THE KINGDOM OF BHUTAN

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
CASH CROP DEVELOPMENT

January 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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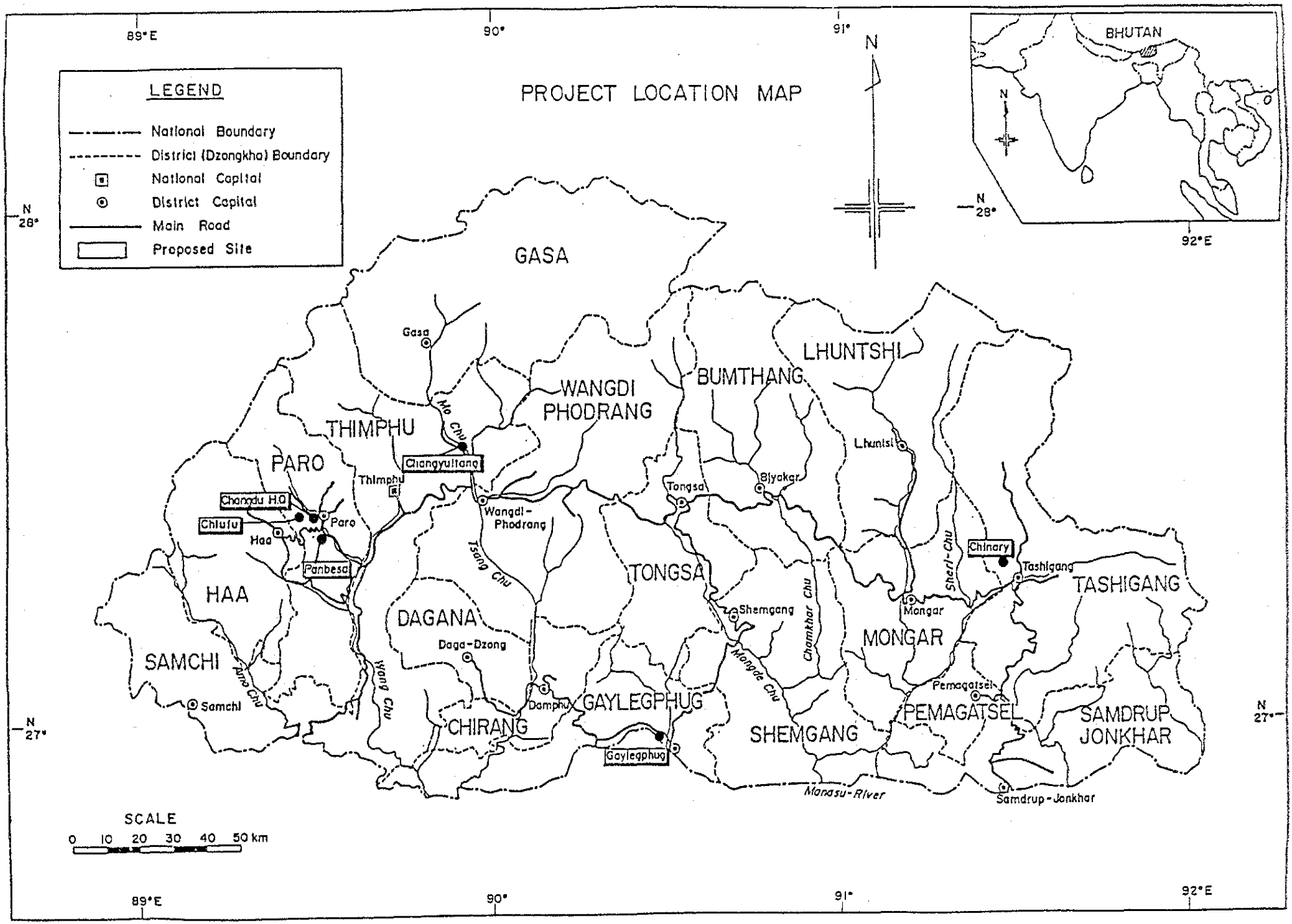
PROJECT LOCATION MAP
LEGEND
National Boundary
District (Dzongkha) Boundary
National Capital
District Capital
Main Road
Proposed Site
BHUTAN
89°E
90°
91°
92°E
N
28°
27°
GASA
Gasa
WANGDI PHODRANG
BUMTHANG
LHUNTSHI
Lhuntsi
THIMPHU
Mo Chu
Chiangyultang
Thimphu
PARO
Changdu H.Q
Paro
Chhufu
Haa
Panbesa
Wangdi-Phodrang
Tongsa
Bjyakar
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HAA
DAGANA
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TONGSA
Shemgang
Chamkhar Chu
Sheri-Chu
Chinary
Tashigang
TASHIGANG
Mongar
MONGAR
SAMCHI
Samchi
Wang Chu
Damphu
CHIRANG
GAYLEGPHUG
Gaylegphug
Mangde Chu
SHEMGANG
Pemagatsel
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SAMDRUP JONKHAR
Manasu-River
Samdrup-Jonkhar
SCALE
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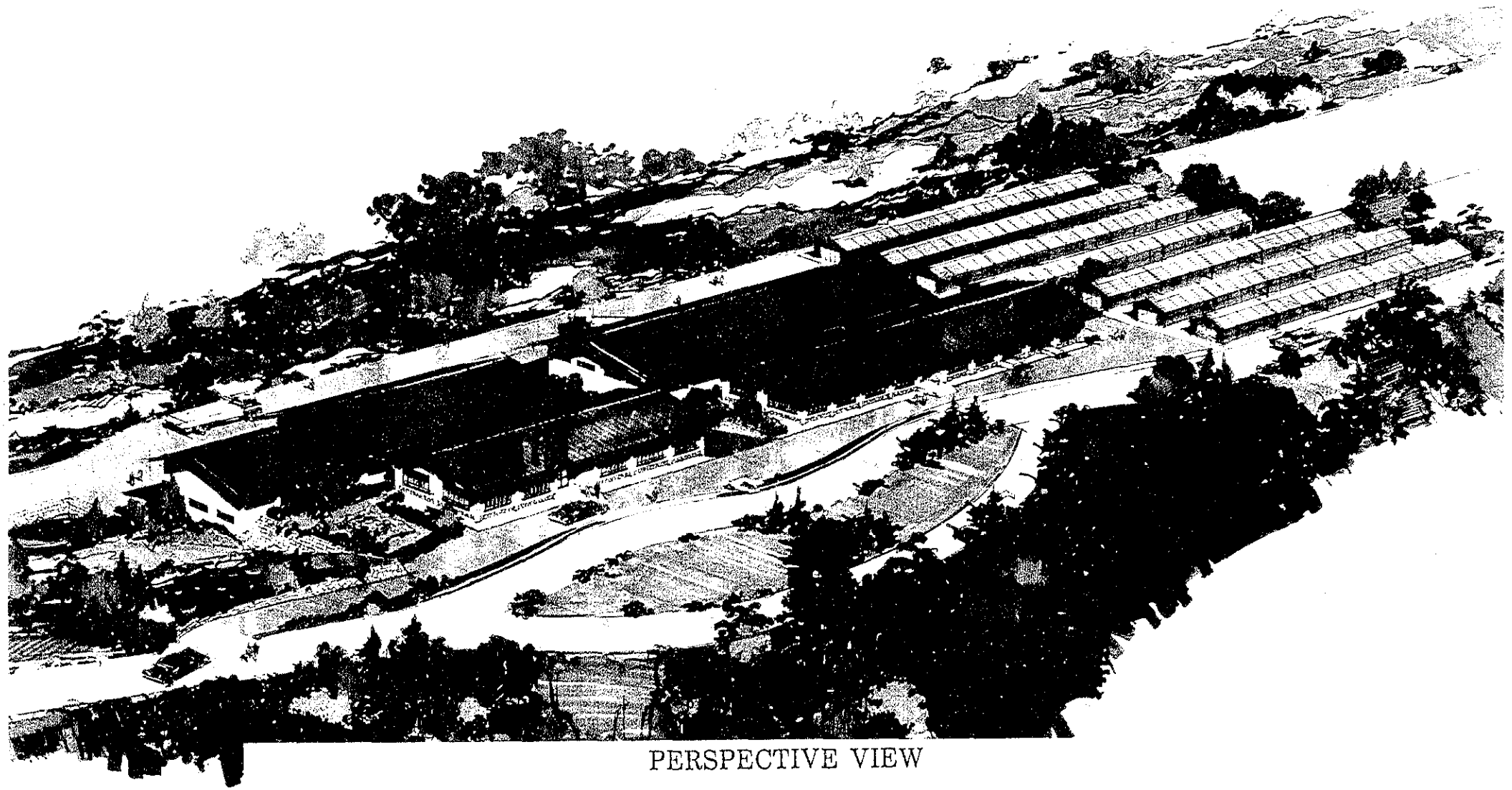

PERSPECTIVE VIEW

OF

CHUNGDU-DINKA HEADQUARTERS

PREFACE

In response to the request of the Government of the Kingdom of Bhutan, the Government of Japan has decided to conduct a basic design study on the Project for Cash Crop Development and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Bhutan a study team headed by Mr. Hideo Yasuki, Special Advisor to the Director of Grant Aid Management Department, JICA from 4th to 26th of August, 1986.

The team had discussions on the Project with the officials concerned of the Government of Bhutan and conducted a field survey in the Paro and other areas. After the team returned to Japan, further studies were made, a draft report was prepared and, for the explanation and discussion of it, a mission headed by Mr. Masahiko Metoki, Official, Research and Programming Division, Economic Cooperation Bureau, Ministry of Foreign Affairs was sent to Bhutan from 11th to 23th of November, 1986. As a result, the present report has been prepared.

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

I wish to express my deep appreciation to the officials concerned of the Government of Bhutan for their close cooperation extended to the team.

January, 1987

Keisuke Arita
President
Japan International Cooperation Agency

SUMMARY

SUMMARY

The Kingdom of Bhutan is a small landlocked country with an area of 46,500 km^2 lying between northeast India and China (Tibet). The country is entirely covered with mountains of the Great Himalayan Range making the terrain one of the most rugged in the world. Because of this physiographical constraint, flat plain is scarce and small valley basins are dispersed throughout the country. The climate is diverse by region and altitude from subtropical to tundra climate although the country is geographically located in the subtropical climate zone. The population is about 1.2 millions with a low density of 26 persons/km^2, and distributed evenly over the low altitude areas.

The country is an agricultural country with 90% of the population engaged in agriculture. The economy is based on small, primarily subsistence-oriented communities. Per capita income is estimated at US$140 in 1984. Given the rugged terrain, agriculture is small scale intensive agriculture practiced on terraced fields over mountain slope. Average arable land of a farmer is 0.7 ha. Staple food of the people are rice and wheat but the agriculture has yet achieved self-sufficiency in these basic cereals resulting in import of 25,000 tons of cereals from India. Coupled with rudimentary shape of other industries, public finance to develop basic infrastructures such as roads, educational and health facilities has been limited. Major part of the national budget and development projects are supported by external aids.

The country enjoys a long history, but the start of modernization of the country was relatively recent. The first country development plan only dates from the early 1960s. As a result, basic infrastructure such as roads, educational and health facilities have not been fully developed yet. Accordingly, early development plans placed emphasis on these infrastructures. Now emphasis has shifted to agricultural development. In recent development plans, the scope has been expanded into new areas such as industries and trades in order to strengthen public finance, although agriculture still has an important place in development efforts. In the agricultural sector, efforts have been targeted toward self-sufficiency in the nation's food supply through improvement of farming techniques, distribution of quality seeds and good irrigation system.

Meanwhile it has become urgent to find a way to increase cash income to raise the nation's standard of living, and increasing cash crop production is recognized as the way. The crops defined as cash crops here are the following.

Vegetables	:	Tomatoes, eggplants, cucumbers, radishes, cabbages, pimentoes, asparagus, carrots etc.
Fruits	:	Oranges, lemons, apples, pears, nuts, plums, mangoes etc.
Cereals	:	Wheat, maize
Others	:	Cardamon, oil seeds etc.

These crops have been selected needless to say in consideration of indigenous crops, planting aptitudes, marketability, export-orientation, price stability, etc.

Bhutan is blessed with diverse climates and is conveniently located near to the Indian market along the southern border, besides most of these crops have different cropping calendars from those of Indian counterparts. Furthermore, production can be expanded through more intensive land use by double cropping, better productivity by distribution of quality seeds/seedlings and promotion of farm mechanization.

Cultivation of cash crops in the country, however, is still in its infancy. The Royal Government has initiated a program of producing and supplying quality seeds/seedling under the National Seed and Plant Program (NASEPP) in 1984 to promote cash crop cultivation and improve productivity. The Government then worked out a comprehensive cash crop development project and listed it in the national agricultural development plan. Owing to financial constraints, the Government filed a request for assistance with the Government of Japan to provide facilities where various services to promote cash crop cultivation are rendered. In response to the request, the Japanese Government dispatched a preliminary study team to the country in April, 1986.

The preliminary study team recognized that the promotion of cash crop cultivation is a very important policy along with achieving self-sufficiency of the basic cereals in order to raise the standard of living of the rural population and subsequent regional development. The project to materialize the policy is deemed to be well founded and reasonably framed from the view point of its standing in

the Sixth Plan, provision of domestic budgetary arrangements, staffing, technical capability, administrative structure, and construction site conditions.

Based on the recommendations of the preliminary study team and to take a further step toward implementation of the project, the Japanese Government dispatched a basic design study team to the country in August, 1986. The basic design study team conducted field reconnaissance on all proposed construction sites and typical farm survey around the sites and collected relevant data on agriculture and constructions in order to grasp the background of the project, see its significance and to evaluate the planning to work out a concrete plan of assistance within the scope set out by the preliminary study team and to confirm the provisions for implementation, operation and maintenance of the project on the side of Bhutan. As a result of the survey, the team was convinced of the viability of the project in line with the preliminary study team. In order to work out a specific basic plan, the team studied the preliminary project plan set out at the preliminary study in detail and discussed this with concerned officials of the Royal Government. As a result, the team has concluded that the Japanese Government's assistance should be extended to a plan based on the preliminary project plan with minor modifications.

The following are the basic contents of the project facilities covered by the Japanese asssistance.

Project Site	Buildings	Equipment	Function
1. Chungdu-Dingka Headquarters (Paro)	Tissue culture house, Seed processing house, Seed store house, Crop processing house, Administration office	Tissue culture equipment, Seed processing equipment, Crop processing equipment, Nursery equipment	Seed/seedling production, Crop processing
2. Chiufu Branch (Paro)	-	Farm machine, Grafting equipment, Nursery equipment	Seedling production
3. Panbesa Branch (Paro)	-	Farm machine, irrigation equipment, counter-animal-intrusion material, crop unloading lift	Pilot crop cultivation
4. Changyultang Branch (Punakha)	Seed processing house	Seed processing equipment	Seed production
5. Gaylegphug Branch (Gaylegphug)	Cardamon processing house	Cardamon drying equipment	Crop processing
6. Chinary Branch (Tashigang)	Seed processing house	Seed processing equipment	Seed production

The project will be implemented by the Department of Agriculture of the Ministry of Agriculture & Forestry and operated by NASEPP under the Department. As NASEPP is an intended national program to produce and distribute all kinds of seeds/seedlings, the project will be practically operated by Chungdu-Dingka Headquarters under NASEPP. Operation and maintenance expenditures will be born in two ways; personnel and facility maintenance expenses being carried by the central government while profit gained through trading seeds/seedlings and processed crops utilized as revolving fund.

Technical capability to operate and maintain the project facilities is good, however, training might be necessary for some of the new equipment. Necessary training will be given while the project facilities are being constructed.

It is estimated that after the exchange of notes between the two governments, at least five months would be necessary for detailed design, tendering and contracting and at least ten months for construction. Since the project sites are dispersed and transportation is very difficult, it is recommended that the construction be divided into two stages as follows:

1) First phase : Chungdu-Dingka Headquarters and Panbesa Branch

2) Second phase : Chiufu, Changyultang, Gaylegphug and Chinary Branches

The extent of the Japanese Government's assistance will be construction of buildings complete, and supply and installation of all equipment, while the Royal Government will prepare lands, provide water and power to the sites and enclose them with fences if necessary.

The project is viable because (1) it is well founded on the pioneer projects such as the Bondey Farm and NASEPP, (2) the technical capability of the staff is good, (3) self-reliance efforts on the side of Bhutan to date have achieved significant progress, (4) the administrative structure is well organized and (5) it is coordinated with other agricultural development projects.

Implementation of the project will establish a sound foundation for cash crop development and will contribute to the increase of cash income of the rural population and subsequent overall enhancement of the standard of living of the nation in the near future. It will also help the country to modernize its economic structure. In this context, the Japanese Government's assistance to the project should be very much appreciated.

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GLOSSARY OF ABBREVIATIONS

AMC	Agriculture Mechanization Center
CIMMYT	Centro International de Mejoramiento de Maiz y Trigo
CIP	Centro International de la Papa
EEC	European Economic Community
DOA	Department of Agriculture
FAO	Food and Agriculture Organization of the United Nations
FCB	Food Corporation of Bhutan
GDP	Gross Domestic Product
HDC	Higher Division Clerk
IDRC	International Development Research Center
IFAD	International Fund for Agricultural Development
IRRI	International Rice Research Institute
LDC	Lower Division Clerk
MOA	Ministry of Agriculture and Forestry
NASEPP	National Seed and Plant Program
Nu.	Ngultrum
Rs	Indian Rupees
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Program

CURRENCY UNIT

Ngultrum = 100 chertum

1 Nu. = 1 Rs = ¥ 12.75 (August, 1986)

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SECTION - 1 INTRODUCTION

SECTION - 1 INTRODUCTION

The Kingdom of Bhutan is an agricultural country with 90% of the population engaged in agriculture. The entire country is covered with mountains of the Great Himalayan Range making the terrain one of the most rugged in the world. The nation's staple food are rice and wheat though self-sufficiency has not yet been attained due to physiographical constraints and low productivity.

Other idustries have not yet been developed and the economy is based on small, primarily subsistence-oriented village communities. Given the rugged terrain, agriculture is small scale intensive agriculture. Per capita income is estimated at US$140 in 1984. The country's development is primarily hinged on that of agriculture.

Landlocked between India and Tibet and involved in border skirmishes, and coupled with natural barriers, the start of modernization of the country was not until 1960s. Therefore, the basic public infrastructure such as roads, educational and health facilities are still rudimentary. Development of these infrastructures along with agriculture is the major issue of the country.

Efforts in agricultural development have been focused on increasing agricultural production particularly rice and maize through technical improvement, distribution of quality seeds and good irrigation systems for the purpose of self-sufficiency of food supply.

The farmer's life has been wholly devoted to subsistence, food, clothing and housing, unable to afford expenditures for cultural thing such as education, health and recreations. In order to enhance the nation's standard of living, a measure to introduce cash income to farmers is essential. The cash crop development project has been designed for this purpose, but is also expected to contribute to modernization of the country as increased cash income would transform the self-contained economy to monetary economy.

Bhutan is blessed with diverse climates and is conveniently near to the large Indian market along its southern border, besides most of the cash crops have different cropping calenders from those of Indian counterparts.

On the other hand, production can be expanded through increase in land use intensity by double cropping, better productivity by distribution of quality seeds/seedlings and promotion of farm mechanization.

Cultivation of cash crops in the country, however, is still in its infancy. To further expand cash crop cultivation, the Royal Government of Bhutan worked out a national development project but owing to the financial constraint, filed a request for assistance with the Government of Japan.

In response to this request, the Japanese Government dispatched through the Japanese International Cooperation Agency (JICA) a preliminary study team headed by Mr. Hideo Yasuki, Special Advisor to the Director of the Grant Aid Project Management Department, JICA, to the country from April 8 thru 20 in 1986. On the preliminary study, the significance and appropriateness of the project was confirmed and concurrently a preliminary project plan was worked out through discussions with the concerned officials of the Government to be subjected to further study. In order to take a further step, based on the report by the preliminary study team, toward implementation of the project, the Japanese Government dispatched a basic design study team, headed again by Mr. Yasuki, to the country from August 4 thru 26 in 1986.

The objective of the basic design study team was to work out a specific basic design of the project based on data collected by field reconnaissance on all the project sites proposed in the optional plans, on typical farm surveys and on general agricultural and constructional matters, and through discussions with the concerned officials of the Royal Government on contents of the project facilities and extent of assistance by the Japanese Government. The team, bearing in mind what has been surveyed and worked out by the preliminary study team, carried out field surveys and collected relevant agricultural and constructional data in order to grasp the background, significance and appropriateness of the project on its own and to work out a specific basic design as well as execution, operation and maintenance plans.

As a result of the survey and discussions with the concerned officials of the Government, the team concluded that the Japanese Government's assistance should be extended to a plan based on the preliminary project plan with some minor modifications for the plan would give a great impact to agricultural development of the country as a whole.

SECTION - 2 BACKGROUND OF THE PROJECT

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2-1 General

Bhutan is a typical agricultural country. The country's economic development hinges upon that of agriculture. The agriculture is small scale intensive agriculture and increase of productivity and value adding to the product is the major issue in it. Needless to say, the agriculture is governed by the natural environment. In summary:

(1) Almost the entire country is covered with high mountains of the Great Himalayan Range. Mountains are engraved by deep valleys with small valley basins and small villages.

(2) The country is located in the subtropical climate zone, however, because of topographical features, it enjoys diverse climates from subtropical to high mountain tundra climates. The agriculture is also diversified by region and by altitude.

(3) 90% of the population is engaged in agriculture, which produced 44% (884.3 M.Nu.) of the GDP in 1984.

(4) Total cultivated land is about 120,000 ha, nearly 3% of the total country area 46,000 km^2. There is little room for expansion of the arable land (about 5%). The average farmer's land is about 0.7 ha producing an annual income of 140 US$ (1984) from the self-contained agriculture.

(5) Major agricultural products are rice, wheat, maize, potatoes, buckwheat, barley, oranges, etc.

(6) Land use intensity is 1.3, which is relatively low compared with other Southeast Asian countries. Unit area harvest of rice is 2.1 t/ha also relatively low. The country has been suffering from a chronic labor shortage adding to the problem in labor intensive cereal production.

(7) The country has not yet achieved self-sufficiency in the food supply. In terms of basic cereals, the degree of self-sufficiency is estimated at 70%. The country has been importing cereals from India as much as 25,000 tons a year.

(8) Transportation, storage and marketing systems have not yet been modernized and agricultural materials such as seeds/seedlings and fertilizers are in short supply. Social capital such as agriculture credits is scarce and agricultural facilities are yet to be well established.

(9) The economy is to a large extent influenced by that of India.

(10) The people are said to be diligent and progressive although present agricultural level is still lower than in advanced countries.

2-2 Country Development Plans

Although Bhutan enjoys a long history it was only in 1908 that the country was unified and 1949 when a treaty was signed with India. It was in 1950 when the first step toward modernization of the country was taken and in 1961 the First Plan was initiated. This year (1986) falls on the last year of the Fifth Plan.

Following are the particulars of the development plans until the 4th Plan:

(1) In the early 1960s the administrative structure had not been well organized and basic economic and social infrastructure such as roads, health services, communication facilities and schools were in poor shape. Consequently, development efforts were concentrated on the public works and educational facilities along with agriculture.

(2) The 1970s saw an expansion of development areas, particularly in forestry, power, mining and health and emphasis came to be gradually shifted to exploitation and development of the natural resources.

(3) Reviewing the development expenditures from the First to the Fifth Plans, there is a sharp growth of over 30 times as shown in Table-VIII.6 attached to Appendix VIII (1986/87, the last year of the Fifth Plan, is not included.) Generally, it is clearly seen that investment was preponderantly put into the public works and education in the early stages while agriculture being given steady priority.

(4) Assessment of the progress achieved is difficult as time related variables are not available. Assessment of the progress therefore is made for the Fifth Plan in the following subsection.

2-3 Review of the Fifth Plan (1981/82~1986/87)

(1) Gross Domestic Product

GDP in 1984	:	2,012 M.Nu.
Per capita annual income	:	US$140 (11.8 Nu. = $1)
Growth of GDP	:	0.4 %/year

(2) External Trade

Trade with India has been free since the border with Tibet was closed in 1960.

India occupies	95% of Bhutan's export	(173 M.Nu.)
	90% of Bhutan's import	(725 M.Nu.)

Bhutan's overall trade deficit (649 M.Nu.) is equal to 80% of import or over 30% of GDP.

The large current account deficit with India is covered by receipts from India in the form of budgetary grants and project aids. The hard currency trade deficit is partly offset by tourism earnings. The volume of external assistance has doubled over the Fifth Plan period from some 480 million Nu. to over 900 million Nu.

(3) Public Finance

Public finance was one of the major areas earmarked for reform during the Fifth Plan. Government revenues have increased by over 270% at an annual increase rate of 28.7%. Major factor responsible for revenue increase is attributable to reforms in tax system. Development expenditures increased over three-fold to 69% of the national budget in 1984/85. These have been almost wholly covered by external assistance.

(4) Prices

The consumer price index has increased at an average rate of 9.9% in a range of 8.2~14.5%. These tendency closely resembles that of India, implying a strong economic tie with India.

(5) Decentralization

Experience with decentralization, the transfer of responsibility for local projects to 18 district administration, has been surprisingly good given the

magnitude of change involved. Achievement of physical work programs, however, has tended to fall below targets due primarily to inadequate technical personnel to implement the programs. Efforts will be made during the Sixth Plan to enhance district level capability through training and recruitment of skilled personnel.

(6) Employment

There has been an increase in the number employed in the non-agricultural sector. The increase is partly due to several industrial units such as Penden cement plant and Gedu timber processing complex and expanded construction activities resulted from the expanded development expenditures. Trading activity has also grown as a result of the increased activity noted above.

On the other hand, a significant proportion of those employed in the non-agricultural sector are non-Bhutanese, mostly Indians and Nepalis.

(7) Agriculture

Principal targets for agricultural development in the Fifth Plan may be summarized as follows:

a) To attain self-sufficiency in food supply (basic cereals)

b) Diversification of agricultural production, especially increase of cash crop production to raise farmers' income

c) To improve people's nutritive conditions

d) To contribute to food self-sufficiency policy through quality seed production

To implement the above item-b, the Government has programed the national cash crop development project and requested a financial assistance to the Japanese Government.

Crop and animal production are the primary sources of income for the bulk of the population. Major crops are rice and maize, the former being grown primarily in western Bhutan, the latter in the east. Agricultural surveys show increases both in production and yield per ha. The 6% per year growth of food grain production is encouraging although it is impossible to assess the relative impact of weather conditions and services provided by the Government on output. The Fifth Plan target of self-sufficiency in basic cereals, however, has yet to be achieved.

Vegetables and horticultural crops, the bulk of which are marketed, averaged even higher rates of growth and are expected to continue their rapid increase in the future too.

Testing of varieties of rice has been initiated at Wangdiphodrang with assistance from IRRI. Promising varieties have been made available to interested farmers and early results appear promising. Cropping system research is also undertaken at Wangdi to encourage second and even third crops on irrigated land. Test planting of vegetables and seed production of the most suitable varieties is a major activity at the Bondey Farm in Paro. Potato production is primarily for market, both as seed and for table use. Most of the production is exported to India.

A major constraint on timely planting and harvesting is the shortage of labor at peak periods. In order to assist farmers to overcome labor constraints, the use of simple mechanized equipment is being promoted.

A farm mechanization center has been established at Paro (by the Japanese Government's grant aid) to train farmers in the use of and maintenance of equipment. Larger equipment such as tractors is also available on hire for land clearing and levelling.

Plant production service provided at no cost to farmers is a major activity of extension workers. The program has been strengthened with assistance from the EEC. Fertilizer use has remained more or less steady and limited to cash crops and paddy in the main river valleys. The extension service sells fertilizers to farmers with the government covering transportation and handling costs.

A rural credit scheme was initiated as a part of an area agricultural development program in four western districts; Ha, Paro Thimphu and Panakha. Funds have also been made available through district administration, initially for short-term (up to one year) and subsequently for medium term credit.

Trial production of mushrooms and silk is underway, the former near Thimphu, the latter in eastern Bhutan. Initial results have been encouraging and promotion efforts will be intensified.

Two major irrigation projects are underway in the south near Gaylegphug covering over 2,000 ha. Responsibility for construction and renovation of minor irrigation works has been transferred to district administration that have

implemented the work normally with the use of village labor provided under the labor obligation system.

To reduce the loss of agricultural land through floods and erosion, a project to control river erosion of farm land is underway in the Paro valley. The river bank program will be expanded in the Sixth Plan.

2-4 Sixth Plan

The Sixth Plan is being drafted and expected to be finalized in November in 1986 by the Planning Commission. The Sixth Plan may be summarised as follows:

(2) Objectives

1) To create a strong, well integrated and just society within the country through social and cultural development for a greater quality of life among the people.

2) To attain rational self reliance by enhancing economic, social and political capacity to sustain economic growth, social development and sovereignty.

3) To preserve and promote the country's rich cultural heritage and to cherish the values and institutions that have contributed to and enhanced the security and sovereignty in the nation, while giving pride in national identity.

(2) Strategies and Policies to Achieve the Objectives

1) To establish a simple, appropriate and progressive tax system.

2) To more effectively mobilize internal resources by optimizing public sector enterprise revenues and through mobilization of private savings.

3) To encourage and support the private sector.

4) To control government expenditure by increasing efficiency, privatising viable government activities and ensuring an effective structure of the Government to meet development needs.

5) To maximize community potential through effective decentralization to district (Dzongkhag) level.

6) To expand educational opportunities and improve the quality of education and manpower training to meet the nation's needs.

7) To expand provision of health facilities and improve environmental conditions.

8) To follow a cautious policy of renewable resource exploitation which provides maximum protection to the eco-system.

(3) Institutional Developments

1) During the Fifth Plan, a considerable amount of manpower and financial resources were transferred to district administrations to implement programs and projects prepared at that level. Development, however, has tended to be concentrated around district headquarters, with the consequence that most areas of the country have yet to experience any development activities. Reflecting on the result, the Sixth Plan envisages establishment of rural service centers at some 80 to 100 sites throughout the country to directly respond to public needs and concerns.

2) Major weakness of the development effort are in project preparation, monitoring and evaluation. Programs are underway to improve the above capacity at ministry and department levels.

(4) Sectoral Allocation

The Sixth Plan outlay is targeted at Nu. 8,200 million. This includes expenditures on projects which have been initiated during the Fifth Plan. This carryover has been estimated at Nu. 400~600 million. The largest sectoral allocations have been made to industry, trade and commerce (20.3%), power (12.7%), public works (10.3%) and education (10.1%). Agriculture together with forestry, animal husbandry and Food Corporation of Bhutan still has a significant share of 15.9%.

2-5 Agricultural Development Programs

The Sixth Plan target for the agricultural sector is national self-sufficiency in basic cereals and a significant expansion of cash crop production. The primary thrust will be upon increasing land use intensity and enhancing labor and land productivity through selective introduction of appropriate technological innovations. Programs will be established taking more area-focused approach.

1) Plant protection services, production and supply of improved seeds, the potato development program, field testing of rice varieties and production systems, provision of rural credit and promotion of agricultural mechanization are all on-going activities, several of which are supported by external agencies including EEC, JICA, Helvetas, UNCDF and IRRI.

2) Maize is the major crop in terms of both planted area and output. To date, no field trial and varietal testing program has been set up. A program focusing on maize will be worked out.

3) In order to utilize the land resources of the nation effectively, a land use survey and planning project will be implemented using aerial photographs and ground survey.

4) A program to set up grower's cooperatives will be initiated. Apple, orange and cardamon farmers will be the first target group.

5) A pilot project to assess yield increases associated with fertilizer application will be initiated.

6) Two major integrated area programs covering three districts, Lhuntsi/ Mongar, Tashigang/Mongar and Chirang will be implemented.

7) A new agricultural training center will be set up at Wangdiphodrang to upgrade staff capability and provide professional skills.

8) An agricultural research station will be set up also at Wangdi to perform soil analysis, cross breeding, genetic research and gene splicing.

9) Additional funds will be raised to strengthen agricultural credit, both short and medium term.

10) In addition to large scale irrigation projects, attention will also be placed on rehabilitation of small-scale irrigation works.

11) Ground water exploration and development will be undertaken particularly in areas where electricity is available to exploit ground water for irrigation purpose.

12) Efforts will be continued to protect river banks to curb encroachment of rivers on farmland.

13) The Government has decided to centralize collection of hydrological and meteorological data. An extensive data collection system will improve crop forecasting capabilities and provide advance warning of potential difficulties such as crop failures.

14) Re-structuring and reviewing the FCBs activities will be made.

2-6 Agricultural Development Projects

(1) On-going Major Projects

1) Taklai Irrigation Project (On-going)

Beneficiary area (ha)	:	1,480
Content	:	Rehabilitation of irrigation canals
Estimated cost (M.US$)	:	3.738
Source of finance	:	UNCDF grant

2) Hill Irrigation Project (F/S finished, expected to start soon)

Beneficiary area (ha)	:	1,750
Content	:	Multi-purpose area development through irrigation system
Estimated cost (M.US$)	:	0.321
Source of finance	:	Not identified yet

3) Soil Conservation Project (Under planning)

Beneficiary area (ha)	:	–
Content	:	Forest conservation, prevention of farmland erosion
Estimated cost (M.US$)	:	2.21
Source of finance	:	FAO

4) IFAD Project (On-going)

Beneficiary area (ha)	:	–
Content	:	Rehabilitation of small-scale irrigation systems, development of small farmland
Estimated cost (M.US$)	:	9.74
Source of finance	:	IFAD loan

5) Area Development Project (On-going)

Beneficiary area (ha)	:	1,400 (First phase 800, second 600)
Content	:	Small-scale irrigation system (First phase completed, second under F/S)
Estimated cost (M.US$)	:	31.0 (First phase 16.0, second 15.0)
Source of finance	:	Indian government grant

6) Flood Protection for Paro Valley (Completed)

Beneficiary area (ha)	:	150
Content	:	Flood control
Cost (M.US$)	:	0.812
Source of finance	:	UNCDF grant

(3) Agricultural Development Projects under Sixth Plan

Agricultural development projects which are planned to be implemented in the immediate future are summarized below. What has to be underlined here is the fact that the Government has made clear that the Project is listed in agriculture sector of the Sixth Plan as a first priority project and is expected

to be implemented immediately now that a request for an assistance has been filed with the Japanese Government.

1) Agricultural Mechanization Program

In the Fifth Plan, agricultural mechanization was a major program. With the Japanese assistance the headquarters was completed at Paro affording a sound base for substantive activity. Further assistance has been extended in the form of farm machine supply (KR2) contributing to popularising agricultural mechanization. The Government has set up two regional workshops, one in Paro and the other in Wangdiphodrang and plans in the Sixth Plan additional regional workshops at Bhur, Mongar and Bumthang. The master plan for agriculture mechanization is now being prepared.

2) Improved Seed/Plant Supply Program

This scheme under NASEPP is mainly intended to ensure timely supply of quality seeds and seedlings. This input is critical to the strategy of intensification and enhancement of agricultural productivity on the existing land, given the very small room for expansion of arable land. The cash crop development project will be a core project within this scheme.

3) Plant Protection Program

Reduction of on-farm losses and post harvest losses is an integral component of the intensification and productivity enhancement strategy. EEC assistance will continue for the establishment of a core group of professional staff with adequate facilities. For ecological reasons an integrated approach utilizing all available control tactics such as resistant varieties, predators, parasites, cultural methods and careful use of chemicals will be adopted.

4) Potato Development Program

This program has been finalized with Helvetas and CIP having agreed to extend support in the Sixth Plan.

5) Rice-Based Farming System

IRRI, through IDRC funding, is assisting in this area. They are expected to extend further assistance to cover this activity over the Sixth Plan.

6) Maize-Based Farming System

A plan to improve maize-based farming systems which is the most predominant farming system in the country. CIMMYT assistance will be sought after for preparation of such a project.

7) Assessment of Land and Water Resources

For optimum use of land and water resources, this exercise is the most important. It remains as a project idea to be detailed in the next few months.

8) Intensive Area Development Projects

a) Chirang Hill Irrigation Project

Previously described in 2-6.

b) Tashigang-Mongar Area Development Project

This project will be commenced at the beginning of 1987 with an IFAD loan (Nu. 60 million), UNDP grant (Nu. 6.5 million) and the Government contribution (Nu. 14.5 million).

c) Punakha-Wangdi Valley Project

This is a small farm development and irrigation rehabilitation project and will be commenced at the beginning of 1987 with IFAD loan (Nu. 34.0 million) and the Government contribution (Nu. 6.0 million).

d) Paro Valley Development Project

Details of this project are yet to be worked out. Estimated cost is Nu. 35 million of which financial source is still to be identified.

e) Gaylegphug Area Development Project

This project is estimated to cost Nu. 45 million. Project details and financing are yet to be worked out.

f) High Altitude Area Development Project

Covering Bumthang Dzongkhag and the higher parts of Tongsa and Wangdiphodrang is also in a project idea stage. Helvetas is considering funding assistance but details are yet to be worked out.

g) Lhuntsi-Mongar Area Development Project

With an estimated total cost of Nu. 30.0 million, this project area has been surveyed by a Japanese prefeasibility study team in July 1986. Subsequent feasibility study is expected to be undertaken by JICA in November 1986.

h) Samchi Area Development Project

With an estimated cost of Nu. 41.0 million, this project idea is in its infancy and will be implemented during the Sixth Plan.

2-7 Administrative Organization Associated with Agriculture

The national administrative structure has 8 ministries under His Majesty. Ministry of Agriculture & Forestry, one of the ministries, constituting 4 departments, Department of Agriculture, Animal Husbandry, Forestry and Food Corporation of Bhutan, administers all matters of agriculture, forestry, animal husbandry and foods. The Department of Agriculture handles all services related to agriculture such as agricultural development, reclamation of farmland, agricultural census, seed/seedling production and supply, agricultural research and experiment, extension service, crop processing, etc. The Department of Animal Husbandry is responsible for animal husbandry in such areas as livestock raising and distribution, epidemic disease, animal husbandry census, etc. and the Department of Forestry for conservation, development and exploitation of forestry resources, forest animal, etc. The Food Corporation of Bhutan has been engaged in stocking and distribution of imported basic cereals and foods granted under World

Food Program, operation of warehouses and cash crop auction yards and market price survey.

The department associated with the cash crop development project is the Department of Agriculture, which has two divisions, the Project Division and the Research Extension & Training Division. The Project Division is consisted of four Programs among which Agriculture Mechanization Center (AMC) has a particular relation with the cash crop development project. The project is placed under the jurisdiction of NASEPP, another Program.

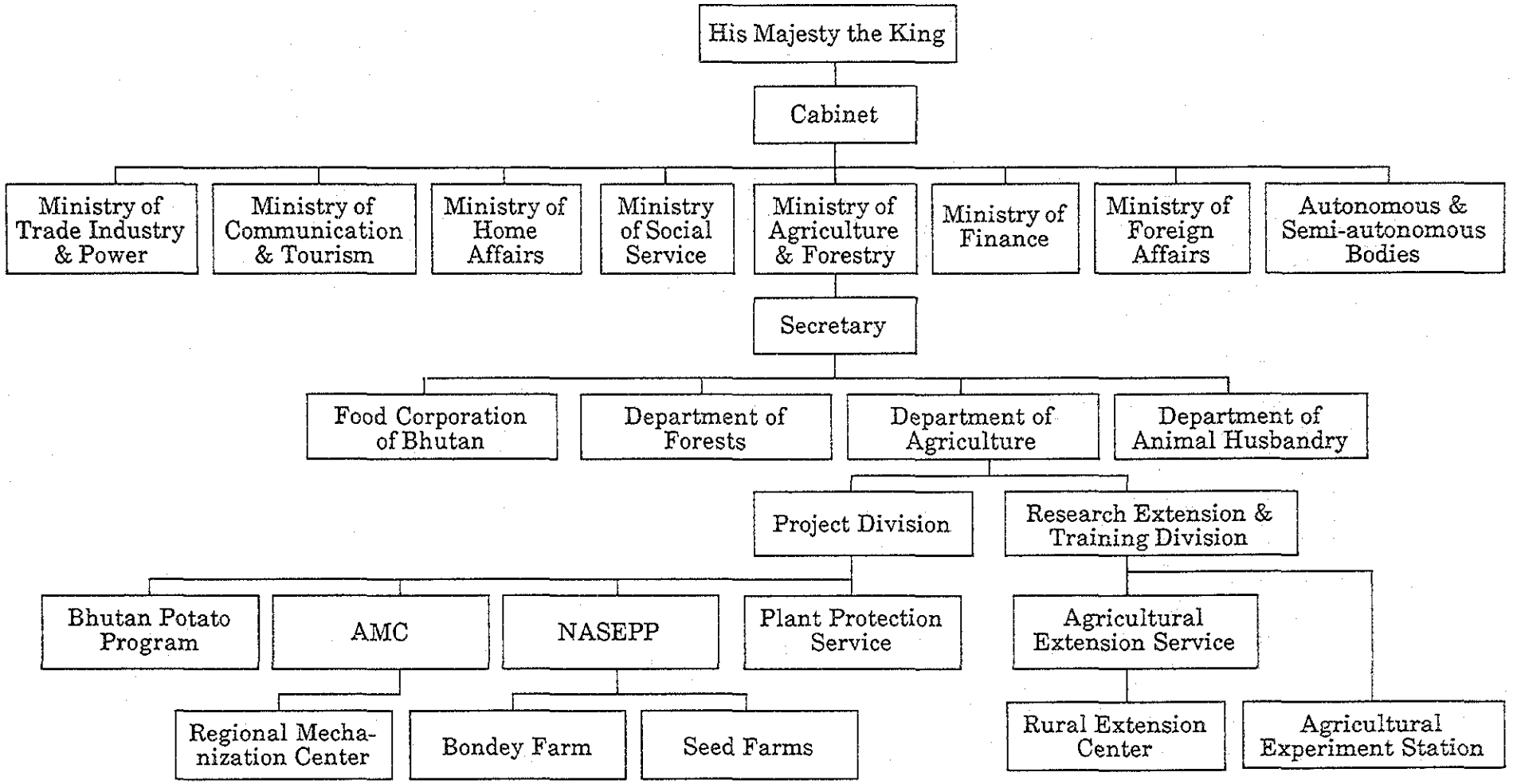
AMC has set up the headquarters in Paro district and regional workshops in Paro and Wangdiphodrang districts and plans to set up three more workshops in Bhur, Mongar and Bamthang in the near future. NASEPP, having the head-quarter in Bondey Farm, is responsible for quality seed/seedling production and supply. It constitutes three sections, procurement and distribution, production and research and development. NASEPP holds 11 farms throughout the country among which the Bondey Farm is by far the most outstanding farm (refer to the location map attached to Appendix VII-1).

As to agricultural experiment and research stations, there are four NASEPP farms and five experimental farms under the Research Extension & Training Division. The NASEPP farms are performing tests of varieties for planting aptitude along with seed production, while those of the latter are focusing on testing activities.

Agricultural extension services are carried out under supervision of the Research Extension & Training Division at district extension offices. At each sub-district there is a regional extension center posted with an extension worker who are rendering daily services.

All told, AMC, NASEPP, experimental farms, and extension service institutes are related with the cash crop development project in some ways. Effective coordination among these would smoothen the way toward overall agricultural development of the country.

Fig.-2.1 ADMINISTRATIVE STRUCTURE RELATED TO AGRICULTURE



2-8 Agriculture

Bhutan is a mountainous country at the foothill of the Great Himalayan Range, mountains ranging from 250~5,000 m. Its characteristic farmlands are on mountain slopes in the form of stepped terraces. Paddy fields are mainly on the bottom of river valleys where small villages and small towns are dispersed.

Bhutan's main industry is agriculture of which the main crops are rice and maize. Local markets are filled with a variety of seasonal agricultural products such as vegetables, potato and fruits region by region. Sellers of them are farmers bringing along surplus crops in exchange for cash. Bartering still remains a popular form of trading.

Over 90% of the population (approx. 1.1 million) is engaged in agriculture and the economy is a subsistence-oriented economy based on small village communities. Industries and commercial services are yet in their infancy, development of which has been being attempted in the country development plans.

Farmers though not rich are living a rather stable life. However, this does not necessarily mean that their life is rich in cultural aspects such as education, health and recreation but only basic needs, food, clothing and shelter, are met. In order to enhance the standard of living, means to increase cash earning is recognized crucial and earnestly sought after.

(1) Scale of Farming

Average farm family is estimated at 7 members based on the field farm surveys where it was found to be 8, 7 and 7 in the western area, eastern area and southern area respectively. National average farm land per family is about 0.7 ha consisted of paddy field 20% and dry field 80% according to the statistics. On field farm surveys relatively larger figures have been obtained, for instance 1.1 ha in Changyultang village, 1.0 ha in Cur village each in Punakha district and 1.3 ha in Dai-Dingka village in Paro district. Regional differences in the proportion of paddy field and dry field have also been observed; paddy field ranging none to as much as 80%.

Summer is the season for rice growing in paddy fields with some vegetable and beans grown in advance. Winter to spring is the season mainly for wheat in

dry field. In the orchard, apple and orange are the major fruits. Cardamon is a special plant grown in Gaylegphug area.

Statistics are not available on land tenure. From the field survey, it was found that owner farmers have a share of about 50%, owner-tenant farmers 30% and tenant farmers 30%.

Because of the physiographical constraints, parcels of land are small and irregular in shape to the disadvantage of farm work efficiency. Farming is small scale and sustained basically by family labor. Income is also small; from the field surveys it is in the vicinity of Nu. 16,000 (US$1,300) per family. Expenditures other than for basic needs are scarce, only a few farmers possess a radio set in a village for instance.

(2) Cultivated Land, Yield per Unit Land and Output

Table-2.1 shows cultivated areas, yield per ha and volumes of output of the major crops in Bhutan. Also tables are attached to the same effect to Appendix VII-1 in Paro, Punakha, Gaylegphug and Tashigang districts where the Project is sited.

In terms of cultivated land area, maize is the largest followed by paddy, millet/buckwheat and wheat/barley. Cereals occupy 80% of the cultivated land.

Maize is grown both in paddy field and dry field in an area of about 58,000 ha. In subtropical southern Bhutan, maize is partly grown in paddy fields in spring in advance of rice and in some areas double cropping is performed in spring and summer, both contributing to the predominance of maize cultivation area. Gaylegphug and Tashigang districts are major production regions where 40% of the cultivated land is occupied by maize.

Rice is widely grown on an area of about 30,000 ha, almost wholly in paddy fields in summer through to autumn. Very little upland rice is grown locally in the same season to that of paddy. Rice cultivation is more predominant in the western region than in the central or eastern region.

Millet/buckwheat are grown in dry field of about 20,000 ha. Cultivation is less intensive than that of rice and wheat where labor is input only for seeding and harvesting.

Wheat/barley are grown in an area of about 14,000 ha which is roughly consisted of 75% of wheat and 15% of naked barley, barley and oat. Orchard area is about 9,400 ha of which 83% is of orange.

Beans are grown in an area of about 7,000 ha of which 60% is of soya bean. Potatoes has an area of about 4,000 ha and in some districts potato has the largest share of the cultivated land.

Vegetables are not significant yet in cultivated land having about 2,700 ha, however, very rich in variety, over 20 kinds with full of local color. Among oil seed plants, mustard is outstanding having about 5,000 ha, which is an indigenous plant to the country and is one of the important export oriented cash crops.

Cardamon, another indigenous and very important cash crop, is grown in the southern border area in an area of about 8,500 ha. Gaylegphug districts where Gaylegphug Branch is set up produces about 1,000 tons per year in an area of about 3,000 ha.

Yield per unit area of land is relatively low. This in turn implies that there is a good possibility to raise the productivity.

Total cereal production of the country is about 168,000 tons of which about 81,000 tons are rice and wheat/barley. About 60 kg/year is the theoretical per capita consumption of the basic cereals, rice and wheat/barley, which obviously falls short of the minimum requirement. Hence Bhutan imported rice and wheat from India, about 4,800 tons and 2,300 tons respectively in 1984. This fact demonstrates the need to enhance production of these basic cereals among other things.

Production of fruits and potatoes are larger in the next place. Among them orange has about 39,000 tons and potato about 33,000 tons.

Production of vegetables and fruits has been steadily increasing in recent years and will be accelerated by promotion of the Government through the cash crop development project. As time runs, the current land use intensity 1.3 would be raised to over 2.0.

Table-2.1 CULTIVATED LAND, YIELD AND OUTPUT

Crops	Cultivated Land (ha)		Yield (t/ha)		Output (t)	
	1982	1984	1982	1984	1982	1984
Rice	27,646	30,258	2.07	2.14	57,350	644,961
Wheat/Barley	12,156	14,189	1.09	1.13	13,290	16,029
Maize	56,116	57,786	1.44	1.51	80,730	87,309
Potatoes	3,638	4,086	6.85	7.98	24,925	32,622
Soybean/Beans	3,988	6,365	0.61	0.83	2,420	5,303
Ginger	420	459	4.76	9.67	2,000	4,439
Mustard	2,870	4,905	0.66	0.88	1,890	3,446
Red Pepper	586	963	1.96	3.77	1,150	3,627
Sugar Cane	66	391	34.4	27.3	2,270	10,684
Oranges	6,172	7,758	4.14	4.98	25,560	38,672
Apples	1,488	1,546	2.25	2.25	3,350	3,480
Cardamon	5,816	8,680	0.48	0.35	2,770	3,013
Millet/Buckwheat	15,376	20,350	0.80	0.82	12,310	16,779
Groundnuts	-	22	-	1.09	-	24
Oilseeds	-	4,927	-	0.70	-	3,470
Tapioca/Yam	-	221	-	4.18	-	923
Radishes	-	536	-	4.43	-	2,373
Other Vegetables	6,070	728	1.50	2.30	9,120	1,674
Other Fruits	50	-	4.5	-	225	-
Arecanuts	64	-	8.2	-	525	-

Source: Department of Agriculture, 1986

(3) Agricultural Support Systems

The agricultural support system includes agricultural research, extension service, seed/seedling production and supply, rural credit and farmer's cooperative.

The agricultural research station are those five experimental farms under the Research Extension & Training Division of the Department of Agriculture and four NASEPP farms as described previously in 2-7. They are Bondey, Simtokha, Yusipang, Nasphel, Bhur, Bajo, Bhangma, Mithun and Phobjikha as listed in Table-2.2. These farms were formerly district experimental farms until taken over by the central government. Problems at these farms have been lack of equipment and shortage of trained staff.

Agricultural extension services are performed at district extension offices under the Research Extension & Training Division. Each district extension office has sub-district extension stations. The staff consist of subject matter specialists, extension supervisors and field extension workers. Each extension station is staffed with an extension supervisor and several field extension workers, however some sub-districts lack station buildings forcing these people to stay elsewhere. Extension services in the districts where the Project is located are given in Table-2.3. Services rendered by the field extension workers are very important as they have direct contact with farmers. As seen in the table, one field extension worker covers almost a whole sub-district on average; theoretically each of them taking care of about 175 ha of paddy field, 386 ha of dry field, 106 ha of orchard or about 667 ha in total. Their services range from operation and administration of demonstration farms, promotion of new crops or varieties, guidance of farmers' action groups, dissemination of modern farming techniques, etc. In spite of the large coverage area and wide range of services, they are not properly equipped with service gears and means of travelling. Various measures will have to be taken to improve the situation.

Quality seeds/seedlings hold a key to enhancement of production and to quality crops. NASEPP is responsible in this area which has been producing seed/seedlings at eleven farms namely Bondey, Chiufu, Panbesa, Samchi, Changyultang, Bajo, Bhur, Nasphel, Tashiyantsi, Chinary and Kanglung. Produced seed/seedlings are wide-ranged including rice, wheat, maize, vegetables and fruits. Among the farms, Bondey Farm is the core farm best established

and equipped where most of the produced seeds are screened, packed and distributed.

Rural credit was initiated with an assistance of UNCDF in four districts, Ha, Paro, Thimphu and Punakha. The credits are extended for farmers to buy farm machines, fertilizers and seeds/seedlings. Credit amounts, terms, interests and repayments are as given below:

Credit Amount	Term	Interest	Repayment
Nu. 1,000	Short	6%	12 months
Nu. 3,000	Medium	8%	36 months
Nu. 5,000	Long	12%	60 months

Account of the rural credits in the districts where the Project is sited is given in Table-2.4.

Farmer's cooperatives have yet to be set up. This is partly due to the self-contained subsistence oriented economy of the country. A monetary economy has not been developed as there is very little trading of commodities and bartering still exercised by farmers. With the increase of cash crops traded, to break the manipulation of cash crop markets by middlemen and to effect scheduled production and marketing of cash crops, establishment of the farmer's cooperative would come to be indispensable.

Table-2.2 EXPERIMENTAL FARMS

Farm	Dzong	Farm Area (ha)	Object Crops	Staff	Establish-ment
1. Bondey*	Paro	1.2	Rice, vegetables & fruits	6	
2. Simtokha	Thimphur	6.4	Vegetables, mush-rooms & asparagus	4	
3. Yusipang	Thimphur	8.4	Vegetables & fruits	4	
4. Nasphel*	Bumthang	0.2	High altitude cereals and temperate fruits	3	
5. Bhur*	Gaylegphu g	10.0	Rice, sugarcane & ginger	9	
6. Bajo*	Wangdi-Phodrang	16.0	Rice-based farming system	14	
7. Bhangma	Kanglung	16.0	Rice, maize, veget-ables & fruits	-	1987
8. Mithun	Chirang	7.0	Rice, maize, veget-ables & fruits	6	
9. Phobjikha	Wangdi-Phodrang	1.0	Potatoes	4	

*: NASEPP farm

Table-2.3 EXTENSION SERVICE BY DISTRICT

District	Staff	Number of Staff	Counties/ F.E.W	Coverage Area by a F.E.W (ha)			
				Lowland	Upland	Orchard	Total
Bhutan	S.M.S	10					
	E.S	35					
	F.E.W	168	1.1	175	386	106	667
Paro	S.M.S	1					
	E.S	2					
	F.E.W	10	1.3	202	250	23	475
Punakha	S.M.S	1					
	E.S	1					
	F.E.W	5	1.4	288	42	13	343
Gaylegphug	S.M.S	1					
	E.S	3					
	F.E.W	16	0.9	253	581	7	841
Tashigang	S.M.S	1					
	E.S	14					
	F.E.W	19	1.0	169	523	7	699

Source : Department of Agriculture, 1986
Note : S.M.S : Subject Matter Specialist
E.S : Extension Supervisor
F.E.W : Field Extension Worker

Table-2.4 RURAL CREDIT

District	Disburse-ment	Repayment	Recycled	Number of Beneficiaries
(Short Term)				
Bhutan	8,536,054	5,981,913	2,017	16,132
Paro	120,000	79,470	-	192
Punakha	120,000	74,235	50,000	195
Gaylegphug	629,759	417,400	98,240	553
Tashigang	1,362,506	1,217,151	499,773	1,396
(Medium Term)				
Bhutan	1,306,188	-	-	227
Paro	-	-	-	-
Punakha	77,600	-	-	26
Gaylegphug	40,000	-	-	4
Tashigang	12,200	-	-	3

2-9 Request for Assistance and Preliminary Study

Owing to financial difficulty, the Royal Government of Bhutan (hereafter referred to as "the Government") has requested a financial assistance from the Japanese Government for construction of project facilities to render seed/seedling production, pilot cash crop cultivation and cash crop processing services. Content of the request are summarized below:

2-9-1 Request for Assistance

(1) Project's name : National Cash-Crop Development Project

(2) Execution agency : Department of Agriculture, Ministry of Development*

(3) Objectives : Establishment of viable and well supported cash crop development program for the purpose of enhancing standard of living through cash income.

(4) Major activities :
- Quantitative and qualitative production and supply of planting materials,
- Expansion of cash crop cultivation and creation of certain cash crop production centers,
- Introduction of pilot marketing scheme in an integrated manner in certain rural areas,
- Processing of certain cash crops to add values and facilitate sales on a pilot scheme basis,
- Expansion of mushroom cultivation in rural areas.

(5) Objective crops : Vegetables, fruits, oil seeds, flowers, oil plants, dye-related crops, medicinal plants, mushrooms, spices, cereals and starchy crops

(6) Expert requirement : Dispatch of experts for installation and operation of equipment is not needed.

(7) Finance and staff : The Government will provide regular budgetary outlays. A total of 55 technical staff and 10 administrative staff have been secured.

(8) Project facilities : (Building)

1. Project Headquarters (total 2,350 m^2)
2. Changyultang Production Center (500 m^2)
3. Chinary Production Center (1,000 m^2)
4. Chiufu Production Center (400 m^2)
5. Tashiyantshi Production Center (400 m^2)
6. Tissue Culture Building (300 m2)
7. Cash Crop Production Center (200 m^2 x 5 nos.)
8. Cash Crop Processing House (1,300 m^2)
9. Storage House (1,600 m^2)

(Equipment)

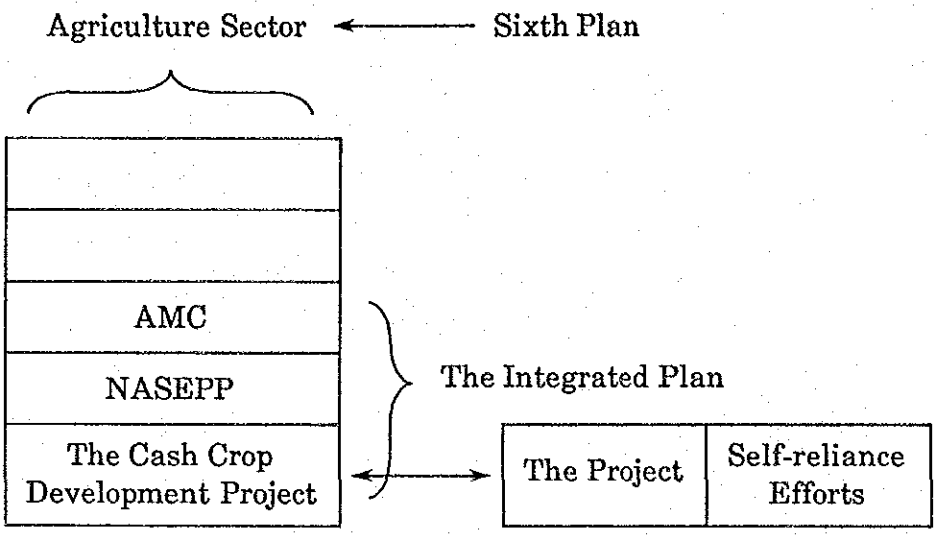
1. Seed/seedling production equipment
2. Tissue culture equipment
3. Cash crop production and extension service equipment
4. Cash crop storage equipment
5. Cashcrop processing equipment
6. Mushroom production equipment
7. Bottling and canning equipment

* This ministry has been re-named to Ministry of Agriculture and Forestry.

2-9-2 Preliminary Study

(1) Standing of the Project

The cash crop development project is listed in the agriculture sector of the Sixth Plan as a major development project and presented conceptually as "the Integrated Plan" where the Project is considered inseparable from the Agriculture Mechanization Center and the National Seed & Plant Program as illustrated below:



As the cash crop development project is a national program having a wide and far-reaching scope, it would take a long time until the project gets fully shaped. The Government, recognizing this, decided to launch the project by establishing a core and pilot scheme to which the Japanese Government's assistance is to be extended and fill up the remaining part by self-reliance efforts. Consequently the word used in this report as "the Project" means the initial part of the undertaking as shown on the right side of the above figure.

The Government has started a program of producing and supplying quality seeds and planting materials in the name of NASEPP in 1983 as a basic policy to raise the agricultural production setting up its headquarter in Bondey Farm in Paro district. Bondey Farm has been producing and supplying seed/seedlings since the 1970s mainly for Paro district. NASEPP is an expansion of what have been successfully achieved in Bondey Farm.

Major activities at Bondey Farm at present are,

(1) Farm mechanization service
(2) Production and supply of seeds/seedlings
(3) Agriculture extension service
(4) Vegetable and fruit processing

Since its start the Japanese Government's assistance such as dispatch of an expert and grant of equipment and materials, construction of the Agricultural Mechanization Center has been contributing to its evolution.

Cash crops aimed at in the Project are vegetables and fruits. The Project aims at expanding cultivation of these crops by farmers to gain cash income through seed/seedling production, pilot cash crop cultivation and cash crop processing services based on experience of Bondey Farm. The Project includes construction of buildings and supply of equipment to carry out the intended services.

The Project to take practical steps to realize the aim is deemed a soundly-founded and properly-framed project from the view point of the standing in the Sixth Plan, financial arrangement, staffing, technical capability and construction site conditions.

(2) Preliminary Project Plan

In the course of discussions with the concerned officials of the Government, basic points to formulate the project plan were found to be the following.

a) To approach directly to the policy of increasing cash income of farmers
b) Reinforcement of present NASEPP's functions
c) To render multi-pronged services
d) To contain variety of crops rather than specific crops
e) To set up a strategic base in Paro
f) To secure an appropriate revolving fund

In line with the above policy, a preliminary project plan was worked out in comparison of several alternative ideas studying the ways to solve the present problems and possible benefits accrued.

Outline of the preliminary project plan is to set up a headquarter at Chungdu-Dingka in Paro district, three branches for seed/seedling production, a branch for pilot cash crop cultivation and a branch for cash crop processing as illustrated below.

Project Site	Building (m^2)	Equipment
1. ChungduDingka-Headquarters (Seed/seedling production & crop processing services)	Administration office (400) Tissue culture house (600) Seed processing house (900) Garage (150) Seed store house (400) Crop processing house (1,600)	Seed processing equipment Tissue culture equipment Crop processing equipment Nursery equipment
2. Chiufu Branch (Seed/seedling production service)	-	Farm machines Grafting equipment Nursery equqipment
3. Panbesa Branch (Pilot cash crop cultivation service)	-	Farm machines Irrigation equipment Counter-animal fencing materials Crop unloading lift
4. Changyultang Branch (Seed/seedling production service)	Seed processing house (200)	Seed processing equipment
5. Gaylegphug Branch (Crop processing service)	Cardamon processing house (400)	Cardamon drying equipment
6. Chinary Branch (Seed/seedling production service)	Seed processing house (600)	Seed processing equipment

SECTION - 3 CURRENT CASH CROP PRODUCTION

SECTION-3 CURRENT CASH CROP PRODUCTION

3-1 Cultivated Lands, Outputs and Market Values

Current agricultural production is as outlined in Section-2. Basic cereals are consumed as staple foods but some vegetables and fruits are marketed as cash crops. The pattern of crop production and trading of crops in Bhutan are summarized below:

(1) Rice, wheat/barley, maize, buckwheat/millet are all consumed domestically but are not self-sufficient.

(2) Production of vegetable and fruits is limited in extent and surpluses are marketed directly by farmers.

(3) Exported items are cardamon, potatoes and oranges.

Under the circumstances, crops defined as cash crops in the cash crop development project are primarily vegetables, fruits and spice plants. In observing current production of cash crops in this section, crops are not classified into groups but cultivated lands, outputs, values, etc. are reviewed as a whole to appreciate the situation of the cash crops.

The following table shows ranking of crops in terms of cultivated area, output and market value:

	Cultivated Area	Output	Market Value
1.	Maize	Maize	Rice
2.	Rice	Rice	Maize
3.	Buckwheat/millet	Potatoes	Oranges
4.	Wheat/barley	Buckwheat/millet	Cardamon
5.	Cardamon	Wheat/barley	Potatoes
6.	Oranges	Sugarcane	Buckwheat/millet
7.	Oil seed/mustard	Soy/kidney beans	Wheat/barley

From the above table, overall ranking is seen to be in the order of maize, rice, buckwheat/millet, wheat/barley, potatoes and cardamon.

Table-3.1 are those for the districts where the Project is sited.

Table-3.1 RANKING OF CROPS BY REGION

	1	2	3	4	5	6	7
Paro							
Cuiltiv. area	Wheat/ Barley	Rice	Buckwheat/ Millet	Potatoes	Maize	Apples	Mustard
Output	Rice	Potatoes	Wheat/ Barley	Apples	Buckwheat/ Millet	Maize	Oranges
Market value	Rice	Potatoes	Wheat/ Barley	Apples	Buckwheat/ Millet	Maize	Cardamon
Punakha							
Cultiv. area	Rice	Wheat/ Barley	Mustard	Maize	Buckwheat/ Millet	Red pepper	Oranges
Output	Rice	Wheat/ Barley	Oranges	Red pepper	Potatoes	Maize	Mustard
Market value	Rice	Wheat/ Barley	Red pepper	Oranges	Cardamon	Mustard	Potatoes
Gaylegphug							
Cultiv. area	Maize	Rice	Buckwheat/ Millet	Cardamon	Oranges	Mustard	Soy/ Kidney beans
Output	Maize	Sugarcane	Rice	Oranges	Buckwheat/ Millet	Cardamon	Ginger
Market value	Cardamon	Rice	Maize	Buckwheat/ Millet	Ginger	Wheat/ Barley	Potatoes
Tashigang							
Cultiv. area	Maize	Rice	Wheat/ Baraley	Buckwheat/ Millet	Soy/ Kidney beans	Potatoes	Mustard
Output	Maize	Rice	Potatoes	Wheat/ Barley	Buckwheat/ Milloet	Soy/ Kidney beans	Red pepper
Market value	Maize	Rice	Potatoes	Wheat/ Barley	Buckwheat/ Millet	Red pepper	Soy/ Kidney beans

The above table demonstrates some regional characteristics in crop production. These regional traits should be taken into consideration in selection of the crops to be promoted in each region.

3-2 Seed/Seedling Production and Distribution

Production of seed/seedlings is being programed, produced and distributed by NASEPP as described previously.

Seed/seedlings produced are wide ranged such as for rice, wheat, vegetables, fruits, flowers, oil seeds, medicinal plants, spice plants, root crops and cother ereals.

Table-3.3 shows the seeds/seedlings produced in Bondey Farm and other NASEPP farms in Paro district.

Among the basic cereals, wheat seed (170 tons) is the largest followed by maize and rice. In contrast, vegetable seeds and buckwheat seed are still very small. However, vegetable seed production is predicted to grow rapidly as production is promoted by the Government. In terms of selling values of seed/seedlings, vegetable seeds is the largest followed by wheat, maize, oil seed, etc. which is attributable to the high selling prices.

Among fruits, apples occupy the largest portion with seedlings of 128,000 pieces, followed by oranges, pears, mangoes, walnuts, etc. In terms of selling value, apple is also the top followed by oranges, mangoes, and pears in the similar order to that of production volume.

Other seeds include those of tea, cardamon, pineapples, flowers, etc. among which cardamon is very outstanding.

About 34 kinds of seeds/seedlings were produced in 1986 of which total selling values amounted to about Nu. 2.631 million, shared by fruit seedlings Nu. 1.507 million, vegetable and crop seeds Nu. 1.093 million and by others Nu. 0.03 million.

Bondey Farm has initiated seed/seedling propagation through tissue culture. Seeds/seedlings now under nursery will be ready for planting in a couple of years. Those propagated to date are shown in Table-3.2.

Table-3.2 SEED/SEEDLINGS BY TISSUE CULTURE

Crops	Laboratory (pcs)	Nursery Farm	Crops	Laboratory (pcs)	Nursery Farm
1. Potato	10,000	250 kg	8. Asparagus	3,360	-
2. Strawberry	3,700	4,200 pcs	9. Rose	4,300	-
3. Apple (Scion)	2,000	-	10. Lily	3,000	-
4. Apple (Stock)	1,500	500 pcs	11. Raspberry	200	-
5. Cherry (Scion)	7,200	-	12. Grape	800	-
6. Cherry (Stock)	3,000	-	13. Garbera	550	-
7. Pear	4,550	-			

Table-3.3 SEED/SEEDLINGS PRODUCTION

(1986)

	Production (t)(pcs)	Selling Value (10^3 Nu.)		Production (t)(pcs)	Selling Value (10^3 Nu.)
Vegetable/Crops			11. Peach	6,000 pcs	0.030
1. Vegetables	1.35 t	0.810	12. Apricot	2,000	0.010
2. Wheat	170.00	0.638	13. Plum	3,000	0.018
3. Rice	16.30	0.082	14. Walnut	11,000	0.044
4. Oil seed	9.12	0.109	15. Cherry	4,000	0.028
5. Barley	6.00	0.023	16. Chestnut	2,000	0.010
6. Buckwheat	1.30	0.005	17. Almond	1,000	0.007
7. Oat	1.60	0.016	18. Arecanut	500	0.001
8. Maize (Hybrid)	13.00	0.104	19. Grape	200	0.002
9. Maize (Truebred)	7.00	0.025	20. Kiwi	-	-
Sub-total		1.093	Sub-total		1.507
Fruit Seeds			Others		
1. Mango	12,000 pcs	0.108	1. Tea	5,000	0.025
2. Orange	33,000	0.230	2. Cardamon	18,000	0.005
3. Lemon	1,890	0.013	3. Pineapple	2,300	0.001
4. Guava	700	0.002	4. Flower seeds & bulbs	-	-
5. Pomegranate	215	0.001	5. Rose and others	-	-
6. Litchi	1,800	0.005	Sub-total		0.031
7. Banana	6,000	0.036	Total		2.631
8. Coconut	1,200	0.016			
9. Apple	128,000	0.768			
10. Pear	21,000	0.105			

Source: NASEPP (Bondey Farm)

Seed/seedlings production bodies are notably Bondey Farm, contract farmers and import along with little farm seed raising as shown in Table-3.4. Fruit seedlings rely on contract farmers and import. By the time the seedlings propagated through tissue culture at Bondey Farm and being nursed in the Chifu Farm get ready for planting, supply of fruit seedlings will become fairly good.

Table-3.4 SEED/SEEDLINGS PRODUCTION BODIES

Unit: t/pcs.

Crops	Total Output	Bondey Farm	Contract Farmers	Import	Home Seed Raising
Vegetables	1.35	0.84	0.50	-	0.01
Wheat	170.00	-	85.00	85.00	-
Rice	16.30	12.30	4.00	-	-
Maize	20.00	-	13.00	7.00	-
Oil seed/Soy bean	9.12	2.50	6.52	0.10	-
Oat	1.60	0.40	1.21	-	-
Tropical fruits	56,805	-	21,000	35,805	-
Temperate fruits	178,200	-	-	178,200	-
Cardamon	18,000	-	18,000	-	-

Source: NASEPP

Flows of seed/seedlings of major items from the production bodies to farmers are illustrated in Figs.-3.1, 3.2, 3.3 and 3.4.

Seed storage capacity at Bondey Farm is 6 tons for vegetables with a storage period of less than 2 years and 50 tons for rice, wheat and other cereals with a storage period of less than 1.5 years. At Chinary Farm, the capacity is 20 tons for maize seed with a storage period of less than 1.5 years. Packing forms for storing are bags for vegetable seeds and jute bags for rice, wheat, cereals and maize seeds.

Fig.-3.1 FLOW OF RICE SEED

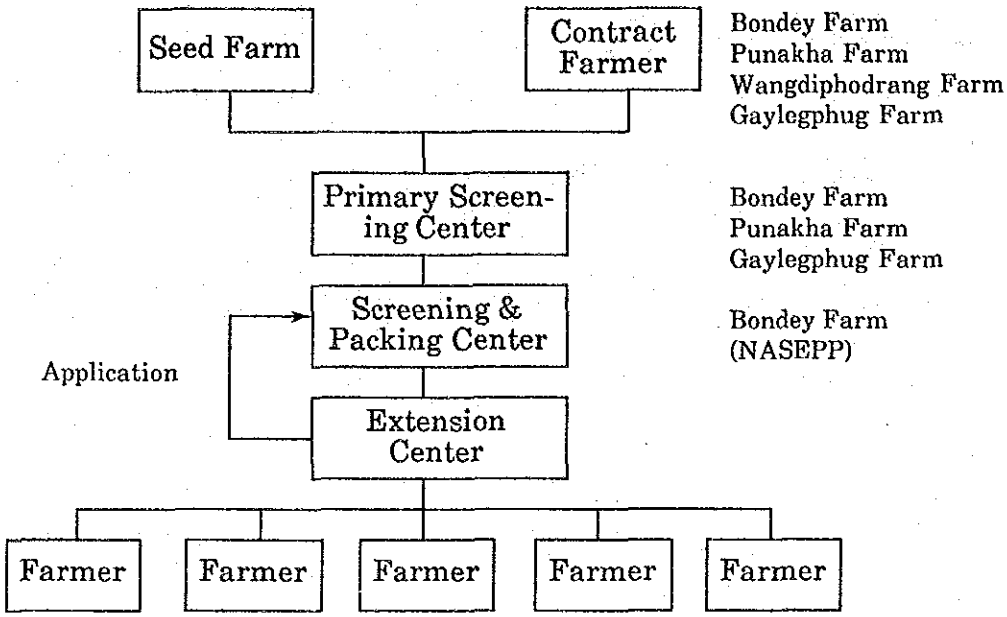


Fig.-3.2 FLOW OF MAIZE SEED

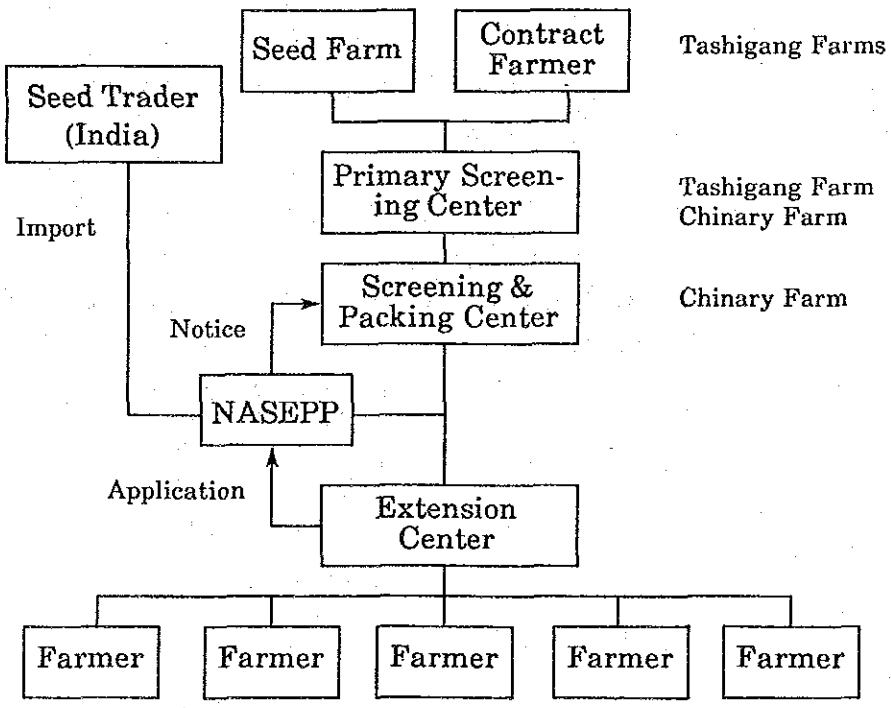


Fig.-3.3 FLOW OF VEGETABLE SEEDS

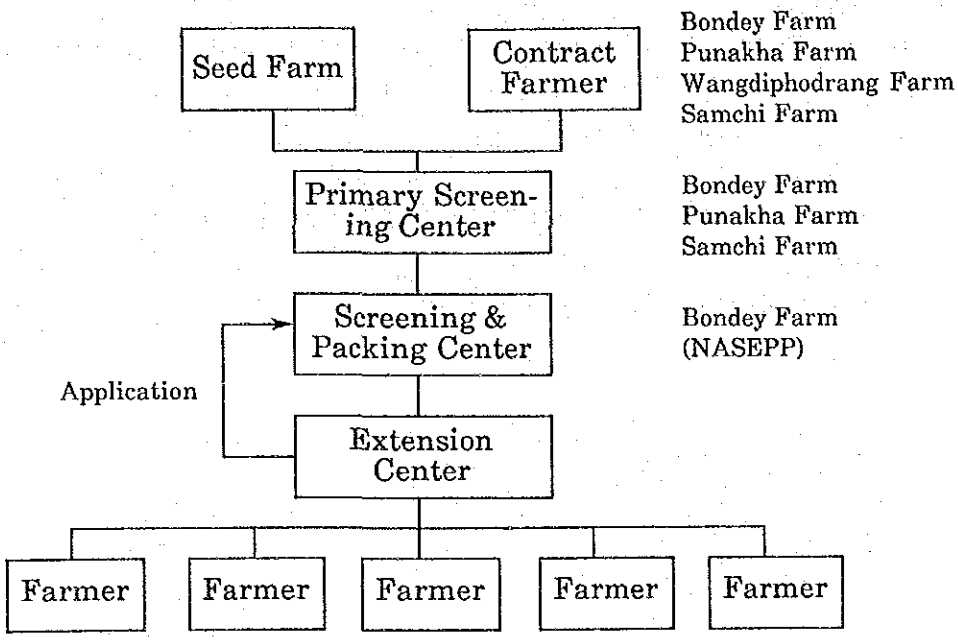
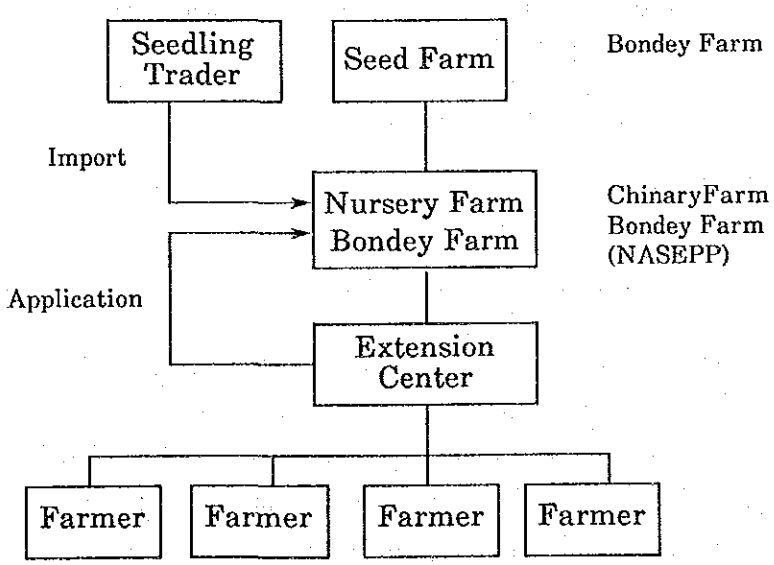


Fig.-3.4 FLOW OF FRUIT SEEDLINGS



3-3 Vegetable and Fruit Processng

Processing of vegetables and fruits include collection, grading, packing and storing of fresh vegetables and fruits for marketing and canning/bottling for the purpose of value-adding, scheduled shipment for price stability, preservation of surplus crops and utilization of labor force in farmer's slack season.

Bondey Farm has been pioneering in this area performing such processing as fruit juice and jams, vegetable cans and soy bean foods as shown in the following table with encouraging results. These activities will further be expanded and strengthened by the Project.

Table-3.5 PROCESSING OF VEGETABLES & FRUITS AT BONDEY FARM

	Products	Q'ty
1.	Apple juice	26,880 bottles
2.	Mushroom can	4,081 cans
3.	Asparagus can	177 cans
4.	Dried mushroom	96 kg
5.	Fried potato chips	200 kg
6.	Onion/plum pickles	527 bottles
7.	Fruit jam	5,400 bottles
8.	Tomato puree	236 bottles
9.	Alcoholic beverage	1,509 liter

Source: Bondey Farm, 1986

3-4 Marketing and Prices

Agricultural products are marketed directly by farmers at local markets. Their prices fluctuate by season according to the balance of supply and demand. Some special indigenous products are manipulated by middlemen to the disadvantage of the farmers. On the other hand, FCB has been engaged in importing basic cereals such as rice and wheat, in operation of auction yards for potatoes and oranges and in distribution of the food granted under the World Food Program to various government agencies.

Current marketing practice in Paro district of fresh vegetables and fruits is that farmers take their own products packed in crates or jute bags to a collection point and collected products are then carried over to Phuntsholing city by hired trucks. Grading and packing of vegetables and fruits are left to the farmers' own hand resulting in uneven qualities and lower prices.

Per capita consumption of basic cereals domestically produced are approx. 60 kg/year consisted of 50 kg of rice and 10 kg of wheat. Even adding supplementary crops such as maize, potatoes, soybean, buckwheat/millet and the like it merely amounts to approx. 170 kg/year, still falling below the average per capita cereal intakes of 100~250 kg/year in the developing countries. In order to offset the shortage, the country has been importing rice and wheat from India. The import has increased from 2,800 tons in 1981 to 7,000 tons in 1984. The population has been increasing at an average rate of 1.9% year (1970~1984) and so is the production of the basic cereals, rice 6.4%/year and wheat 10%/year. It, however, is difficult to foresee where the nation's food supply will stand in the future.

Other miscellaneous cereals and potato are mainly consumed domestically as substitute foods while surplus vegetables and fruits after the farm house consumption and spice plants are locally marketed or exported as the cash crops. The following table shows the marketed cash crops of the country.

Table-3.6 MARKETED CASH CROPS

	Crops	Production (t)	Marketed Volume (t)	%
1.	Oranges	38,672	36,956	96
2.	Cardamon	3,013	3,013	100
3.	Potatoes	21,622	22,168	68
4.	Ginger	3,627	2,569	71
5.	Apples	3,480	3,031	87
6.	Chilies	3,627	556	15
7.	Mustard	3,446	527	16
8.	Soybeans	2,751	926	34
9.	Sugarcane	10,684	1,337	97
10.	Other beans	2,552	427	17
11.	Areca nuts	563	503	89

A notable cash crop is cardamon, a special spice plant produced in the southern border areas particularly in Gaylegphug district which is 100% exported at a very high price. Trading of cardamon, however, is manipulated by Indian middlemen as described previously to the disadvantage of the farmers. Intervention or subvention of the central government to break the links with the middlemen is very important.

Sugarcane, oranges, arecanut, apples, ginger, potatoes also have a high marketability.

Table-3.7 shows the average market prices of cash crops in Bhutan and those of the counterparts at a market in Calcutta city and costs of agricultural imputs. Although hasty comparison of prices is risky it could be argued that given the large differences, marketability of Bhutan's cash crops is promising as far as quality products are concerned.

Table-3.7 MARKET PRICE OF CASH CROPS AND INPUT COSTS

Cash Crops	Bhutan (Nu./kg)	Calcutta* (Rp./kg)	Item	Bhutan
Rice	5.08		Fertilizer	
Unhulled rice	3.15		Mixed fertilizer	2.21 Nu./kg
Wheat	2.61		Agro-chemical	-
Barley	2.61		Agro-machinery	
Maize	2.55		Plow	180
Millet	2.63		Pedal thresher	1,000
Buckwheat	2.75		Winnower	320
Soybean	3.00		Handweeder	92
Beans	3.71	6.00	Hoe	28
Potatoes	2.55		Sickle	12
Sweet potatoes	3.00	5.00	Farm labor**	
Taro	1.00	4.00	Male	30 Nu./day
Rape	4.00		Female	25
Radishes	1.97			
Ginger	6.55	8.00		
Red peppers	6.93	10.00		
Cabbages	3.50	8.00		
Tomatoes	0.43	10.00		
Carrots	5.00	10.00		
Mustard	4.50			
Oranges	4.07	8.00		
Apples	3.50	10.00		
Cardamon	45.00			
Bananas	1.00 (Nu./5 pcs)	3.00		
Green peas	5.00			
Onions	3.37			
Cucumbers	4.00	4.00		
Cauliflowers	7.00			
Eggplants	6.00	2.50		
Pimentoes	10.00	15.00		

Source : Department of Agriculture, 1985
* : Public market, 1986
** : Incl. two meals
1 Rp. = 1 Nu.

SECTION - 4 PROJECT PLAN

SECTION - 4 PROJECT PLAN

4-1 Objective of Project

The objective of the Project is to enhance the standard of living of the rural population who account for 90% of the whole by introducing cash income through trade of cash crops.

Because of the rugged terrain, farmers are engaged in small-scale, intensive, subsistence-oriented agriculture. Cash income is meager, therefore, the farmers can not afford expenditure for a better cultural life.

Cultivation of cash crops in the country is still in its infancy. However, some attempt has been made in Paro district where with the Government's encouragement, farmers have been increasing cultivation of cash crops and earning cash income through sale of surplus vegetables and fruits proving the policy of promoting cash crop cultivation in effect to be the way to provide cash income to the farmers and to be a nation-wide project.

It is also recognized that to increase cash income to the rural population would contribute to balanced regional development and subsequent modernization of the country's economy toward a monetary economy.

4-2 Study of Proposed Project Plan

Study of the proposed project plan by the Government and the preliminary project plan set out at the preliminary study as described in Section-2 has been made in detail from the following viewpoints:

4-2-1 Basis of Project

(1) Standing in the Sixth Plan

The Project will be included in the Sixth Plan (1987/88~1991/92) now under preparation and due to have been finalized by November of this year (1986), and is expected to be a major project in its agriculture sector if implementation is realized with the assistance of the Japanese Government.

(2) Financial Arrangements

The necessary local funds for implementation of the Project will be allocated from the regular budget of NASEPP as major part of its activities is to be taken over by the Project.

The fiscal year budget of NASEPP (1986/87) is Nu. 7.785 million whereas expenditures required to implement the Project is estimated at Nu. 3.000 million in the first year. The local budget is deemed to be well prepared.

(3) Staffing Plan

It is estimated that a total of 103 staff and operation personnel would be necessary to operate the Project.

Among them 55 can be shifted from NASEPP but the remaining 48 have to be newly recruited. Graduates are scarce, but some trained staff will be available from Bondey Farm and district extension offices while a small number of new graduates of technical high school remains to be sought after.

(4) Technical Base

Since the Project is an extension of NASEPP's activities based on the experience and achievement of Bondey Farm, and since most staff are to come from there, the Project is founded on a sound technical base.

(5) Project Site Conditions

All lands for proposed Project sites have been secured and access to these are all good, and there is no obstacle for construction.

(6) Administrative Structure

The administrative structure to implement the Project is well organized as well as to coordinate with AMC and NASEPP.

(7) Technical Assistance

The technical capability to operate and maintain the equipment is deemed to be good. Some training, however, would be necessary for new kind of equipment.

4-2-2 Study of Proposed Project Plan

(1) Possibility of Expansion of Cash Crop Cultivation

The physical possibility of expanding of cash crop cultivation lies in the following factors. As explained previously, substantial expansion of arable land is not posssible because of the physiographical conditions of the country; expansion would be minimal 5%. Expansion of cash crop produce therefore should not be based on that of the arable land.

1) Increase of land use intensity through double cropping (current rate 1.3 to over 2.0)
2) Utilization of idle land
3) Distribution of quality seed/seedlings including high yielding varieties (NASEPP)
4) Proper use of fertilizers, herbicides and plant protection chemicals
5) Farm mechanization (AMC)
6) Improvement of farming techniques (extension service)
7) Reclamation of arable land (maximum 5%)
8) Improvement of irrigation facilities

Among the above, expansion of cash crop production basically lies in increasing land use intensity. As Bhutan is blessed with a diverse climate suitable for growing a variety of vegetables and fruits, this means could be well justified.

(2) Marketability of Cash Crops

As explained hereto (3-4), cardamon, potatoes, maize, etc. are subjected to speculation of Indian traders. In order to secure stable incomes for farmers through cash crops, the Government's intervention is called for by such measures as agriculture credit and price support.

Marketability of the cash crops to justify the implementation of the Project could be as summarized below:

1) Quantitatively, Indian market is far larger than the domestic market.

2) The objective Indian market would be in the southern border region plus surroundings of Calcutta city where the population well exceeds 10 million. Market scale is sufficiently large.

3) Owing to the climate, lots of crops have a different cropping calendar from those of their counterparts in India (cabbages, cauliflowers, tomatoes, greenpeas, chili, etc.).

4) Bhutan produces such exotic fruits as strawberries, kiwi, etc., which are not available in the Indian border region or around Calcutta.

5) Value can be added to the crops by improving their quality (agro-technical improvement), introduction of new crops, improved packing and grading.

6) Large price differences have been observed between Thimphu (Bhutan) and Calcutta as surveyed at vegetable and fruit markets.

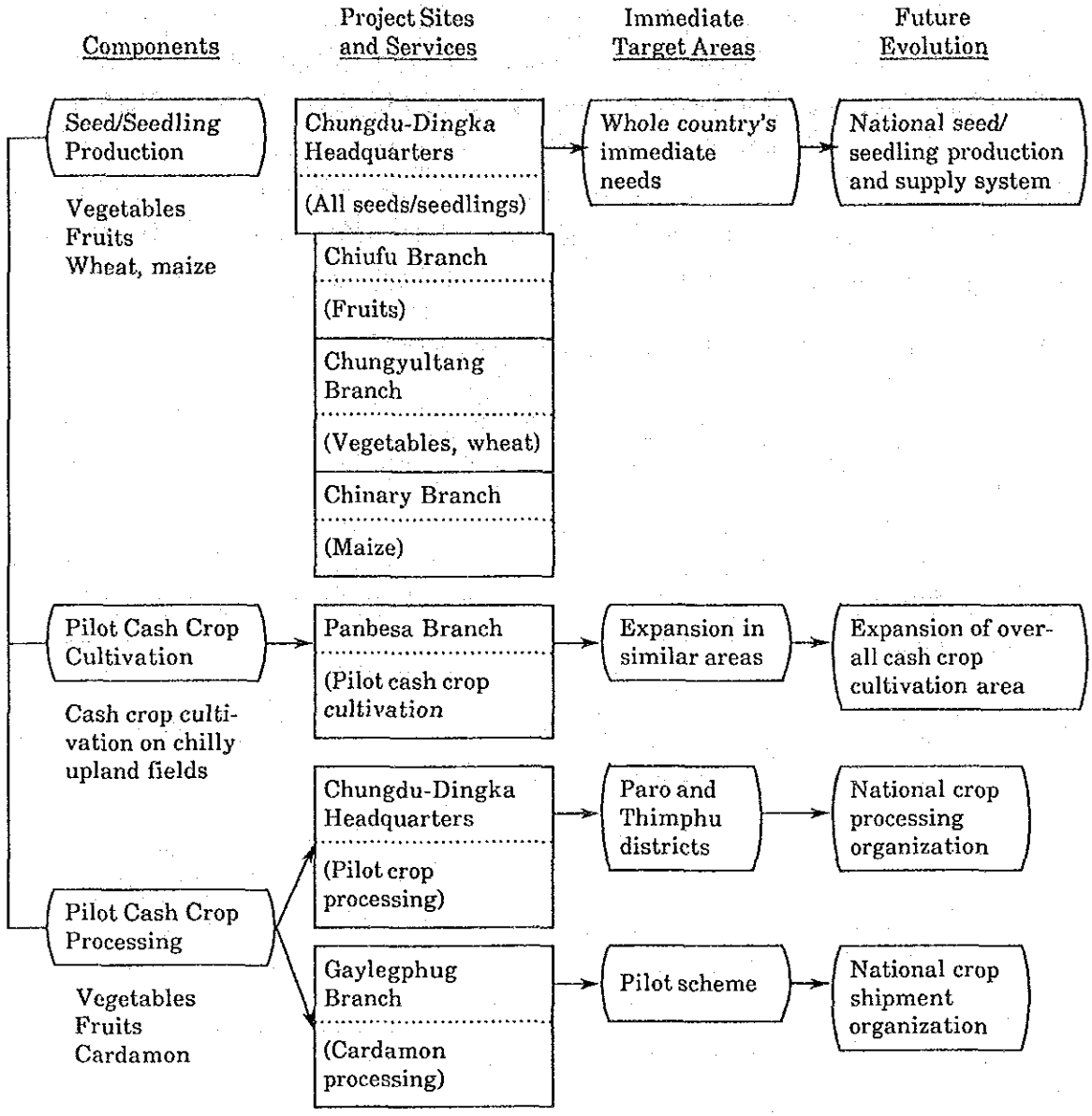
7) The statistics indicate an encouraging increase in the export of cash crops.

(3) Basic Concept of Project

The Project would include of the following three components.

1) Quality seed/seedling production and supply
2) Pilot cash crop cultivation
3) Pilot cash crop processing

These can be visually illustrated as below.



The cash crop development undertaking would not be complete without a balanced development of the above-mentioned three components, otherwise, a bottle neck formed in between would hinder the overall progress. As seen in the illustration, the basic policy of the Project, to set up cores and launch pilot schemes, is clearly and systematically planned; the headquarters and five branches constituting indispensable parts of the whole, being assigned with different functions and having visions of future evolution.

A major focus is placed on seed/seedling production service, for which production centers have been strategically located over the country. As one way to expand cash crop cultivation area, to launch a pilot cultivation on a moderately cold upland field is very noteworthy because the achievement here would tap a new area of cash crop production. Crop processing service is also an untapped area and therefore to be initiated in the most agriculturally advanced region Paro. This service is very significant for enlightening the farmers on the importance of quality crops and value adding and for price stability.

(4) Function of Project Sites and Coverage Areas

The basic concept of the Project discussed in the foregoing paragraph (3) is summarized by the Project sites with specific functions and coverage areas as follows:

Table-4.1 FUNCTIONS AND COVERAGE AREAS OF PROJECT SITES

Project Site	Seed/Seedling Production	Cash Crop Production	Cash Crop Processing
Chungdu-Dingka Headquarters	- Vegetable seeds — (Whole country) - Vegetable and fruit seedlings — (Whole country)	–	- Vegetable and fruit grading and packing — (Paro and Thimphu dist.) - Fruit canning and bottling — (Paro and Thimphu dist.)
Chiufu Branch	- Fruit seedlings — (Whole country)	–	–
Panbesa Branch	- Vegetable and cereal seeds — (Reinforcement of headquarters)	- Vegetables, fruits and cereals — (Pilot scheme)	–
Changyultang Branch	- Wheat and vegetable seeds — (Reinforcement of headquarters)	–	–
Gaylegphug Branch	- Cereal seeds (rice, wheat) — (Southern region)	–	- Cardamon drying — (Southern region)
Chinary Branch	- Maize seeds — (Eastern region)	–	–

The above coverage areas are illustrated on maps attached to Appendix-VII.

(5) Selection of Project Sites

Selection of the Project sites (headquarters and branches) was based on the following considerations:

1) Balanced regional development throughout the country,
2) Regional cropping pattern,
3) To set up activity centers at the existing NASEPP farms,
4) To newly set up the headquarters at Chungdu-Dingka in place of the Bondey Farm which has little room for expansion and whose existing facilities are aged and inefficient. Chungdu-Dingka is in Paro district, the most advanced region in agriculture in Bhutan.

The sites for the headquarters and branches have been selected on the following reasons.

1) Chungdu-Dingka Headquarters Site

① Located in the most agriculture-advanced district Paro, also close to Thimphu, the capital city of Bhutan,

② Closely located to Bondey Farm and AMC, ideal as a new base for further agricultural development effort,

③ Land is secured. However, a rather steep mountain slope would call for terracing, hence it is recommended to put the crop processing building in the Bondey Farm compound,

④ Has a good access by public road.

2) Chiufu Branch

① Performing fruit seedling growing since 1984,

② Closely located to AMC and Bondey Farm,

③ The seedling farm has room for expansion. Contract farmers could be engaged as needed.

④ Has a good access by public road.

3) Panbesa Branch

This area is a high altitude terrace formed by a Tertiary Glacier at an altitude of approx. 2,800 m. The climate is therefore colder. The village is engaged in single cropping of cereals due to this climate resulting in a relatively lower standard of farmers' living than that of paddy farming lower flat field. Countless villages are in the similar setting throughout the country. It is in these type of villages that is significant to increase cash income to the farmers by the cash crop through double cropping in the context of overall enhancement of the farmers' standard of living of the country.

The Project activities in this village should be the model case to grow vegetables on a high-altitude, chilly-climate terrace, and if successful other similar village can follow suit.

4) Changyultang Branch

The area has begun wheat cultivation as a back crop in winter in addition to rice cultivation since 1982. Furthermore, there has been vegetable seed production since the following year at the initiation of NASEPP. The area therefore deserves the name of "agro-developing district". This branch will play a key sole in producing wheat and vegetable seeds in collaboration with the Headquarters to meet the demand of the whole country.

① The relatively lower precipitation, yearly rainfall of 750 mm, is ideal for vegetable seed production.

② NASEPP has been performing wheat seed screening since 1983 moving over a seed screening machine and a diesel generator from Bondey Farm for about 2 months during the harvest season.

③ Among the vegetable seeds, the area is supposed to produce such fruit-vegetable seeds as tomatoes, cucumbers, eggplants, etc. When such seed production gets into full swing, it will become essential to process the seed at this production center because to carry ripe fruits over to the Headquarters would not be energy-efficient.

④ New seed processing facilities would further encourage the farmers to produce wheat and vegetable seeds as this area is in a developing stage.

The current seed processing activity in the existing shack is in a shambles.

⑤ Vegetable seed production will need careful guidance by the extension worker. The new center in a way could be the action base for extension workers as well.

5) Gaylegphug Branch

This branch is planned to process (dry) cardamon seed. Cardamon is grown in extremely limited spots in the world and Bhutan is said to share about 60% of the world production of which about 60% comes from Gaylegphug region (the other major source is Sikkim). Cardamon therefore is a very important cash crop and an export commodity for Bhutan due to its scarcity value. It is very significant to set up a cardamon processing branch here.

① Cardamon is bought up before harvest by Indian middlemen and is very vulnerable to their speculation.

② Cardamon seeds need drying before trading. Currently they are dried by farmers with fire wood which is illegally taken from the surrounding forest, posing a very serious threat to forest conservation.

To break the link with these middlemen for price stability and to prevent deforestation, the Project facilities here carry a significant responsibility.

6) Chinary Branch

Bhutan's agriculture can be represented by paddy farming in Western region, maize in Eastern region and subtropical crops in Southern region. In this context, Tashigang district where Chinary Branch is to be set up is equivalent to Paro in Western region. This Branch is planned to handle maize seed and is expected to effect a coordinated development along with the Lhunti-Mongar Development Project (2-2-5) through production of quality maize seed.

(6) Selection of Cash Crops

The main point of selection of cash crops is to promote endemic crops to each region having different geographical, climatic, soil and socio-economic conditions. On the other hand, from a farm economy point of view, it is recommendable to

cash crops which can be grown on a long term basis without losing marketability or to select those which are competitive in Calcutta and the border area markets depending on the different cropping calendars. In this context, the first step should be to select the crops which currently have large cultivated areas, production volume and market values as described previously (2-5).

Regarding vegetables, of which production statistics are not available, tomatoes, eggplants, cucumbers, cabbages, radishes, turnips, carrots, cauliflowers, onions, pimentoes, lettuces, asparagus, etc. were all observed on the field surveys to command high prices and are competitive in Indian market because of different cropping calendars. Production of these vegetables, small as yet, should be promoted.

Fruits could be another cash crop group. Bhutan is producing apples, oranges, pears, peaches, cherries, grapes, kiwi, etc. which are also competitive in the Indian markets. Quality improvement could be effected through quality seedling supply by the Project.

Last but not least, cardamon growing should further be developed in the southern region.

Various aspects of these prospective cash crops have been summarized in Table-4.2 and cash crops to be promoted regionally are illustrated in Fig.-4.1.

Table-4.3 is a production forecast of these cash crops around the year 1991 after implementation of the Project. As seen, large increase of vegetable production is forecast followed by fruits. These will be mainly orientated to Indian markets.

Table-4.2 CHARACTERISTICS OF CASH CROPS

Kind of Crop	Production Volume	Planting Aptitude	Market-ability	Export-ability	Price Stability
1. Cardamon	4	4	2	4	1
2. Oranges	4	4	3	3	2
3. Apples	3	4	4	3	2
4. Potatoes	3	4	2	2	2
5. Vegetables	2	4	4	4	1
6. Chilies	4	4	3	3	1
7. Nuts	1	4	3	4	3
8. Ginger	4	3	3	3	1
9. Oil seed	2	4	3	3	3
10. Other temperate fruits	2	4	3	4	3
11. Tropical fruits	1	4	3	3	3

4: Excellent, 3: Fair, 2: Normal, 1: Poor

The poor price stability of some crops in the table is attributed to speculation by Indian traders and substandard grading of crops, the fact that requires a subventive price stabilizing policy by the Government on one hand and implies importance of the crop grading and processing activities at the Project facilities.

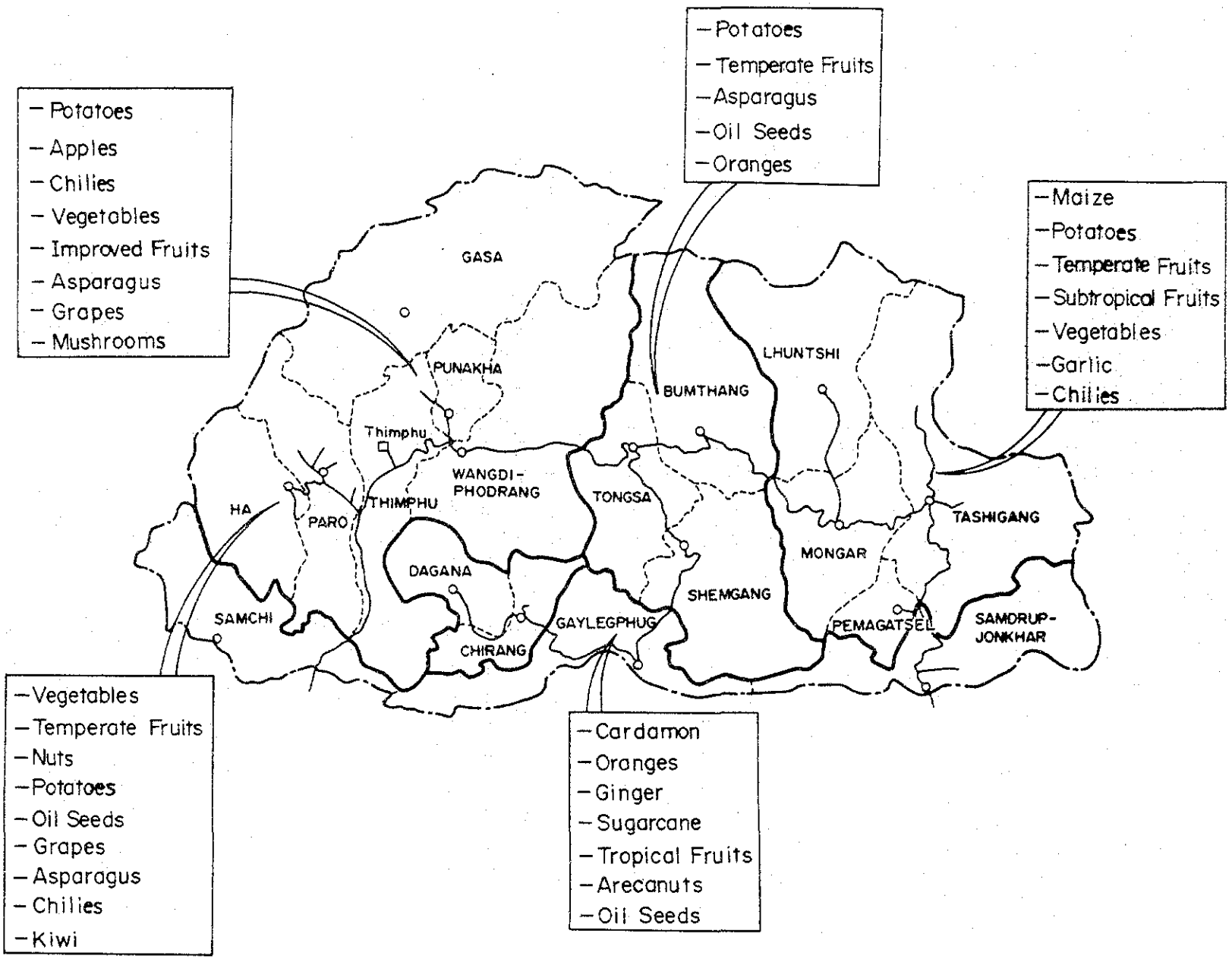


Fig-4.1 PROSPECTIVE CASH CROPS BY REGION

Table-4.3 CASH CROP PRODUCTION FORECAST

		Increase of Planting Land (ha)	Increase of Production (ton)
Crops	Vegetables	4,000	40,000
	Wheat	5,000	15,000
	Rice	2,500	12,500
	Oil seed/Beans	600	900
	Barley	250	750
	Buckwheat	150	225
	Oats	100	150
	Maize (Hybrid)	1,000	2,500
	Maize (Truebred)	300	600
Fruit & Others	Maize	600	1,200
	Oranges	300	9,000
	Lemons	20	400
	Guava	7	21
	Pomegranates	10	20
	Litchi	40	80
	Bananas	60	300
	Coconut	40	120
	Apples	1,000	20,000
	Pears	300	9,000
	Peaches	100	2,000
	Appricots	120	2,400
	Plums	40	80
	Walnuts	800	2,400
	Cherries	120	360
	Chestnuts	120	240
	Almonds	60	180
	Arecanuts	60	120
	Grapes	100	1,500
	Kiwi	200	1,000
	Tea	40	80
	Cardamon	175	70
	Pineapples	2	40
	Flower seeds	500	-
	Rose and others	300	-

Source: NASEPP, 1986

(7) Demand Forecast of Seed/Seedling

Demand forecasting of the seed/seedlings over a large time span is practically very difficult, for actual planting of cash crops by the farmers would vary according to the price fluctuations and climatic changes. Table-4.4 shows a seed/seedling demand forcast in the year around 1991 based on the forecast of cash crop production as discussed in the foregoing paragraph (6). These figures will be used to work out the scale of the seed/seedling propagation facilities, nursery farms and processing equipment of the Project.

Though they are susceptible to the socio-economic situation of the country and to the farmers' responsiveness, seed/seedling demand of vegetables and fruits will witness an increase of 4~6 times those currently being produced. Those of staple foods, rice and wheat, are also expected to increase to 3~4 times, which is to comply with the Government's policy to augment the self-sufficiency in the food supply.

Table-4.4 DEMAND FORECAST OF SEEDS/SEEDLINGS FOR CASH CROPS (1991)

	Demand Forecast
Crop/Seeds (t)	
1. Vegetables	8.0
2. Wheat	500.0
3. Paddy	75.0
4. Oil seed/Beans	30.0
5. Barley	20.0
6. Buckwheat	3.0
7. Oats	3.0
8. Maize (Hybrid)	50.0
9. Maize (Truebred)	15.0
Fruits/Seedlings (pcs)	
1. Mango	30,000
2. Orange	90,000
3. Lemon	6,000
4. Guava	2,000
5. Pomegranate	500
6. Litchi	4,000
7. Banana	6,000
8. Coconut	4,000
9. Apple	200,000
10. Pear	60,000
11. Peach	25,000
12. Apricot	6,000
13. Plum	8,000
14. Walnut	40,000
15. Cherry	12,000
16. Chestnut	6,000
17. Almond	3,000
18. Arecanut	3,000
20. Kiwi	20,000
Perennial Crops (pcs)	
1. Tea	20,000
2. Cardamon	70,000
3. Pineapple	10,000
4. Flower seed	10
5. Rose and other	150,000

Source: NASEPP, Bondey ferm, 1986

(8) Seed/Seedling Production and Supply Program

As cash crop production in Bhutan is still in its infancy, and demand for seed/seedlings will not arise evenly from all over the country in the immediate future. The national policy in fact aims at regionally balanced development of the country, which principle is also incorporated in the national cash crop development project (master plan). However, as the Project is aimed at establishing a core and to act as a pilot scheme, production and supply of the seeds/seedlings at first will be directed toward the surrounding areas of the Headquarters and the Branches and afterwards to be extended toward remote areas.

Table-4.5 shows a plan of seed/seedlings production in the immediate future based upon the cash crop production forecast as discussed in the previous paragraph (6).

Seed/seedlings production and distribution will be programed and supervised by the Headquarters in its entirety.

Vegetable and cereal seeds are produced at Chungdu-Dingka Headquarters, Panbesa and Changyultang Branches. Temperate fruit seedlings will be grown at Chinary Branch. Maize seed will be produced at Chinary Branch by contract farmers. Seedlings of cardamon will be imported from India. Seed/seedlings produced or processed at the Headquarters and the Branches are summarized in Table-4.6.

Table-4.5 SEEDS/SEEDLINGS PRODUCTION PLAN

Unit: (ton or pcs)

Seed/Seedling	Total	The Project Facilities	Contract Farmers	Home Seed-raising
Vegetables	8.0	7.97	-	-
Wheat	500.0	500.0	-	-
Rice	75.0	75.0	-	-
Maize	65.0	65.0	-	-
Oil seed/beans	30.0	30.0	-	-
Tropical fruits	145,500	-	30,000	30,000
Temperate fruits	400,000	245,000	45,000	45,000
Cardamon	70,000	-	70,000	70,000

Source: NASEPP

Table-4.6 SEED/SEEDLINGS PRODUCTION BY PROJECT SITES

Project Site/ Activities	Object Crops	Operation Period	Production Target (t)	Person-nel
Changdu-Dingka Headquarters				
Tissue culture	Apple, Cherry, Pear, Potato, Strawberry, Asparagus, Rose, Transvaal daisy, Grape, etc.	Year round	120,000 (nos.)	10
Seed processing & packing	Rice, Wheat, Naked barley, Buckwheat, Oat, Soybean, Groundnuts, Cucumber, Squash, Melon, Watermelon, Chinese cabbage, Cabbage, Welsh onion, Radish, Tomato, Red pepper, Green peas, Rape, Celery, Lettuce, Onion, Carrot, Cauli-flower, Eggplant, Turnip, Mustard, Spinach, Kidney bean	Year round	324	24
Crop grading & packing	Apple, Pear, Peach, Green pea, Mustard, Radish, Tomato, Red pepper, Potato, Pimento, Asparagus, Celery, Lettuce, Melon, Carrot, Pear, etc.	June-December	-	12
Canning & bottling	Apple, Peach, Green pea, Soy bean, Tomato, Strawberry, Mushroom, Walnut, etc.	Year round	-	10
Chiufu Branch				
Seedling raising	Fruit seedlings	Year round	-	10
Changyultang Branch				
Seed processing	Rice, Wheat, Soybean, Mustard, Onion, Cauliflower, and other Vegetable fruits	Year round	300	11
Chinary Branch				
Seed processing	Maize, Rice, Groundnuts, Soy bean, Red pepper, Mustard, Radish, etc.	Year round	80	11
Panbesa Branch				
Seed production	Apple, Potato, Cabbage, Asparagus, Celery, Lettuce, Carrot, Radish, etc.	Year round	-	6

Seed/seedlings supply scheme is summarized in Table-4.7. This scheme has been made based on the current farming practice, geographical, climatic and soil conditions and assuming increase of land use intensity at each area. The present land use intensity of 1.3 is assumed to rise generally to 2.2.

Seed/seedlings distribution service will be performed at local extension service centers upon request of the farmers. Supply of seed/seedlings to each center from the Branches will be administrated by the Headquarters. The seed/seedlings are charged for and current prices of them are shown in Table-4.9.

Tabale-4.7 SEED/SEEDLING DISTRIBUTION SCHEME

	Paro	Punakha	Gaylegphug	Tashigang	Other	Total
Crops (t)						
Rice	15.0	10.5	28.5	21.0	-	75.0
Wheat	100.0	27.0	19.0	130.0	220.0	500.0
Barley	8.0	1.5	0.5	8.0	5.0	23.0
Oil seed/Beans	1.5	0.5	5.0	23.0	-	30.0
Millet/Buckwheat	0.2	0.1	1.5	1.2	-	3.0
Maize	1.5	0.5	26.0	23.0	14.0	65.0
Vegetables	2.4	0.4	1.4	1.4	2.4	8.0
Fruit seedlings & others (pcs)						
Mango	-	5,000	10,000	1,000	5,000	30,000
Orange	1,500	1,500	84,000	3,000	-	90,000
Lemon	-	3,000	-	3,000	-	-6,000
Guava	-	-	-	-	2,000	2,000
Pomegranate	-	-	-	-	500	500
Litchi	-	1,000	1,000	1,000	1,000	4,000
Banana	-	1,000	4,000	1,000	-	6,000
Coconut	-	1,000	1,000	1,000	1,000	4,000
Apple	180,000	10,000	-	10,000	-	200,000
Pear	20,000	-	-	-	40,000	60,000
Peach	25,000	-	-	-	-	25,000
Apricot	-	1,000	1,000	1,000	3,000	6,000
Plum	4,000	-	-	-	4,000	8,000
Walnut	-	10,000	10,000	10,000	10,000	40,000
Cherry	5,000	-	-	-	7,000	12,000
Chestnut	-	1,000	1,500	1,500	2,000	6,000
Almond	-	1,000	1,000	1,000	-	3,000
Arecanut	-	500	1,000	1,000	500	3,000
Grape	10,000	-	-	-	10,000	20,000
Kiwi	4,000	4,000	4,000	4,000	4,000	20,000
Tea	5,000	-	-	-	15,000	20,000
Cardamon	-	-	68,000	2,000	-	70,000
Pineapple	-	-	10,000	-	-	10,000
Flower seed	1,000	400	400	400	7,800	10,00
Rose and others	25,000	25,000	15,000	15,000	70,000	150,000

Required storage capacity of seed/seedlings at each Project Site is estimated as below:

Tabale-4.8 REQUIRED SEED/SEEDLING STORAGE CAPACITY

Project Site	Seed/Seedling	Capacity (t)	Storage Period
Changyultang Headquarters			
Normal storage	Cereals, vegetables, oil seed	500	Less than 3 years
Emergency storage	Cereals	200	Less than 3 years
Source seed	Cereals	2	5~7 years
Chinary Branch			
Normal storage	Maize	300	Less than 2 years
Changyultang Branch			
Normal storage	Paddy, wheat, vegetables	200	Less than 1 year

The stored seed/seedlings will in principle be fumigated once a year.

Renewal cycle of seeds at farms in the immediate future is assumed as follows:

Paddy	:	Approx. 5 years
Wheat	:	3~5 years
Maize	:	(Hybrid) : Every year
		(Truebred) : 3~5 years
Vegetables	:	Every year
Apple	:	10~15 years
Peach	:	10 years
Pear	:	10~15 years

Tabale-4.9 PRICES OF SEED/SEEDLINGS (1986)

Prices (Nu./kg)

Crops Seeds			
Rice	5.00	Coconut	13.00
Wheat	3.75	Apple	6.00
Barley	3.75	Pear	5.00
Oats	10.00	Peach	5.00
Buckwheat	3.50	Apricot	5.00
Maize (Hydbrid)	8.00	Plum	5.00
Maize (Truebred)	5.00	Wallnut	4.00
Vegetables	60.00	Cherry	7.00
		Chestnut	5.00
Fruit Seedlings & Others		Almond	7.00
Mango	9.00	Arecanut	2.00
Orange	7.00	Grape	10.00
Lemon	7.00	Kiwi	10.00
Guava	3.00	Tea	5.00
Pomegranate	5.00	Cardamon	0.30
Litchi	4.00	Pineapple	0.50
Banana	6.00	Flower seeds/Bulbs	100.0
		Rose and others	5.0

Source: NASEPP, 1985

(9) Pilot Cash Crop Cultivation

Panbesa Branch (Panbesa village) is a typical upland field located in Paro district. The pilot scheme here is to grow cash crops as back crops in winter. Problems in agriculture here at present are;

① Damage to crops by wild animals (bears, wild boars, deer, monkeys, etc.)

② Difficulty in transport of crops for marketing

③ Lack of irrigation system

By overcoming these problems, there is a good possibility of growing vegetables such as cabbage, Chinese cabbage, cauliflower, peas, radishes, mustard, etc. as back crops in winter. Panbesa village has a cultivated field of about 100 ha which could further be expanded to about 300 ha. There are countless villages in

the similar setting and scale over the country. The achievement of the pilot activities here could be applied to these areas.

Current counter animal fencing is simple wooden hedges which are ineffective for powerful animals, besides to enclose all around the field is impractical. As the result, farmers are forced to stand vigil all night in harvest season over their fields. An electric fencing with energized wires and flickering lamps is thought to be effective and worth trying. The energy source should be of solar batteries in view of the scarcity of power supply in the country.

The upland fields like Panbesa village are generally 300~500 m higher than the valley bottom fields. Current means of transport of crops for marketing is on pony-back in small quantity over some kilometers on the mountain slopes, a fact that discourages farmers to produce surplus crops. A mechanized unloading lift with simple rail and engine powered carrier would be a sensible way to solve this problem as construction of road networks to connect these small village is unlikely in the immediate future. This simple mechanized device could be manufactured domestically if found to be satisfactory.

Cultivation of vegetables is in winter after harvest of cereals when rainfall is seldom resulting in unsuitable moisture content in soil for vegetables. Hence artificial irrigation is necessary. As spring water is abundant in these upland fields, irrigation with piping such as drip irrigation or rain gun irrigation system would do the job. These simple irrigation methods could well be manufactured domestically and applied in other similar areas.

The Project will select equipment and materials which are economical and reproducible in domestic shops to popularize them nationwide.

(10) Cash Crop Processing Scheme

The Project will be planned to process cash crops produced in Paro, Thimphu and Gaylegphug regions. Vegetables and fruits from Paro and Thimphu regions will be processed at the Chungdu-Dingka Headquarters and cardamon at Gaylegphug Branch.

Processing vegetables and fruits will include, grading, washing, packing, storing and processing (canning, bottling, etc.), and processing of cardamon will include drying, hull removal, cleaning and bagging.

As previously described, Bondey Farm has been processing vegetables and fruits in the form of jam and juice and earning reasonable profits. The Project based on this achievement is to substantially expand the activities. Vegetables and fruits to be processed will be apples, asparagus, potatoes, mushrooms, tomatoes, onions, plums, oranges, etc. Quantities brought along by the farmers depend on production volume, house consumption and freshly marketed volumes. Table-4.10 shows a forecast of the processing volume and processing forms assuming that about 80% of apples, asparagus, potatoes and onions produced in Panbesa area will be consumed or freshly marketed and the remaining 20% will be turned over for processing. Likewise 10% of other areas will be subjected to processing.

Tabale-4.10 CASH CROP PROCESSING PLAN

Crops	Raw Material (t)	Form of Processing	Volume of Product (t)	Packages (case)
Apples	1,060	Juice	530	26,000
		Jam	210	14,500
	200	Can	320	26,700
Pears	200	Can	200	25,000
Peaches		Juice	100	5,000
		Can	100	8,300
Grapes	75	Juice	15	3,800
Oranges	12	Juice	12	600
Cherry/Plums	15	Jam	15	1,000
Asparagus	50	Can	50	4,200
Potatoes	1,800	Fried chips	1,800	-
Onions	40	Pickles	40	-
Tomatoes	20	Puree	20	-

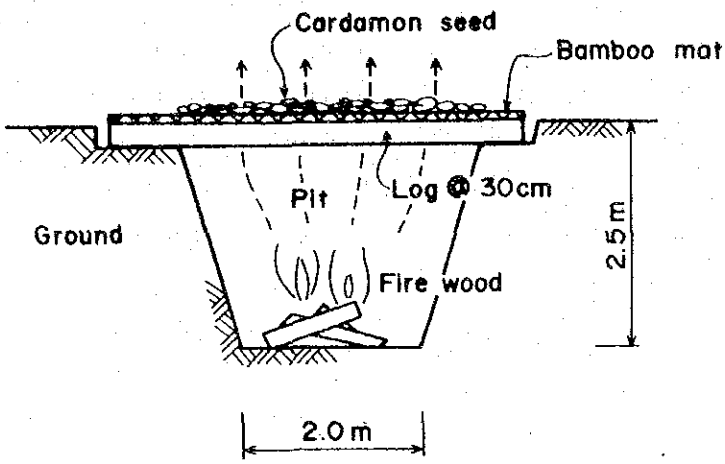
Note: 48 cans/case, 675 g/can, 375 g/can (jam), 200 g/can (juice)

The above processing is significant from the view point of countering price falls in bumper years, value adding, effective labor force use in the farmer's slack season, and scheduled marketing through storing. Therefore as much crops as possible should be transferred for processing.

Main point of cardamon processing is to dry it without impairing its flavour, taste and color. These peculiar traits are quickly lost by careless heating. The current method of drying cardamon by the farmers is by fumigation; fire wood is

burnt in a pit dug in the ground and cardamon spread over bamboo mat placed over the smoke as illustrated below:

Drying method :



Drying takes 6 days and nights as quick drying impairs the quality.

Other drying methods are natural drying by sun, drying in a smoke house, curing shed or curing rack house, fuel curing, etc. employed according to regional conditions. The drying method proposed in the Project is a heat chamber type where trolleyed rack carrying cardamon is heated in the chamber at a temperature of 55°C. The racks must be replaced up and down after 12 hours in order to effect a uniform drying.

Current production of cardamon in Gayleghug is about 1,000 ton/year, of which 20% is assumed to be collected at the Branch in consideration of the distance and transport conditions from the production areas. The cardamon drying facilities will be specified to handle this volume. Processed cardamon will all be exported through Indian traders.

(11) Cash Crop Marketing Plan

Current marketing of cash crops mainly constitute rudimentary trading by the farmers in there they carry surplus crops to local markets in exchange for daily household goods. Some potatoes and oranges, the outstanding cash crops so far, have been brought to the auction yards of FCB for export to Indian markets. In the advanced Paro district, vegetables and fruits (cabbages, apples, peaches, etc.) have

begun to be collected and exported to Indian markets by hired trucks. Generally, most of the exported cash crops are handled by Indian middlemen.

Modernizing the marketing system will be indispensable to fulfilling to the objective of the cash crop development project. The Project, though not assigned with the modernization of the marketing system, could take an initiative on the production side to improve the outflow of the marketable cash crops. One is to attempt lifting down the crops from a high altitude production field to a nearby public road by mechanical means and the other to perform a pilot schedule shipment.

The first idea will be attempted at Panbesa village where vegetables and fruits produced with introduction of counter-animal fencing and irrigation systems will be lifted down to the public road running below over a distance of 3 km by a mechanical lift.

The latter idea will be attempted at Chungdu-Dingka headquarters where screening, grading, packing and storing of fresh vegetables and fruits will be carried out to upgrade the quality and shipment at times advantageous to the farmers.

In view of the fact that the farmers' cooperative has yet to be organized, the activities here could be a pilot toward a comprehensive marketing system.

4-3 Outline of Project Plan

4-3-1 Operation of Project

Details of administrative, operation and maintenance, staffing and financial provisions for the Project are discussed hereafter in Section-6. The important point in operating the Project facilities is the technical capability to operate and maintain the supplied equipment. As the Project is furnished with many kinds of equipment to perform the diverse services, to secure trained staff will be very important. As discussed hereto, activities in the Project are of quantitative expansion rather than qualitative change, i.e., all activities are an extension of the past experience and bulk of the staff come from the existing institutes as shown below.

Equipment	Technical Basis	Staff Assignment
Tissue culture equipment	Tissue culture by NASEPP at Bondey Farm	Assignment of NASEPP staff
Nursery house	Seedling nursery by NASEPP at Bondey and Chiufu Farms	- do -
Crop processing equipment	Crop processing at Bondey Farm	Assignment of Bondey Farm staff
Fruit seedling nursery equipment	Fruit seedling growing by NASEPP at Chiufu Farm	Assignment of NASEPP staff
Seed processing equipment	Seed processing by NASEPP at Bondey, Changyultang, Chinary Farms, etc.	- do -
Farm machines and irrigation equipment	Extension service and farm mechanization by MOA and AMC	Assignment of AMC staff
Cardamon drying equipment	Farm mechanization by AMC	- do -

4-3-2 Project Planning

Based upon the basic concept of the Project, the selection of the Project Sites and assigned functions thereto as discussed hereto, the Project facilities at each Site along with their capacities are determined on the following factors.

1) Selection of prospective cash crops and their production forecast
2) Seed/seedling demand forecast based on the above production forecast
3) Scale of pilot cash crop cultivation activities at Panbesa village and needs arising therefrom
4) Selection of vegetables and fruits and quantities of them to be graded, packed, canned and bottled.

The facilities thus determined are outlined in the following paragraph.

4-3-3 Content of Project Facilities

(1) Chungdu-Dingka Headquarters

1) Administration Office

Function : Overall administration of the Project
Building : 430 m2
Equipment : Wireless radio, copy machines

2) Tissue Culture House

Function : Seed propagation by plant tissue culture
Building : 600 m2
Equipment : Tissue culture equipment

3) Seed Processing House

Function : Seed screening, sterilizing and packing
Building : 860 m2
Equipment : Seed screening, sterilizing and packing equipment

4) Seed Store House

Function : Seed storing
Building : 400 m2
Equipment : Cold storage chamber, forklift

5) Garage

Function : Parking vehicles
Building : 150 m2
Equipment : -

6) Nursery Houses

Function : Seedling nursery
Building : Mist house 300 m2
Glass houses 600 m2
Net houses 600 m2
Equipment : Misting equipment

7) Crop Processing House

Function	:	Fresh crop grading and packing
		Canning and bottling
Building	:	1,600 m^2
Equipment	:	Fresh crop washing and grading equipment
		Canning and bottling equipment

(2) Panbesa Branch

Function	:	Fruit seedling nursery
Building	:	Nursery houses 1,800 m^2
Equipment	:	Grafting equipment
		Misting equipment

(3) Panbesa Branch

Function	:	Pilot cash crop cultivation
Building	:	-
Equipment	:	Counter animal fence fabricating machine
		Farm machines
		Irrigation equipment
		Crop unloading lift

(4) Changyultang Branch

Function	:	Seed processing
Building	:	Seed Processing House 200 m^2
Equipment	:	Seed screening equipment

(5) Gaylegphug Branch

Function	:	Cardamon drying
Building	:	Cardamon Processing House 400 m^2
Equipment	:	Cardamon drying equipment

(6) Chinary Branch

Function : Seed processing
Building : Seed Processing House 600 m2
Equipment : Seed screening and storing equipment

4-3-4 Project Site Conditions

(1) Chungdu-Dingka Headquarters Site

① Location : Paro district, 10 min. drive from Bondey Farm to its north or 400 m west of AMC
② Altitude : Approx. 2,480 m
③ Climate : Temperate climate
④ Topography : Mountain slope close to the ridge facing valley to the north. Gradient approx. 20°
⑤ Flora : Entirely covered with pine trees and bush
⑥ Soil : Clay (refer to the ground survey record in 5-3-4)
⑦ Land tenure : The Government
⑧ Existing facilities : None
⑨ Utilities : Water : φ2"pipe line running under the pathway (refer to Appendix VI)
⑨ Power : 800 m to the power supply source at AMC (Tr. 150 kVA)
⑩ Accessway : Existing pathway
⑪ Load bearing capacity of ground :
14 t/m2 at 1.0 m under the surface tested by a cone penetrometer

(2) Chiufu Branch Site

① Location : Paro district, 15 min. drive from the Bondey Farm or 9 km to its west
② Altitude : Approx. 2,520 m
③ Climate : Temperate climate
④ Topography : Mountain slope facing river valley to the north
⑤ Flora : Surrounded by pine forest

⑥	Soil	:	Clay
⑦	Land tenure	:	NASEPP
⑧	Land area	:	8 ha, NASEPP farm
⑨	Activities of NASEPP	:	Set up in 1984. Fruit seedling growing by grafting (apple, peach, pear, cherry, plum, nut, etc.). Production: 200,000 pcs/year, Labor: 8
⑩	Existing facilities	:	2-storied farm house (total floor area: approx. 120 m^2, first floor being used for fertilizer store, second floor for labors' dwelling)
⑪	Utilities	:	Water : taken from a spring Power : None Road : Public road (asphalt paved)

(3) Panbesa Branch (Panbesa village) Site

①	Location	:	Paro district, 70 min. drive from Bondey Farm to its south or approx. 20 km.
②	Altitude	:	Approx. 2,800 m
③	Climate	:	High altitude chilly climate
④	Topography	:	Terrace formed by the Tertiary Glacier
⑤	Flora	:	Surrounded by pine forest
⑥	Soil	:	Clay
⑦	Cultivated land	:	Approx. 100 ha. Could be expanded to 300 ha
⑧	Major crops	:	Wheat, barley, buckwheat, mustard, etc.
⑨	Cropping system	:	Single cropping of cereals
⑩	Activities of NASEPP	:	Leasing 2 ha of common land of the village and producing seeds of peas, naked barley, etc. since 1984.
⑪	Problems in farming	:	- Intrusion of wild animals into the field (bear, wild boar, deer, monkey, etc.) often in herds of a hundred. - Difficulty of transporting crops for sale down to the public road below; currently carried on pony-back in small quantity over 3 km distance. - Lack of proper irrigation facilities

⑫ Potential for farming : By countering the above problems, the place has a good potential of vegetable growing (cabbages, Chinese cabbages, cauliflowers, peas, beans, radishes, mustard, etc.) through double cropping, besides, has an advantage of different cropping calendars from those of the lower field.

(4) Changyultang Branch Site

① Location : Approx. 2 km from Punakha bazaar

② Topography : River bench besides Mochu river, Flat

③ Soil : Fine sandy clay

④ Land area : Approx. 1,500 m^2

⑤ Land tenure : NASEPP

⑥ Existing facilities : A workshop, wood structure, bamboo mat walled, canvas roofed, plank floored. In shambles. Approx. 80 m^2

⑦ Utilities : Water : None
Power : None
Road : Attached to a public road, gravel metalled

⑧ Load bearing capacity of ground :

Assumed to be 14 ton/m^2

Changyultang Village

① Location : Punakha district, 4 hours and half drive from Paro to its north-east or 140 km or 3 hours drive from Thimphu city to its north-east or 76 km

② Altitude ; Approx. 1,200 m

③ Climate : Subtropical climate due to low altitude.
Relatively dry and very light frost in winter.
Temperature : Max. 26~34°C (Jul.~ Aug)
Min. 7~22°C (Dec~ Jan)
Rainfall 750 mm/year

④ Topography : Valley basin

⑤ Flora : Surrounded by pine forest

⑥ Soil : Alluvial soil

⑦ Cultivated land : Approx. 1,600 ha

⑧ Major crops : Rice, wheat

⑨ Cropping system : Single cropping of rice. Back cropping of wheat in winter introduced in 1982.

⑩ Historical aspect ; Owing to the Punakha Dzong, the winter capital of the Government and the dwelling of highest ranking monks, there used to come flock of people paying homage. These people took rides on horses and cows which were unleashed for feeding, frequently intruding into the cultivated field. Coupled with lack of knowledge and proper fencing materials, the farmers could not engage in double cropping in winter.

It so happened when NASEPP recognized this fact, brought in wheat seed, fencing materials, farm machines and fertilizers and encouraged interested farmers to grow wheat as winter crop, double cropping started and has been expanding ever since. Currently about 10% (40 ha) of the farmers are engaged in double cropping.

⑪ Potential of farming : Due to the subtropical climate, double cropping is of good possibility. Also possible is vegetable growing in winter due to dry and moderate climate.

NASEPP Dajo Farm

① Land area and activities : 2 ha. Vegetable seed production

② Wheat seed production by contract farmers :

By 245 contract farmers on approx. 200 ha of field. The seed is processed and packed at Bondey Farm after screening here by a seed screening machine and a diesel generator temporarily moved from Bondey Farm for about 2 months during the harvest season.

(5) Gaylegphug Branch Site

①	Location	:	NASEPP Bhur Farm
②	Topography	:	Flat
③	Soil	:	Clay down to 40 cm below surface, underneath lies sand
④	Land	:	Open land is sufficient for the new building
⑤	Existing facilities	:	No obstacle on the proposed lot
⑥	Utilities	:	Water : The Farm uses spring water Power : Available in the Farm Road : Attached to a public road
⑦	Load bearing capacity of ground :		Empirically 30 ton/m^2 could be assumed

Gaylegphug Region

①	Location	:	Southern border region at about 450 km down to south of Thimphu
②	Altitude	:	Approx. 250 m
③	Climate	:	Subtropical climate, hot and humid
④	Topography	:	North edge of the Hindustan Plain at the foot of the Great Himalayan Range
⑤	Soil	:	Sandy clay
⑥	Major crops	:	Rice, maize, mustard, potatoes, oranges, cardamon, sugarcane, pineapples, bananas, mangoes, etc.
⑦	Cropping system	:	Double cropping

Cardamon

① Perennial plant, ginger family, used as spice.

② Grown under tree shade on north slope of mountains. Gaylegphug has a cultivated land of about 3,000 ha, producing about 1,000 ton/year.

③ Harvest season : In August thru October 4 years after planting

④ Highly priced (44 Nu./kg). All exported. Speculative item.

⑤ Traded by Indian middlemen after drying by farmers.

⑥ Drying method : Collection → Drying → Hull removing by foot trampling → Washing → Bagging

Drying time : 6 days and nights
Fire wood : 3 tons of fire wood burnt to dry 1 ton of cardamon

NASEPP Bhur Farm

① Location : 8 km west of Gaylegphug city
② Land area : Approx. 94 ha
③ Activities : Paddy and wheat seeds production

(6) Chinary Branch Site

① Location : NASEPP Chinary Farm
② Topography : River bench having a rather steep slope (20%) toward the river
③ Soil : Clay
④ Climate : Subtropical climate

Temperature : Max. 31°C (Jul)
Min. 12°C (Jan)

Relative humidity : Max. 96% (Aug)
Min. 57% (Oct)

⑤ Land area : Max. 900 m^2 is available for the new building
⑥ Existing facilities :

Office	26 m^2
Warehouse	38 m^2
Residence	2 nos.

⑦ Utilities :
Water : The Farm uses river water
Power : A hydraulic power house is located nearby
Road : Attached to a public road

Tashingang District

① Location : Approx. 640 km east of Paro
② Altitude : 800~1,200 m
③ Climate : Subtropical climate, relatively dry
④ Topography : Valley basin

⑤ Soil : Alluvial soil

⑥ Major crops : Maize, paddy, potatoes, wheat, beans, bananas, papayas, mangoes, etc.

⑦ Animal husbandry : Cow grazing

⑧ Farm economy : Maize is consumed as staple food by farmers and the rest is used as animal feed. Surplus potato is exported to India.

NASEPP Tashigantsi Farm

① Location : Approx. 45 km north of Tashigang city

② Altitude : Approx. 1,700 m

③ Land area : 9 ha

④ Activities : Maize seed production

NASEPP Chinary Farm

① Location : Approx. 2 km west of Tashigang city

② Altitude : Approx. 800 m

③ Land area : 1.7 ha

④ Activities : Cauliflower seed production. Experimental growing of fruits (papayas, mangoes, lemons, etc.)

⑤ Work force : 1 staff and 3 labors

NASEPP Kanglung Farm

① Location : Approx. 27 km south-west of Tashigang city

② Altitude : approx. 1,700 m

③ Land area : 3.7 ha

④ Activities : Maize seed production

SECTION - 5 BASIC DESIGN OF PROJECT

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5-1 Architectural Design

5-1-1 Design Principle

Following are the basic points in architectural design.

(1) To conform to Bhutan's climate, custom, and traditional architecture.

(2) To make good use of natural ventilation and sunlight for low running cost and easy maintenance.

(3) To take into consideration capability of local constructors as well as labor conditions for an easy and economical construction.

(4) To utilize domestic materials as much as possible. Importation of materials would be mainly from India.

5-1-2 Grade of Building

Grade of building has been determined according to the importance and functions given to each building and surrounding natural conditions including those of the site.

Factors for design are the services rendered in the building, durability, operation and maintenance, complexity of construction, comfort and aesthetic appearance.

Among the Project Sites, buildings in Chungdu-Dingka are of the highest grade in view of the standing in the Project and variety of services rendered, besides they would have to be of the same grade of the buildings of the nearby Agriculture Mechanization Center which has been constructed also under a grant aid of the Japanese Government. Grade of buildings of the other Branches is slightly lower but not lower than the buildings in the surrounding areas.

5-1-3 Optimum Scale of Buildings

Scale of buildings has been basically determined according to the content of activities and volume of them. Content of activities in the Project Site is rather diverse requiring many kinds of service rooms along with administrative spaces.

Space of each room has been determined according to arrangement of equipment and tools, required working and storing space and number of people working. Relevant Japanese design manuals have been referred to to figure out the optimum space on top of local conditions.

5-1-4 Design Process

(1) Chungdu-Dingka Headquarters

At the Headquarters, seed/seedling production and cash crop processing are the major services in addition to administrative function for the whole Project. The seed/seedling production includes those of vegetables and fruits to be supplied to the whole country in collaboration with Chiufu and Changyultang Branches and Bondey Farm. The cash crop processing is meant to cover Paro and Thimphu districts.

1) Buildings

	Total Floor Area (m^2)	Storey	Structure
Administration Office	432	Single	Reinforced concrete frame with hollow concrete block wall and wooden roof
Tissue Culture House	600	Single	- do -
Seed Processing House	864	Single	- do -
Garage	150	Single	- do -
Seed Store House	405	Single	- do -
Crop Processing House	1,620	Single	- do -
Nursery House Net House*	900 (300x3)	Single	Steel structure
Glass House*	600 (300x2)	Single	- do -
Mist House*	300 (300x1)	Single	- do -

* Materials to be supplied as part of the equipment supply scheme (ref. 5-5)

2) Layout Plan

Among the above mentioned buildings, it is proposed that the Crop Processing House be sited in a vacant lot in Bondey Farm because the proposed site for the Headquartera is on hill slope having a rather steep slope of 20% requiring a bulky earthmoving work to make a terrace for a substantial building like this, besides the site would be inconvenient for farmers bringing crops because it is about 80 m higher than the level of farms at the foot of the hill. Planning of this building is discussed separately in a latter paragraph.

(a) Approach Road

Two approach roads have been provided, one from south to Administration Office and Tissue Culture House and the other from north to Seed Processing House and Seed Store House.

As the land needs be stepped in terraces because of the slope ramp ways have been provided as sub-roads to connect these terraces.

(b) Zoning by Function

Activities at the Headquarters can broadly be classified into administration, tissue culture, seed/seedling processing and seed/seedling storing. Accordingly the site has been divided into administration plus tissue culture and seed processing and storing zones.

- The axis (longitudinal direction) of each building has been aligned along the contour of the hill (east-west direction). This setting will minimize the effect of sunlight from the west on a summer afternoon and enable large openings (windows) on south and north faces affording good ventilation in summer and comfort in winter. Winter in Bhutan produces gusty winds blowing from south to north; from south valley bottom to hill top. As the site is on the north slope of the hill, the effect of wind is much less than on the south side.
- On the upper terrace, Administration Office and Tissue Culture House together with Mist House, Glass House and Net House have been sited as they are more of static buildings. On the lower terrace Seed Processing House and Seed Store House have been sited as they are more of dynamic buildings where entry and exit of people and vehicles to and from are frequent.

3) Storey

All buildings have been made single storied for the following reasons.

Administration Office : Building is small

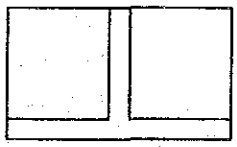
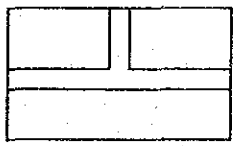
Tissue Culture House : Laboratory, tissue culture room, fog room, etc. are functionally inseparable. Separate floors are not good, besides building is small.

Seed Processing House : For loading and unloading seeds and frequent outdoor work around the building, single storey is better.

4) Floor Planning

(a) Administration Office and Tissue Culture House

Possible patterns are finger plan, box plan, center corridor plan and side corridor plan. Among these center or side corridor plan are better in consideration of land configuration and scale of buildings. Comparison of these two plans is as follows:

	Side Corridor Plan	Center Corridor Plan
Floor Plan		
Traits	· Good for small buildings and for those requiring uniform sunlight intake. · Better in natural ventilation. · Movement lines of people are longer. · Exterior wall areas of rooms are smaller. · Corridor area is larger.	· Good for medium to large buildings. · Poor in sunlight intake. · Poor in natural ventilation. · Connection of each room is good (movement lines of people are shorter). · Corridor area is smaller.

In this case, center corridor plan is better than side corridor plan from the following point of view.

- To minimize required land area.
- Smaller corridor space lowers construction cost.

- Shorter movement lines will enable better connection of rooms.
- Cable and pipe line length is shorter resulting in lower cost.

Countermeasures for the disadvantages have been taken as follows:

· Sunlight intake
Rooms requiring sunlight intake have been arranged on the south side and less important rooms such as toilet, kitchen, store room and such like on the north side.

· Ventilation
Motor driven ventilation fans have been proposed as required.

(b) Seed Processing House

Activities here are rather dynamic. Following are the major points of consideration.

· Loading/unloading of seeds : To prevent foreign articles from entering, vehicles should not be allowed to be driven in.
Floor has been raised above the ground, of which level will be adjusted to the platform of a typical truck.

· Span and length : 9 m span is a reasonable span for arrangement of seed processing equipment and people's work.
Larger 12 m span is recommended for seed storage room as operation of forklift to handle seed bags inside the room is planned.

· Partitioning : Seed processing room – For good workability, an open space is recommended. As room will get dusty, windows have been provided as much as possible to discharge foul air.
Seed storage room – Open space is also recomended for operation of forklift.
Seed fumigation room and temperature conditioned seed storage room have been attached to the main room.

5) Sectional Planning

Land reclamation : Land has been stepped into terraces as shown in Fig.-5.1. Terraces will be made after stripping top soil to balance cut and fill volumes.
Soil has been found to be clay in a thickness of 1.5~2.0 m covering rock substratum. Fill portion has to be compacted to 90% of the maximum density of the clay. After the initial compaction, at least 2 months will be necessary to allow consolidation of the clay. Hence, ground reclamation work by the Government has to be finished at least 2 months before the start of construction of buildings.

Raised floor : Floors of all buildings have been raised above the ground by over 50 cm in consideration of the following points.
Dampproofing – Seeds have to be processed and stored in a dry room.
Seed loading/unloading – Already discussed above.

6) Room Environment

The seed Processing House has been planned to be spacious on vertical scale as well because lots of dust is produced here. Dust will be collected in the upper space and discharged from upper windows making the lower space good for working people. To ensure better sunlight intake skylights will be provided. Higher roof is also good to mitigate heat radiation from the roof to the lower space and to collect hot air to the above space.

7) Nursery Houses

(a) Mist House

The room has to be maintained constantly at a temperature of 10~30°C and a relative humidity 100%. In order to keep the room humid, a misting equipment has been provided which will concurrently lower the room temperature in summer. In addition, a room heating system has been provided as temperature often drops below 0°C in winter.

(b) Glass House

The Glass House is the secondary nursery house where seedlings from the mist house will be brought on. Room conditions do not have to be controlled so severely as in the Mist House, only room heating system for winter has been provided. As the room is hot and humid all the time and sometimes chemicals are used, building materials have been made corrosion resistant.

(c) Net House

This is the last nursery house. No artificial room conditioning has been provided. Main point in this house is prevention of aphids that carry pathogenic viruses to the plants. The entire wall is covered with anti-aphid net.

(2) *Crop Processing House (To be constructed at Bondey Farm)*

1) Plotting and Approach

The building has been placed in a vacant lot at the entrance of Bondey Farm along the access road. Approach to the building can be directly taken from this access road.

2) Functional Planning

The building includes two processing services; fresh crop grading and packing, and canning and bottling. These two service spaces have been combined in a single building as they have a lot in common and not enough land is available to allow separate buildings.

3) Storey

The building has been made single-storied for the following reasons.

- Loading and unloading of crops and frequent use of exterior space around the building.
- Efficient and speedy work.
- To minimize auxiliary space such as toilet and corridor.
- To minimize cabling and piping length.

4) Floor Planning

As dictated by the land configuration, the building has been made laterally long, divided into two parts, one for fresh crop grading and packing and the other for bottling and canning. Loading/unloading and storage spaces have been taken at both ends of the building in order to facilitate unconflicting access of vehicles and people to each part. At the center of the building, packing material store room, shipment room and office room have been arranged which are commonly used by both processing rooms.

5) Sectional Planning

Raised floor : Crop processing spaces need be clean. On the other hand raised floor adjusted to platform of a typical truck will enable an easy loading/unloading of crops and processed products.
There would be alot of cables and pipes to operate the processing equipment. Raised floor is advantageous to prepare trenches and pits for cables and pipes as well as for waste drainage.

Higher roof : There is no false ceiling over the room. Vertical clearance has been taken over 4 m. Vertical spaciousness will afford the same room environment as those discussed in Seed Processing House.

(3) Changyultang Branch

1) Building

	Total Floor Area (m^2)	Storey	Structure
Seed Processing House	200	Single	Reinforced concrete frame with hollow concrete block wall and wooden roof

2) Design

As the building is small and activities inside the building simple there is not much to discuss.

Attention has been paid to the seed store room where good but economical insulation design is called for.

(4) Chinary Branch

1) Building

	Total Floor Area (m^2)	Storey	Structure
Seed Processing House	600	Single	Reinforced concrete frame with hollow concrete block wall and wooden roof

2) Design

The same discussion as Changyultang Branch applies here.

(5) Gaylegphug Branch

1) Building

	Total Floor Area (m^2)	Storey	Structure
Cardamon Processing House	400	Single	Reinforced concrete frame with brick wall and wooden roof

2) Design

The same discussion as Changyultang Branch applies here.

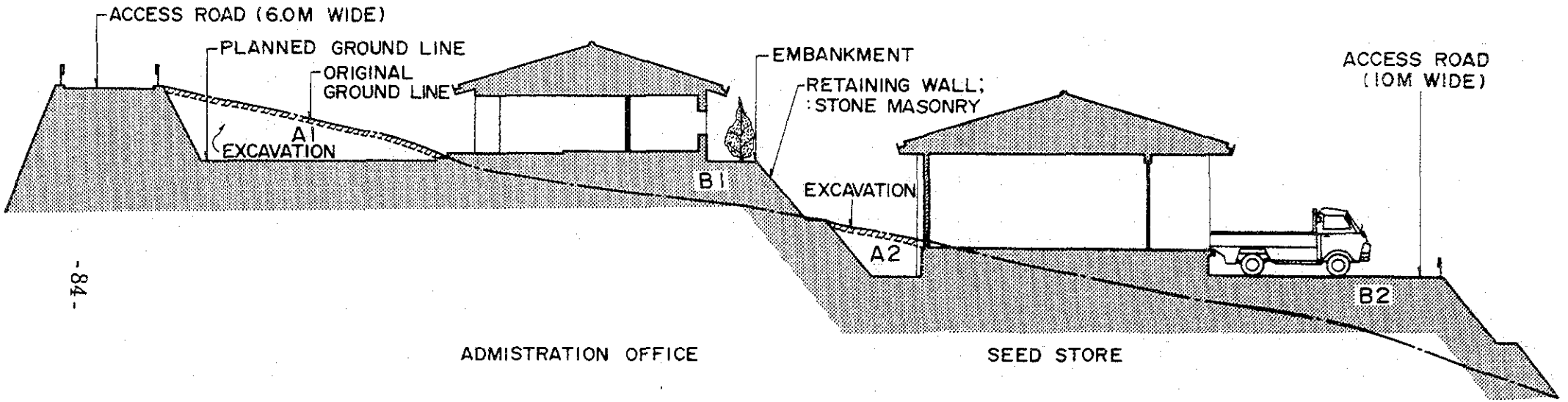


Fig.-5.1 LAND RECLAMATION (SECTION)

5-2 Finishing Scheme

5-2-1 Design Principle

a) To minimize kinds of finishing materials.

b) To select durable materials, corrosion resistant or waterproof materials as required.

c) Easy maintenance such as use of washable material.

d) Coordination with existing buildings nearby (AMC, Bondey Farm, other NASEPP buildings).

5-2-2 Exterior Finishes

Place	Finishes
Roof	Corrugated iron sheet, painted
Wall	Cement plaster, painted
Door & Window	Wood door and window Steel door for large entrances