefore, prevention of forestry destruction, and conservation of natural resources and environment are vital issues under the Seventh National Economic and Social Development Plan (1992-1996).

More importantly, following are agricultural development targets under the Seventh Plan:

(1) To maintain 3.4% of annual growth in agricultural sector,

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(3) To improve the quality of farmers' livelihood from the view points of education, health and public sanitation; and,

(4) To develop and conserve the natural resources towards a well-balanced nature as follows;

Forestry	To maintain over 25% of the national land as protected forestry region and 15% of the national land as economic forestry region.
Land	To reform 4 million rai per year.
Water resources	To execute over 500 small-scaled water resources development projects for agricultural purposes.
Marine resources	To protect marine resources as well as increase marine production.

2-1-2 Agricultural Development Policy under the Seventh Plan

In order to achieve the objectives and targets of the Seventh Development Plan, development policy on production, marketing, protection of natural resources and promotion of agricultural cooperatives has been established as follows;

(1) Regions damaged by drought and other poor region with soil problems in 10,945 villages, where are located in 42 provinces or 120 districts must be improved.

(2) Land must be distributed to poor tenant farmer through agrarian reform.

(3) Vocational training to farm workers must be conducted to transfer to industry and must be supported along with effective land reform improvement plan.

2-2 Current Situation of Hilltribes

There are 9 hilltribes in Thailand. The Largest hilltribe is Karen, occupying 49% of all hilltribe population, followed by Meo with 15% and Lahu with 11%. The details are shown below.

Table 2-1 Population of Hilltribes in Thailand (1988)

Tribe	Population	%
Karen	275,615	49
Meo	82,356	15
Lahu	59,813	11
Yao	34,757	7
Akha	32,245	6
H'tin	27,754	5
Lisu	24,573	5
Lua	9,345	1
Khamu	7,714	1
Total	554,172	100

Source: Thai-Australian Highland Agricultural and Social Development Project

554,172 persons of 9 hilltribes spread over 20 provinces and are engaged in agriculture.

Farm land is, however, narrow and abounds in sloping field. Food crops, vegetables and legumes for self-supply, and even poppy are cultivated.

These areas are, in general, remote and secluded places in the mountains and provided with poor infrastructure as unimproved road, inconvenient transportation, and less and aged medical facilities. The isolated schools there are often happened in rainy season. Without any facility of electricity and water works there are provided in some villages. Students come down to middle and high schools at lowland staying at the dormitory prepared by the

Government.

Some villages are concentrated in the place and some are spread over. They live in narrow and high or low floor residences with little windows. Recently, replacement from poppy to other crops are rapidly promoted through the Royal Projects and other assistance from foreign countries. Major replaced crops are vegetables, flowers, fruits and coffee upto now. These products are marketed not only at Chiang Mai city but also at other larger cities like Bangkok in the country.

However, poor infrastructure of road and communication network are obstacles to smooth marketing of those products.

2-3 Tendency of Foreign Assistance

Assistance affairs from foreign countries are in charge by Royal Projects, Department of Public Welfare (DPW) belonging to the Ministry of Interior (MOI) and the Office of Narcotics Control Board (ONCB) and the related Government agencies.

The foreign assistance covers such wide range of fields as agricultural, public welfare and forestry development, etc.. From 1972 to 1993 (plan), the amount of financial assistance will reach to US$ 95,309,700 (on the basis of currency exchange rate 1$ = 24.75 Bahts).

Source : A Summary Account on Present and Past Foreign Assistance in Support on Hilltribe Welfare and Development Program, Department of Public Welfare (DPW)

(1) Thai-Australia Highland Agricultural and Social Development Project

The project was commenced in 1980 as a World Bank funded project to assist hilltribe development in Northern Thailand. Technical assistance, in the form of Australian advisers, was provided by the Australian Government. Phase I ran until 1987 when the World Bank loan, and Governmental fund of Australia, Great Britain and Thailand were provided. The project was headquartered in Chiang Mai and operated in 9 zones spread over 5 provinces in Northern Thailand. Project assistance was provided to 48 key villages plus 249 satellite villages and reached about 9,800 hilltribe families over 50,000 people. Phase II of the project, now called as the Thai Australia Highland Agriculture and Social Development (TA-HASD) project, is a bilateral aid project funded solely by the Thai and Australian Governments. It will continue until 1993 and will address a further 11 zones in 6 provinces with a target population of about 13,000 hilltribe households over 55,000 people in 49 key villages plus about 300 satellite villages.

Project budget will become about 715.4 million Bahts as summarized in the following table.

Table 2-2 Source of Assistance for the Project

Unit : Mil Bahts

Tribe	Phase I	Phase II	Total
The World Bank	106	-	106
The Government of Australia	115	214.9	329.9
The Government of United Kingdom	11	-	11
The Government of the Kingdom of Thailand	116	152.5	268.5
Total	348	367.4	715.4

The following terminal infrastructure will be achieved.

Table 2-3 Infrastructure Achievements Supported by the Project

Tribe	Phase I (Achieved)	Phase II (Planned)	Total
Village Water Supplies	500 km	153 km	653 km
Motorcycles Tracks	0 km	250 km	250 km
Village Water Supplies	117 schemes	115 schemes	232 schemes
Weirs	42 schemes	0 schemes	42 schemes
Channels	42 schemes	70 schemes	112 schemes
Zonal Centers	9 schemes	11 schemes	20 schemes
Key Village Centers	48 schemes	31 schemes	79 schemes

As shown in the following table of distribution, total 5,846 ha agricultural field was developed until 1990.

Table 2-4 Cumulative Crop and Development Area Supported by the Project (1990)

Crop	Developed Area (ha)
Field Crops	3,293
Paddy	1,344
Coffee	298
Tea	119
Rubber	26
Grass Strips	766
Fruit/Bamboo (*	56,381
Total	5,846

Note : (* means number of seedlings

(2) Thai-German Highland Development Programme

The central focus underlying this project is that new adaptations to a changing situation are best managed through

examining and improving the relations among people, their environment and institutions which have been designed to better function in their world. The project has been implemented successively in 3 project areas as follows.

Table 2-5 Basic Data on the Project

Item \ Project Area	Tambon Wawi	Nam Lang	Huai Poo Ling
District & Province	Mae Suai Chiang Rai	Pang Ma Pha Mae Hong son	Muang Mae Hong Son
Land Area	425 sq. km	600 sq. km	370 sq. km
Population	13,500 persons	6,000 persons	3,500 persons
Households	2,400	900	900
Villages	61	27	31
Ethnic Groups	Akha, Karen, Lahu, Lisu, Yao & Chinese	Meo, Karen, Lahu, Lisu & Shan	Karen
Project Term	1982 ~ 1994	1983 ~ 1994	1990 ~

1) Activities

a. Agriculture

Land use planning, soil and water conservation, diversification of crops and forestry

b. Public health

Improved water, sanitation, nutrition and health care services

c. Education

Increased access to primary, secondary and nonformal education

d. Community development

Strengthening of local development organizations and resources

e. Women's development

Special programmes to ensure the status and role of women in the developing community

2) Related agencies

The Office of the Narcotics Control Board (ONCB), Ministry of Interior (MOI), Ministry of Public Health (MOPH), Ministry of Agriculture and Co-operatives (MOAC), Ministry of Education (MOE) and Ministry of Commerce (MOC)

3) Project cost (until 1991)

Government of the Federal Republic of Germany	124 million Bahts
The Government of the Kingdom of Thailand	8 million Bahts
Total	132 million Bahts

(Refer to Appendix 6-2-2 and 6-2-3)

2-4 Current Situation of Agriculture in Northern Thailand

The hilltribe people live mostly in the highland areas of the North and South West parts of Thailand and spread over 20 provinces. By province, Chiang Mai, Chiang Rai and Mae Hong Son have the largest population of hilltribes. According to the National Statistical Office in 1988, the population of hilltribes are 139,965 persons or 25% of the total in Chiang Mai, 98,105 persons or 18% in Chiang Rai

and 82,967 persons or 15% in Mae Hong Son.

Depending on the fact, current situation of agriculture in Chiang Mai may be described as the representative in Northern Thailand.

Total area of Chiang Mai is 20,107 square kilometer, of which 75.6% is covered by forestry. Major indexes concerned on agriculture in Chiang Mai show 260,404 hectare farm land, 167,391 farming households, and 1.56 hectare average farming field per household, which is fairly small when compared with average 4.5 hectare of the whole country. Of which the areas of lowland paddy field, upland field, orchard and others are 0.87, 0.28, 0.17 and 0.24 hectare respectively. Yield of lowland rice per hectare in Chiang Mai is, however, 3,193 kg extremely higher than 2,021 kg in the whole country in 1989. The garlic is the special products, which were produced 45,677 ton or 30% share of the whole country in 1988/1989 crop year. In recent years, production of vegetable, flower and strawberry are increased, of which strawberry shows the largest share in the country. (refer to Appendix 6-4 ~ 6-6)

2-5 General Agricultural Condition

2-5-1 Current Situation of Highland Agriculture

Most popular farming in highland area is rainfed upland field farming and configuration of the land is most of steepy sloping land.

Meteorologically, it is clearly separated 2 seasons of dry and rainy, starting from May upto October or November while 95% of total annual rainfall is concentrated, and minimum mean temperature down to below 15 °C during December to March and maximum mean temperature 21 ~ 22 °C.

Land is sandy soil and medium level in fertility at the level of weak acid or neutral in soil acidity. (Appendix 6-1-1 and 6-1-2 can be referred)

Upland rice, corn and soybean are cultivated as major food crops. Recently, field cultivation has been settled instead of shifting cultivation by the administrative guidance of the Government. Those cash crops as vegetable, flower, fruits, coffee and tea are introduced to cultivate especially in the sites of Royal Projects and the other projects assisted by the foreign countries. Furthermore, the postharvest technology such as grading, collecting and delivering farm products and credit are started to introduce systematically. However, coffee farmers are suffering so much from the fall of the international price of coffee in 1992.

The Department of Land Development carried out the Economic and Social Condition Survey of Hilltribe in the Doi Tung Development area in 1988/1989. In view of the situation of the satellite farmers surrounding the project in the study report, it is understood that a family make-up is 6~7 persons, their livelihood are depended on the agriculture, the cultivation area per household is average 1.9 hectare spreading over steepy sloping hills, rice field is limited, and single field cropping per year is available.

In developed area, however, small-scaled double cropping and permanent crops are also planted. Major crops are maize for feed (average yield 2.6 ton/ha), upland rice (2.0 ton/ha), soybean (0.3 ton/ha) and kidney bean (0.6 ton/ha). As vegetables, cabbage, chinese cabbage and carrot are mainly planted and mungbean, ginger and other vegetables are also cultivated. Permanent crops such as lichee, coffee, peach and tea are also newly introduced and planted at about 0.13 hectare per household. Chicken dung is applied to

vegetable and fruits tree.

Meanwhile, annual income is average 20,800 Bahts per household, of which 80% getting by farming, 20% by forestry and cottage products together with wage labor.

In reaction to the settlement or land distribution plan for farming and living proposed by the Government, 84% people desire to get the land for permanent life. Furthermore, the study by interview confirms also the stable stay due to the following reasons ;

a. Poppy planting is strictly prohibited by the low.

b. Although young generation feels a repugnance to shifting cultivation and poppy planting seeing the declining life condition of the old generation, it is difficult for them to get jobs with equitable income.

c. The available fields for shifting cultivation with lower farming cost are decreased and restricted.

d. They hope to enjoy the social infrastructural facilities of education, medicine, electricity and road.

Although sampling method is unclear, the other study reports the spreading rate of small truck, motor cycle and bicycle, 20, 20 and 8 families per unit respectively. Also the radio and sewing machine are prevailed.

Villages in some projects introduce the sprinkler irrigation system for vegetable and flower cultivation by use of spring water and keep the stable income.

2-5-2 Outline of Highland Agricultural Development Project

Highland agricultural development projects have been promoted as the Highland Agricultural and Social Development Projects mainly by the Royal Family and the Department of Public Welfare, Ministry of Interior in cooperation with ONCB, related Government agencies, assistance agencies of foreign countries and international institutions.

On-going Royal Projects are now executed at 25 places.

The highland agricultural and social development projects cover 14 zones, some of where have been completed by the assistance of Germany, Norway, Canada, Sweden, Australia and international agencies as UNDP, UNDCP, UNFPA and UNICEF. (refer to Appendix 6-2-2 and 6-2-3).

Details of completed and on-going projects by country and international agencies are summarized as follows ;

Table 2-6 Number of Projects Assisted by Foreign Countries and International Organizations

Foreign Countries and International Organization	Number of Projects assisted
Australia + United Kingdom	1
Australia	4
Norway	1
Germany	1
United Kingdom + EEC	1
U.S.A.	1
New Zealand	1
United Kingdom	1
International Organizations	3
Total	14

All the above mentioned projects are concentrated on agricultural development and many comprehensive rural development projects also there are, including welfare, education, water supply and so on.

For example, Highland Development Project assisted by the Norwegian Church Aid was commenced in 1985 and will continue until 1993 more addressing the following targets ;

① Upland rice cultivation

To improve cultivation method and to increase productivity

② Soil conservation

To protect soil erosion

③ To increase production of all other crops

④ To assist cultivation of replaced cash crops instead of poppy

⑤ To assist medical health care, sanitation and other health services

Target area spreads over 4 provinces of Chiang Mai, Chiang Rai, Lampan and Phayao, and the amount of project cost reaches to 169 million Bahts.

(1) Correspondence to Highland Agriculture in Chiang Mai University

The Highland Coffee Research and Development Center, Faculty of Agriculture, Chiang Mai University, is now conducting training of agricultural extension officers, advanced farmers and agricultural extension officers from neighboring countries both at the premise of the Faculty and Chang Khian station as shown below. The said station is located at Chang Khian village

but the training environment is not so good because the facilities and equipment installed become already too old.

Table 2-7 Achievements Trained by the Highland Coffee Research and Development Center, Faculty of Agriculture, CMU

Foreign Countries and International Organization	Number of Trainees (persons)			
	1989	1990	1991	Total
1. General Highland Agriculture	15	150	140	441
** Hilltribe	60	60	58	178
** Extension Official	91	90	82	263
2. Agricultural Discipline	105	326	116	547
* Plant Protection	-	171	-	171
** Hilltribe	-	81	-	81
** Extension Official	-	90	-	90
* Coffee Cultivation	100	100	100	300
* Neighboring Countries	5	55	16	76
3. Mobile Training	800	900	900	2,600
Total	1,056	1,376	1,156	3,588
4. Seminar on Highland Development	170	-	88	258

(2) Research activities for increasing yield of highland crops (1989~1991)

Total 183 researches have been conducted by Chiang Mai University, Royal Projects and Department of Agriculture as follows ;

1) Chiang Mai University (total 65 researches)

a. Vegetables (total 16 researches)
Lettuce (5), tomato (1), potato (4) and sweet corn (4)

b. Fruit trees (total 3 researches)
Peach (1) and persimmon (2)

c. Industrial Crops (total 28 researches)
Coffee (28)

d. Field Crops (total 18 researches)

Upland rice (6), wheat (5) and legume (7)

2) Royal Projects (total 66 researches)

a. Vegetables (total 36 researches)

Sweet corn(2), cabbage (3), leek (2), carrot (2), lettuce (9), sweet pea (3), cucumber (5), radish (2), tomato (3) and others (5)

b. Fruits trees (total 15 researches)

Peach (3), apricot (2), persimmon (2), apple (3), strawberry (4) and pear (1)

c. Flower (total 15 researches)

Carnation (5), gysophila (2), gerbera (3), chrysanthemum (4) and gladiolus (1)

3) Department of Agriculture (total 52 researches)

a. Fruits trees (total 20 researches)

Coffee (5), tea (4), peach (6), apricot (2) and persimmon (3)

b. Field crops (total 23 researches)

Upland rice (12), wheat (7) and barley (4)

c. Industrial crops (total 9 researches)

Coffee (5) and tea (4)

2-6 Outline and Progress of the Request

Based on the results of a study team headed by Mr. Koichi Aiboshi, Deputy Director, Policy Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, on "Replaced Crops Promotion Project in Northern Thailand", to Thailand from November 27 to December 26, 1990, the Government of the Kingdom of Thailand requested to the Government of Japan to assist the establishment of the Highland Agricultural Research and Training Center through Grant Aid in March, 1991.

The major contents of the request are to establish the Highland Agricultural Training Center at Chang Khian together with procurement of the necessary equipment and to improve the equipment for highland agricultural research and development at Faculty of Agriculture, Chiang Mai University together with the construction of related laboratories summarized as follows;

- Chang Khian Highland Agricultural Station

  Building : Total 1,000m^2, consisting of training room, library, dining room, exhibition room, dormitory, administration office and audio visual room.

  Equipment : Related training equipment, farm machinery, transportation vehicle and etc.

- Research Facilities and Equipment for the Highland Agricultural Research and Training Center at Faculty of Agriculture, Chiang Mai University

  Equipment : Equipment for Analytical Laboratory
  Equipment for Plant Biotechnology Laboratory

Equipment for Post Harvest Laboratory

Equipment for Land Use Planning Laboratory

Equipment for Environmental Plant Physiology Laboratory

Building : Total 2,000m^2, consisting of the above said 5 laboratories and 2 administration rooms

In response to this request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a basic design study on the Establishment of the Highland Agricultural Research and Training Center Project under the Grant Aid, and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Thailand a study team headed by Mr. Masashi Kono, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, from January 27 to February 20, 1992.

Then after, this Basic Design Study Report was prepared.

CHAPTER3 OUTLINE OF PROJECT SITE

CHAPTER 3 OUTLINE OF PROJECT SITE

3-1 Location of Project Site and Economic Condition

3-1-1 Location of Project Facilities

The Project area is located at Chang Khian village, Maeo Lim district, Chiang Mai Province, with an area of 40 hectare sloping field surrounded by forest at the northeastern foot of Mount Suthep, about 32 km northeast of Chiang Mai downtown. There are no villages near by the Project area, and only Chang Khian Station of the Highland Coffee Research and Development Center belongs to Chiang Mai University, which is about 4 km south of the Project area. The Project area is at the Site B of Chang Khian Station.

3-1-2 Economic and Social Condition

Chiang Mai, the central province of politics, economics and traffic network in the northern Thailand, has an area of 20,107 km^2. It has a population of 1,356,556 and 67.5 persons/km^2 density.

GDP per capita shows 18,051 Bahts or US$706 in 1987, which covers only 22% of that in Bangkok and less than 82% as compared to the national average GDP per capita. Recently, industry is growing prosperously and population has a tendency to increase. The details of agricultural production are shown in Appendix 6-5 and 6-6.

Major agricultural products of rice, soybean, peanut and garlic are produced higher than those in neighboring provinces of Chiang Rai, Lampan, Lanphun, Mae Hong Son, Nan and Tak.

3-2 Natural Condition

Chiang Mai is located 300 meter above the sea level and 32.9°C of annual average maximum temperature, highest in April and 36.8 ~ 38.0°C of monthly average temperature during 1989 ~ 1991. On the other hand, the annual minimum temperature shows 20.3°C, the lowest in December and January, and it comes down 12.6°C. More than 78% of the annual rainfall is concentrated in May to October, and no crops can be cultivated without irrigation facilities in dry season in the area. (Appendix 6-1-1 refers)

Land use in Chiang Mai Province consists of 75.6% forestry, 13.0% agricultural field and 14% others.

3-3 Outline of the Project Area

The Center will be constructed at Site B of Chang Khian station which belongs to the Highland Coffee Research and Development Center.

The present conditions of Site A and B were surveyed as follows :

Site A is situated 1,300m above the sea level with an area of 41.9 ha of which 16 ha is cultivated mainly with coffee. This site is being managed by 1 officer and 22 workers.

It has building facilities consisting of one training building with an administration and a lecture room, 3 dormitories and 3 warehouse cottages, one workshop building annexed with a seedling bed, and one weather station.

There are also such equipment as 1 unit of 40 Hp 4-wheel tractor, 1 unit of 7.5 Hp hand tractor, 2 units of generators, one of which is 22 KVA diesel and the other 3 KVA gasoline driven, 9 units of sprayers, 3 units of brush cutters and etc.. Spring water is supplied for drinking, and electricity is generated by generator. However, these

equipment are already timeworn and the training activities could be hindered.

On the other hand, Site B covers an area of 40 ha, of which 7.13 ha are allocated for cultivation and the remaining 32.87 ha for building, road, forest, pasture and waste land, respectively. It is located with an altitude of 1,150m. The cultivation area of 7.13 ha consists of 0.64 ha for vegetables and flowers, 1.14 ha for general crops and 5.35 ha for orchard.

Building facilities consist of 1 administrative office, 3 guest houses, 3 workers' houses, 3 warehouses, 1 greenhouse, and 1 seed bed together with a weather station and a pond. Unpaved road is leading to the other village crossing the site. There are 4 paths provided in the site. Electricity is supplied by generator and spring water is used for drinking. There are no good equipment. Current condition of farmland use in the Site B is as follows ;

Table 3-1 Present Farmland Use at Chang Khian (Site B)

Tribe	Area (ha)	Remarks
Upland Field		
Demonstration Field	0.64	Vegetable & Flower
1st Field	0.20	Field Crops
2nd Field	0.17	Field Crops
3rd Field	0.14	Field Crops
4th Field	0.33	Field Crops
5th Field	0.30	Field Crops
Sub-Total	1.78	
Orchard		
Apricot Field	2.06	
Pomelo Field	0.63	
Lichee Field	1.36	
Peach Field	0.50	
Mixture Field	0.50	
Sub-Total	5.35	
Total	7.13	

CHAPTER4 OUTLINE OF THE PROJECT

CHAPTER 4 OUTLINE OF THE PROJECT

4-1 Objective

In line with the emphasized targets under the Seventh Five Year National Economic and Social Development Plan (1992~1996); viz, stable growth of economy, fair distribution of income, improvement of living standard, and conservation of the natural resources and the environment, the Government is promoting the development of the hilltribes region in the Northern Thailand, which is considered depressed area.

However, their activities in the region are interfered with such problems as shortage of highland agricultural technology to select the suitable crops and varieties, extension institution and manpower, and training facilities and equipment. In order to solve these problems, the Government has appointed Chiang Mai University as the implementing agency to newly establish the Highland Agricultural Research and Development Center for protecting the destruction of natural resources, stabilizing the highland agriculture, establishing the crop production system and for transferring effectively the new technology to hilltribes.

4-2 Study and Examination on the Request

For the purpose of the review of the Project outline and the execution of the Basic Design, under eventual Japanese Grant Aid, the contents of the request were examined whether the Project was appropriate to be implemented under the Japanese Grant Aid System, in connection with its desired effects, the actual conditions and the executing capacity of the recipient country.

4-2-1 Review of the Validity and Need of the Project

The team discussed and confirmed the validity and need of the Project with the Thai side based on those results. Moreover, the detailed contents of the Project were discussed and agreed with Thai side to proceed the basic design study.

Namely, both parties have agreed that higher priority will be given to (1) transferring and extensioning activities of technology and information, which were researched and stored in Chiang Mai University and related agencies, and (2) scientific and technological activities to the hilltribes in Thailand and neighboring countries. Consequently, transferring and extensioning activities have immediate effects and were more urgent matter to be solved than the scientific research activities.

The contents of the Project are now focused on the training facilities and equipment at site B, Chang Khian station to establish the Highland Agricultural Development and Training Center instead of the scientific facilities and equipment to establish the research center at the premise of Chiang Mai University.

As shown in the training results since 1978 that exceeding 1,000 hilltribes farmers and 500 extension officers including trainees from Laos were trained successfully, further promotion of training activities will practically and effectively contribute to the epoch-making reduction of poppy cultivation in Asia, especially at golden triangle zone, protection of forestry destruction caused by shifting cultivation and effective utilization of natural resources.

4-2-2 Review of Implementation Plan of the Project

Following the five-year training plan, the Center will be maintained and managed by Chiang Mai University with the coordination of ONCB, and considering the foreign assistance and Thai Government budget, necessary adjustment in the annual budget will be made among the Ministry of Finance, Bureau of the Budget and the Ministry of University Affairs,

Furthermore discussions were made between Thai side and the team concerning on the following subjects:

① Possibility of technological correspondence

② Appropriateness of training plan

③ Manpower requirement in the training program

④ Selection of trainees

⑤ Necessity of training

(1) Possibility of technological correspondence

The Faculty of Agriculture of Chiang Mai University, has the following departments; namely, Departments of Agricultural Economics, Agricultural Extension, Agronomy, Animal Science, Entomology, Food Science and Technology, Horticulture, Plant Pathology, Soil Science and Conservation, etc. The Faculty has a total of 126 staffs consisting of professors, assistant professors and lecturers. Lecturers for the Center are nominated among themselves and technological correspondence is fully possible.

(2) Appropriateness of training plan

In Faculty of Agriculture, Chiang Mai University, the Highland Coffee Research and Development Center was established under the assistance of the Netherlands Government during 1983 to 1992. This Center was implemented into 3-phases together with the 3 stations at Chang Khian, Nong Hoi and Pa Kia. The objectives for establishing the Center are (1) to study and develop the suitable coffee stock for the northern part of Thailand, (2) to study on how to prevent infection of disease from insects and virus, (3) to study favorable climate condition, (4) to study proper use of pesticide, and (5) to explore the market.

Highland agricultural training courses have been completed at the Center to train agricultural extension officers and highland farmers, in addition to the organization of coffee seed and seedling distribution. Presently, 26 researches and exceeding 124 times training courses were executed.

As shown in the following table of training results, there is no problems to plan, implement and evaluate the training from now on since their rich experiences.

No institution stands comparison with the Center to train the highland agriculture to the hilltribes of the ethnic minorities especially in neighboring countries, considering living custom, life-style and language.

Table 4-1 Training Courses Achieved by the Highland Coffee Research and Development Center, Faculty of Agriculture, CMU

Training Course and Trainees	Number of Trainees (persons)			
	1989	1990	1991	Total
1. General Highland Agriculture	151	150	140	441
** Hilltribe	60	60	58	178
** Extension Official	91	90	82	263
2. Agricultural Discipline	105	271	100	471
* Plant Protection	-	171	-	171
** Hilltribe	-	81	-	81
** Extension Official	-	90	-	90
* Coffee Cultivation	100	100	100	300
** Hilltribe	40	40	40	120
** Extension Official	60	60	60	180
3. Neighboring countries	5	55	16	76
* Laos	5	30	16	51
** Hilltribe	-	10	4	14
** Extension Official	5	20	12	37
* Vietnam	-	25	-	25
** Hilltribe	-	5	-	5
** Extension Official	-	20	-	20
4. Mobile Training	800	900	900	2,600
** Hilltribe	800	900	900	3,600
5. Other Course	170	-	88	258
* New Dimension for Highland Development	90	-	-	90
** Administrator Official	90	-	-	90
* Workshop for highland Development	80	-	-	80
** Administrator Official	80	-	-	80
* Seminar on highland Development	-	-	88	88
** Policy Official	-	-	48	48
** Implementation Official	-	-	40	40

On the other hand, 35 persons from Chiang Mai University, 5 persons from Department of Agriculture, Ministry of Agriculture and Cooperatives, 5 persons from Royal Forestry Department, 2

persons from ONCB and 3 persons from Health Care Office participated in training at the Coffee Center as lecturers. The University will be the responsibility in arranging the group of those lecturers including assistants as 10 persons for crop production course, 10 persons for discipline course, 15 persons for other course and 3 persons for mobile training under the cooperation of the related agencies for the Center of this Project. Therefore, the training plan is reasonable viewing from the possible preparation of lecturers.

In relation to the category of courses, all courses are indispensable for developing highland, protecting forestry destruction, preserving soil and natural resources, and promoting replacement of crops, such as crop production course consisting of vegetable, fruits, upland rice and flower course, discipline course of highland farming system, pest control, soil conservation, environmental and meteorological course, other course of seminar / workshop on highland, highland agricultural development, narcotics crop control and prevention training, highland community development and forestry community development course, and mobile training, all of which are called the coffee center extension.

Training courses and their curricula planned are justifiable.

Taking into account the past training result and its efficiency, it is appropriate to train maximum 25 trainees per class per time and total 32 times per year for crop production and discipline course; maximum 40 trainees per class per time

and 5 times per year for other course, and 16 times per year for the total 800 farmers for mobile training.

(3) Manpower requirement in the training program

To perform the drafting and implementing the above mentioned training plan smoothly, a total of 40 persons will be recruited in the administration, training and development section under the supervision of a manager and 2 assistant managers. The staffs responsible on the development will be strengthened properly. A manager and 2 assistant managers will hold their positions in the University concurrently, every chief in sections and staffs charged on audio-visual, machinery and repair shop will be placed from the University, and the other staffs recruited newly.

(4) Selection of trainees

In view of their training achievement during the past 3 years at the Highland Coffee Research and Development Center with an average 1,200~1,300 persons trained yearly, the enlisting activities of Governmental officers, agricultural extension officers and selected farmers will be surely continued by the ONCB in association with the internal and foreign agencies concerned from Royal Projects, as well as the Projects assisted by international agencies, related Governmental agencies, hilltribes farmers, and neighboring countries.

(5) Necessity of training

Faculty of Agriculture, Chiang Mai University is now extending the training to agricultural extension officers and

highland farmers for the purpose of extensioning the new highland agricultural technology as part of highland agricultural development. However, the above beneficiary can not cover all over the highland agricultural area due to shortage of extension officers. Necessity of training activities will therefore be emphasized.

4-2-3 Review of Existence of Similar Projects, Relationship with Assistance programs of the International Agencies, Functional Roles Sharing Between the Project and Existing Facilities

Based on 1988 National Statistics office, the total population of hilltribes in Thailand was reported to be 554,172 persons and distributed to 3,474 villages at 88 districts in 20 provinces.

Since 1961, Thai Government started the agricultural, social and economic development programs. Under this program, the Government has completed already 11 projects, while are now being implemented 13 projects. The target areas covered 20 provinces, or 1.2 projects only per Province.

Development programs will be increased yearly in the future, therefore the qualitative and quantitative increase of agricultural extension officers will be required. The training institution of agricultural extension officers will, however be conducted only at Faculty of Agriculture, Chiang Mai University. Even after the completion of this Project, it is rather hard to cover all the highland area within the limited time. The additional centers may be required under the present situation. The major completed and on-going projects are shown in the Appendixes.

Table 4-2(1) Major Foreign Assisted Highland Development Program

Program	Project Site	Duration	Source of Assistance	Budget
1. Thai-German Highland Development Program (TG-HDP)	Chiangral & Mae Hong Son	1981 1994	The Government of the Federal Republic of Germany Royal Thai Government	419.0 million Bahts 19.5 million Bahts
2. THai-Norwegian Highland Development Program (TN-HDP)	Chian Mai, Chianral, Payao Lumpang	19851992	Norwegian Church Aid Royal Thai Government	5.6 million $ 41.0 million Bahts
3. Pae-Por Highland Development Program (PP-HDP)	Tak & Chiang Mai	19871992	UNDP UNFDAC UNFPA UNICEF Sub-Total Royal Thai Government	783,200 & 783,850 & 115,050 & 202,500 & 1,884,600 & 31,895,273 Bahts
4. Sam Mun Highland Development Project (SM-HDP)	Chiang Mai & Mae Hong Son	19871992	UNFDAC Royal Thai Government	2,594,500 & 144,780,200 Bahts
5. Thai/WIF Highland Development Communi-cation Support Project (THAI/WIF-HDCSP)	9 ethnic groups totalling 500,000 people	19871996	Norwegian IOGT Royal Thai Government USA-NAS Others Total	700,292 & 178,032 & 46,204 & 57,230 & 981,757 &
6. Wiang Pha Highland Development Project (WP-HDP)	Chiang Mai	19871992	UNFDAC Royal Thai Government	2,984,740 $ 60,194,516 Bahts
7. Doi Yao-Pha Mon Highland Development Project (DYPM-HDP)	Chiang Rai & Payao	19901994	UNFDAC/Baptist Union of Sweden Royal Thai Government	4,524.193 $ 107,015,877 Baht

Table 4-2(2) Major Foreign Assisted Highland Development Program

Program	Project Site	Duration	Source of Assistance	Budget
8. Highland Coffee Research and Development Center (HCRDC)	Chiang Mai	19831992	Government of Netherland	3,866,525 Guilders
9. Narcotics Crop Cultivation Control Project (NCCCP)	General Hilltribes	19811991	NAS/USA Embassy	6,455,000 $ (19881991)
10. Intergrated Pocket Area Development Project (IPAD)	Mae Hong Son, Chiang Mai, Chiang Rai, Tak & Nan	19911993	UNFDAC Royal Tai Government	3,950,000 & 21,150,000 Bahts
11. Mae Chaem Watershed Development Project (MC-WDP)	Chiang Mai	19801989	USAID Royal Tai Government Total	8,286,560 $ 11,800,000 $ 20,086,560 $
12. Thai-Australian Highland Agricultural and Social Development Project (TA-HASD)	Chian Mai, Mae Hong Son, Chian Rai, Lampang & Nan	19801993	The World Bank Goverment ofAustralia Government of United Kingdom Royal Thai Government (DPW) Royal Thai Government (Others) Total	106 million bahts 329.9 million bahts 11.0 million bahts 267.2 million bahts 1.3 million bahts 715.4 million bahts

Note: UNDP = United Nations Development Program
UNFDAC = United Nations Fund for Drug Abuse Control
UNFPA = United Nations Fund for Population Activities
IOGT = International Organization of Good Templars
UNICEF = United Nations International Children's Fund
WIF = Worldview International Foundation
NAS = Narcotics Affair Section
USAID = United States Agency for International Development
DPW = Department of Public Welfare

4-2-4 Review of Components of the Project

It was agreed between the team and Thai side that the components of this Project consist mainly of construction of training building, dormitory, workshop building and the access road inside the premise, and provision of the equipment required.

The team acknowledged that the components required for the above mentioned training activities together with necessary administration functions are described in 4-3 Outline of the Project.

4-2-5 Review of Contents of Requested Facilities and Equipment

(1) Facilities

Requested facilities were divided into 2 groups: one was a plan in the campus of Chiang Mai University and the other a scheme in Chang Khian Site B.

One scheme in university has not been made clear to have direct relation with highland agriculture. The facilities requested in university premises were therefore eliminated from this Study.

The facilities requested for Chang Khian Site B were administration, lecture, training, library, dining and kitchen rooms, and dormitory for trainees. When the team visited the sites, including Site B, under control of the Faculty of Agriculture, most of the existing facilities were found to be in good condition even though they are made of simple wooden houses for the last 20 years. The field however being managed in good

condition within the limited budget. Based on these facts therefore, the Faculty of Agriculture would have sufficient capability to act as the implementing agency.

The construction and improvement of the following facilities necessary for the Project were therefore studied.

a. Establishment of Training Building

There exist now a training cottage in Site B consisting of a site manager's room of about 25.0 sq.m. and a lecture room of 36.0 sq.m. with 20 chairs for trainees but without any desks. However, a new building will be designed since this cottage now aged 20 years and very limited to execute a training program.

The new building however will consist of a manager's room, an assistant manager's room, a meeting room, a printing room, an administration room, a library, an exhibition and entrance hall, 2 lecture rooms, a preparation room, a storage room, training room and lavatories.

b. Establishment of Dormitory Building

There are 3 guesthouses which are called huts in the Project site. Each guesthouse, which is designed to accommodate 2 or 3 persons, will be utilized by staff workers after construction of dormitory building. Since there is no dormitory on the site, trainees are now coming from Site A, 4 kilometers from Site B, which causes several hours loss. The Faculty intends to utilize both Sites simultaneously under different programs so as to improve base efficiency and train more field

officers and leaders. A dormitory building should be constructed to perform the plan effectively.

The building will be composed of 13 trainees' room; 4 trainees available to stay in each room, 1 room reserved for 1 guest lectures, 1 room for 3 cooks, an entrance hall, a dining room and a kitchen and lavatories.

c. Establishment of Workshop

There are, no workshops at the site, but simple repair service is done by mechanics coming from university. It takes, however, more time to repair due to long distance from Chiang Mai City, and inaccessibilities of transportation and communication. A workshop is also required to be built for full and smooth operation of the equipment procurements under the Project.

d. Greenhouse

The existing-aged greenhouse will be improved, which was constructed with 6 square light steel columns, 2 rectangular light steel girders and crust of glass together with angle-shaped light steel frames. All steel parts are rusted and broken in some places. Several prices of glasses are also broken; moreover, windows do not move due to rust and warp of the frame.

e. Simple Water Treatment and Distribution Tank

Water is led to the site by 4-inch pipes from a spring near the top of the mountain. Water contains many sand and soil

particles, which often causes bridges inside the small diameter pipes and not safe for drinking water. A simple water treatment tank will therefore be installed near the existing storage cottage. At the same time, a water distribution tank will be installed near the water treatment tank so as to reserve water for the buildings.

(2) Review of Contents of Requested Equipment

According to the results of the discussions concerning the equipment requested for training, research, road maintenance and others, the equipment being requested by the Thai Government under the training plan were as follows:

1) Equipment for Training

The following modifications for the related requested equipment will be given priority. Approval for introducing telecommunication equipment such as wireless radio set and fax was already obtained by Chiang Mai University from Telephone Organization of Thailand(T.O.T.). Fax will be also installed at Chiang Mai University so that the information between the University and the agencies concerned can be exchanged quickly and correctly.

① Major equipment excluded from the request

a. Video Set

Considering that the existing audiovisual equipment for medium class business use are operated effectively at the Highland Coffee Research and Development Center, no

problem could be seen in the operation of the equipment after introduction. However, the overlapped equipment such as outdoor video camera with related facility and indoor camera with related facility of the components in the line of video system shall be provided one of them for common use with the condition of no trouble for outdoor video production, indoor video production, video editing, video duplication and video display.

b. Developing, printing and enlarging equipment

Film developing, printing and enlarging services should be ordered to professional camera shop in Chiang Mai City to secure reliability and lower cost. It therefore, is appropriate to exclude them from the list of the requested items.

c. 2-ton truck

2-ton dump truck requested for road maintenance could be used as common truck requested for cargo transportation vehicle. This vehicle should be also excluded from the list of the requested item.

② Major equipment with specifications changed

a. Video Equipment

Considering the current trend of popularity in the video market, it is preferable to provide S-VHS (2/1" in tape width) in addition to U-Matic (3/4" in tape width) and VHS for increasing versatility. Furthermore, the system

shall be provided with the function available to duplicate even video and 16mm film, which are surely brought into the Center not only from Thai internal agencies but also from foreign countries, for promoting the training efficiency, ensuring smooth rental and distribution of video film, and strengthening training activities. Video distribution equipment such as video cassette player, video projector and etc. shall be movable-model for use at 2 lecture rooms.

b. Printing machine

It is appropriate to provide stencil printer with related facility instead of offset printer and the related facility, considering lower electricity consumption and cheaper running cost.

c. Workshop tools

In accordance with the guideline provided by Ministry of Agriculture, Forestry and Fishery, Japan, measuring and workshop tools shall be procured to secure in significant process and repair of small-scaled equipment including facilities belonging to the building, and periodical inspection, maintenance and replacement of spare parts for medium and large-scaled equipment. A basic carpenter's kit shall be also provided to fabricate training materials and publicity service by effective use of packing wood for promoting training effects.

③ Reduction of major equipment

Considering the relationship between the maintenance cost and the training plan, the number of units of major equipment to be used shall be reduced as follows:

a.	Video set	from 4 sets to 1 set
b.	Overhead Projector	from 4 units to 3 units
c.	Camera	from 2 units to 1 unit
d.	Hand tractor	from 4 units to 2 units

2) Equipment for research

Of the equipment requested, it is recommendable to use in the research the following: scale, water bath, oven, pH meter and soil moisture meter as basic equipment for practical training of land and soil conservation, and plant protection.

Furthermore, microscope (stereo microscope available to observe the article placing directly under lens without any using sliding glass; compound microscope available to observe the prepared specimen cut from plant; and, compound microscope with camera and display for lecturer), incubator and autoclave are provided as basic equipment for practical plant protection training. A complete set of micro plate reader is also recommended to lecturer to determine the correct name of disease. Finally, an appropriate number of side table shall be installed inside the practice room.

The requested land use planning equipment, consisting of computer, paintjet color printer, pen plotter, image processing system, digitizer, tape backup system, uninterrupted power

supply and software concerned on geographic information system, requires sophisticated skills, higher cost and administrative adjustment with the agency concerned. Therefore, it is preferable to provide a simple global positioning system (GPS) instead of a complicated system. It is also appropriate to prepare meteorological instrument and runoff plots set as practical training both inside and outside door for acknowledging forestry and environmental destruction at mountain area caused by shifting cultivation.

One set of automatic weather station shall be installed at the Center to collect basic meteorological data for a long term effectively.

Other equipment such as growth chamber, phytotron, etc. is rather expensive and requires high maintenance cost, and shall therefore be excluded from the list of the requested items, which causes no obstruction to the Center's activities in due course without purchase.

3) Equipment for maintenance of road

Approximately 12 km of the access road to the Center is not paved yet. Each unit of the requested small bulldozer, 2-ton dump truck and hydraulic excavator are recommended to be used as basic road maintenance equipment for securing picking up and sending off trainees and transportation of daily commodities smoothly all year-round.

4) Others

80 units of tables and chairs requested shall be changed to 50 units together with provision of additional lecturer's table and chair in accordance with training plan.

4-2-6 Basic Principle for Implementation of Cooperation

The Project is deemed appropriate for implementation. Due to the feasibility and outcome of the project, the Thai ability to execute it has been confirmed, and its anticipated meeting of the requirements of the Japanese Grand Aid system. In the event the Project is granted by the Japanese Government under Grand-Aid assistance, the team will review the outline of the project and prepare the draft basic design in the following sections. As stated in "Review of Components of the Project" and "Review of Contents of Requested Facilities and Equipment", it is recommended that some parts of the requested components of the Project should be changed.

4-3 Outline of the Project

4-3-1 Executing Agency and Administration System

(1) Executing Agency

Chiang Mai University (CMU) will be the executing agency for the Project, and the Highland Agricultural Development and Training Center belonging to the Institute of Agricultural Science Research and Development to be established under direct control and supervision of the President of the University, which is in the same level of the existing faculty.

(2) Organization Chart of the Highland Agricultural Development and Training Center

The organization chart of the Center is shown in the succeeding page. One manager and two assistant managers will be assigned at the Center but will hold concurrent posts at the University.

(3) Manpower Plan

A total of 40 persons, consisting of 17 persons in administration section, 19 persons in training section and 1 person in development section including 1 manager and 2 assistant managers, are planned to be assigned in the management of the Center. Manpower for development section is however planned separately.

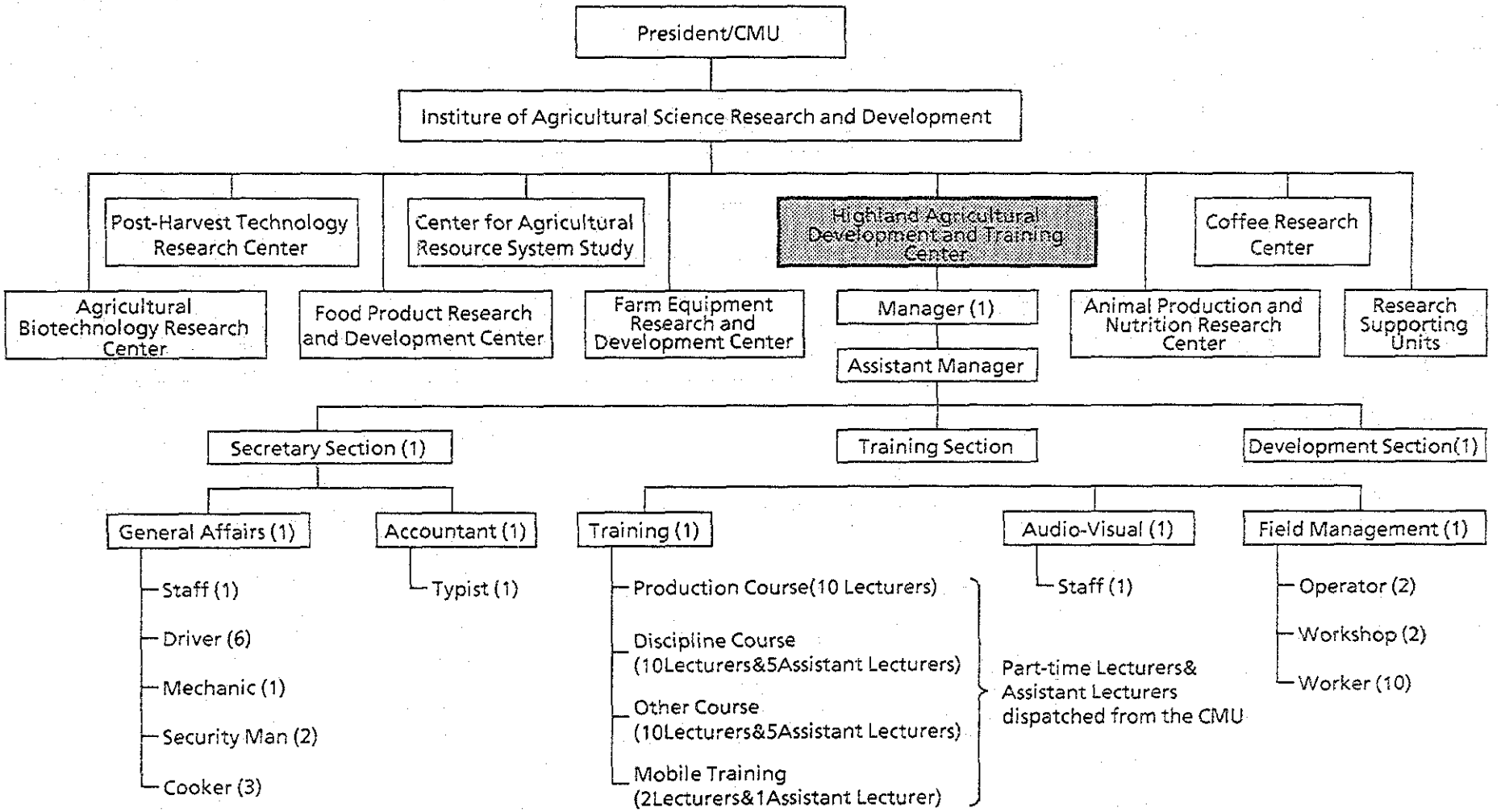
4-3-2 Activity Program

In preparing the draft basic design of the Project, the basic design team discussed with the Thai side the functions and roles of the training activities, the concrete and practical relationship among them, and the contents of their training activities and agreed with the Thai side as follows;

(1) General

Trainees in this Center are mainly agricultural extension officers working at Royal Projects and Ministry of Interior together with leading farmers and extension officers in neighboring countries such as Laos, Cambodia, Vietnam, Myanmar and Philippines for technology transfer in the field of agriculture.

Fig.4-1 Organization Chart of Highland Agricultural Development and Training Center



Training courses consist of 4 courses which are independently executed. The number of times of the training and trainees in the first year (1994) is summarized in the next table. Detail annual training plan is shown in Appendix 6-9-1~6-9-6.

Table 4-3 Training Plan in 1994

Course	Frequency (time)	No. of Trainees (person)			
		Extension Officer	General Farmer	Neighboring Country	Total
1. Production Course					
a. Vegetable Course	4	80	60	8	12
b. Fruits Course	4	48	36	5	7
c. Hill Rice Course	3	60	45	6	9
d. Field Crop Course	3	60	45	6	9
e. Flower Course	4	80	60	8	12
Sub-Total	17	328	246	33	49
2. Discipline Course					
a. Highland Farming System Course	3	60	51	-	9
b. Plant Protection Course	2	40	34	-	6
c. Soil Conservation Course	1	20	17	-	3
d. Environmental Course	1	20	17	-	3
e. Meteorological Course	4	64	54	-	10
Sub-Total	11	204	173	-	31
3. Other Course					
a. Seminar/Workshop on Highland Course	1	32	27	-	5
b. Highland Agricultural Development Course	1	32	27	-	5
c. Narcotics Crop Control and Prevention Course	1	32	27	-	5
d. Highland Community Development Course	1	32	27	-	5
e. Forestry Community Development Course	1	32	27	-	5
Sub-Total	5	160	135	-	25
4. Mobile Training	13	650	-	650	-
Total	46	1,342	554	683	105

Training lecturers are mostly dispatched from Chiang Mai University. Crop production course is conducted by 2 lecturers respectively for indoor and outdoor practical training.

Discipline course is executed by 1 lecturer and 1 assistant not separating indoor and outdoor training, while the other course is conducted by 2 lecturers for respective course.

Mobile training team consists of 2 lecturers, 1 assistant lecturer, 1 audio-visual operator and 1 driver, or a total of 5 staffs.

Accordingly, Chiang Mai University will arrange 10 lecturers for crop production course, 5 lecturers and 5 assistants for discipline course, and 10 lecturers and 5 assistants for other course respectively.

* Other Course

Conducting various kinds of seminars and workshops concerned on the highland agriculture.

* Mobile Training Course

Driving to the hilltribe villages and to train agricultural technology most suitable in that area.

Considering the period, the shortest of which is 5 days for other course and the longest 90 days for plant protection course, audio-visual equipment will be utilized thoroughly to cover the incomplete practical training.

In crop production course, training on seed germination test, planting, nursery and irrigation is compulsory .

Maximum number of trainees is limited to 25 persons for a more concentrated training since only 1 lecturer conducts the training in each course.

(2) Curriculum

1) Crop Production Course (for extension officer and farmer)

1)-1 Vegetable Cultivation Course

a. Kinds of Vegetables

lettuce, leek, sweet pea, sweet corn, pumpkin, radish, baby corn, carrot, asparagus, tomato, green pepper, cucumber and potato

b. Cultivation Method

According to the cropping calendar (refer to Appendix) training on such technology as plowing, ridging, volume of fertilizer supplied, application method of fertilizer, sowing volume, sowing method, space between the row, space between the hill, thinning, weed killing, application of insecticide, irrigation method, harvesting etc., both in the room and field will be conducted.

As to transplanting vegetables, transfer of technology in seedbed preparation, management of seedling, transplanting timing and transplanting method will also be made. Cropping calendar as shown in the Appendix means standard. However, training on how to nurse the seedling during winter and to harvest in March and April such as tomato, lettuce, sweet pea, pumpkin, cucumber, green

pepper, etc.

Also training on the sorting of harvested products, packing, storage before delivery, etc.

c. Improvement and Conservation of Soil

It is necessary to inspect the acidity of soil and to reform soil by applying calcium in the vegetables. Acid is hazardous to acid soil. Therefore, training on soil inspection method, quantity of corrective agent and application method will be required.

As to soil conservation , protection method of soil erosion as shown below is conducted because trainees will be assigned in hilly area.

* Contour and Terrace Cultivation

* Cultivation of soil erosion protection crops together with the purpose of soil improvement like as leuceana tree, pigeon pea, cologoponium, sesbania, acacia, media and etc.

d. Investigation of growth

Training on determination of grass height measurement in each stage during germination, transplanting, budding, flowering and harvesting.

e. Investigation of Yield

Training on how to measure the yield per rai and estimation on the available volume of delivery.

f. Curriculum by Season

Vegetable production course is conducted 4 times, each 10 days in September, October, November and December. While preparations of sowing, transplanting and management work are done in September. Harvesting is occasionally done in October. Finally, harvesting, selecting and packing are done in November and December as shown in the cropping calendar.

As mentioned above, audio-visual equipment will be fully used in practice because training in the field varies according to months.

1)-2 Fruits Course

a. Kinds of Fruits

Lichee, apricot, peach and persimmon

b. Cultivation Method

To train such technology as nursery, cutting, budding, transplanting (space between seedlings and transplanting hole), irrigation, applying fertilizer, weed killing, mulching, thinning out, spraying, harvesting, pruning, branch cutting and etc., both in the room and orchard. Drip irrigation is recommended by using bottle to each seedling for a year after transplanting.

c. Post Harvest

To train such technology as selection by size, packing and storing at farm yard.

d. Gardening Method

Terrace method is most popular at highland area. It has close relationship between width of terrace and thickness of planting. This method includes training on gardening technology such as designing of farm road, which is more important for transporting farm input and products, protection method of soil erosion, etc.,

e. Curriculum by Season

Fruits course is conducted for 10 days each in May, July, September and November. Training on harvesting, selection and packing of lychi, pruning of persimmon, management of apricot and etc. in May will be conducted; only management of each fruit tree in July; harvesting, selecting and packing of persimmon and management of other fruits in September, and finally, pruning of apricot and peach, management of other trees in November.

Audio-visual equipment is fully applied because available practical training subjects at orchard are limited. Training on cutting and grafting are taken up in all courses as they required special technics.

1)-3 Upland Rice Course

a. Cultivation Method

Upland rice is the most important food crop for highland farmers. Training on how to cultivate traditional and new variety at this Center will be conducted even though the improvement of upland rice variety is also conducted in Thailand. Subjects under this method are seed selection and disinfection, sowing volume, method and timing, necessary volume of fertilizer, suitable volume of base and additional fertilizer, weed killing, plant protection control, harvesting, drying, etc..

b. Post Harvest

This training includes each processing as threshing paddy dried at field, drying, sorting, weighing and bagging. Training on milling by using audio-visual equipment or surveying on rice mill as outdoor training are also included.

c. Soil Improvement and Conservation

It is necessary to check soil acidity even though upland rice is rather resistant against acid soil although the growth will be damaged if pH is below 5. Training on testing method of soil acidity, necessary volume and applying method of correction agent, etc., is also included.

d. Investigation of Growth and Yield

This included training on the following subjects;

- Grass height at the stage of germinating, tillering, young ear generating, booting, flowering and harvesting.

- Measuring of yield per rai.

e. Curriculum by Season

Upland rice course is conducted for 10 days respectively in June, August and October. Practical training at the field, preparation of sowing and sowing in June in sowing stage; plant protection control in August as tillering, young earing generating stage and also booting stage of new variety. These are most important stages for rice, physiologically and ecologically.

October is the first half of harvesting season and so such practical technology as harvesting, drying, threshing, sorting, weighing and packing will be important including the visit to rice mill.

Audio-visual equipment will be fully utilized to sustain the degree of training even in a short period. Germination test is conducted in all courses.

1)-4 Field Crop Course

a. Kinds of Field Crops

2 kinds of crops, wheat and corn, will be taken up as representative field crops at highland agriculture.

b. Cultivation Method

Training will be concentrated on the following subjects;

Seed selection and disinfection, sowing volume, method and timing, land clearing, ridging, space between hills in case of corn, volume and timing of base and additional fertilizer, thinning of corn, weed killing, plant protection control, harvesting, drying, etc..

c. Post-Harvest

This includes training on grading, weighing, packing and etc. required after harvesting and drying.

d. Soil Improvement and Conservation

This relates to the subjects for upland rice.

e. Investigation of Growth ad Yield

Training includes the following subjects;

- Wheat Measuring method of grass height at the respective stage of germination, tillering, booting, earing, flowering and harvesting, number of tillering, and yield per rai.

- Corn Measuring method of grass height at the respective stage of germination, heading of female ear, earing and harvest, and yield per rai.

f. Curriculum by Season

Field crop course is conducted 3 times each in June, October and December respectively. June and October are the initial growing periods for corn and wheat respectively, and special management shall be taken. December is the heading stage of wheat and training of weed killing and plant protection control shall be concentrated. Germination test is conducted in all courses.

1)-5 Flower Course

a. Kinds of Flowers

Straw flower, lavender and carnation.

b. Cultivation Method

Period of transplanting and sowing varies for most flowers. Method of seedling nursery shall be employed for the above 3 flowers. Thenafter, they are planted provisionally and set. Subsequent management works correspond to the vegetable cultivation.

c. Soil Improvement and Conservation

This corresponds to vegetable cultivation.

d. Investigation of Growth

This includes training on how to investigate the growth at the stage of germination, transplanting, flower-bud-appearing and flowering.

e. Investigation of Yield

Training on how to count the total number of flower stalks and estimation on the number of flowers available to be delivered.

f. Curriculum by Season

Flower course is conducted 4 times in September, November, December and January respectively. Field preparation, sowing and seedling nursery stage will be conducted in September. Inter-management, and preparation of field and nursery bed for the late sowing flowers will be done in November, while inter-management, and sowing and nursery stage for the late sowing flowers will be done in December. January is the harvesting stage and also the transplanting stage for the late sowing flowers.

Other works will use of audio-visual equipment. Germination test will be conducted in all courses.

2) Discipline Course (for extension officer)

2)-1 Highland Farming System Course

Under this course, training on how to establish the farming plan for individual farmers and villages, increase of

production, promotion of production groups, and grading, packing and delivery in group will be conducted.

Types of farming are assumed as follows;

A. upland rice	a. vegetable
B. corn	b. flowers
C. wheat	c. fruits
	d. livestock (pig and chicken)

Examples of farming

A+B+a+c

A+C+b+c

A+a+d

A+b+d

For the livestock course, both lectures in the room and practical training at neighboring farmers will be conducted because animals are not raised at the Center. Also the outline of the crop cultivation and operation of hand tractor will be included in the training.

2)-2 Plant Protection Control Course

It is easy to collect samplings of damaged crops because a total of 23 kinds of crops are cultivated at the Center. These crops consists of 13 kinds of vegetables, 4 fruits, 3 field crops and 3 flowers.

Training on the actual condition of diseases and insects for 23 kinds of crops cultivated at the Center and their countermeasures for protection by use of Loupe or microscope

will be conducted. Plant protection is done by knapsack type sprayers. During the period of 3 months course, the outline of 23 kinds of crops will also be included.

2)-3 Soil Conservation Course

Training on how to protect soil erosion together with soil recovering method, assuming that some part of farm fields are already soil-eroded and progress of soil fertility has made rapid decrease.

The following protection methods for soil erosion will be included in the training in the room and at the inclined field.

a. Contour cultivation

b. Terrace cultivation

c. Cultivation of leguminous trees to protect soil erosion

d. How to install drainage

e. Others

2)-4 Environmental Course

This course includes training aiming at the betterment of awareness on environmental conservation for hilltribes. The shifting cultivation will be stopped and then promote the stational farming at the stabilized field. Field survey in the selected area will be conducted with particular emphasis on destruction of forestry, and decrease and extermination of animals.

2)-5 Meteorological Course

This course is intended to determine correctly condition and apply to the crop cultivation as basic data by use of meteorological instruments. The Center is provided with such instruments as thermohygrograph, digital anemometer, sunshine autograph, rain gauge, precipitation recorder, evaporation pan, and Assman aspiration psychrometer. This will also include training on how to operate and maintain these instruments, and to analyze the data investigated.

3) Other Course (for extension officer)

3)-1 Seminar/Workshop on Highland Course

This seminar will be conducted once a year reporting the natural and social conditions at highland by extension officers with a great deal of practical experiences.

3)-2 Highland Agricultural Development Course

This course will hold once a year a seminar on economical and rational means of agricultural development in conformity with natural environment by experienced extension officers.

3)-3 Narcotics Crop Control and Prevention Training Course

A seminar will be conducted on the achievements and plans for introducing replaced crops and cottage industry instead of poppy.

3)-4 Highland Community Development Course

A seminar on the improvement of hilltribes livelihood, introduction of electricity improvement of road, medical and educational infrastructure, etc., will be conducted

3)-5 Forestry Community Development Course

A seminar on the improvement of livelihood in forestry community, improvement of road, medical and educational infrastructure, introduction of electricity, etc., will be held.

4) Mobile Training

This training will involve 16 hilltribe villages for cultivation technology, farming system and farm management by using text books and audio-visual equipment. Training for the most suitable technology for each village with different characteristics will be conducted.

4-3-3 Site of the Project and its Condition

(1) Site of the Project

The Highland Agricultural Development and Training Center is located at the Site B of the Chang Khian Station belonging to the Highland Coffee Research and Development Center, Faculty of Agriculture, Chiang Mai University, about 32 km northwest far from Chiang Mai City, at the foot of Mount Doi 1,685 meter above the sea level (Refer to the Project Site Location Map).

(2) Condition of the Site

The total area of the site is 40 ha, which consists of 7.13 ha farm field and 32.78 ha building, forestry and related area. An average temperature of 20.4°C, 24.5°C in maximum average temperature, 16.8°C in minimum average temperature, and 1,150~1,200m in altitude, had been observed. Soil is sandy and large stones and rocks are found in the site. Farm field is located with 7~10° in average inclination and terrace cultivation is introduced. Fruits trees are planted at the stony slope. There are cultivated upland rice and wheat as well as food crops, vegetables and flowers as cash crops, and apricot, peach, persimmon, coffee, etc. as fruits trees.

(3) Land Use Plan

As stated above, the total area of the site is 40ha, of which 7.13ha is cultivated for farming and the remaining 32.87ha is allocated for building, road, forestry, grazing land, etc.

It is planned to divide the farm land into crop field and orchard. Furthermore, the farm land is divided into the demonstration farm and the field with 5 partitions. Also the training building, dormitory, workshop building and the access road will be constructed at the site.

Rehabilitated demonstration farm, crop field and orchard are provided to trainees for their practical outdoor training. Sprinkler irrigation system will be installed at the demonstration farm for cultivating vegetables and flowers for

practical training of irrigation technology at highland. (Refer to Appendix 6-7)

4-3-4 Outline of Facilities and Equipment

(1) Outline of the Facilities

The following facilities will be provided.

1) Training building

This building will cover approximately 1,000m^2 including lecture rooms, practice room, assistant manager room, conference room, library, etc..

2) Dormitory

Approximately an area of 660m^2 for dormitory consisting of trainees' rooms, dining room, kitchen, linen room, cooker's room, guest lecturer's room, etc. will be provided.

3) Workshop Building

Approximately an area of 430m^2 for workshop building consisting of inspection and repair yard, yard for construction and farm machinery, spare parts room, management room, generator room, etc. will be also provided.

(2) Outline of the Equipment

1) Equipment for training

a. Audio-visual equipment such as outdoor video production equipment, indoor video production equipment, video editing

equipment, video duplicating equipment, video display equipment and etc.

b. Training material production and support equipment such as typewriter, plain paper copying machine, printing machine, communication equipment, etc..

2) Equipment for demonstration farm management and training

a. Equipment for demonstration farm management and practical training such as hand tractor 4-wheel tractor, sprayer, bush cutter, etc..

b. Equipment for maintenance and repair tools for building facilities and equipment such as mechanical tools, electrician's tools, measuring kit, carpenter's kit, etc..

3) Equipment for transportation

Road maintenance equipment such as bulldozer, dump truck and hydraulic excavator for maintaining the access road to the site.

4) Equipment for transportation

Vehicles for mobile training, picking up and sending off trainees and transportation goods required daily such as station wagon, pick-up truck, microbus and motor cycle.

5) Equipment for highland agricultural development

a. Equipment for highland agricultural development

Scale, meteorological instrument, global positioning system machine, soil moisture meter, soil sampler, etc..

b. Equipment for plant protection development and training

Microscope, plate reader, oven, water bath, autoclave, grain moisture meter, etc.

4-3-5 Upkeep and Management Plan

Management cost is estimated to be below based on the fixed rate in 1992.

(1) Personnel expenditure

The Center is managed by a manager and 39 staffs and workers.(Fig.4-1 refers)

A manager and 2 assistant managers who are concurrently holding positions in Chiang Mai University shall be taken. Therefore, their salaries to be paid by the University shall be excluded from the personnel expenses.

The personnel expenses required for the Center are 1,668,000 Bahts estimated as follows ;

Table 4-4 Annual Personnel Expenses Required

Tribe	Number	Monthly income (Bahts/man)	Annual income (Bahts/man)	Total (Bahts/man)
Section Manager	3	5,000	60,000	180,000
Section Chief	5	4,500	54,000	270,000
Staff	29	3,500	42,000	1,218,000
Total	37	-	-	1,668,000

Also the expenses for lectures and assistant lecturers to be dispatched from the University shall be borne by the University.

(2) Miscellaneous Expenses for Trainees

a. Expenses for meals

Expenses for meals for trainees shall be borne by the Center and 90 Bahts per day per trainee for 3 times meals. Fuel expenses for cooking shall be included in the expenses for meals.

900,000 Bahts will be estimated for the first training year (1994) and 1,206,000 Bahts for the targeted training year (1998) in accordance with the increase of the number of trainees.

Table 4-5 Expenses for Meals

Course	1994	1998
Crop Production Course	3,280 person-day	5,000 person-day
Discipline Course	6,720 person-day	8,400 person-day
Total	10,000 person-day	13,400 person-day
Total Expenses for Meals	900,000 person-day	1,206,000 person-day

b. Miscellaneous Expenses

Miscellaneous expenses during the period of training shall be provided for trainees to get daily necessaries depending on the qualification of the trainees as follows ;

Table 4-6 Miscellaneous Expenses per Trainee

Qualification	Short Term (Bahts)	Long term (Bahts)
Extension Officer	500	2,000
Advanced Farmer	300	1,500
Extension Officer from Neighboring Countries	500	2,000

Note : Short Term : Less than 19 days of training period Term
Long Term : More than 20 days training period

Total miscellaneous and meal expenses during the first training year (1994) and the target year (1998) will be estimated 469,400 Bahts and 629,6900 Bahts respectively as follows ;

Table 4-7 Total Miscellaneous Expenses

Year / Trainee	1994				1998			
	No. of Trainees		Amount (Bahts)		No. of Trainees		Amount (Bahts)	
	Short	Long	Short	Long	Short	Long	Short	Long
Extension Officer	300	119	B150,000	B150,000	443	148	B221,500	B296,000
Farmer	33	-	B9,900	-	52	-	B15,600	-
Extension Officer from Neighboring Countries	59	21	B29,500	B42,000	85	27	B42,500	B54,000
Sub-Total	392	140	B189,400	B250,000	580	175	B279,600	3B50,000
Total	532		B469,400		755		B629,600	

Note: B = Bahts
Short : Less than 19 days of training period
Long : More than 20 days of training period

(3) Field Management Expenses

Total field area in the Center is designed to be 7.13ha, consisting of 1.78ha field and 5.35ha orchard, in where total 23 kinds of crops are planted.

Assuming that the efficiency of land use is 2.5 times for demonstration farm and 1.5 times for general field, and 3,000 Bahts /1 farm input per hectare, total expenses for farm input is estimated to be 25,980 Bahts per year. Labor cost is appropriate in the personnel expenses.

Demonstration Field	4,8000 Bahts	(0.64ha×2.5×3,000 Bahts)
General Field	5,130 Bahts	(1.14ha×1.5×3,000 Bahts)
Orchard	16,050 Bahts	(5.35ha×1.0×3,000 Bahts)
Total	25,980 Bahts	

Note : /1 = Cited from Agricultural Statistics of Thailand Crop Year 1989/1990

(4) Fuel Cost for Vehicles

a. Annual Accumulated Distance for welcoming and sending off Trainees

Table 4-8 Annual Driving Distance

Course	1994	1998
Production Course	18 courses×2/1×2/2 ×32/3km = 2,304km	21 courses×2×2 ×32km = 2,688km
Discipline Course	11 courses×2×2 ×32 = 1,408 km	11 courses×2×2 ×32 = 1,408 km
Other Course	5 courses×2×3 ×32 = 960 km	5 courses×2×4 ×32 = 1,280 km
Mobile Training	13 courses×200km = 2,600 km	16 courses×200km = 3,100 km
Others (10%)	728 km	824 km
Total	8,000 km	9,400 km

Note : /1= No. of time of welcoming and sending off trainees

/2= No. of vehicles

/3= Distance between Chiang Mai City and the Center

b. Annual Driving Distance for Road Maintenance Services

Annual No. of Servicing Days	60 days
Average Daily Driving Distance	50 km
Annual Driving Distance	3,000 km (60days×50km/day)

c. Annual Driving Distance for Purchasing Food and Communication

Annual No. of Driving Days	290 days
Annual Driving Distance	18,560 km (32km×2times-round trip-×290days)

d. Annual Fuel Cost

Table 4-9 Annual Fuel Cost

Item \ Year	1994	1998
Total Driving Distance	29,560 km	30960 Bahts
Fuel Consumption (8km/ℓ)	3,695 ℓ	3,870 ℓ
Fuel Cost (8.82 Bahts/ℓ)	32,600 Bahts	34,100 Bahts
Lubrication Oil Cost (10% of Fuel Cost)	9,800 Bahts	10,200 Bahts
Total	42,400 Bahts	44,300 Bahts

(5) Annual Utility Cost

a. Estimated Daily Electric Power

Table 4-10 Daily Electric Power Required

Building	Daily Electric Power Required
Training Building	
Lighting	13KVA×0.85(power factor) ×0.8(inequality ratio)×9 hours/day = 80KWH
Equipment	4KVA×0.7×1.0×9 = 28KWH
Sanitation Facility	1.2KVA×0.8×1.0×3 = 28KWH
Sub-Total	111KWA
Dormitory	
Lighting	9KVA×0.85×0.8×15 = 86KWH
Refrigerator	5KVA×0.8×1.0×24 = 96KWH
Electric Stand & etc.	4.8KVA×1.0×1.0×5 = 24KWH
Sanitation Facility	1.2KVA×0.8×1.0×24 = 24KWH
Sub-Total	208KWH
Workshop Building	
Lighting	3.35KVA×0.85×0.9×10 = 26KWH
Equipment	6.5KVA×0.85×0.4×10 = 22KWH
Sub-Total	48KWH
Existing Generator	8KVA×0.8×1.0×24 = 154KWH
Total	521KWH

b. Estimated Annual Electricity Cost

Table 4-11 Annual Electricity Cost

Building	Fuel	Lubrication Oil	Total
Training	111KWH/day×1.35(distribution loss) ×1.1(generating loss) ×0.2 *l*/Hp·hr×8.21 Bahts/*l* ×314 days/year = 84,987 Bahts	0.0025/Hp·hr×29Hp(Max. engine output)×9 hrs/day ×37.3 Bahts/*l* ×314 days/year = 7,642 Bahts	92,629 Bahts
Dormitory	208KWH/day×1.35×1.1 ×0.2 *l*/Hp·hr×1.33(fuel increase while lower load at night)×8.21 Bahts/*l* ×335 days/year = 225,974 Bahts	0.0025*l*/Hp·hr×29Hp ×24 hrs/day×37.3 Bahts/*l* ×335 days/year = 21,742 Bahts	247,716 Bahts
Workshop	48KWH/day×1.3×1.1 ×0.2 *l*/Hp·hr×8.21 Bahts/*l* ×225 days/year = 25,492 Bahts	0.0025*l*/Hp·hr×12Hp ×10 hrs/day×37.3 Bahts/*l* ×225 days/year = 2,518 Bahts	28,010 Bahts
Existing Generator	154KWH/day×1.24×1.1 ×0.2 *l*/Hp·hr×8.21 Bahts/*l* ×365 days/year = 125,260 Bahts	0.0025*l*/Hp·hr×9Hp ×24 hrs/day×37.3 Bahts/*l* ×365 days/year = 7,352 Bahts	132,612 Bahts
Total			approx. 501,000 Bahts

(6) Annual Sprinkling Cost

Annual Operation Period : November 1~April 30 (181 days)

Annual Operation Hours : 8 hours/day×181 days/year

=1,448hrs/year

Annual Fuel Consumption : 0.21 *l*/hr×5Hp×1,448hrs =1,520 *l*

Annual Fuel Cost : 1,520 *l*×8.21 Bahts/*l* =12,500 Bahts

(7) Total Operation and Maintenance Cost

Table 4-12 Annual Operation and Maintenance Cost

Item \ Year	1994	1998
Personnel Expenses	1,668,000 Bahts	1,668,000 Bahts
Miscellaneous Expenses for Trainees	1,369,400 Bahts	1,835,600 Bahts
Field Management Cost	26,000 Bahts	26,000 Bahts
Fuel Cost for Vehicles	42,400 Bahts	44,300 Bahts
Utility Cost	501,000 Bahts	501,000 Bahts
Sprinkler Operation Cost	12,500 Bahts	12,500 Bahts
Total	3,619,300 Bahts	4,087,400 Bahts

(8) Selection of Trainees

The ONCB selects the trainees from the Royal Projects, projects under Department of Public Welfare (DPW) and the other Governmental agencies concerned. After its selection, a continuous yearly training plan is established by the ONCB in cooperation with this Highland Agricultural Training Center of the Institute of Agricultural Science Research and Development of Chiang Mai University.

4-4 Technical Cooperation

The main objective of the Center is established to train the agricultural extension officers for the new highland agricultural technology, who will in turn train the hilltribe farmers, to increase the latter income.

Toward this end, training should be given priority in order to transfer technology to hilltribe farmers particularly on cultivation of cash crop which will be conducted by the staffs concerned in the University.

It is recommended that the Thai lecturers concerned on the Center participate into the training courses in Japan under technical cooperation from Japanese Government to acquire the latest post-harvest technology as well as training through the use of audio-visual equipment and implementation technology concerned on the training program.

CHAPTER5 BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5-1 Basic Design Policy

(1) According to the meteorological data of the Site A, located behind the mountain of the Site B, the annual average temperature is approximately 20°C and the minimum temperature shows nearly 10°C during cold season from December until February. The annual average humidity is about 74%. It is muggy during hot and wet season and chilly during cold season. All rooms should therefore, be located on the sunny side to maintain a warm temperature during cold season. Wide openings of buildings shall be provided to lighten rooms, ventilate and dehumidify rooms naturally while maintaining airtight performance to keep rooms cool.

(2) All buildings shall be designed with reinforced concrete and rigid frame structure, which is locally popular, simple and with a lower cost. The sanitary equipment shall be installed in accordance with trainees' life-style.

(3) Chiang Mai municipality also has an ordinance which requires that the construction of buildings must conform with the building code for the city, but this Project, in principle, has no restrictions. Since buildings are constructed on a terrace of a mountain, planned buildings shall be fireproof and necessary units of fire extinguishers shall be provided.

(4) Most of the construction materials and equipment which are produced in Metropolitan Bangkok shall be procured in Chiang Mai city. The buildings shall be designed by taking into account the employment of available materials and equipment in the city. In

1991, cement vanished off in the market for some time and the price rapidly rose. But the market now has calm since factories increased the production and the hasty construction of buildings completed.

(5) The transportation of the materials and equipment from the city to the site will be done by small capacity trucks because of narrow and rugged roads. 18 km-road (out of total 32 km) to the site is asphalted and another 2 km is metal-paved and the rest is unimproved. Moreover, the average width of the unimproved road, where there are sharp corners and slopes in places, is 3.0m and therefore special consideration shall be paid to the transportation cost and construction period.

(6) The University plans to conduct training to the neighboring countries of Laos, China, Cambodia and Vietnam, but those who live in the same altitude, climate and weather as the hilltribes in Thailand. The University also plans to conduct training of foreigners at the Center and therefore facilities will be required to save maintenance cost. The durable materials and equipment shall be adapted to the facilities.

(7) After the completion of the Project, the facilities shall be turned over to the University and will function as one of the 9 centers which will be integrated into the Institute of Agricultural Science Research and Development. The capability of management and operation has been proven high through good control of the existing several organizations. Also, the operation and maintenance cost for equipment is of great importance, and on this

regard, the ONCB expresses positively to extend cooperation to the University.

(8) The construction work will be started by the end of November at the latest which is the beginning month of the first dry season. The construction period will take about 12 months including 1 month each for preparation, final inspection and repair work. It will be taken in the work schedule that roofing work will be completed by the end of April before beginning of the rainy season and wall and interior works shall be done during the rainy season from May to October.

5-2 Study and Examination of the Design Criteria

5-2-1 Design Criteria

The Control of the Construction of Buildings Act governs the design. The by-laws of the Metropolitan Bangkok and Japanese relative rules and standards are applied correspondingly to this Act.

5-2-2 Factors Determining the Scale of the Facilities

A zone system is adopted to determine the scale of facilities. Each room is independently designed in accordance with the design standards of Japan by plotting required items of furniture in the rooms. The design adopts minimum space of furniture for most of rooms of minimum, optimum and generous space, so that the space for every furniture is overlapped with each other and moreover there is some restriction to furniture use. In this design passageways of 60, 75, 90,150 and 180 cm wide are adopted in a room according to use of a room, location of passageway and dimension of furniture. By this way

the extent of every room is decided and these rooms are classified according to function of the rooms so as to unify them as an economical building. In addition to this consideration is paid to the space of furniture, particularly in the office room, because the height of furniture and partitions are restricted to obtain natural draught in a room through windows. As a result of this study, the standard bay of 3.6 × 9.0m is adopted for the training center building, 3.6 × 7.2m for the dormitory and 5.0 × 5.0m for the workshop.

5-3 Basic Plan

5-3-1 Site and Facilities Layout

The site is extended at a gentle verdant of a mountain and faces to the north. The existing houses are aligned to the south along with the surface of the mountain. Rooms where intercepted by sunlight is by the mountain shall be constructed at the north side along with an edge line of gentle slant field.

The main road in the site will be paved with gravel and simple gutters shall be constructed on both sides of the road. Pedestrian roads around the main buildings shall be laid with gravel. The gravel-paved area in front of the training building will be utilized for car parking and 3 flag poles shall be installed in the area.

5-3-2 Architectural Design

(1) Plan

Floor plan is designed by aligning each room without a middle corridor so as to take natural draught and sunlight into one.

While the temperature in the site reaches up to 29°C in daytime of April every year, it goes down near to 10°C in morning and evening hours of December to January. Moreover, annual rainfall comes to over 2,000mm. Wide and airtight openings, therefore, shall also be designed to obtain natural ventilation and keep rooms from rain and cold weather. Furthermore, attention shall be paid to install cabinets and racks so as to store up documents, prints and stationery instead of few storage rooms which was previously planned and abandoned because it caused increase the floor area.

a. Administration Room

This room will be provided to a manager and 2 assistant managers, 2 trainers and 8 staff members. The manager and 2 assistant managers are professors who are concurrently holding their posts in the University. The Center has an equivalent level with the faculty of the University and that 2 rooms for a manager and assistant managers are to be provided independently. Also, a meeting room, printing room and a small kitchen will be provided with a staff room which is divided by cabinets in every section.

b. Library

The room, where books, magazines and reference data concerned with highland agriculture will be stored, will be designed on the assumption that one-fourth of the trainees are able to read books in their respective tables.

c. Entrance Hall

The hall will also be utilized as an exhibition room for development and training to display known to the public.

d. Lecture Rooms

Although the number of trainees varies depending on courses, a total of 2 rooms each with a capacity of 25 trainees are planned. Both rooms which are separated with folding sound insulation will be utilized as a multipurpose room. Both preparation and apparatus rooms are attached to the lecture room, where training apparatus such as video set, overhead projector, opaque projector, etc. are previously arranged. Equipment and apparatus for training will be arranged on the tables and in a line along wall of the room so as to practice trainees at the place of operation.

e. Practice Room

A maximum of 25 trainees would be able to practice at one time to obtain knowledge by guiding hilltribes concerning highland agriculture by means of utilizing equipment. Experiment and practice will be done on cereal, vegetable and fruit seeds and seedlings, meteorology, plant control, soil analysis, etc.

Equipment and apparatus for training are arranged on tables and in a line along wall of the room so as to practice trainees in their operation at the place.

f. Dormitory

Each room will be provided with sleeping accommodation for 4 trainees by using bunk beds. A total of 16 rooms are comprised of 13 trainees' rooms, 1 cook's room, 1 linen room and 1 room for 2 guest lecturers. Lavatories and shower rooms are provided with common use for respective men and women, and not provided in each room except the guest lecturer's room.

g. Dining Room and Kitchen

These rooms will occupy a maximum capacity of 80 persons. The room is, therefore, designed on the basis of accommodating only 40 persons at once. Three persons will work in the kitchen and 2 tables will be provided for broiling and cooking. A storage room attached to the kitchen will be used to stock food for several days and a refrigerator will be provided in the room for the food that will be carried into the site once every several days.

h. Workshop

Workshop is planned for minor repair and maintenance of equipment supplied under the Project. Large repairs will be done outside the workshop. The space will be determined according to Facility Standard for Agricultural Machinery Repair. A tool storage room and a station for 6 mechanics will also be provided.

i. Floor Area

Floor areas will be determined as follows.

Table 5-1(1) Floor Area Planned for the Highland Agricultural Development and Training Center

Name of Room	Floor Area (m^2)	Remarks
Training Building		
Manager Room	25.9	1 manager and 4 guests
Assistant Manager Room	27.5	2 assistant managers and 4 guests
Printing Room	21.1	
Kitchen	10.5	
Meeting Room	25.2	8 persons
Administration Office	98.6	13 persons
Inner Corridor	50.4	
Outer Corridor	259.2	
Library	64.8	12 persons available for reading simultaneously
Entrance Hall	64.8	
Lecture Room	129.6	25 trainees x 2 classes = 50 trainees
Storage Room	19.4	AV equipment
Preparation Room	13.0	2 persons
Practice Room	129.6	1 trainer and 25 trainees
Lavatories for Staff	29.2	
Lavatories for Trainees	29.2	
Sub-Total	998.0	
Dormitory		
Entrance Hall	38.9	
Trainees' Room	252.7	4 trainees/room x 13 rooms = 52 trainees
Linen Room	19.5	
Rest Room for Cooks	19.4	3 cooks
Guest Lecturers' Room	25.9	2 persons, with lavatory
Inner Corridor	110.2	
Dining Room	77.8	42 persons/time
Kitchen	25.9	3 cooks
Food Storage Room	16.2	
Lavatories for Men	38.9	with shower room

Table 5-1(2) Floor Area Planned for the Highland Agricultural Development and Training Center

Name of Room	Floor Area (m^2)	Remarks
Lavatories for Women	29.2	with shower room
Terrace	5.1	
Sub-Total	659.7	
Workshop		
Agricultural Machinery Shed	180.0	
Workshop	100.0	
Storage Room	50.0	spare parts and tools
Mechanic Room	50.0	1 field manager, 3 mechanics and 2 operators, with lavatory
Generator Room	50.0	
Sub-Total	430.0	
Car Shed	144.0	
Sub-Total	144.0	
Greenhouse	90.0	rehabilitation
Sub-Total	90.0	
Total	2,321.7	

(2) Elevation

To keep the natural inclination of the Site, the buildings are designed without leveling the land. The ground floor level is set on 1.2m high from designated ground level so that both substructure and plumbing work under the ground floor slab shall be facilitated.

Attention shall be paid to the design to cope with the existing buildings and surrounding environment, and to facilitate the construction work.

The buildings shall have openings as large as possible to avail of the natural draught and sunlight so that high ceiling, sliding windows and louver blocks can be employed while aluminum sash windows and steel doors are to be installed in the opening to keep the rooms cool.

(3) Section

In order to have natural draught and sunlight into the rooms, the height of the ceiling of the training building shall be more than 3.0m as well as of the dormitory with more than 3.4m.

(4) Structural Design

Concrete strength used in the work is Fc = 210 kg/cm^2 and reinforcements used SR24 (starup, hoop reinforcing bar, etc.) and SD30 (reinforcing bar, distributing bar, etc.)

a. Substructure

Judging from the excavation of the soil condition, it is sandy soil, and rocks and stones are found in many places. The buildings will, therefore, be constructed on the direct spread foundations. The foundations shall be designed at 5.0 ton/m^2 of the soil bearing capacity with the condition that the capacity should be reconfirmed before the beginning of the work.

b. Superstructure

The superstructures shall be reinforced-concrete and rigid frame structure popularly used in the local area. External and

internal walls are fabricated with material bricks and concrete hollow blocks.

Structures are designed in accordance with the live load, wind load stipulated in the Control of the Construction of Buildings Act, by-laws of the Bangkok Metropolis and Japanese relative laws and regulations.

5-3-3 Architectural Equipment Plan

A reliable and durable building equipment shall be employed to guarantee safe and easy maintenance.

(1) Electric Facilities

1) Power Source

The site has no electricity for commercial use, since the site is located far from Chiang Mai municipality. At present, a low capacity generator is being used as a source of power. The electric power of the site is, therefore, made up for any deficiency by installing power-augmented generators. The voltage supply will be 380/220V and 220V of the present power will be used in the existing buildings.

2) Load Capacity

Electric load capacity required for each building is calculated as follows ;

a. Training building

Lighting	13.0 KVA
Ceiling fan, etc.	2.0 KVA

Training equipment	11.8 KVA (9.047 KW, refer to Appendix (3) of 5-3-5)
Highland agricultural development equipment	7.3 KVA (5.642 KW, refer to Appendix (3) of 5-3-5)
Water treater	1.2 KVA
Sub-Total	35.3 KVA

b. Dormitory

Lighting	9.3 KVA
Refrigerator	3.0 KVA
Ventilation fan, etc	2.0 KVA
Electric stand, etc	4.8 KVA
Water treater	1.2 KVA
Sub-Total	20.3 KVA

c. Workshop building

Lighting	3.35 KVA
Demonstration farm equipment	3.1 KVA (2.38KW, refer to Appendix (3) of 5-3-5)
Water treater	1.2 KVA
Sub-Total	7.65 KVA

3) Capacity of Generator required

Electric power required for each building is calculated as follows in accordance with assumed rate of demand and inequality ;

a. Training building

Facility and Equipment	Electricity (KVA)	Rate of Demand	Power Required (KVA)
Lighting	13	× 0.9	11.7
Ceiling fan, etc	2.0	× 0.8	1.6
Training equipment	11.8	× 0.6	7.1
Highland agricultural development equipment	7.3	× 0.6	4.4
Water treater	1.2	× 0.5	0.6
Sub-Total			25.4

Each peak of the above mentioned 5 items may not be happened at the same time. Consequently, expected maximum power required is calculated by the following formula in case assuming the rate of inequality 1.05 ;

$$25.4 \text{ KVA} \div 1.05 = 24.2 \text{ KVA}$$

b. Dormitory

Facility and Equipment	Electricity (KVA)	Rate of Demand	Power Required (KVA)
Lighting	9.3	× 0.95	8.8
Refrigerator	3.0	× 1.0	3.0
Ventilation fan	2.0	× 0.8	1.6
Electric stand	4.8	× 0.6	2.9
Water treater	1.2	× 0.5	0.6
Sub-Total			16.9

Assuming the rate of inequality 1.05, expected maximum power required for dormitory is calculated as follows ;

$$16.9 \text{ KVA} \div 1.05 = 16.1 \text{ KVA}$$

c. Working building

Facility and Equipment	Electricity (KVA)	Rate of Demand	Power Required (KVA)
Lighting	3.35	× 1.0	3.4
Equipment	3.1	× 0.6	1.9
Water treater	1.2	× 0.5	0.6
Sub-Total			5.9

It is difficult to consider the rate of inequality due to smaller capacity. Therefore, the expected maximum power required will be 5.9 KVA. The starting current should, however, be considered for electric motors (especially for 1.14 KW power plane and 0.7 KW compressor) and so the expected maximum power required

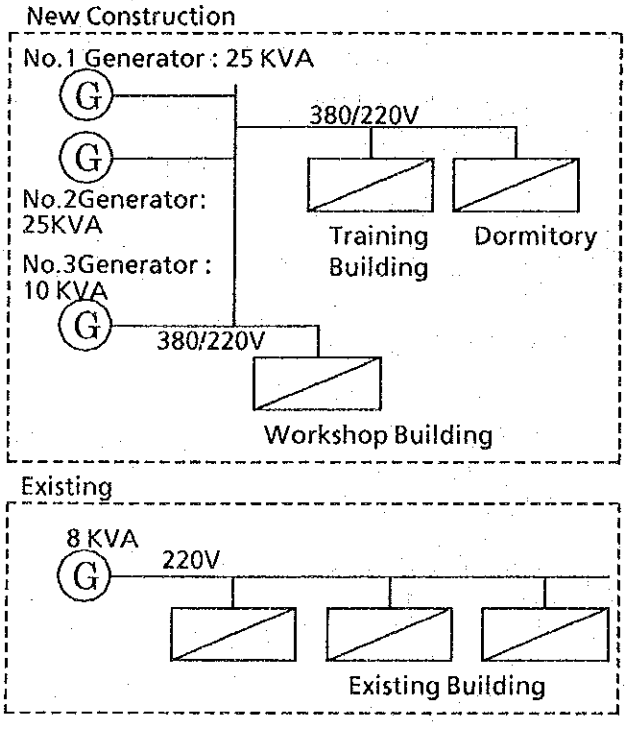
for workshop building will become to be 8.36 KVA (5.9 KVA + 2.46 KVA)

Because of difficult time of electricity demand in dormitory and training building, 1 unit of 25 KVA generator should be provided in meet with the bigger power consumption in the training building. For the emergency use, extra 1 unit of the same model should be installed as the stand-by generator. Total 3 units of generators are required including 1 unit of 10 KVA generator for the workshop building.

4) Power Supply

The different capacity generators are installed to enhance economic efficiency. After introducing new generators together with existing one, the wiring of the site will be rearranged. The wiring diagram is shown as follows : -

Fig.1 Wiring Diagram



5) Lighting and Receptacles

The sort of lights and the luminous intensity of main rooms shall be as follows:-

Table 5-2 Luminous Intensity for Main Rooms

Name of Room	Luminous Intensity (lux)	Light
Administration Room	200	fluorescent
Library	200	fluorescent
Entrance Hall	100	incandescent lamp
Lecture Room	200	fluorescent
Practice Room	200	fluorescent
Dormitory	50	fluorescent
Dining Room	200	incandescent lamp
Kitchen	200	fluorescent
Corridor and Lavatory	-	fluorescent
Machinery Shed	-	fluorescent
Workshop	200	fluorescent
Tool Storage Room	100	fluorescent
Generator Room	-	fluorescent

Receptacles based on Thai Standard will be provided for their specific purposes and earth work will be considered where necessary.

6) Radio and Paging System

For workers in the site, an paging system will be installed. A wireless radio will be installed for smooth and quick

communication by the exclusive frequency between the site and the University.

7) Lighting system

A lighting conductor will be installed both in the training and dormitory building.

(2) Plumping Service

1) Water Supply

Water led by 4 inch pipes from a spring will be treated by a simple water treatment tank constructed at the site. Two outlets will be provided for the tank. One outlet will be for the buildings and the other for field irrigation. Water for buildings will be first led to a water distribution tank constructed near the water treatment tank, and then discharged into the supply pipes for the training and dormitory building and other facilities.

The respective capacities of the water treatment and distribution tanks are calculated as follows:-

Volumes of building supply water/day	$20m^3$
Volume required for field irrigation	$38m^3$
Total	$58m^3$

Therefore,

- As for a simple water treatment tank, assuming that one half of one day-volume can be stored and taking into account the 20% allowance:-

$$\text{Capacity} = 60 \times 1/2 \times 1.2 = 36m^3$$

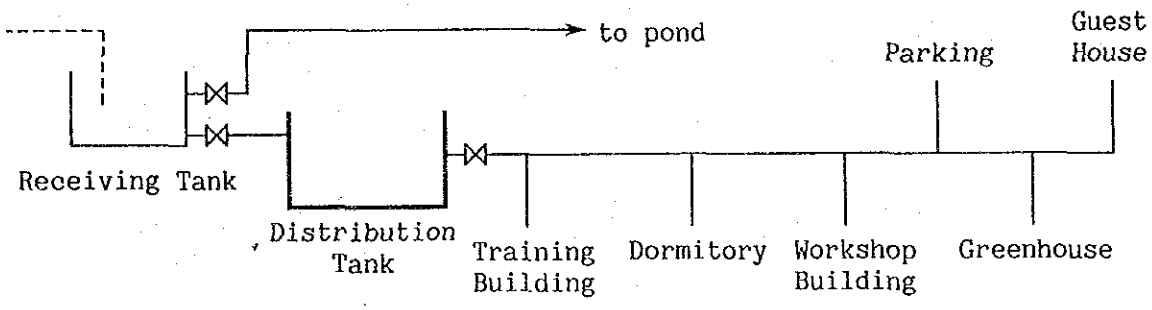
$$6.0L \times 3.0W \times 2.0H\ m$$

- As for a water distribution tank, a capacity of $20m^3$ is assumed as follows:

$$4.0lL \times 3.0W \times 2.0H\ m$$

The plumping diagram for water supply is shown as follows:-

Fig. 5-2 Water Supply Chart for the Highland Agricultural Development and Training Center



2) Drainage

The drainage of the buildings consists of 2 systems; namely, ① rainwater is spread in the ground after being brought by drain gutters through down pipes from roof gutters., and ② sanitary sewage is penetrated with waste water in the ground after being disposed of by a septic tank.

3) Gas Supply

A propane gas supply system will be adopted. However, for safety purposes, the gas cylinders shall be installed by pipes at the outside of the building up to the rooms.

(3) Ventilation

In order to change air in a room, ceiling fans will be installed in the administration office, while propeller fans will be provided for lavatories, shower rooms and a kitchen.

5-3-4 Construction Material Plan

Materials which could be procured in Thailand shall be, in principle, utilized in the construction of building. Special consideration will be constructed and hollow concrete blocks will be utilized in partial walls.

The finishings of the main buildings will be as follows:-

(1) Exterior Finishing

Roof : Slate on steel

Wall : Concrete plastering

Sash : Aluminum window and steel door

Floor : Mortar trowel finishing

(2) Interior Finishing

Ceiling : Plaster board (t=12mm), VP finishing

Wall : Two liquid mixed type epoxy resin enamel paint on epoxy resin paint as undercoat over mortar (t=20mm), and porcelain tiles (H=1.8m) over mortar (t=25mm) for lavatories

Floor : Mortar trowel finishing, and porcelain tiles over mortar (t=30mm) for lavatories

5-3-5 Irrigation Facility Plan

(1) Water Supply Plan

1) Irrigation Area

Irrigation area covers 0.64 ha demonstration field, where is located about 20 meter higher and apart from the control pond.

2) Examination of Irrigation Method

Most suitable irrigation method will be selected mainly for vegetables and flowers to be cultivated in the field. Irrigation between the rows is not applicable, because of its low efficiency, and the possible occurrence of the drainage problem on the slope and soil erosion.

Therefore, hose and sprinkler irrigation is considered and low pressure sprinkler is employed since vegetables and flowers to be planted here are rather low in height. Considering the steep land condition of the site and small volume of water requirement, pipeline canal is employed.

3) Source of irrigation Water

Water for irrigation is lead from the spring located at the upper place of the mount near the site to the water receiving tank temporarily, which is installed at the higher place than pipeline, and lead to the designated field by pipeline. However, it is necessary to investigate the capacity of the control pond for adjusting irrigation hours required daily.

(2) Calculation of Volume of Water Required

1) Irrigation Period and Water Volume Consumed

Meteorological data collected by the University show that rainy season near around the site is from November to April. Therefore, the field is irrigated during that season. Consequently, and effective rainfall is not considered. Consumption volume of water for crops is assumed to be 5.0mm/day owing to the volume of evaporation and transpiration. Also 5-days intermittent irrigation system is employed considering the sandy soil condition (TRAM = 25mm).

2) Irrigation Efficiency and Hours

Irrigation efficiency is assumed to be 85% owing to the sprinkler irrigation by use of pipeline as above mentioned and daily irrigation time 8 hours considering the demonstration farm and ordinal working hours at the site.

3) Water Volume Required

From the above mentioned conditions, maximum water volume required per day is calculated as follows ;

5.0mm/day × 6,400m^2/0.85/86,400 sec × 24/8 = 1.307ℓ/sec

Also the daily requirement of water is calculated as below ;

5.0mm/day × 6,400m^2/0.85/1,000 = 37.65m^3

Consequently, daily volume of water required is about 38m^3.

4) Assessment of Control Pond Capacity

It is assumed that capacity of control pond shall be able to control the difference between 2 hour and 8-hours irrigation time at the terminal and the water distribution hours from receiving tank. However, the maximum capacity of control pond reaches to the maximum at the time of 12-hours irrigation, and at that time, volume of control pond is calculated by the following formula ;

$VF1 = 60/Ef \cdot D/T \cdot A$

VF1 = volume of control pond (m^3)

D = daily volume of water consumption(mm/day)

Ef = irrigation efficiency

T = irrigation hour (hr)

A = covering area of control pond

$VF1 = 60/0.85 \cdot 5.0/8.0 \cdot 0.64 = 28.235m^3$

Consequently, the volume of control pond required is assumed to be 30m^3 including allowance. The pond with dimensions of 7.0m in length × 7.0m in width × 1.0m in depth is required. However,

existing pond is usable by rehabilitation. Rubber sheet is employed to protect the water leakage because of sandy soil.

(3) Irrigation Facility Plan

1) Diameter of Pipe

Hard vinyl chloride pipe is employed for piping considering the sprinkling head required. According to 1,307 ℓ/sec maximum requirement calculated in the above formula, diameter of pipe required is calculated to be 50mm owing to Harzen Wilian's formula, assuming that the inner velocity inside main pipe is about 7.0m/sec.

2) Pumping Station and Filter

As mentioned before, pumping station is installed at the side of the improved pond. Capacity and diameter of pump are 78.3 ℓ/min and 40mmφ respectively because of 1,307 ℓ/sec maximum water requirement.

Considering the practical condition at the site, the pump is driven by diesel engine. 4 kg of necessary pressure is applied considering 20m difference in height, 10m of necessary water pressure for sprinkler and distribution loss of pipeline.

Filtering device is provided at the side of down stream of the pump to eliminate dust because of the utilization of the existing pump and the sprinkler irrigation.

In view of the above mentioned conditions, 5 HP engine is required for driving pump.