

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

No. 01

MINISTRY OF AGRICULTURE  
THE KINGDOM OF BHUTAN

THE PARO VALLEY AGRICULTURAL  
DEVELOPMENT PROJECT

BASIC DESIGN REPORT  
( PHASE III )

OCTOBER 1992

HOKKAIDO ENGINEERING CONSULTANTS CO.,LTD., JAPAN

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国際協力事業団

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## PREFACE

In response to a request from the Royal Government of the Kingdom of Bhutan, the Government of Japan decided to conduct a basic design study on the project for the Paro Valley Agricultural Development and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bhutan a study team headed by Mr. Motonobu Nishimura, Official, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, from 7 April to 7 May 1992.

The team held discussions with the officials concerned of the Government of Bhutan, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission headed by Mr. Kanji Kitazawa, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, was sent to Bhutan from 26 August to 5 September 1992 in order to discuss a draft report, and the present report was prepared.

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

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

October 1992



Kensuke Yanagiya  
President,  
Japan International  
Cooperation Agency





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

### Letter of Transmittal

We are pleased to submit here the basic design study report on The Project for the Paro Valley Agricultural Development in the Kingdom of Bhutan (Phase III).

This study has been made by Hokkaido Engineering Consultants Co.,Ltd., based on a contract with JICA, from March 16, 1992 to October 16, 1992. Throughout the study, we have taken into full considerations the present situation in the Kingdom of Bhutan, and have planned the most appropriate project in the scheme of Japan's grant aid.

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

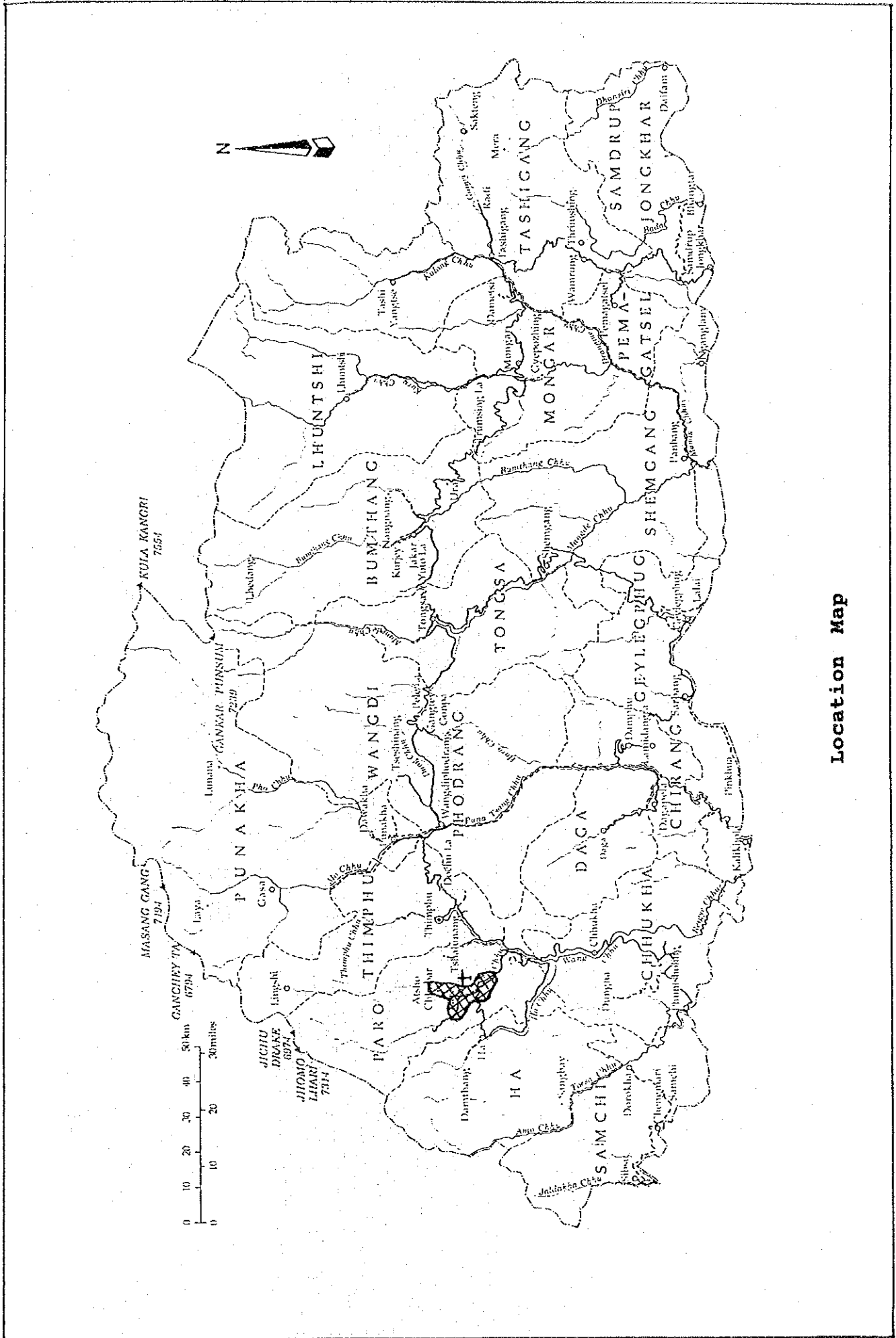
At last, we hope that this report will be effectively used for the promotion of the project.

Very truly yours,



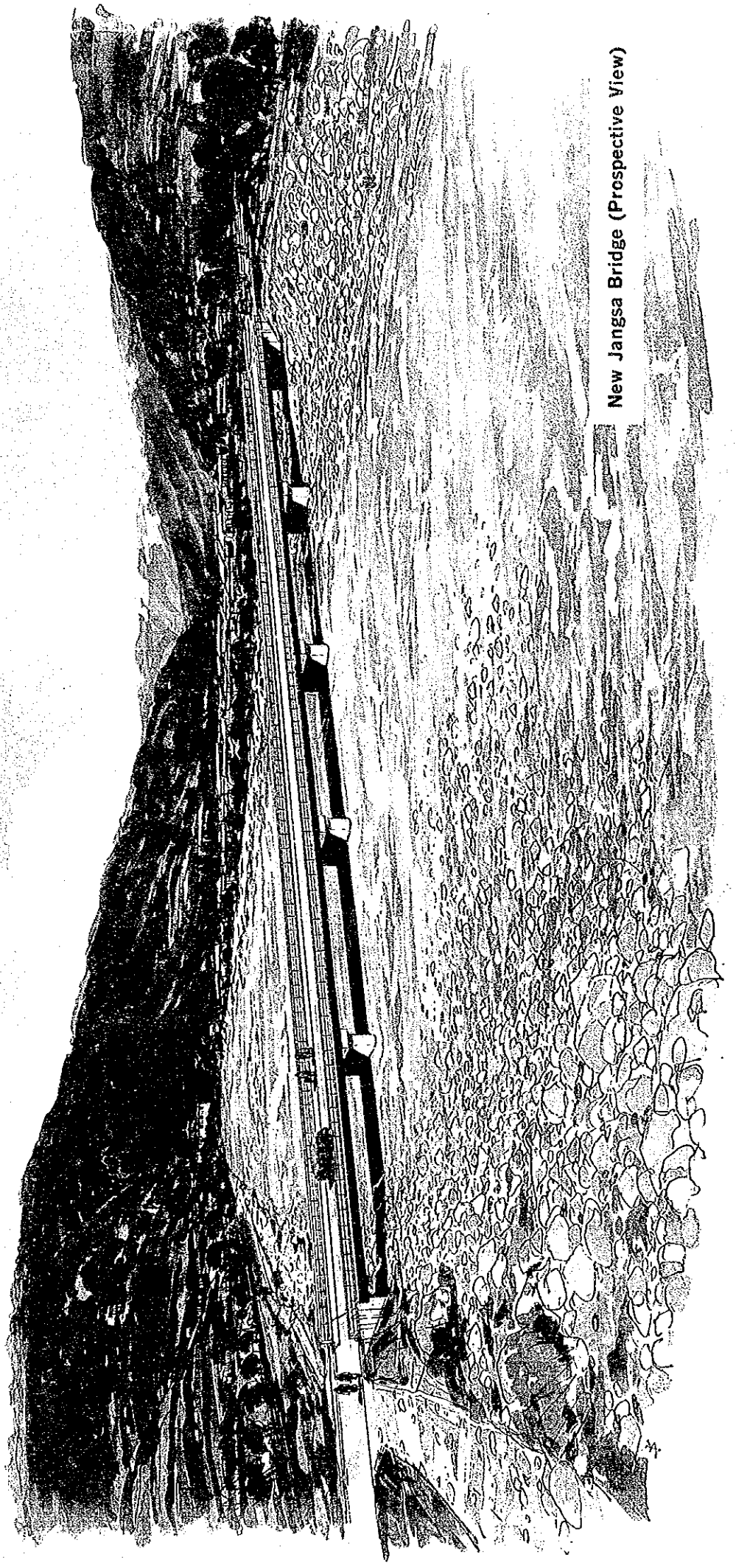
Kaoru Hoshii  
Project Manager  
Basic design study team on  
The Project for the Paro Valley  
Agricultural Development (Phase III)  
Hokkaido Engineering  
Consultants Co.,Ltd.





Location Map



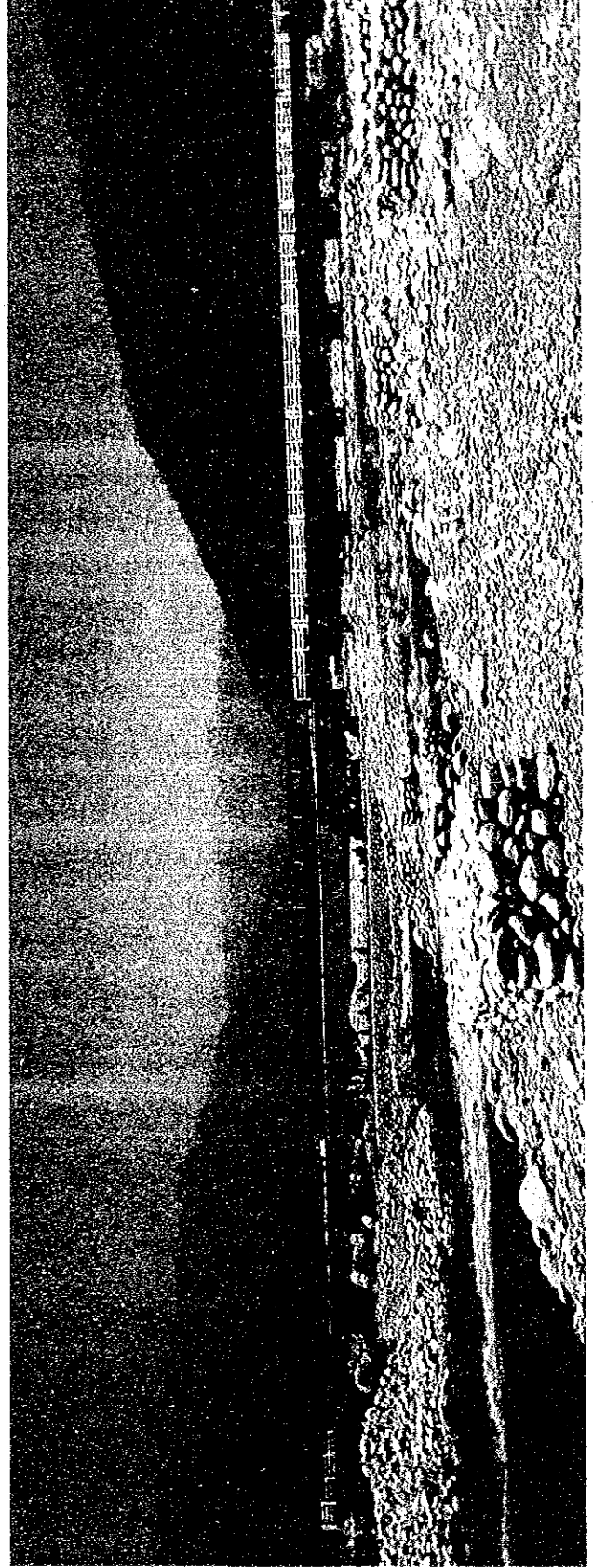


New Jangsa Bridge (Prospective View)





Project Area (Left: Paro River; Right: Dotey River)



Existing Jangsa Bridge (Temporary Truss Bridge)





## SUMMARY

Economic independence was the principal goal of the Sixth Development Plan (1987-1992), and to realize it, each region had to be self-reliant. With this in mind, the Government of Bhutan selected five areas in the country as priority areas for agricultural development, and had planned and built agriculture-related facilities in each of them. The area where the Paro Valley Agricultural Development Project is being carried out is one of the five selected areas.

In response to a request made by the Government of Bhutan, the Regional Office for Asia and the Pacific (RAPA) of the Food and Agriculture Organization of the United Nations (FAO) carried out a preliminary survey in Bhutan and prepared a developmental proposal in 1987. On the basis of this proposal, the Government of Bhutan asked the Government of Japan for grant aid. Upon receiving this proposal, the Government of Japan decided to carry out a basic design survey, and Japan International Cooperation Agency (JICA) dispatched a preliminary survey team in 1988. On the basis of the results obtained by the team, the basic design was formulated and carried out in two phases. In the basic design, the construction of agricultural facilities (irrigation facilities, farm roads, river protection work and farmland consolidation) and the supply of construction equipment were decided to be done in five stages. Following the above plan, the two stages' work was completed in March 1992. The remaining work has been postponed for two years due to financial considerations and is scheduled to begin in 1993.

Further, the Jangsa Bridge over the Paro River was damaged due to flood in September 1991, during the course of Stage 1.2, and the Government of Bhutan requested the Government of Japan to reconstruct it as a grant aid project. The Government of Japan then decided to carry out a basic design study, the Phase III study, and dispatched the basic design team headed by Mr. Motonobu Nishimura, Official, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, to Bhutan for one month from 7 April to 7 May 1992.

The main objectives of the study were the following two items:

1) To carry out the resurvey and to review the construction of irrigation facilities and the supply of construction equipment, both of which were preliminarily planned in the previous phase and were to be implemented in the remaining stages. (The time period from the previous phase to the postponed implementation time is quite long, and changes in the condition of the equipment supplied, labor costs, work sites and social situation have been foreseen.)

2) To carry out a survey and a basic design for the recently requested reconstruction of the Jangsa Bridge.

The team made the field survey on the above matters and held a discussion for the purpose of mutual agreement on some basic items, including the project implementation policy, with the related agencies of the Department of Agriculture (DOA) and the Department of Roads (DOR), Bhutan.

During the course of the meeting, the DOA proposed 1) the exclusion of the farmland consolidation work planned in the previous phase, 2) the change and addition of some construction equipment, and 3) extension work on a farm road. It was decided that the construction equipment issue would be settled after a detailed study in Japan. The farm road extension work and the exclusion of the farmland consolidation work proposals were agreed upon.

After coming back to Japan, a basic design was made based on the field survey results and the above proposals. It was presented in the Draft Final Report, and a mission, headed by Mr. Kanji Kitazawa, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, was sent to Bhutan from 26 August to 5 September 1992, for discussions and approval by the Government of Bhutan.

As a result of the Phase III study, the components of the project were determined as below:

### **Stage 1.3**

Bridge : Reconstruction of the Jangsa Bridge

Type and Scale :

Length of the bridge : 100 m

Number of spans : 5 spans

Substructure : Reinforced concrete (RC) piers,

open foundation,  
2 abutments and 4 piers  
Superstructure : H-shaped steel girders, simple beam  
Additional work : Protection work of banks and riverbed.  
Reconstruction of an irrigation  
intake.  
Access roads.  
Demolition of the existing bridge.

Farm Roads : Site 2 (along the left bank of the Paro River)  
Bamdoley-Jangsa (Jangsa Bridge), L= 6.2 km  
(excluding subsurface work)

River Protection : Site 2 (Bamdoley-Jangsa (Jangsa Bridge))  
L= 6.2 km (\*)

Procurement of Construction Equipment (No.1) :  
(Improving concrete work)

Mixer truck (2.2 m<sup>3</sup>) : 2 units (for concrete transportation)  
Wheel loader (1.2 m<sup>3</sup>) : 1 unit (for transportation in the plant)  
Concrete test machine (100 ton) : 1 unit (for strength test)

### Stage 2.1

Irrigation Facilities :

No.19 : Chendo Chukha, L= 2,991 m (\*), concrete weir intake  
No.21 : Bamdoley, L= 1,904 m (\*), masonry intake  
No.28 : Rema Thangyul, L= 837 m (\*)  
No.13 : Sharimochu, L= 1,230 m (\*), concrete weir intake  
No.14 : Gangyul, L= 2,547 m (\*), concrete weir intake

Farm Roads :

Site 2 : Bamdoley-Jangsa (Jangsa Bridge), L= 6.2 km  
(Left bank of the Paro River, subsurface work only)  
Site 7 : Chorten-Sarpa-Deankha, L= 3.4 km  
(Left bank of the Paro River)

River Protection :

Site 7 : Chorten-Sarpa-Deankha, L=3.4 km (\*)

Procurement of Construction Equipment (No.2) :

Bulldozer (21 ton) : 1 unit (for excavation and  
earth movement work)  
" (15 ton) : 1 unit ( " " )  
Motor grader (86 ps, 2.8 m blade width) : 1 unit  
(for leveling work)  
Backhoe (0.6 m<sup>3</sup>) : 2 units (for excavation)  
" (0.2 m<sup>3</sup>) : 1 unit ( " )  
Dump truck (11 ton) : 5 units (for soil transportation)  
Vibrating roller (10 ton) : 1 unit (for banking work)  
Pick-up car (4 WD) : 1 unit (for transportation)  
High pressure washer : 1 unit (for equipment washing)  
Crusher (10 ton/hr) : 1 unit (for production of crushed stones)  
Spare parts : L.S.

### Stage 2.2

Irrigation facilities :

No.8 : Tshetey Yuwa, L= 667 m (\*), concrete weir intake  
No.6 : Serekha, L= 1,398 m (\*), " "  
No.1 : Shaba Shengo, L= 1,906 m (\*), wooden mattress intake  
No.4 : Dujey Dingkha, L= 1,672 m (\*), " "

No.3 : Shaba Bara, L= 2,240 m (\*), " "

Farm Roads :

Site 1 : Extension from the end of the road completed in Stage 1.2,

L= 1.4 km

(Upstream on the left bank of the Dotey River)

Site 3 : Satsam Chorten - Tshongdu, L= 8.6 km

(Right site of the Paro River,  
along the foot of the mountain)

Site 4 : Nyemizam-Khangku, L= 1.7 km

(Right bank of the Paro River: Dzong - Airport)

Site 6 : Bonde-Gyebjana, L= 1.7 km

(Right bank of the Paro River,  
along the foot of the mountain)

River Protection :

Site 1 : Extension from the end of the road completed in Stage 1.2,

L= 1.4 km (\*)

(Upstream on the right bank of the Dotey River)

Site 4 : Nyemizam-Khangku, L= 1.7 km (\*)

Site 5 : Right bank of the Gyebjana Rongchu, L= 2.05 km

(Note): The mark (\*) in the above shows the total length of the route; which is different from the length to be constructed in this project.

Implementation of this project is responsibility of the DOA, the Ministry of Agriculture, Bhutan. Its on-site agency is the Paro Valley Agricultural Development Project Office located in Paro. The bridge construction work included in this project is, in principle, to be supervised by the DOR, and its staff is to work with the above project office during the bridge construction stage in order to offer technical support.

Operation and maintenance are to be done by the Water Users Association (WUA) which is to be established in the construction stage. Maintenance of farm roads, river protection installations and the bridge is to be done by the Dzongkhag. Operation and maintenance of construction equipment and plants are to be carried out by the Project Office. After the completion of the project, the equipment is to be placed under the DOA. However, it has not yet been determined. It is proposed that the Project Office continue to exist after this project is completed in order to maintain the equipment and promote other development programs which were not included in this project.

During the construction work, the Japanese contractor is to rent the equipment which were procured in the past stages and will be supplied

in future stages. The rental costs should be composed of those for repair, fuel, operators' wages and insurance.

The Government of Bhutan's responsibilities include: land acquisition for the proposed construction sites, arranging work staging areas (free of charge), handling import procedures for materials and equipment, providing related tax exemptions, operation and maintenance of the Project Office, etc. Other work to be done by the Government is land development for the crushing plant and to supply electric power as required, and so on. Access roads to farm roads and lighting equipment for the bridge, including electric cables, are out of the scope of the project. Thus, they should be constructed by the Bhutanese.

The construction time is estimated at 15 months for Stage 1.3, including the reconstruction of the bridge, and 12 months each for the two remaining stages. Construction of the irrigation facilities is estimated at 9 months and will not be carried out during the wet season or the planting season.

The benefit to be derived from the whole project is an increased production of rice and cash crops, as estimated below:

Rice	:	900 ton
Potatoes	:	2,800 ton
Apples	:	3,400 ton

The above increase is considered to be equivalent to Nu. 52 million (Yen 260 million)/year at the farmyard prices, or Nu. 28,000 (Yen 140,000)/farmer/year. The increase in farmer's income will contribute not only to increase in the farmers' standard of living, but also to an increase in farm productivity, since it will be partly used for procurement of agricultural materials and equipment. Furthermore, the project area will contribute to the promotion of other national development programs, as a model of a self-reliant area.

The reconstruction of the Jangsa bridge, together with the construction of new farm roads, will facilitate implementation of the project and the immediate transportation of agricultural products, as it is an important part of the traffic infrastructure in the area.

From the effects outlined above, it is deemed appropriate to implement this project utilizing the Japanese grant aid.

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## Chapter 1. INTRODUCTION

Economic independence was the principal goal of the Sixth Five Years Development Plan (1987-1992), and to realize it, each region had to be self-reliant. With this in mind, the Government of Bhutan selected five areas in the country as priority areas for agricultural development, and had planned and built agriculture-related facilities in each of them. The area where the Paro Valley Agricultural Development Project is being carried out is one of the five selected areas. In response to a request made by the Government of Bhutan, the Regional Office for Asia and the Pacific (RAPA) of the Food and Agriculture Organization of the United Nations (FAO) carried out a preliminary survey in Bhutan in 1987, and prepared a developmental proposal that the Paro Valley area be divided into 4 sub-areas for development and its first priority be placed on the Dotey area. On the basis of this proposal, the Government of Bhutan asked the Government of Japan for grant aid. Upon receiving this proposal, the Government of Japan decided to carry out a basic design survey, and the Japan International Cooperation Agency (JICA) dispatched in 1988 a preliminary survey team. By this survey, project components for the Paro Valley were preliminarily decided. Then, the JICA dispatched in 1989 the basic design survey team headed by Mr. Yasuhiko Yamamoto, the Ministry of Agriculture, Forestry and Fisheries. General conditions in the Paro area, the detail of the project components, and a master plan for the development were studied in the Phase I study; and detailed site survey for each component was carried out in the Phase II study. As a result, the project was decided to be implemented in the following five stages.

- 
- Stage 1.1 - Procurement of construction equipment (1st)
    - Construction of crushing/concrete plants
  - Stage 1.2 - Irrigation channel : 4 (11.2 km in total length)
    - Farm road and river protection : 1 (3.7 km in length)
    - River protection : 1 (3.7 km in length)
  - Stage 1.3 - Procurement of construction equipment (2nd)
    - Irrigation channel : 3 (5.7 km in total length)
    - Farm road and river protection : 1 (6.2 km in length)
    - River protection : 1 (6.2 km in length)
  - Stage 2.1 - Irrigation channel : 4 (6.35 km in total length)
    - Farm road and river protection : 2 (10.3 km in length)
    - River protection : 1 (1.7 km in length)
    - Farmland consolidation : 50% of the total, upstream side
  - Stage 2.2 - Irrigation channel : 3 (9.31 km in total length)
    - Farm road and river protection : 2 (5.1 km in length)
    - River protection : 2 (5.5 km in total length)
    - Farmland consolidation : 50% of the total, downstream side
-

Following the above plan, the two stages' work was completed in March 1992. The remaining work has been postponed for two years and is scheduled to begin in 1993.

On the other hand, the Jangsa Bridge over the Paro River was damaged due to flood in September 1991 during the course of Stage 1.2, and the Government of Bhutan requested the Government of Japan to reconstruct it as a grant aid project. The Government of Japan then decided to carry out a basic design study, the Phase III study, and dispatched the basic design team headed by Mr. Motonobu Nishimura, Official, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, to Bhutan for one month from 7 April to 7 May 1992.

The main objectives of the study were the following two items:

1) To carry out the resurvey and to review on construction of irrigation facilities and the supply of construction equipment, both of which were preliminarily planned in the previous phase and were to be implemented in the remaining stages. (The time period from the previous phase to the postponed implementation time is quite long, and changes in the condition of the equipment supplied, labor costs, work sites and social situation have been foreseen.)

2) To carry out a survey and a basic design for the recently requested reconstruction of the Jangsa Bridge.

The team made the field survey on the above matters and held a discussion for the purpose of mutual agreement on some basic items, including the project implementation policy with the related agencies of the Department of Agriculture (DOA) and the Department of Roads (DOR), Bhutan.

During the course of the meeting, the DOA proposed 1) the exclusion of the farmland consolidation work planned in the previous phase, 2) the change and addition of some construction equipment, and 3) extension work on a farm road. It was decided that the construction equipment issue would be settled after a detailed study in Japan (This was accepted as a result of the detailed study in Japan. The farm road extension work and the exclusion of the farmland consolidation work proposals were agreed upon.

This report presents the results of the Phase III study.

The lists of the survey team members and the survey activities, the list of participants, the minutes of discussions and the data collected and analyzed are given in the Appendices.

## Chapter 2. BACKGROUND OF THE PROJECT

### 2.1 Outline of Bhutan

#### 2.1.1 General Information

##### (1) Topography and Climate

The country of Bhutan is situated on the southern slope of the Himalayas' eastern end. Most of the country is mountainous and it has a total area of 46,500 km<sup>2</sup>. The country belongs to the monsoon climate zone, and is divided into three climatic areas: 1) the subtropical area with high temperature and high humidity, 2) the cold inland Himalayan area, and 3) the tundra Himalayan area.

##### (2) Tribe, Language and Religion

Considering tribe and language, Bhutan is divided into three big regions:

<u>Region</u>	<u>Language</u>
Western Bhutan	Dzongka
Eastern Bhutan	har chop
Southern Bhutan	Lhotsam

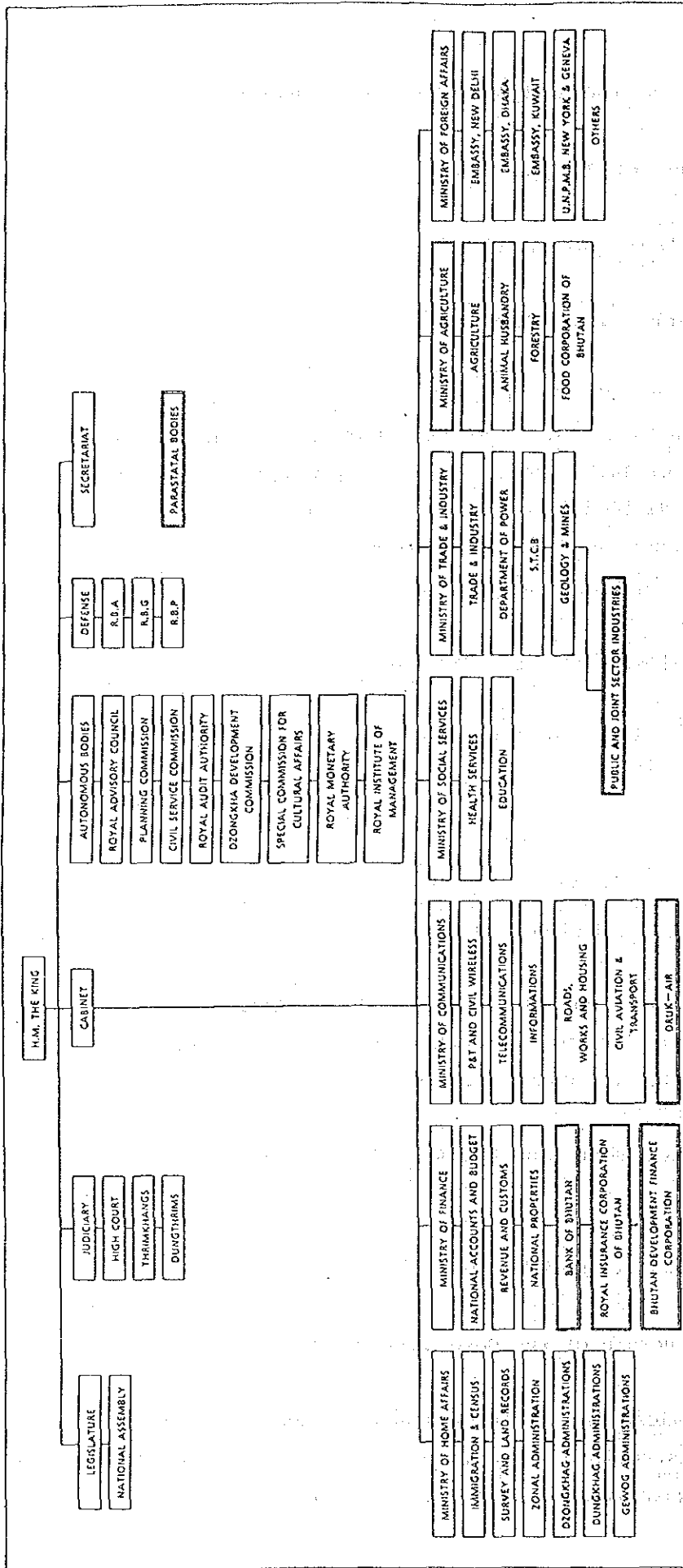
The official language is Dzongka. The English-language education is also popular; for communication among the different tribes, the English-language is commonly spoken.

Considering religion, about 75% of the people are Buddhists, and 25% are Hindus.

##### (3) Political Organization

The basic structure of the Government is shown in Fig.2.1.

Bhutan is divided into 18 Dzongkhags, which are categorized into four Zonal Administrations (ZA) in the framework of the 6th Development Plan. The objectives of ZA are as follows;



=====  
 : Extra departmental  
 Body

Fig 2.1 Organization Chart (Government of Bhutan)

- 1) To strengthen decentralization and local autonomy.
- 2) To strengthen mutual cooperation of the Dzongkhags in ZA and to promote developmental cooperation in each zone.
- 3) To strengthen the implementation capability of projects and programs transferred to the zone.
- 4) To coordinate ZA to promote the developmental capability of each Dzongkhag.
- 5) To promote various development projects for local inhabitants by cooperating with the agencies concerned.

The Zonal Administration is classified as given in Table 2.1 and Fig.2.2.

**Table 2.1 Zonal Administration**

Zone	Dzongkhag
Zone I (Western Zone)	Ha, Paro, Chhukha and Samchi
Zone II (Western-Central Zone)	Punakha, Wangdiphodrang, Chirang
Zone III (Eastern-Central Zone)	Bumtang, Tongsa, Shemgang and Geylegphug
Zone IV (Eastern Zone)	Lhuntshi, Mongar, Tashigang, Pemagatsel and Samdrupjongkhar

(Note): Thimpuh is an independent metropolitan zone, and excluded from the above zones.

#### (4) Education

The formal education system is in principle composed of 1) one year pre-primary, 2) six years primary (Grade I-VI), 3) four years secondary (Grades VII-X), 4) two years senior secondary (Grades X-XII), and 5) a three-year degree program. As of 1990, there were 156 primary schools, 21 middle schools, 10 high schools, one university, 46 community schools and 11 education institutes in Bhutan.

Constraints regarding education are: insufficient number of schools, remoteness of many schools, shortage of teachers, large number of withdrawal from schools, large number of failures in classes, etc. The gross primary enrollment ratio was estimated at 66.9% in 1990. However, at the end of the primary level, about 32% of the children do not return to continue their education at the secondary level, and further, an average of 27% of the pupils every year do not progress to the next grade level.

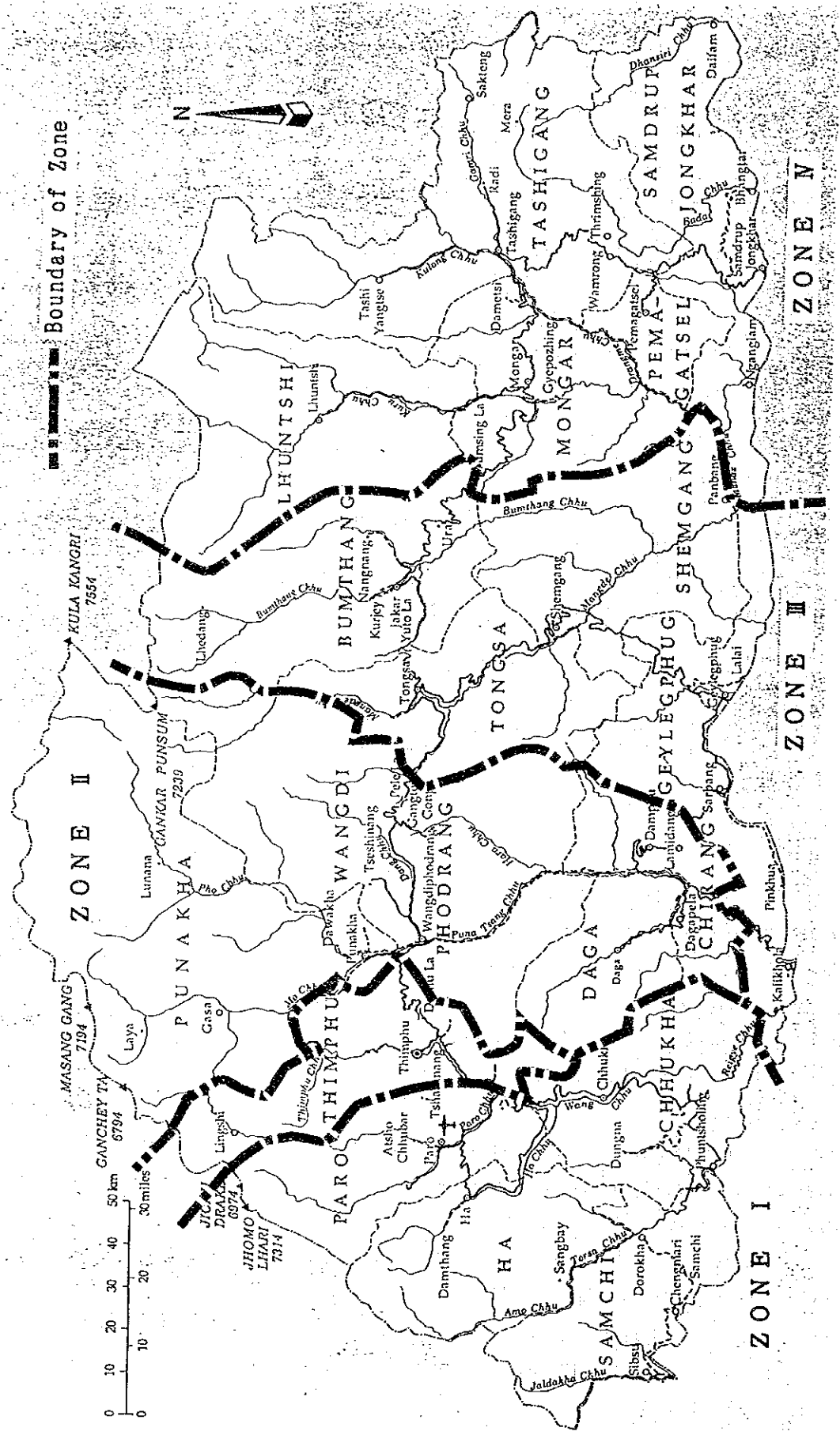


Fig. 2.2 Zone Map of the Kingdom of Bhutan



On the other hand, the number of pupils (Grade Pre-Primary to Grade X) nearly doubled, from 36,075 pupils in 1981 to 68,013 in 1990. University students and other educational institutes numbered 2,341 in the year 1990. Thus, the number of people who have some form of high education is gradually increasing.

### **2.1.2 Population**

The population in the year 1987 was originally estimated at 1,343,600, based on the 1980 census. However, its reliability was in doubt and presently a new census is being carried out; its result is scheduled to come out in 1992/93. According to the latest estimate, the population in 1990 was 600,000. Depending on the birth and mortality rates (39.1 persons and 19.3 persons per 1,000 persons, respectively in 1984) adopted, the population is projected to rise to 713,200-768,100 by the year 1997.

### **2.1.3 Economy and Finance**

#### **(1) Economic Growth**

During the 1990s, the GDP (Gross Domestic Product) grew at an average of 7.5% per annum; by 1989, the GDP was 90% above its 1980 level. Assuming a population growth rate of 2.5% per annum, per capita GDP growth was 5.0% per annum, with per capita GDP estimated at US\$ 370 by 1991. Unlike previous Plan periods, the major cause for GDP growth was not from an increase in foreign aid, but was largely based on the expansion of the electric power and mining/manufacturing sectors. The growth rate is recognized as comparatively higher than that of other developing countries. Share and growth rate of the GDP for each sector are presented in Table 2.2.

**Table 2.2 GDP Sector Share and Growth Rate (1980-1989)**

Sector	GDP Share (%)		Annual Growth Rate of GDP (%)
	1980	1989	( 1980 - 1989 )
Agriculture	55.7	45.1	5.0
Mining and Quarrying	0.6	0.6	13.8
Manufacturing	3.2	6.0	15.2
Electric Power	0.2	10.8	65.4
Construction	7.8	6.3	4.7
Trade, etc.	10.9	6.3	1.1
Transport/Communication	4.3	6.7	12.9
Financial Services	6.3	7.7	9.8
Community/Social Services	10.9	10.2	6.8

Source: Central Statistical Office

**(2) Finance**

Budgetary operation in the Government of Bhutan is shown in Table 2.3.

**Table 2.3 Budgetary Operation of Bhutan Government**

Item	1987/88	1988/89	1989/90	1990/91	1991/92
<b>REVENUES</b>					
Tax revenues	188.7	232.0	231.8	250.6	
Current non-tax revenues	393.3	480.0	586.0	640.7	1,194.2
Other	1.4	93.0	161.4	319.7	
Total Domestic Revenue	673.4	805.0	980.0	1,211.0	
<b>EXPENDITURES</b>					
Current	619.7	909.0	1,068.5	1,094.0	1,027.6
Capital	772.1	1,069.0	669.0	1,135.5	932.7
Total Expenditures	1,391.8	1,978.0	1,737.5	2,229.5	1,960.3
<b>GRANTS</b>					
From India	567.1	564.0	290.2	440.6	213.8
Other	176.8	227.0	198.3	66.8	448.0
Total Grants	743.9	791.0	488.5	907.5	661.8
<b>Financed by:</b>					
External Borrowings	168.2	491.0	57.3	18.4	103.7
Internal Borrowings	-193.7	-109.0	211.6	92.6	0.6
<b>TOTAL FINANCE</b>	<b>-25.5</b>	<b>382.0</b>	<b>268.9</b>	<b>111.0</b>	<b>104.3</b>

Source: Royal Monetary Authority

### (3) Price Movement

The consumer price index for the years 1982-1990 is given in Table 2.4. It increased approximately 10% annually.

**Table 2.4 Consumer price Index**  
( Base Year = 1982 )

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990
Index (%)	100.0	115.6	122.6	123.5	135.8	142.4	157.4	171.7	190.4

### (4) International Trade

Bhutan has an open economy: in 1980 exports amounted to about 27% of the GDP, while imports were 38%. The trade balance continued to be a deficit. Owing to a substantial growth of exports from the mid-1980s, the deficit decreased from Nu. 769.6 million in 1985/86 to Nu. 412.3 million in 1987/88. However, the deficit still persists, averaging Nu. 625.7 million per year.

India is by far the dominant trading partner for Bhutan: India has been the destination for more than 90% of Bhutan's exports, and 60-80% of Bhutan's imports come from India. Other main trading partners are Bangladesh and Singapore for exports; and Japan, Germany and United States for imports.

#### 2.1.4 Industry

As indicated in the GDP share (Table 2.2), agriculture is the most important industry followed by electric power. Regarding annual growth rates, the agriculture and construction sectors have comparatively low rates of about 5%; sectors in mining, manufacturing, transport/communication and financing show higher rates of 10-15%. The surge in the export of electricity was due to the commencement of electricity sales from the Chhukha project. Gross domestic product by sector is given in Table 2.5.

Table 2.5 Gross Domestic Product (1980-1989)

( Unit: Nu. million, 1980 constant prices )

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Agriculture	310	313	331	369	388	412	436	458	488	515
Livestock	139	145	150	155	161	169	177	185	192	202
Forestry	172	179	212	218	257	254	267	283	263	247
Sub Total	621	636	692	742	807	834	881	926	940	963
Mining and quarrying	7	9	12	9	16	13	22	22	19	22
Manufacturing	36	59	60	63	67	75	71	105	110	128
Electric power	3	3	3	6	5	6	60	229	25	232
Construction	89	131	158	185	174	169	142	152	129	134
Wholesale/retail trade	122	140	132	122	123	132	143	142	129	134
Transport/communication	48	55	58	65	66	79	84	91	122	142
Financing/insurance	21	32	19	25	39	30	33	46	57	70
Real estate/business service	49	49	58	66	70	80	93	90	85	93
Sub Total	70	80	77	91	109	110	126	136	141	164
Community/social services	120	122	102	113	130	126	169	200	210	217
Less: bank service charges	-20	-30	-24	-26	-32	-25	-24	-30	-32	-41
GDP (Gross Domestic Product)	1,095	1,205	1,269	1,370	1,466	1,520	1,675	1,973	1,994	2,094
Less: consumption of fixed capital	61	70	75	83	88	94	122	197	202	215
NDP (Net Domestic Product)	1,034	1,134	1,195	1,287	1,378	1,426	1,553	1,776	1,792	1,879
Rate of growth of GDP over preceding year		10.0%	5.3%	8.0%	7.0%	3.7%	10.2%	17.8%	1.0%	5.0%

Source: Central Statistical Office

### 2.1.5 Foreign Aid

Aid has underpinned Bhutan's development efforts, both by financing successive development plans and by improving the skills of Bhutanese through training and technical assistance. In the early 1980s, aid amounted to around 50% of GDP, but rapid economic growth combined with a fairly constant level of aid has reduced the aid/GDP ratio to about 25%. This is still a high figure compared with many other developing countries. India has been Bhutan's main aid provider giving 83% of the total in 1981/82. This had decreased to 70% in 1990/91. Non-India aid is as follows:

#### 1) IFAD

- Small Farmers Development and Irrigation Development Project : US\$ 7.19 million
- Tashigang Mongar Area Development Project : US\$ 5.87 "
- Punakha Wangdi Valley Development Project : US\$ 2.64 "

#### 2) The World Bank

- Bhutan Calcium Carbide Project : US\$ 12.41 million
- Forestry Project (Phase I) : US\$ 7.13 "
- " " (Phase II) : US\$ 1.06 "
- Construction of Primary Schools : US\$ 4.09 "
- Technical Assistance for the above : US\$ 3.70 "

#### 3) The Asian Development Bank

- Multi-project (Phase I) : US\$ 5.28 million
- " " (Phase II) : US\$ 9.81 "
- Chirang Hill Irrigation Project : US\$ 4.42 "
- Road Mechanization : US\$ 4.91 "
- Urban Center Sewerage : US\$ 3.48 "
- Highland Livestock Development Project : US\$ 5.82 "
- Industrial Estates : US\$ 1.16 "
- Bhutan Development Finance Corporation : US\$ 2.44 "

#### 4) The Kuwait Fund

- Gedu Wood Manufacturing Corporation : US\$ 9.56 million
- Bhutan Board Products : US\$ 11.15 "
- Bhutan Calcium Carbide : US\$ 7.08 "

## 2.2 Outline of the Project Area

### 2.2.1 National Development Plan

#### (1) National Development Plans in the Past

The Government of Bhutan, with the assistance of the Indian Government, the United Nations and other international aid agencies, has planned and executed six Development Plans. Through these plans, agricultural infrastructure and social infrastructure have been enlarged. Sectorial and yearly allocation of expenditures of the Development Plans is given in Table 2.6.

Table 2.6 Outlays of Development Plans

( Unit : Nu. million )

Sector	First Plan 1961-66	Second Plan 1966-71	Third Plan 1971-76	Fourth Plan 1976-81	Fifth Plan 1981-87	Sixth Plan 1987-92
Agriculture	1.9	21.6	58.3	259.0	419.4	822.1
Food Corporation	-	-	-	-	135.5	106.5
Animal Husbandry	1.5	5.8	24.2	61.5	162.4	331.0
Forestry	3.2	6.9	28.4	110.3	229.9	418.2
Power	1.5	9.1	30.1	50.5	340.5	1,247.9
Trade/Industries	1.1	1.0	25.2	175.0	323.3	1,276.1
Public Works	62.9	70.5	84.6	128.3	787.5	887.2
Transportation	7.5	12.0	9.5	-	26.3	48.8
Post/Telegraph	0.5	5.9	11.4	16.9	65.8	68.1
Telecommunication	-	-	14.8	37.3	33.7	133.8
Tourism	-	-	14.1	12.5	29.1	-
Druk Air	-	-	-	-	-	391.0
Education	9.4	35.7	90.0	134.6	519.1	778.8
Health	3.1	16.7	38.1	54.6	237.5	399.1
Information	0.1	1.4	4.0	11.0	36.1	95.9
Urban Development	-	-	-	-	187.3	248.7
General Government	-	-	-	-	1,114.9	1,973.8
Dzongkhags	-	-	-	-	-	238.5
Others	14.6	15.6	42.5	54.7	-	-
Total Outlay	107.2	202.2	475.2	1,106.2	4,648.3	9,500.9

Source: Planning Commission

The Sixth Development Plan, which ended in June 1992, aimed at the following nine items as goals.

- 1) To improve the administrative capability of the central government.
- 2) To defend, to maintain, and to promote national identity.
- 3) To mobilize domestic resources.
- 4) To raise income in the rural sector.

- 5) To improve the housing conditions in the rural sector and to promote relocation.
- 6) To integrate and to improve development services.
- 7) To develop human resources.
- 8) To encourage people to participate in their country's development.
- 9) To promote national "self-reliance".

## (2) The Seventh Development Plan

The Seventh Plan started in July 1992. The Seventh Plan, which has been under consideration since December 1989, succeeding the Sixth Plan, has the following main contents.

- 1) Objective: To raise the living standards and to increase the average of all the population, together with an increase in the GDP at the national level

### 2) Development Approach

- Self reliance
- Sustainability
- Efficiency and development of the private sector
- People's participation and decentralization
- Human resource development
- Regionally balanced development

### 3) Role of the Government of Bhutan

- Provide a framework of law and order which fosters economic activities
- Macroeconomic management, including regulation of the currency
- Management of Bhutan's international economic relations, including aid and trade
- Provide and maintain basic economic infrastructure
- Provide and maintain basic social infrastructure (educational and health services), and develop the country's human resources
- Direct involvement in major enterprises (notably hydropower) where the Government is the custodian of the natural resources involved and/or the proposed development is on too large a scale to be accommodate by the indigenous private sector
- Seeking a national consensus on development objectives and strategy and act as the custodian of national interests

GDP projections and outlays of the Seventh Plan by sector are shown in Tables 2.7 and 2.8.

Table 2.7 GDP Projections (1989-1997)

Sector	Growth 1980-90	GDP 1989	Annual Growth Rate	1997 GDP (Price of 1989)	Share of GDP	
					1989	1997
Agriculture/ Livestock	5.0%	1,371.7	4.5%	1,946.4	33.0%	30.9%
Forestry	-	429.1	4.8%	626.3	10.3%	9.9%
Mining	13.8%	35.7	7.4%	63.3	0.9%	1.0%
Manufacturing	15.2%	302.5	13.4%	829.0	7.2%	13.2%
Electric Power	65.4%	391.0	2.7%	482.5	9.4%	7.7%
Construction	4.7%	358.2	4.5%	509.4	8.6%	8.1%
Trade/Hotels	1.1%	268.8	2.4%	325.0	6.5%	5.2%
Transportation /Communication	12.9%	235.6	6.7%	369.8	5.7%	6.3%
Financial Services	9.8%	306.9	5.4%	468.1	7.1%	7.4%
Community Services	6.8%	525.1	4.9%	771.9	12.6%	12.2%
Less: bank charges	-	-67	7.2%	-117	-1.6%	-1.9%
GDP	7.5%	4,157.6	5.3%	6,301.7	100%	100%

(Gross Domestic Product)

Source: Planning Commission



Table 2.8 Seventh Plan Outlay Sectorial Allocation

(Unit: Nu. million)

Organization	Capital	Current Quality	Total	Percentage (%)
His Majesty's Secretariat	0.00	27.33	27.33	0.2%
National Assembly	10.00	10.85	20.85	0.1%
Royal Advisory Council	0.00	14.51	14.51	0.1%
Judiciary	0.00	76.83	76.83	0.5%
Royal Audit Authority	1.00	35.28	36.28	0.2%
Royal Bhutan Police	0.00	376.54	376.54	2.4%
Central Monastic Affairs	0.00	183.64	183.64	1.2%
Cultural Affairs	38.99	85.20	124.28	0.8%
Planning Commission Secretariat	0.00	52.66	5.66	0.3%
Central Statistical Organization	27.56	2.04	29.60	0.2%
National Environment Secretariat	3.14	20.83	23.52	0.2%
Dzongkha Development Commission	0.00	9.20	19.20	0.1%
Royal Institute of Management	63.00	32.71	95.71	0.6%
National Women's Association	21.30	25.78	47.08	0.3%
Royal Civil Services Commission	1,300.00	23.27	1,323.27	8.5%
Ministry of Finance	0.00	1,978.55	1,978.55	12.7%
a) Secretariat & Department	0.00	756.64	756.64	4.9%
b) Debt Servicing	0.00	1,221.91	1,221.91	7.9%
Ministry of Foreign Affairs	0.00	400.53	390.53	2.6%
Ministry of Home Affairs	119.78	190.93	310.70	2.0%
Ministry of Social Services	1,658.90	1,867.33	3,526.21	22.7%
a) Secretariat	0.00	43.29	43.29	0.3%
b) Education Dept.	683.00	1,055.00	1,738.00	11.2%
c) Health Services Dept.	475.88	559.63	1,035.51	6.7%
d) Works & Housing Dept.	500.00	209.41	709.41	4.6%
Ministry of Agriculture	1,275.60	1,158.08	2,433.64	15.7%
a) HRH Office	599.18	318.53	917.71	6.0%
b) Agricultural Dept.	333.32	375.69	709.01	4.6%
c) Animal Husbandry Dept.	97.57	230.32	327.89	2.0%
d) Forest Dept.	245.48	233.54	479.02	3.1%
Ministry of trade and Industry	680.00	722.36	1,402.36	9.0%
Ministry of Communications	1,675.70	1,008.63	2,684.31	17.3%
a) Secretariat	0.00	26.70	26.70	0.2%
b) Post, Telegraph and Wireless Dept.	20.18	143.59	63.77	1.1%
c) Telecommunication Dept.	857.58	231.29	1,088.87	7.0%
d) Information and Transport Dept.	31.03	64.99	96.20	0.6%
e) Civil Aviation and Transport Dept.	76.00	19.27	95.27	0.6%
f) Roads Dept.	690.89	522.79	1,213.68	7.8%
District Administration	50.00	305.39	355.39	2.3%
<b>Total for Central</b>	<b>6,874.97</b>	<b>8,302.72</b>	<b>15,177.68</b>	<b>97.7%</b>
<b>Total Plan Expenditure</b>	<b>6,924.97</b>	<b>8,608.11</b>	<b>15,533.07</b>	<b>100.0%</b>

Source: Seventh Plan

## 2.2.2 Development Projects in the Project Area

### (1) Development Projects Completed

Development projects implemented in Paro are mostly assisted by foreign aid programs. They are as follows:

#### 1) National Seed and Plant Program (NASEPP)

- Name of Project : National Seed and Plant Program (NASEPP)
- Objectives : Production and supply of improved seeds and seedlings.  
Production of vegetables and high-value seeds for export.  
Production base of major fruit tree seedlings.  
Production of sterile seeds by tissue culture.
- Assisting Foreign Agency : Government of Japan
- Executing Agency : Ministry of Agriculture
- Project Cost : Nu. 95.2 million
- Location : Bondey

#### 2) Agriculture Mechanization Center (AMC)

- Name of Project : Agriculture Mechanization Center (AMC)
- Objectives : Extension of agricultural mechanization.  
Increase of agricultural productivity.
- Assisting Foreign Agency : Government of Japan
- Executing Agency : Ministry of Agriculture
- Project Cost : Nu. 132.6 million
- Location : Bondey

#### 3) Public Water Supply System

- Name of Project : Paro Urban Water Supply and Sanitation
- Objective : To supply clean and constant drinking water and sanitation to urban population of Paro.
- Assisting Foreign Agency : Danish International Development Assistance (DANIDA)
- Executing Agency : Paro Dzongkhag
- Implementation Period : 4 years (commissioned in 1991)
- Beneficiary : The town of Paro

### (2) Social Service Project

Social service projects currently being implemented or scheduled in Paro are mostly assisted by foreign aid programs; they are as listed below:

#### 1) Teachers Training College (TTC)

- Name of Project : Teachers Training College (TTC)
- Objectives : The improvement of existing facilities, and to increase the enrollment of teacher training courses and supply of teachers for primary schools.
- Assisting Foreign Agency :  
World Bank and UNICEF for Phase II (current), and SDC (Swiss Development Corporation through HELVETAS) for Phase III.

- Executing Agency : Department of Education,  
Ministry of Social Services
- Project Cost : Phase II = Nu. 3.391 million  
Phase III = Nu. 53.966 million (Aid) +  
Nu. 2.008 million (Bhutan Government)  
= Nu. 55.974 million (Total)
- Implementation Schedule :  
Phase II = 1 Oct. 1990 - Oct. 1992  
Phase III = Sept. 1993 - 1997 (construction)  
(Planning in 1992, schedule enclosed)
- Location : Chang Nangkha, Paro
- Capacity : Present trainees = 60  
After Phase II, an increase in enrollment of 50
- Beneficiary : The entire country

## 2) Drugyel High School

- Name of Project : Drugyel High School
- Objectives : Increase the enrollment and the number of students who  
complete Grade XII
- Assisting Foreign Agency : United Kingdom (TCO)
- Executing Agency : Department of Education,  
Ministry of Social Services
- Project Cost : L 860,000- (pounds)
- Implementation Schedule : July 1990 - March 1994
- Location : Chento, Paro
- Capacity : Phase I (432 students) + Phase II (160 students)  
= 592 students
- Beneficiary : The entire country

## 3) Paro District Hospital

- Name of Project : Paro District Hospital
- Objective : Provide curative, preventive, and fundamental services  
to the people of Paro District
- Assisting Foreign Agency : Danish International Development  
Assistance (DANIDA)
- Executing Agency : Department of Health Service, Ministry of Social  
Services
- Project Cost : Nu. 22 million
- Implementation Schedule : Construction commencement in May 1992
- Facilities to be Constructed :  
Main hospital building, service centers and administrative blocks  
in Phase I, and staff quarters and sanitary provisions
- Location : Geptey Village, Paro
- Capacity : 40 beds and 150-300 patients per day
- Beneficiary : All the local inhabitants of the Paro District, plus  
all the migratory population within Paro including  
foreign nationals.

## 2.3 Agricultural Sector and related Sectors

### 2.3.1 Agricultural Status and Constraints

#### (1) General Information

The agricultural sector represents the most important sector in the Bhutanese economy, accounting for 45% of the gross domestic product (GDP) in 1989 and 90% of the total employment. In rural areas, the economy is almost self-sufficient. Even though it is an agricultural country, Bhutan is not completely self-sufficient. The self-sufficiency rates for major grains, rice, wheat, and edible oil are 66%, 52%, 24%, and 20% respectively. The balanced volume of grain is imported mainly from India by the Government and private dealers. The Government imports have been increasing in recent years and reached 30,000 ton in 1990. These increases are thought to be due to the following reasons:

- An increase in the non-farming population and foreign laborers who engage in construction work on roads and public facilities.
- An increased demand for rice and wheat which are replacing maize and cereals in rural areas.
- An unstable grain production and insufficient grain distribution and marketing system.

On the other hand, horticulture products such as oranges, apples and potatoes are exported to India, Bangladesh and Singapore, earning US\$ 6.5 million in 1990.

#### (2) Land Use

Bhutan is made up of steep mountains. According to the "Master Plan for Forestry Development (MPFD Draft 1991)", which was prepared based on aerial photography taken by the Landsat and the SPOT satellites, forest comprises 26,400 km<sup>2</sup>, or 56.8 %, of the total land area, and agricultural land area is estimated at 6,480 km<sup>2</sup>, or 13.9 % of the total. The area under cultivation has been estimated as given in Table 2.9.

**Table 2.9 Land under Cultivation (1991)**

Cultivation Land	Area ( ha )	Percentage ( % )
Valley cultivation	46,000	7.1
Terraced cultivation	204,000	31.5
Unterraced cultivation	304,000	46.9
Shifting cultivation	75,000	11.6
Orchards	19,000	2.9
Total	648,000	100.0

Source: Master Plan for Forestry Development  
(Draft 1991)

### **(3) Landownership**

The agricultural sector consists of 65,000 farm households with an average family of 8.5 persons and a farm size of 1.5 ha. Farm distribution is highly skewed. 45% of the farmers have less than 1 ha and cultivate 16% of the total land. Conversely, 16% of the farmers have holdings of more than 2.5 ha, 42% of the total area. Farm size has been decreasing as farms are subdivided between children. A study in the Punakha Wangdi area during 1990 showed that 40% of all farmers operated as part owners/tenants. Small numbers of landless tenants were also identified, accounting for 3-5 % of the total.

### **(4) Productivity**

In general, agricultural productivity is low; unit productions in 1989/90 were 1.66 ton/ha for rice, 0.64 ton/ha for wheat and 0.74 ton/ha for beans. The reasons are considered to be cultivation of traditional seeds, traditional agricultural methods and an insufficiency of agricultural infrastructure such as irrigation facilities.

### **(5) Livestock**

Livestock is bred on 95% family farms, averaging 6-10 heads a house. A typical farm's livestock consists of 3 heads of cattle, 3 of milk cattle, 2 horses or donkeys, 3 pigs and 3 chickens.

## (6) Agricultural Materials

The Ministry of Agriculture supplies agricultural materials. They were as follows, in 1989/90.

Material	Quantity Supplied
Fertilizer	1,669 ton
Oil seed	11 ton
Grain seed	492 ton
Vegetable seed	1,409 ton
Temperate fruit seedling	53,012 pieces
Subtropical fruit seedling	28,200 pieces

### 2.3.2 Agricultural Sector and Related Sectors

The goals and policy of the agricultural sector in the Sixth Plan are outlined below:

#### (1) Agricultural Sector

##### 1) Goals

- a) Increasing self-sufficiency in staple foods.
- b) Increasing farmers' income through diversification of cash crops.
- c) Improving productivity of land and labor.

##### 2) Basic Development Policy

##### a) Development of Prior Areas

Under the policy of decentralization, several areas where high agricultural productivity would be expected were selected for agricultural development projects of consolidate the agricultural infrastructure. As a result, the following five areas were selected for high priority projects.

#### Chirang Hill Irrigation Project

- Components : Improvement of the existing irrigation facilities; soil conservation and improvement of management in the river basin; and strengthening of the support services for promotion of crop diversification.

- Areas : Four districts of Chirang Dzongkhag  
River basin : 4,400 ha  
Farmland area : 2,800 ha  
Irrigated area: 1,310 ha
- Project cost : US\$ 4.35 million  
( US\$ 3.48 million by ADB and US\$ 0.78 million by the Government )
- Assisting organization : ADB

#### Tashigang-Mongar Area Development Project

- Components : Rehabilitation and improvement of irrigation facilities in four areas; construction of farm roads with a total distance of 34 km in three areas; and strengthening of various agricultural support services.
- Areas : Tashigang and Mongar Dzongkhags
- Project cost : US\$ 6.667 million  
( US\$ 0.75 million by UNDP, US\$ 4.75 million by IFAD and US\$ 1.167 million by the Government )
- Assisting organization : UNDP and IFAD

#### Punakha-Wangdi Valley Development Project

- Components : Rehabilitation and improvement of irrigation facilities; strengthening of various agricultural support services; and soil conservation and environmental protection through pilot projects with strengthen community forests.
- Areas : 9 Gewogs in Punakha Dzongkhag, 8 Gewogs in Wangdi Dzongkhag and 2 Gewogs in Thimphu Dzongkhag
- Project cost : US\$ 3.74 million  
( US\$ 2.58 million by IFAD, US\$ 0.44 million by UNDP and US\$ 0.72 million by the Government )
- Assisting organization : IFAD and UNDP

#### Paro Valley Development Project

This project is under consideration.

#### Geylephug Area Development Project

- Components : Irrigation development and rehabilitation; soil and land resource assessment; land terracing and soil conservation; green manuring and compost sheds; agricultural extension services; manpower development; agricultural development; Bhur Farm development; horticulture development; technical assistance; adaptive research; intensification of food grain and oilseed production; improvement of cattle through cross breeding; improvement of buffaloes; piggery development; poultry development; development of feed and fodder; livestock extension.
- Areas : 7 Gewogs in Geylephug Dzongkhag
- Project cost : Nu. 51.57 million
- Assisting organization : Government of India

#### b) General Agricultural Development Programs

Various agricultural support services were to be strengthened.

### c) Strengthening General Agricultural Support Services

Support services are to be provided and strengthened along the following lines:

- Technical support for irrigation and land development through design, supervision, etc.
- Agricultural research.
- Plant protection services.
- Supply of agricultural equipment, seeds and plants, fertilizer, tools and agricultural machinery.
- Agricultural credit for farmers.
- Post-harvest support services.
- Agricultural extension and training services.

### (2) Livestock Sector

#### 1) Goals

- a) Self-sufficiency in the livestock sector.
- b) Increase of household income in agricultural areas.
- c) Nationwide support services for farmers by supplying farmyard manure and the motive power force of a draft animal.

#### 2) Development Policy

##### a) Intensive Livestock Development Program

35 Gewogs were to be selected nationwide for dairy-based development projects. Further, fishery development projects are to be implemented in 5 Gewogs.

#### High Altitude Area Development Project

- Areas : 4 Gewogs in Bhumtang, 2 Gewogs in Lhuntshi and 4 Gewogs in Wangdiphodrang.
- Objectives: To improve livestock productivity through effective utilization of resources; and to realize self-sufficiency in main livestock products such as milk, butter and cheese.
- Components: Artificial insemination, supply of bull, vaccination, farmers' credit, and construction of a dairy factory in Bumthang.
- Project cost : Nu.39.3 million
- Assisting organization : Government of Switzerland

#### Highland Livestock Development Project

- Areas: 3 Gewogs in Mongar, 1 Gewog in Lhuntshi, 2 Gewogs in Tashigang, 1 Gewog in Samdrupjongkar, 7 Gewogs in



Pemagatsetel, 10 Gewogs in Chhukha, and 1 Gewog in Samchi.

- Objectives : To improve livestock productivity; to increase farmers' income, to improve marketing systems for domestic use of livestock products; and to conserve environmental conditions through proper management of grazing lands.
- Components : Artificial insemination; supply with bulls; vaccination; construction of veterinary service centers; farmer credit; and construction of a dairy factory (700 lit/hour) in Phuntsholing.
- Project cost : Nu. 83.3 million
- Assisting organization : ADB and Government of Norway

#### Integrated Fishery Development Project

- Areas : 2 Gewogs in Geylegphug and 3 Gewogs in Samdrupjongkhar
- Components : Fish farming in ponds with a total area of 108 ha; technical training of fish farming for 300-400 farmers; and supply of 1,090,000 fry, 9,400 piglets and 71,400 ducklings.
- Project cost : Nu. 11.482 million

#### b) Dzongkhag General Livestock Development Program

- Areas : 156 Gewogs which are not involved in the Intensive Livestock Development Program.
- Components : Artificial insemination; supply with bulls; vaccination; construction of veterinary service centers; farmer credit, etc.
- Project cost : Nu. 51.042 million

#### c) Central Management Scheme

- Objectives : To manage and control machinery, equipment, and materials where are necessary for development at the central administrative agencies in order to ensure effective utilization.
- Project cost : Nu. 114.775 million

### 2.3.3 Agricultural Sector in the Seventh Plan

#### (1) Objectives

The objectives for the Seventh Plan relate to the national objectives of:

- Sustained increases in overall and per capita incomes and standard of living for the whole population.
- Promotion of self-reliance.
- Conservation of the environment.

The objectives for the agricultural sector are:

- Sustainable development of agricultural production to enable self sufficiency in food.
- Improvements in the incomes, living, and nutrition standards of the rural population.

## **(2) Strategy**

To achieve the above objectives, the following programs have been formulated.

### **1) Arable Sector Development Program**

In order to achieve the objectives of increasing cultivation on a sustainable basis, it will be necessary to strengthen Regional and Dzongkhag planning and implementation capabilities. The central support programs will concentrate on providing support service at the Regional and Dzongkhag levels. These include research, extension, supply of seeds and planting materials, farm mechanization, irrigation, and other technical support services.

### **2) Livestock Sector Development Program**

The livestock sector program will focus on increasing productivity through breed improvement and the processing of livestock products, rather than on increasing livestock numbers.

### **3) Marketing Development Program**

The Food Corporation Department (FCD) will continue to be responsible for wholesale distribution of essential commodities with fixed prices. Agricultural marketing and pricing issues will be the responsibility of the Policy and Planning Division of the Ministry of Agriculture.

## **(3) Actual Development Programs**

Actual programs including support programs in the agricultural sector are proposed as given in Table 2.10. The issue is that almost half of them have not been budgeted for or lack financing.

Table 2.10 Agricultural Development Programme

Part 1

Title	Implementing Agency	Location	Total Project Cost		Capital Recurrent External Funds Required		Start Year	Completion Year	Funds Secured		Financing Insufficiency
			mil. Nu. mil.	Nu. mil.	Nu. mil.	Nu. mil.			mil. Nu. mil.	mil. Nu. mil.	
1. STRENGTHENING, PLANNING, AND POLICY DEVELOPMENT	Planning and Policy Division, Ministry of Agriculture	Thimphu	16.524	10.722	5.802	16.524	1990	1997	10.150	5.802	
2. LAND USE PLANNING PROGRAMME	Policy and Planning Division	National	32.200	28.280	3.920	32.200	1992	1997	Nil	Nil	32.200
3. NATURAL RESOURCES TRAINING INSTITUTE	Policy and Planning Division	* 1	21.865	16.832	5.033	21.865	1992	1997	16.832	5.033	
4. REGIONAL DEVELOPMENT PROGRAMME	Ministry of Agriculture	National	739.336	543.347	195.989	739.336	1992	1997	Nil	739.336	
5. INTEGRATED HORTICULTURE DEVELOPMENT	Department of Agriculture	National	23.818	2.577	21.241	17.418	1992	1997	17.418	Nil	
6. NATIONAL POTATO PROGRAMME	Department of Agriculture	* 2	17.295	4.565	12.730	17.295	1983	1997	5.410	11.708	
7. RESEARCH SUPPORT PROGRAMME	Department of Agriculture	National	42.018	38.250	3.768	22.123	1992	1997	5.958	16.500	
8. PLANT GENETIC RESOURCE CENTRE	Department of Agriculture	Wangdiphodrang	13.005	11.213	1.792	13.005	1992	1997	0.219	12.786	
9. AGRICULTURAL EXTENSION SUPPORT PROGRAMME	Department of Agriculture	National	22.415	11.100	11.315	11.920	1990	1997	11.920	Nil	
10. NATIONAL SEED AND PLANT PRODUCTION PROGRAMME	Department of Agriculture	National	85.283	38.079	47.204	87.490	1984	1997	Nil	87.490	
11. INPUT DELIVERY SYSTEM	Department of Agriculture	National	39.441	36.216	3.225	39.441	1992	1997	Nil	39.441	
12. PLANT PROTECTION SERVICE	Department of Agriculture	National	25.285	20.000	5.285	25.285	1984	1997	20.000	5.285	

Table 2.10 Agricultural Development Programme

Title	Implementing Agency	Location	Total Project Cost		Recurrent Cost		External Funds Required		Start Year	Completion Year	Funds Secured	Financing Insufficiency
			mil. Nu.	mil. Nu.	mil. Nu.	mil. Nu.	mil. Nu.	mil. Nu.				
13. IRRIGATION SUPPORT	Department of Agriculture	National	10.835	1.450	9.385	10.835	1992	1997	Nil	10.835		
14. AGRICULTURAL MACHINERY CENTER	Department of Agriculture	National	145.049	118.069	26.980	120.000	1992	1997	Nil	120.000		
15. NATIONAL ARTIFICIAL INSEMINATION PROGRAMME	Department of Animal Husbandry	National	8.735	4.535	4.200	8.735	1992	1997	Nil	8.735		
16. NATIONAL ANIMAL HUSBANDRY FARMS	Department of Animal Husbandry	National	17.697	12.297	5.400	17.697	1992	1997	4.025	13.672		
17. STRENGTHENING OF VETERINARY SERVICES	Department of Animal Husbandry	National	63.281	56.382	6.899	63.281	1991	1997	56.382	6.899		
18. NATIONAL FODDER SEED PRODUCTION PROGRAMME	Department of Animal Husbandry	National	14.809	10.592	4.217	16.135	1992	1997	2.842	10.510		
19. STRENGTHENING OF INOCULANT PRODUCTION CENTRE	Department of Animal Husbandry	National	6.694	5.939	0.755	6.694	1986	1997	Nil	6.694		
20. NATIONAL SHEEP DEVELOPMENT PROJECT	Department of Animal Husbandry	*3	10.178	7.829	2.349	3.843	1974	1997	Nil	3.843		
21. FOOD CORPORATION OF BHUTAN	Food Corporation of Bhutan	National	51.798	51.798	0.000	51.798	1992	1997	51.798	Nil		

SOURCE : Seventh Five Year Plan 1992

\* 1 : Lobesa, Wangdiphodrang

\* 2 : Wangdiphodrang, Tongsa, Pemagatshel, Bumthang, Fashigang, Mongar, Thimphu, Yuspang

\* 3 : Dechenpelri, Thimphu and Wabthang, Bumthang

#### **2.3.4 Road Traffic**

##### **(1) Basic Situation**

The lack of a well developed transportation network has been identified as one of the major constraints to the development of the more remote areas of the country.

In the whole country, there are less than 2,400 km of roads for motor vehicles; and they are often impassable during the rainy season. Besides these roads, there are footpaths, horse trails and suspension bridges. The road network, by Dzongkha, is shown in Table 2.11.

The construction and maintenance of roads are technically difficult because of the steep and hilly terrain and danger during the monsoon season.

Shortage of labor is another reason for the difficulty of road construction and maintenance. The number of laborers employed by the Department of Roads is about 1,700 Bhutanese and 2,200 foreigners. However, they have not been well trained and lack experience and, as a result, the quality of their work is at a lower level. As for construction machinery and equipment, various manufacturers' products have been imported due to conditions imposed by aid agencies and a lack of selection criteria. Further, as spare parts for them are not available in India, their operation time is limited.

Suspension bridges, important facilities for transportation which were planned in the Sixth Plan, have not been constructed as proposed due partly to a shortage in the local labor force. In addition, an insufficient amount of the cement and reinforcing bars necessary for their construction, together with a lack of technical knowledge, caused further problems.

##### **(2) Roads and Bridges for Vehicle Use**

The country has a lateral East-West highway from Thimphu to Tashigang (546 km). The East-West highway is connected to Southern Bhutan by 3

North-South highways: Thimphu-Phuntsholing highway (179 km), Tongsa-Geylegphug highway (244 km), and Tashigang-Samdrup Jongkhar highway (180 km). The motor vehicle road network is generally limited to providing access between 18 Dzongkhag headquarters and 12 Dungkhags. The highways have an 8 ton axle capacity and were built according to Indian Hill Road Standards and Specifications by Project Dantak, an organization of the Government of India. As for the bridges, most of them were constructed as temporary structures, except the Confluence Bridge, which was recently built, and they have exceeded their design life and will not be suitable for use by heavy vehicles within a few years.

### (3) Transportation

Presently in rural areas, horses, yaks and cattle are still widely used.

Traffic is comparatively heavy in the western and southern areas. At the beginning of the Second Plan, the number of vehicles was only 131 and it has currently increased as shown in Table 2.12.

Table 2.11 Road Network in Bhutan by Dzongkha, June 1990

( Unit : km )

Dzongkha	National Highway	District Road	Feeder Road	Total
Thimphu	102	-	19	121
Chhukha	132	46	17	195
Ha	15	11	16	42
Paro	104	51	17	172
Samchi	-	84	13	97
Chirang	67	-	24	91
Daga	22	87	-	109
Punakha	-	20	42	62
Wangdiphodrang	101	14	49	164
Bumthang	122	-	24	146
Geylegphug	106	-	41	147
Shemgang	142	-	-	142
Tongsa	163	-	-	163
Lhuntshi	-	47	10	57
Mongar	177	20	24	221
Pemagatsel	-	23	15	38
Samdrupjongkhar	59	48	5	112
Tashigang	141	45	71	257
Total	1,453	496	387	2,336

Source: Department of Roads  
Statistical Yearbook of Bhutan, 1990

**Table 2.12 : Number of Vehicles Registered (1980-1989)**

Year	Car	Jeep	Truck	Bus	Bull- dozer	Tiller	Taxi	Motor- cycle	Diplo- matic	Total
1980	76	118	156	9	-	-	23	299	19	700
1981	167	185	333	14	-	-	39	455	19	1,212
1982	319	276	431	23	6	-	55	707	23	1,840
1983	402	377	498	27	8	-	60	946	27	2,345
1984	620	469	673	37	9	-	78	1,200	36	3,122
1985	782	627	826	57	9	-	117	1,513	49	3,980
1986	934	810	955	78	10	-	153	1,883	58	4,881
1987	1,027	951	1,075	99	10	-	213	2,281	65	5,721
1988	1,235	1,105	1,249	118	12	80	250	2,882	71	7,002
1989(*)	1,287	1,151	1,345	140	19	129	291	3,222	80	7,664

Source: Statistical Yearbook of Bhutan, 1990

(\*): Data up to 30 September 1989

### 2.3.5 Review of Past Performance

Roads constructed since the Fourth Plan are as shown in Table 2.13.

**Table 2.13 : Accumulated Road Length Since the Fourth Plan**

Category	( Unit : km )		
	Fourth Plan	Fifth Plan	Sixth Plan (1990)
National Highways	1,358	1,450	1,453
District Roads	216	447	500
Feeder Roads	185	268	408
<b>Total</b>	<b>1,759</b>	<b>2,168</b>	<b>2,361</b>

The target set for the DOR in the Sixth Plan was 300 km of formation cutting, 437 km of base course and 379 km of bituminous sealing. Due to delays in the arrival of construction machinery and bituminous sealing equipment and the shortage of skilled and technical manpower, the amount completed was much lower than the projected target, as shown in Table 2.14.

**Table 2.14 Progress of Road Construction and Maintenance  
(July 1991)**

Work	Length (km)	Amount (Nu. mil.)	Number of Contractors Involved
Formation cutting	76.1	32.2	11
Base course	21.5	6.4	2
Permanent works	32.0	6.1	3
Restoration	800.0	0.9	3
Routine maintenance	245.0	1.7	11
<b>Total</b>		<b>47.3</b>	

Source: Seventh Plan

### 2.3.6 Road Sector in the Seventh Plan

#### (1) Target

The long-term program in the road sector is to construct and maintain national highways and bridges; finally to establish road networks to link population centers. The initial phase of the Seventh Plan is the rehabilitation and maintenance of road networks, particularly the national highways. In the Plan, new roads have not been proposed.

#### (2) Strategy

For construction and maintenance work, the private sector is to be utilized. The Department of Roads is to survey, design, and study design criteria. Furthermore, manuals, criteria and unit prices shall be reviewed immediately and transferred completely to the DOR and the private sector. Some private companies have experience in such construction work. However, construction machinery has been rented from the DOR in some cases because of financial problems in the private sector. With mechanization in road construction work, the labor force is able to be supplemented and the technical level of road construction work increased. Mechanization, however, is limited to excavation; subbase and asphalt pavement work are to be carried out manually.

The DOR is to reconstruct at least two bridges and improve the engineering of them.



### (3) Development Program in the Seventh Plan

Activities in the Seventh Plan are as follows.

#### 1) Strengthening of Road Maintenance

Maintenance divisions located in Lobesa, Tongsa, Lingmethang, and Thimphu each have the capacity to maintain 200 km of road. By the end of the Seventh Plan, the DOR will have the responsibility of maintaining 1,657 km of road, assuming that the Thimphu-Phuntsholing and Tashigang-Samdrup Jongkhar highways will be taken over from Dantak.

Routine maintenance will be taken care of by communities and contracted to the private sector. This work consists of the cleaning of drains, bridges, and culverts after minor landslides; the repair of sign boards, milestones, parapet walls, and warning signs; and the planting of trees and grasses along the roadside. There are two categories of routine contracts awarded on the basis of soil conditions: at Nu. 6,000 or at Nu. 9,000 per km a year.

There are 7 divisional workshops now and an additional 4 divisional workshops will be established in the Seventh Plan. In addition, the equipment and tools in the existing workshops will need to be replaced. The central workshop located in Geylegphug is considered to be in an inappropriate location, making it difficult to go to Geylegphug for repairs. Therefore, it is intended to establish a central workshop at Lingmethang.

#### 2) Bitumen Sealing Unit

The Department has one resurfacing unit with a capacity to resurface 40 km per year. In the Seventh Plan however, as a total of 720 km (130 km of district roads and 580 km of national highways) are to be complete, which is 160 km per year, an additional bituminous sealing unit will be procured. There are 13 roads to be resurfaced and the cost is estimated at Nu. 180 million.

### 3) Road Construction Equipment

The DOR has approximately 450 pieces of construction equipment of various makes, including 21 road rollers, 22 bulldozers, 52 air compressors, 47 long body tipper trucks, 10 water pumps, etc. In the Seventh Plan, almost half of the equipment will be replaced with new machinery.

### 4) Establishment of a Formation Cutting Unit

The DOR has a formation cutting capability of 45 km per year; the private sector has a capability of 30 km per year, together making 75 km of formation cutting possible. The Seventh Plan target for formation cutting work is 93 km per year. The equipment required for the work is: one 80kw dozer, four 150kw dozers, 6 air compressors, 4 tipper trucks, 3 fuel tanks and one fuel tanker, etc.

### 5) New Road Construction

Most of the new road construction will be in the areas of Pema Gatshel and Tashigang where road density is the lowest. The Seventh Plan target for construction work has been estimated at 60 km per year by the DOR and 30 km by private construction companies.

### (4) Actual Development Program

The development program for the road sector is proposed as shown in Table 2.15, consisting of 9 projects (total cost: Nu. 788 million). However, the financing has not yet been secured.

### 2.3.7 Agriculture Development and Relation to the Project

The current project, the Paro Valley Agricultural Development Project, started as a high priority as the Sixth Plan was being implemented. Its aims were 1) increased self-sufficiency in staple foods, 2) increased farmers' income through, and 3) improved productivity of land and labor. The Seventh Plan is now beginning, and its basic development policy for the agricultural sector does not differ from

that of the Sixth Plan. The current project is planned to be implemented in the course of "application of local development achieved in the Sixth Plan", one of the Seventh Plan's strategies. This project shall be carried out upon the achievement of Stages 1.1 and 1.2 already completed.

As described in the study reports of Phases I and II, there are many people in this area who have a strong desire to farm. At almost the same time as Stage 1.2 was completed, several farmers, who were beneficiaries of the new farm road, purchased trucks for agriculture, taking advantage of farmers' credit available. Furthermore, beneficiaries, including future potential beneficiaries, organized a Water Users Association, under the direction of the governmental staff concerned. Thus, they are intentionally going to improve farming work. Such experience suggests that investment in this area would contribute to future agriculture in the whole country of Bhutan.

Table 2.15 Road Development Programme

Title	Implementing Agency	Location	Total Project Cost		External Funds Required	Start Year	Completion Year	Funds		Financing Insufficiency
			mil.Nu.	mil.Nu.				Secured	mil.Nu.	
1. STRENGTHENING ROAD MAINTENANCE CAPACITY	Department of Roads, Ministry of Communications	National	116.544	23.494	116.544	1992	1997	Nil	116.544	
2. BITUMEN SEALING UNITS	Department of Roads, Ministry of Communications	National	66.090	48.000	66.090	1992	1997	Nil	66.090	
3. ROAD SECTOR STUDIES AND TRAINING	Department of Roads, Ministry of Communications	National	5.000	5.000	5.000	1992	1997	Nil	5.000	
4. IMPROVEMENT OF NATIONAL HIGHWAYS	Department of Roads, Ministry of Communications	***	201.908	147.632	54.276	201.908	1994	1997	Nil	
5. DISTRICT ROADS PROGRAMME	Department of Roads, Ministry of Communications	National	222.428	179.423	43.005	222.428	1992*	**	Nil	
6. FEEDER ROADS PROGRAMME	Department of Roads, Ministry of Communications	National	92.247	83.259	8.988	92.247	1992*	**	Nil	
7. RECONSTRUCTION OF BRIDGES	Department of Roads, Ministry of Communications	National	139.970	17.000	122.970	139.970	1992	1997	Nil	
8. ROAD CONSTRUCTION EQUIPMENT	Department of Roads, Ministry of Communications	National	158.653	117.528	41.135	145.049	1992	1997	Nil	
9. NATIONAL DRIVING SCHOOL	Department of Civil Aviation and Transport	Phuntsholing	8.374	-	8.374	1992	1997	Nil	8.374	

SOURCE : Seventh Five Year Plan 1992

\*\*\* : Thimphu-Phuntsholing(40km)

Simtokna-Tashigang(Khei)(26km)

Tongsa-Geylegphug-Sarbhong(20km)

\* : With carry-over from FYP6

\*\* : Will carry forward into FYP8

## 2.4 Background of the Project

### 2.4.1 Background of the Project

The Paro Valley Basin is Bhutan's most advanced agricultural area and has been playing a role in agriculture leadership. The government made the Paro Valley Agricultural Development Project one of the priority development projects in the Sixth Plan. Implementation of the current project, which is intended to form a base of agricultural modernization, is considered quite significant for Bhutan from the viewpoints of increasing self-sufficiency of food and farmers' income, and productivity of land and labor.

In response to a request made by the Government of Bhutan, the Regional Office for Asia and the Pacific (RAPA) of the Food and Agriculture Organization (FAO) carried out a preliminary survey in Bhutan in September through October 1987 and prepared a development proposal for the four areas of the Paro Valley Basin in which it concluded that the Dotey Basin would be given top priority. On the basis of this proposal, the Government of Bhutan asked the Government of Japan for grant aid. Upon receiving this request, the latter dispatched a preliminary survey team to Bhutan from November through December 1988. On the basis of the results obtained by the team, basic design studies for the project were carried out in two separated phases. The Phase I study carried out in March to April 1989 established a master plan for agricultural development. The Phase II study done in November to December 1989, based on the results of the Phase I study, made the basic planning for implementation. It proposed that the project be implemented in 5 stages (Stages 1.1, 1.2, 1.3, 2.1 and 2.2) using grant aid. As shown above, Stage 1.1 was implemented during April 1990 to March 1991, and Stage 1.2 during December 1990 to March 1992. Implementation of the remaining three stages was postponed for two years (Japanese fiscal years 1991 (April 1991 - March 1992) and 1992 (April 1992 - March 1993) due to financial considerations. In September 1991, during the course of Stage 1.2 implementation, Jangsa Bridge was damaged due to flood. The Government of Bhutan made a request for grant aid for the renewal of the Jangsa Bridge to the Government of Japan. The bridge is important

for implementation of the remaining stages of the project, in a point of transportation of construction equipment and materials. The Phase III study was thus carried out due to this request and for the solution of issues coming from the postponement of the project implementation. In the Phase III study, review was made on prices' escalation, change in socio-economic conditions, and stagewise planning for the project implementation.

#### 2.4.2 Outline of the Project

In the preceding Phases I and II, the following project components were proposed.

##### Stage 1.1

###### A) Procurement of Construction Equipment (First)

- Bulldozer (21 ton)	: 1
- " (15 ton)	: 4
- " (3 ton)	: 1
- Backhoe (0.6 m <sup>3</sup> )	: 3
- " (0.2 m <sup>3</sup> )	: 1
- " (0.04 m <sup>3</sup> )	: 2
- Clamshell (0.6 m <sup>3</sup> )	: 1
- Dump truck (11 ton)	: 8
- Vibrating roller (10 ton)	: 1
- Truck mixer (2.2 m <sup>3</sup> )	: 2
- Mortar pump	: 1
- Power trowel	: 1
- Compressor (7.5 m <sup>3</sup> /min)	: 1
- Jackhammer	: 2
- Vibrator	: 2
- Tamper	: 4
- Tractor shovel (0.34 m <sup>3</sup> )	: 1
- Conveyer belt (7 m)	: 1
- Supporting equipment	: 1 set

###### B) Plants

- Crushing plant (30 ton/hr)	: 1 set
- Batcher plant (Forced mixing type)	: 1 set
- Precast concrete plant	
Block manufacturing equipment	: 1 set
Steam curing equipment	: 1 set
Forklift	: 2
Diesel generator (45 kw)	: 1
Steel-bar cutter	: 1
Water treatment facility	: 1 set

##### Stage 1.2

###### A) Irrigation Facilities

- No.17 : Jangsa Channel (L= 5,234 m(\*)), wooden mattress intake

- No.12 : Gessa Chawa Channel (L= 1,623 m(\*)), "
- No.11 : Kempa Tangyul Channel (L= 1,912 m(\*)), "
- No.15 : Damjimayu Channel (L= 2,390 m(\*)), "

B) Farm Road and River Protection

- Site 1 : Left bank of the Dotey River (L= 3.7 km)

C) River Protection

- Site 1 : Right bank of the Dotey River (L= 3.7 km(\*))

Stage 1.3

A) Irrigation Facilities

- No.19 : Chendo Chuka (L= 2,991 m(\*)), concrete dam intake
- No.21 : Bamdoley (L= 1,904 m(\*)), masonry intake
- No.28 : Rema Thangyul (L= 837 m(\*))

B) Farm Road

- Site 2 : Bamdoley-Jangsa (Jangsa Bridge) (L= 6.2 km)  
(Left bank of the Paro River)

C) River Protection

- Site 2 : Bamdoley-Jangsa (Jangsa Bridge) (L= 6.2 km(\*))

D) Procurement of Construction Equipment (Second)

- Bulldozer (21 ton) : 1
- " (15 ton) : 1
- Rakedozer (15 ton) : 1
- Backhoe (0.6 m<sup>3</sup>) : 1
- " (0.35 m<sup>3</sup>) : 1
- Dump truck (11 ton) : 8
- Vibrating roller (10 ton) : 1

Stage 2.1

A) Irrigation Facilities

- No.13 : Sharimochu (L= 1,230 m(\*)), concrete dam intake
- No.14 : Gangyul (L= 2,547 m(\*)), "
- No. 1 : Shaba Shendo (L= 1,906 m(\*)), wooden mattress intake
- No. 8 : Tshetey Yuwa (L= 667 m(\*)), concrete dam intake

B) Farm Road

- Site 3 : Satsam Chorten - Tshongdu (L= 8.6 km)  
Right side of the Paro River,  
along the foot of the mountain
- Site 4 : Nyemizam - Khangku (L=1.7 km)  
Right bank of the Paro River (Dzong-Airport)

C) River Protection

- Site 4 : Nyemizam-Khangku (L= 1.7 km(\*))

D) Farmland Consolidation

- Approximately 50%, Upstream side

Stage 2.2

A) Irrigation Facilities

- No.3 : Shaba Bara (L= 2,240 m(\*)), wooden mattress intake
- No.4 : Dujey Dingkha (L= 1,672 m(\*)), "
- No.6 : Serekha (L= 1,398 m(\*)), concrete dam intake

B) Farm Road

- Site 6 : Bondey-Gyebjana (L= 1.7 km)  
Right side of the Paro River,  
along the foot of the mountain
- Site 7 : Chorten-Sarpa-Deankha (L= 3.4 km)  
Left bank of the Paro River

C) River Protection

- Site 5 : Right side of Gyebjana Rongchu (L= 2.05 km(\*))
- Site 7 : Chorten-Sarpa-Deankha (L= 3.4 km(\*))

D) Farmland Consolidation

- Approximately 50%, Downstream side

(Note): The mark (\*) in the above shows the total length of the route; which is different from the length to be rehabilitated under this project.

**2.4.3 Progress of the Project**

Based on the schedule proposed in the basic studies of Phase I and II, Stage 1.1 was carried out (date of E/N : April 1990; date of completion: March 1991), in which construction equipment was procured and plants were constructed.

Following the above, Stage 1.2 was executed (date of E/N : December 1990; date of completion: March 1992), which was composed of construction of irrigation channels and a farm road, and river protection work. In addition, some construction equipment ( one concrete pump and 3 crawler carriers with cranes ) was additionally purchased.



## 2.5 Outline of the Request

### 2.5.1 Background of the Request

As described in the preceding section, the Jangsa Bridge, which is over the Paro River and links the Paro Market, a central area of the project area, and the Dotey area located on the other side of the Paro River, was damaged due to flood in July 1990 during the course of the project. The riverbed was partly swept away, a pier of the bridge sunk, and concrete slabs fell, resulting in passage restriction. Later, in September 1991, due to another flood, the above-mentioned pier and concrete slabs from two spans fell down. The Government of Bhutan requested Dantak, an Indian aid agency, to make emergency repairs, and a steel truss bridge was temporarily installed. However, passage of heavy vehicles was still restricted. Thus, the Government of Bhutan made a request to the Government of Japan for reconstruction of the bridge.

On the other hand, implementation of Stages 1.3, 2.1, and 2.2 was decided to be postponed for the Japanese fiscal years of 1991 and 1992, as before mentioned.

Thus, the basic design study, Phase III of the Paro Valley Agricultural Development Project, including the basic design for the new Jangsa Bridge, was carried out, taking the following issues into consideration.

- 1) With the delay of the Paro Valley Agricultural Development Project, the project cost might change depending on price fluctuations.
- 2) With the above delay, the social situation and the condition of equipment and plants supplied will change.
- 3) The repair of the Jangsa Bridge will significantly effect the implementation schedule of the project.
- 4) Use of the equipment supplied by the project is indispensable to the construction work of the new Jangsa Bridge.

## 2.5.2 Contents of the Request

### (1) Agricultural Development Plan

Prior to the basic design study of Phase I, the Government of Bhutan submitted a list of requests, which is summarized below.

- 1) Irrigation channels
  - Number of channels : 27
  - Total length : 64.39 km
  - Command area : 1,795 ha
- 2) Farm roads
  - Number of roads : 10
  - Total distance : 64.78 km
- 3) Farmland consolidation
  - Number of farms : 2
  - Total land area : 58.7 ha
- 4) Equipment
  - Number of items : 12
  - Total quantity : 57 units and supporting equipment
- 5) Plant
  - Crushing plant : 1
  - Precast concrete plant : 1
- 6) Others
  - Supply of spare parts
  - Cost for transportation, installation and training

Each of the above components was examined in the basic design study of Phases I and II considering necessity and priority. The results were presented in the study report of Phase II, and approved by both the Governments of Bhutan and Japan. Accordingly, the contents of the request in the current basic design study of Phase III are the contents of the remaining Stages 1.3, 2.1, and 2.2; together with the items which were newly requested by the Paro Valley Agricultural Development Project Office, the Ministry of Agriculture, in the course of the Phase III field survey.

#### 1) Contents of the Remaining Three Stages (See Fig.2.3)

##### a) Irrigation Facilities

- No.19 : Chendo Chuka (L= 2,991 m(\*)), concrete dam intake
- No.21 : Bamdoley (L= 1,940 m(\*)), masonry intake
- No.28 : Rema Thangyul (L= 837 M(\*))
- No.13 : Sharimochu (L= 1,230 m(\*)), concrete dam intake
- No.14 : Gangyul (L= 2,547 m(\*)), concrete dam intake
- No. 1 : Shaba Shengo (L= 1,906 m(\*)), wooden mattress intake
- No. 8 : Tshetey Yuwa (L= 667 m(\*)), concrete dam intake

- No. 3 : Shaba Bara (L= 2,240 m(\*)), wooden mattress intake
- No. 4 : Dujey Dingkha (L= 1,672 m(\*)), wooden mattress intake
- No. 6 : serekha (L= 1,398 m(\*)), concrete dam intake

b) Farm Roads

- Site 2: Bamdoley - Jangsa (Jangsa Bridge) (L= 6.2 km)  
(Left bank of the Paro River)
- Site 3: Satsam Chorten - Tshongdu (L= 8.6 km)  
(Right side of the Paro River,  
along the foot of the mountain)
- Site 4: Nyemizam - Khangku (L= 1.7 km)  
(Right bank of the Paro River, Dzong-Airport)
- Site 6: Bondey - Gyebjana (L= 1.7 km)  
(Right side of the Paro River,  
along the foot of the mountain)
- Site 7: Chorten - Sarpa - Deankha (L= 3.4 km)  
(Left bank of the Paro River)

c) River Protection

- Site 2: Bamdoley - Jangsa (Jangsa Bridge) (L= 6.2 km(\*))  
(Left bank of the Paro river)
- Site 4: Nyemizam - Khangku (L= 1.7 km(\*))
- Site 5: Right side of Gyebjana (L= 2.05 km(\*))
- Site 7: Chorten - Sarpa - Deankha (L= 3.4 km(\*))

(Note): The mark (\*) in the above shows the total length of the route; which is different from the length to be rehabilitated under this project.

d) Farmland Consolidation

- Shaba area, 18.5 ha

e) Construction Equipment

- Bulldozer (21 ton) : 1
- " (15 ton) : 1
- Rakedozer : 1
- Backhoe (0.6 m<sup>3</sup>) : 1
- " (0.35 m<sup>3</sup>) : 1
- Dump truck (11 ton) : 8
- Vibrating roller (10 ton) : 1

2) Requested Changes at the Time of Field Survey of Phase III Study

- Exclusion of farmland consolidation work
- Extension of Farm Road No.1, left bank of Dotey River, by about 1.4 km from the terminal point of Farm Road No.1 constructed in Stage 1.2
- Revision of construction equipment procurement  
(See Table 2.16, Revised Request)

3) Requested Change at the Time of the Draft Report Explanation of Phase III Study

- Change of the terminal point of Farm Road Site 3  
(From "Tshongdu" (original) to "Taju" (revised) )

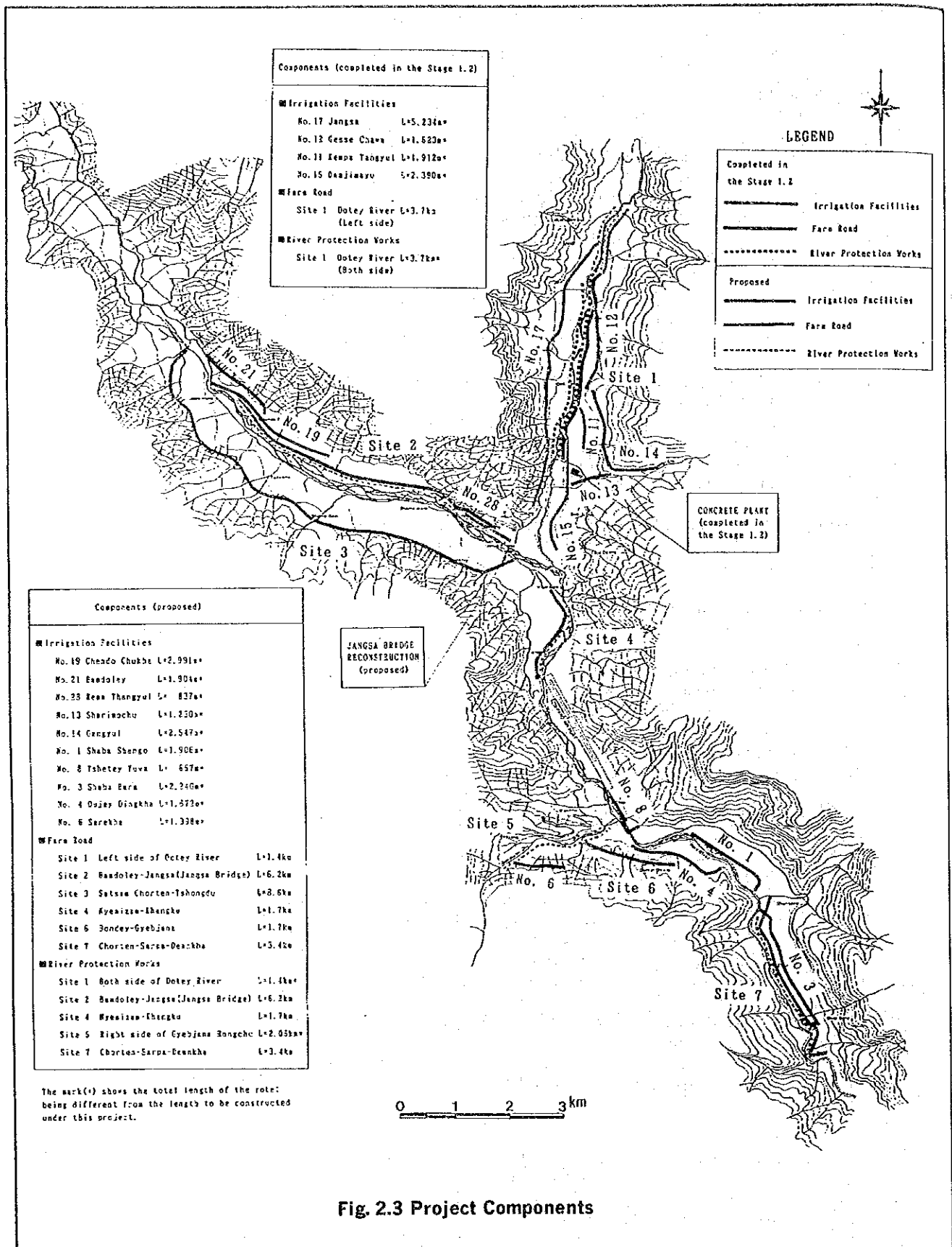


Fig. 2.3 Project Components

Table 2.16 Revised Request of Construction Equipment

Originally Proposed Construction Equipment  
for Stage 1.3

1) Bulldozer (21 ton)	: 1
2) " (15 ton)	: 1
3) Rakedozer	: 1
4) Backhoe (0.6 m <sup>3</sup> )	: 1
5) " (0.35 m <sup>3</sup> )	: 1
6) Dump truck (11 ton)	: 8
7) Vibrating roller (10 ton)	: 1

Actually Required Construction Equipment  
for Stage 1.3

1) Bulldozer (21 ton)	: 1
2) " (15 ton)	: 1
3) (*) Motor grader (85-112 HP, or GD 461A-313A)	: 1
4) Backhoe (0.6 m <sup>3</sup> )	: 1
5) " (0.35 m <sup>3</sup> )	: 1
6) (**) Dump truck (11 ton)	: 5
7) (*) Mixer truck (2.2 m <sup>3</sup> )	: 2
8) Vibrating roller (10 ton)	: 1
9) (*) Wheel loader (WA 100)	: 1

Support Equipment

1) (*) 4x4 double cabin pick-up	: 1
2) (*) High pressure washer with accessories	: 1

Others

- |  |
|--|
| 1) (*) Additional spare parts for equipment and machinery which are already at the project site. |
| 2) (*) Spare parts for the mixer truck which have had recently damaged.                          |
| 3) (*) Spare parts for the rough terrain crane which have had recently damaged.                  |
| 4) (*) Training abroad.  |

(Note) (\*) : Additional item.  
(\*\*) : Number changed.

## (2) Reconstruction Plan of the Jangsa Bridge

As mentioned in the "Background of the Request" section, the request from the Government of Bhutan, made in January 1992, is as follows, assuming that the bridge would be reconstructed.

### 1) Dimension and Structure

- Length of the Bridge : 250 feet
- Span Number : 3
- Substructure : RCC type, 2-abutment and 2-piers
- Superstructure : RCC type, T-beam
- Loading : 24 ton

### 2) Accessories

- Protection work on bank for abutments
- Realignment of an irrigation channel using an excavator
- Protection work for piers

## Chapter 3. OUTLINE OF THE PROJECT AREA

### 3.1 Location and Socio-Economic Conditions

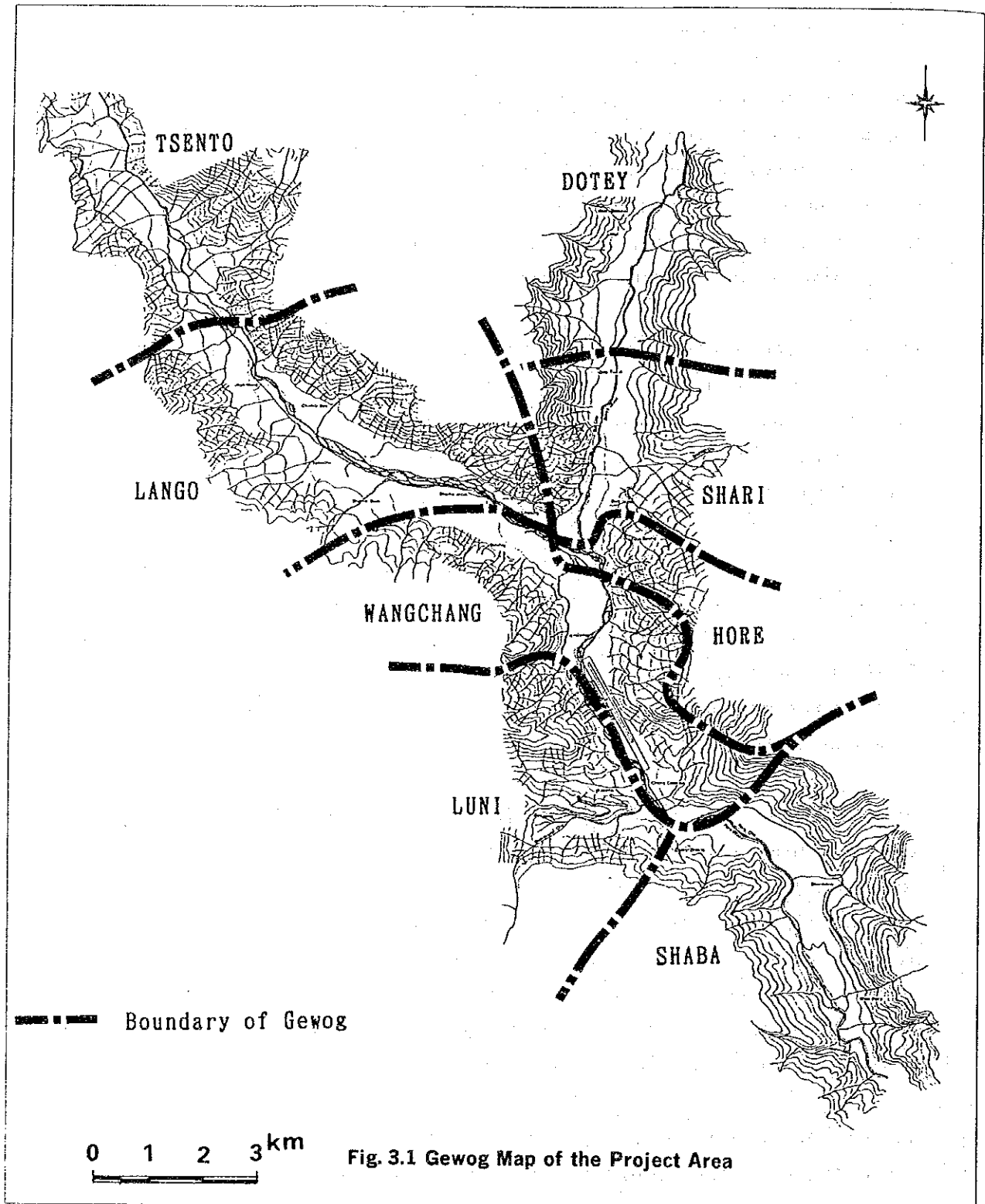
The area is located in the Paro Dzongkhag, part of the Western Zone (Zonal Administration I), and at a north latitude of 27° 20'-27° 35' and east longitude of 89° 15'-89° 30'. It is situated along the Paro River and its tributary, the Dotey River. The project aims at the farmland areas near the confluence of and along the above rivers to the extent of about 20 km in distance.

There is an international airport in Paro, the only one in Bhutan. The area is linked to the capital, Thimphu, by Highway No.1 and has an important role in national transportation. The highway was just paved with asphalt and is 50 km in length. It takes an hour and a half to drive from Paro to Thimphu.

The Paro Government Office (Paro Dzongkhag) is on the left bank side of the confluence of the Paro and the Dotey rivers. Together with the Paro Market, a commercial center, situated on the opposite site of the Paro Dzongkhag, the project area forms the central zone of administration and commerce in Paro. The area is composed of 8 gewogs as shown in Fig. 3.1.

Population in the eight gewogs was estimated at 11,900 in the year 1990, assuming a population of 11,168 in the year 1987. As for foreigners living in the area, Indians dominate and engage in work related to the operation and maintenance of national highways and airport expansion. Most of them live in temporary cottages and form their own community. Since the Dalai Lama's escape from Tibet in 1959, refugees from Tibet have settled in the Paro area. They have been given farmland and scattered among various gewogs.

Agriculture and forestry are the main industries in Paro, and as for agricultural production, the area is one of the biggest granaries in which paddy and wheat are produced. As cash crops, potatoes and other vegetables thrive and are exported, as well as timber.





There are many tourist attractions such as the Togtshang Monastery, called the Tiger's Nest, the Paro Dzong and the Drugyal Dzong Museum. Having the international airport, the area acts as a base for tourism.

### **3.2 Natural Conditions**

#### **3.2.1 Topography**

The project area is situated in the eastern part of the Himalayas. It is called the Himalayan Heights which was subject to geological folding eons ago; and it is of deep valleys and steep mountains. The Paro River which flows from the northwest towards the southeast meets the Thimphu River at the Dzongkhag boundary and becomes the Raigewong River and finally flows into the Indian Plain. The overall riverbed longitudinal gradients of the Paro River and its branch of the Dotey River are steep: 1/80 upstream of the confluence, 1/120 downstream of the confluence; and 1/90 in the Dotey River. Hence, their tractive forces are strong and the shapes of the riverbeds change with each flood. The agricultural areas are located on the land which is deposited with flood sediments and on the delta formed by small streams at the foot of the mountains.

#### **3.2.2 Geology**

Geology in and around the project area is composed of gneisses from the Precambrian age and covered with overburden consisting of fan deposits, talus deposits and riverbed deposits from the Pleistocene age to the Recent Quarternary age.

The Gneisses are of two types: a melanocratic banded gneiss containing a large amount of biotite (garnet bearing) and a leucocratic gneiss consisting mainly of quartz and feldspar.

The weathered zone is found near the surface. It can be divided into two zones: 1) a highly weathered zone where rocks are brown in color and some of the rocks have changed into clay; and 2) a slightly weathered zone where joints are open and weathering is in progress. The weak weathered zone is around two to three meters thick.

Fan deposits are found at the sloping foot of mountains but are not widespread. They consist of silt and subangular gravels derived from the highly weathered gneiss zone.

Riverbed deposits are distributed on riverbeds and consist mainly of cobble to boulder size rounded gravel. In addition to gneisses, the lithology of the main gravel consists of metamorphic rocks derived from the Precambrian series such as crystalline schist, marble, and quartzite.

### **3.2.3 Climate**

Paro Dzongkhag is located in the monsoon climate zone with a rainy season (June to September) and a dry season (December to February). The annual precipitation is 500-1,000 mm and monthly average temperatures range from 5 to 25 degrees centigrade. Meteorological observations are made at Bitekha, near the border with Ha Dzongkhag, at Bondey Farm and at Dotey. The records for the Bondey Farm, which are relatively complete, are given in the Appendix. According to the above records, rainfall in the four months of a wet season makes up 72-80 % of the annual precipitation. Average temperatures in that season range from 18 to 20 degrees centigrade.

### **3.2.4 Hydrology**

Major water resources in this area are the Paro River and the Dotey River, and their water flow is considered enough for irrigation for farmlands in the area, even in the dry season. The Sharirongchu River and the Gebjanarongchu River, which are small rivers, and the above rivers have similar irrigation properties. However, in upstream regions on the delta area of the Sharirongchu River, the river is mostly underground and is not considered a stable water source.

### **3.2.5 Water Quality**

The water quality of the Paro and Dotey rivers, as surveyed in the Phase II study, is on the alkali side and contains slight amounts of calcium and magnesium. In general, the water quality is basically

fair, meeting Japanese water source criteria of Rank A. However, in times of rainfall during the wet season, there is a high concentration of suspended solids.

### 3.2.6 Natural Environment

Of the 213,000 ha of land making up Paro Dzongkhag, 171,900 ha (81%) is forest. Most of the trees are pine, cypress, oak, walnut or rhododendron, with little bamboo grass. Major animals and plants are as follows:

- Animals : bear, wild boar, deer, fox, etc.
- Birds : sparrow, crow, dove, kingfisher, woodpecker, finch, etc.
- Fishes : brown trout
- Plants : pine, cypress, oak, walnut, rhododendron, willow, pear, apple, etc.

### 3.3 Social Infrastructure

#### (1) Roads

Roads in Bhutan can be classified into highways, district roads, and farm roads. A district road is one that interconnects gewog centers. A farm road is also called a feeder road. The road network in Paro is shown in Fig. 3.2; and Table 3.2 gives construction years, construction agencies, and maintenance agencies. There are three bridges able to be used by vehicles in Paro: the Jangsa Bridge, the Shari Ramna Bridge, and the Bondey Bridge. The Jangsa Bridge is now a temporary structure restricted for heavy vehicles. The Bondey Bridge is now being renewed by Dantak, the Indian organization.

Table 3.2 Existing Roads in Paro

( 1992 )

Route	Year	Construction Agency	Maintenance Agency
<b>Highway</b>			
1) Confluence - Paro Market	1962	BRTF	BRTF
2) Paro Market - Drukgel Dzong	1966	BRTF	BRTF
<b>District Road</b>			
1) Paro Market - Museum	1976	PWD	PWD
2) Paro Market - Olathang hotel	1966	PWD	PWD
3) Bondey Bridge - Chundudingkha	1975	Forest D/BRTF	BRTF
4) Bondey Bridge - Airport	1967	BRTF	BRTF
<b>Feeder Road</b>			
1) Shari Ramna Dotey Acho (Bridge) R.B.	1976	BRTF	BRTF
<b>Farm Road</b>			
1) Shari Ramna Bridge Jabji Bridge	1977	Dzongkhag	Farmers
2) Bondey Farm - Pangbina	1974	Dzongkhag	Farmers
3) Bondey Village - Bondey Farm	1973	PWD	PWD
4) Bondey Farm - Gyebjana	1976	Forest Contract	Forest Contract
5) Shaba School - Shinagkana	1986	Farmers	Farmers
6) Nichiphu - Sachan Choten	1976	Farmers	Farmers
7) Geta Zampa - Lango School	1977	Farmers	Farmers
8) Highway - Kichu	1973	PWD	PWD

## (2) Water Supply

The "Paro Urban Water Supply and Sanitation" project was implemented and a water supply was provided to the people of Paro in 1991. This system, however, has not functioned well, because installation of house connection pipes has been infrequent. Presently a considerable number of households use irrigation water or small stream water for domestic use; an example of this is the Jangsa Channel, completed in Stage 1.2, the water of which is used domestically.

## (3) Schools

In Paro, there are 8 primary schools, one secondary school, and one high school. Although the number of schools is less than that of Thimphu, it is more than the average of Zone I and the national

average, considering the proportion of the number of schools to population. Considering the ratio of the number of schools to land area, Zone I has a higher ratio than the national average, and Paro's ratio is average for Zone I. The Paro area is considered to have excellent education conditions, although the distance to schools is comparatively far.

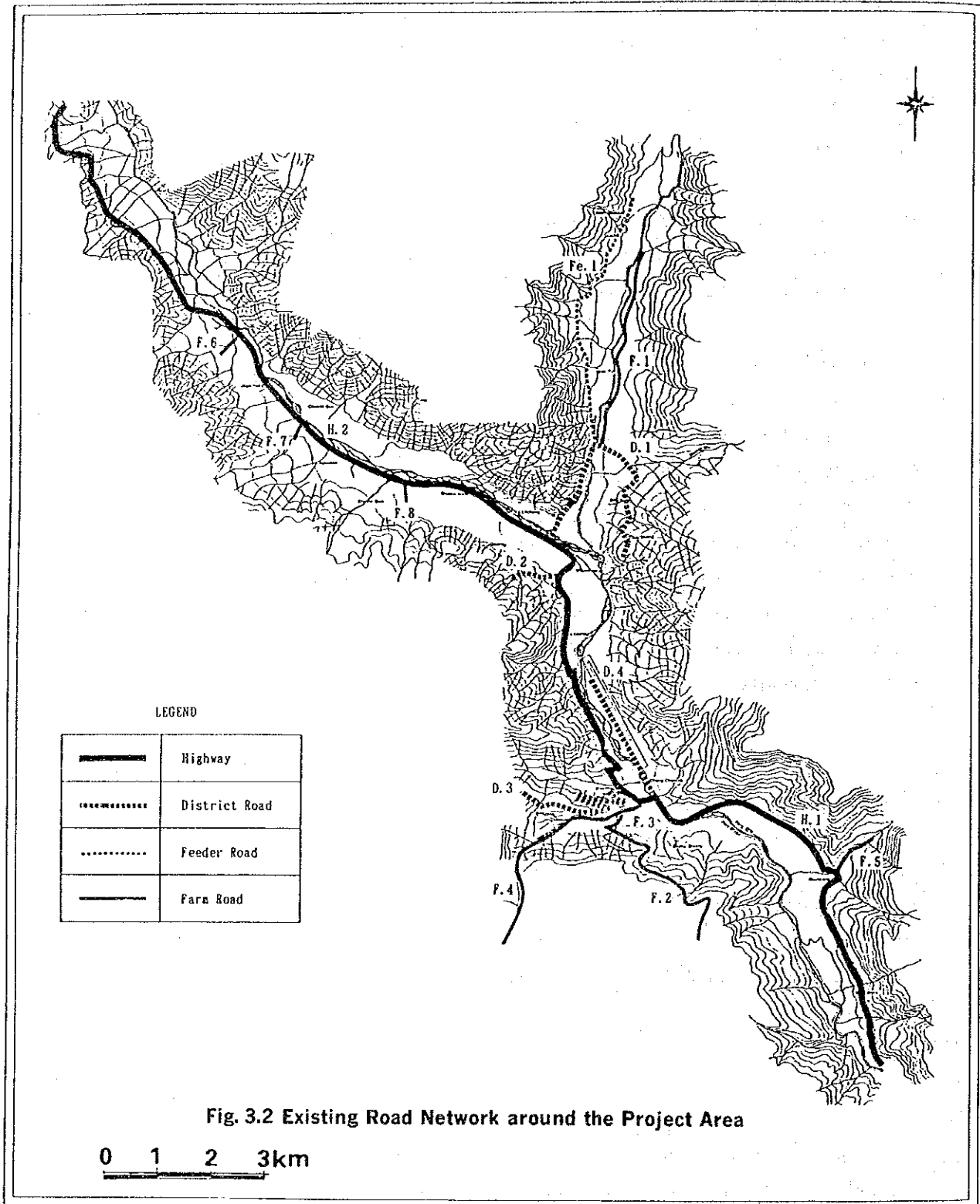
#### **(4) Other**

The number of hospitals and telephones is less than that in other major cities, but more than the national average. Worth particular mention is that the only international airport in Bhutan is here.

#### **3.4 Related Projects**

In Paro, there are three completed projects and three other on-going ones, as described in Chapter 2. Of these, the projects most closely related to the current project are the National Seed and Plant Program (NASEPP) and Agricultural Mechanization Center (AMC); and they are now actively operating. The agricultural infrastructure made by these two projects and the current project are effectively connected to each other; agricultural modernization and an increase in land productivity will be promoted.

PARO VALLEY AGRICULTURAL DEVELOPMENT PROJECT



## **Chapter 4. OUTLINE OF THE PROJECT**

### **4.1 Objective**

The project area is in a relatively advanced agricultural area for Bhutan. However, from an international perspective, the rate of development, both in agricultural infrastructure and social infrastructure, is considered low. The purpose of the project is to encourage the Bhutanese to construct similar infrastructure and to present a model of the work, while playing a role in increasing food self-sufficiency. In its implementation, care shall be taken that forms of production and social conditions are not drastically changed.

On the other hand, the purpose of the reconstruction of the Jangsa Bridge is to provide a safe bridge for the local people, normalization of transportation of agricultural materials and agricultural products, and facilitating the current project implementation.

### **4.2 Contents of the Request**

#### **4.2.1 Validity and Necessity of the Project**

##### **(1) Agricultural Development Program**

The Paro Valley is an advanced agricultural area and the people are highly motivated. As clarified in the previous studies during Phases I and II, consolidation of related infrastructure has not been sufficient and productivity would therefore not increase markedly. The related infrastructure has the following problems.

##### **1) Irrigation Facilities**

Most of the irrigation facilities in the project area are not equipped with permanent intake facilities. Therefore, water intake is difficult during seasons when the river water level is low. Sometimes the planting time changes, resulting in product instability. Furthermore, most irrigation channels are made of soil, causing a

great deal of leakage and making irrigation somewhat ineffective. The maintenance of these irrigation facilities has been labor intensive.

## 2) Farm Roads

The main roads in the project area are as mentioned in the preceding chapter. National Highways and District Roads are paved with asphalt; but, feeder roads which connect with them lack maintenance, and their surfaces are poor. As most farm roads have not been well constructed, the movement of agricultural equipment and the transportation of products has been affected.

## 3) River Protection

The main rivers in the project area are the Paro River and its tributary, the Dotey River; their banks have not been reinforced, except for places near the airport, the national highways, and district roads. Due to heavy floods which happened in 1968 and 1973, agricultural land was damaged. The main farmlands in the area are located where they are susceptible to flood and farmlands situated along the rivers are eroded during the rainy season year after year, resulting in a reduction of farmland area.

In order to solve the above problems, it is necessary to construct permanent intake facilities, line the irrigation channels and install accessory equipment. Further, facilities which are deteriorated or damaged are urgently in need of repair, as mentioned in the previous Phase's study. Good farm roads are necessary for an increase in labor productivity; and river protection work for preservation of limited farmlands. These agricultural development plans were selected as the grant aid program, from a large list of requests from the previous Phases, based on urgency and necessity. Bhutan intends to promote development from time to time, using the Japanese aid project as a model. Presently, there is a manpower and construction equipment shortage in Bhutan. Thus, supplying construction equipment and spare parts is quite effective both for the smooth implementation of the grant aid project and in the implementation of other projects in the district.



## **(2) Reconstruction of the Jangsa Bridge**

There are just two bridges over the Paro River, the Jangsa Bridge and the Bondey Bridge, and are therefore important to local transportation. Reconstruction of the Jangsa Bridge is essential for the implementation of the above agricultural development project as machinery will be used and needs to be transported. In and around the area, there are many bridges which need to be reconstructed due to deterioration or poor condition (including suspension bridges). Also from the viewpoint of a technology transfer of bridge engineering to Bhutanese engineers, the reconstruction work has enough merit.

### **4.2.2 Operation and Maintenance**

The operation and maintenance of the project has been carried out by the Paro Valley Agricultural Development Project Office, under the Ministry of Agriculture, Bhutan, since the beginning of Stage 1.1. The land development work, water supply, and electrical work for the concrete plants in Stage 1.1 were the obligation of the Bhutanese, utilizing government funds. At first, as the office was newly established and the work time did not fall within the Bhutanese fiscal year, budgeting was not secured. However, disbursement for the above works and assignment of personnel were made in turn. In Stage 1.2, an annual budget of Nu. 7 million was prepared and disbursed as necessary. Operators of construction equipment and other required personnel were hired; AMC in the area also cooperated in the project implementation.

Judging from the above, and from the fact that the Project Office still exists even during the present project postponement, project implementation and operation and maintenance will certainly be executed in the coming stages.

### **4.2.3 Relationship with Similar Projects**

In the Paro area, the offices of both the National Seed and Plant Program (NASEPP) and AMC are active, as mentioned in section 3.4. Judging from their areas of concern, the current project will not

duplicate their work. Further, in the Seventh Plan and the prior projects, there is and has been no such project that duplicates work in the Paro Valley Agricultural Development Project.

#### 4.2.4 Facilities Components

Requests by the Government of Bhutan, as mentioned in Section 2.5, are classified into the following items.

- Agricultural Facilities (irrigation facilities, farm roads, river protection work, and procurement of construction equipment)
- Jangsa Bridge (reconstruction)

The above items are related to each other and their components are considered appropriate for the agricultural development project.

#### 4.2.5 Facilities Requested

The items requested are evaluated as follows.

##### (1) Agricultural Facilities

###### 1) Irrigation Facilities

The Paro area has an abundance of surface water and therefore irrigation water is available even in the dry season. Taking climate and farm production into consideration, double or triple cropping a year is expected. However, most of the existing irrigation facilities have no permanent intake facilities able to maintain the intake water level in the dry season. Also, most channels are constructed of earth and the irrigation efficiency is very low. On the other hand, the demand for products, both for domestic supply and export, has been increasing in recent years. Thus, the rehabilitation work on 10 irrigation channels in the remaining 3 stages of the project is considered appropriate.

###### 2) Farm Roads

Road networks in the Paro area are inadequate in terms of total road length. In particular, farm roads are lacking in total length and further, most of them are footpaths or cattle trails. Following the above-mentioned rehabilitation of irrigation channels and agricultural mechanization promoted by AMC, it is considered very important to construct five main farm roads as proposed in the remaining 3 stages for the purpose of agricultural equipment and material access and the transportation of products.

The farm road constructed on the left bank of the Dotey River in Stage 1.2 had a strong impact on the people nearby: not only an increase in farming efficiency, but also greater convenience in their daily lives. For the people living upstream of the end of the completed road, who produce apples as a cash crop and have been forced to do considerable labor to ship the product, extension of the road has been strongly requested. The extension of the Dotey Farm Road, requested in the

course of the Phase III study, seems reasonable for the following reasons.

- According to the field reconnaissance, upstream of the completed road, there are 27 farm houses with paddy fields of 71 ha, agricultural lands of 71 ha and 4,800 apple trees. Thus, the road extension is required.
- There is an existing farm road, constructed by the Paro Dzongkhag on the right bank of the Dotey River, and the Dzongkhag is planning to rehabilitate and extend it. For this rehabilitation of the road, Nu. 20,000 has already been committed and work is scheduled to begin this year, 1992. This extension will be connected to the Dotey Farm Road extension requested; thus, it may be very beneficial.

### 3) River Protection

River protection work at 4 sites as proposed in Phases I and II is intended to protect the new and existing farm roads from erosion, preserve the back section of farms, and is considered essential. For the Dotey Farm Road extension work recently requested, the river protection work is necessary because the road is located along the river. In addition, the opposite site of the road also requires river protection work, from a viewpoint of riverflow alignment, at places where the riverflow hits the bank.

### 4) Farmland Consolidation

Of the work to be done in the remaining stages, the Government of Bhutan proposed excluding the farmland consolidation work. In the Sixth Plan, an increase in food production had been given a high priority. For a production increase to be realized within the limited farmland area, the farmland consolidation work, one type of integrated development, was considered the most effective. In the Seventh Plan, however, a policy of "balanced local development" is used. Although the rate of food self-sufficiency is still not enough, the policy controls development of the limited land, excessive farming, and drastic development. The reason for the exclusion of the farmland consolidation work is a fear that it might stand out on a national level. "Sustainable and effective use of natural resources" is also one of the Seventh Plan's policies. Development which brings drastic change is feared to be unsustainable, unless it is of a comparatively

high technical nature. As the work of land consolidation involves the replacement of farm soil, production might decrease for a short period. In order to prevent this, usage of soil-improving materials and fertilizer is essential. In Bhutan, however, they are not readily available and equipment to utilize them is also lacking. There would be a problem whether farmers could continue farming work under such circumstances. Unless there is a large possibility of success, it may adversely affect other areas to a great extent.

In conclusion, it has been decided that the land consolidation work should be done at some later time when the level of agriculture is higher.

#### 5) Procurement of Construction Equipment

For the agricultural development work in the area, a mechanized construction method is necessary in order to supplement the labor force and to make the construction period short. Agricultural development is not only to be done in the remaining three stages financed by grant aid, but in other project to be carried out by Bhutan. Thus, the request from the Government of Bhutan is basically acceptable. Needless to say, the equipment requested: bulldozer, backhoe, dump truck and vibrating roller, are necessary for earth work on a large scale like the farm road work and river protection work. The following items are newly-requested or additional equipment.

- Motor Grader:

Judging from Stage 1.2, just the use of a vibrating roller and a bulldozer cannot make the road surface completely level, and the surface may be damaged easily by vehicular traffic. For better road surface work and for maintenance work in the area after the project completion, this equipment is very useful, and worth procuring.

- Wheel Loader:

In Stage 1.1, the location of the concrete plant was shifted to the Shari area, at the meeting point of the Shari River and a feeder road, from the originally-proposed site at Lango, on the right bank of the Paro River, in order to prevent noise problems. With the change, the distance between the crushed-stone storage yard and the concrete batching plant has increased, because of the land condition for land development work. The purpose of the equipment, a wheel loader, is to convey crushed stones to the batching plant. As future work, including the construction of a new bridge, requires more concrete, the wheel loader is worth being procured.

- Mixer Truck:  
For the construction work of the new Jangsa Bridge, the volume of concrete used will be large, and proper transportation of it will be necessary. To supplement the existing two mixer trucks, an additional mixer truck is necessary.
- Pick-up Truck:  
The work site is to be enlarged in future stages. For proper construction supervision work, the addition of a pick-up has been determined necessary.
- High Pressure Washer:  
In Stage 1.2, the washing of equipment was carried out by a private workshop for a fee. This washing is fundamental for the maintenance of vehicles and machinery and necessary for keeping nearby roads clean; procurement of the washer is necessary.
- Spare Parts:  
Judging from the operating conditions of the equipment, the rate of damage will become higher in future stages. Therefore, in order to change the damaged parts with assembled units, i.e., an engine, a hydraulic unit, etc., block-unit spare parts are proposed to be supplied.
- Test Machine:  
Concrete to be used in the reconstruction work of the Jangsa Bridge should be of good quality; however, cement available in Bhutan is not always satisfactory. Accordingly, the concrete work shall be supervised carefully. There is only one cubic type test machine in Bhutan. Considering the frequency and accuracy of the machine, it is necessary for the project. It was determined to be necessary from the quality test results of cement samples which were obtained in the field, although this machine was not requested by the Government of Bhutan.
- Crushing Plant:  
Currently a crushing plant is located in the Shari area. It is estimated that transportation of crushed stones, mainly to be used for farm road construction, from the Shari site to the downstream region of the the Paro River, may be time-consuming and costly, since the necessary quantity of crushed stones is large. Therefore, it is considered necessary to construct a smaller crushing plant near the construction sites for the production of crushed stones.

## (2) Reconstruction of the Jangsa Bridge

The request from Bhutan asks that the bridge be about 76 m in length, a reinforced concrete (RC) structure, and of three spans. However, judging from a field reconnaissance at the river site, the bridge length should be 100 m. Further, from the results of material tests and considering the construction time frame, the superstructure of the bridge should be made of steel, H-shaped girders and 5 spans.

The realignment work of an irrigation channel, as an additional task requested by Bhutan, will be carried out by the Bhutanese. However, it will be financed by the Japanese grant aid, in order to avoid being confused with the work near the abutment, since it is composed of riverbank protection work and riverbed protection work. The inclusion of the above work will not raise the construction costs to be borne by the Japanese aid substantially.

#### 4.2.6 Technical Cooperation Study

The type of technical cooperation requested by the Department of Agriculture of Bhutan is the training of plant engineers and equipment operators; and that by the Department of Roads is the training of bridge engineers.

The training of the plant engineers, who are two engineers working for AMC under the Ministry of Agriculture, was carried out in Japan for six months prior to the implementation of Stage 1.1. However, it was determined to be insufficient to acquaint them with the actual operation methods for the plants installed at the site and training was requested once more. The two trainees would not be able to transfer the technology to others, and the plants would not be properly maintained by the Bhutanese only. Accordingly, further training is considered necessary until the end of the Japanese grant aid project. As to the method of training, it is thought more effective to dispatch Japanese engineer/s to the plant site, because the equipment layout differs because of site conditions and some equipment is sometimes combined with that of other manufacturers.

The training of equipment operators was requested in particular on transportation equipment. The purpose of the training is to master maintenance, repair, and operation techniques for equipment which was supplied in Stage 1.1, but is not imported often in Bhutan. The equipment was produced by ordinary manufacturers in Japan and reception of trainees will not be a considerable problem. The mechanics of the transportation equipment does not differ particularly from that of other manufacturers, and the training period will be about 2-3 months.

The training of bridge engineers is considered quite necessary, since bridge rehabilitation work in Bhutan is often required in the Seventh Plan. On-the-job training during the next stage is also being considered as an alternative plan.

#### **4.2.7 Direction of Technical Cooperation**

The financing of the technical cooperation, due to the above considerations, will to be borne by the Japanese grant aid, since it meets the grant aid system's requirements.

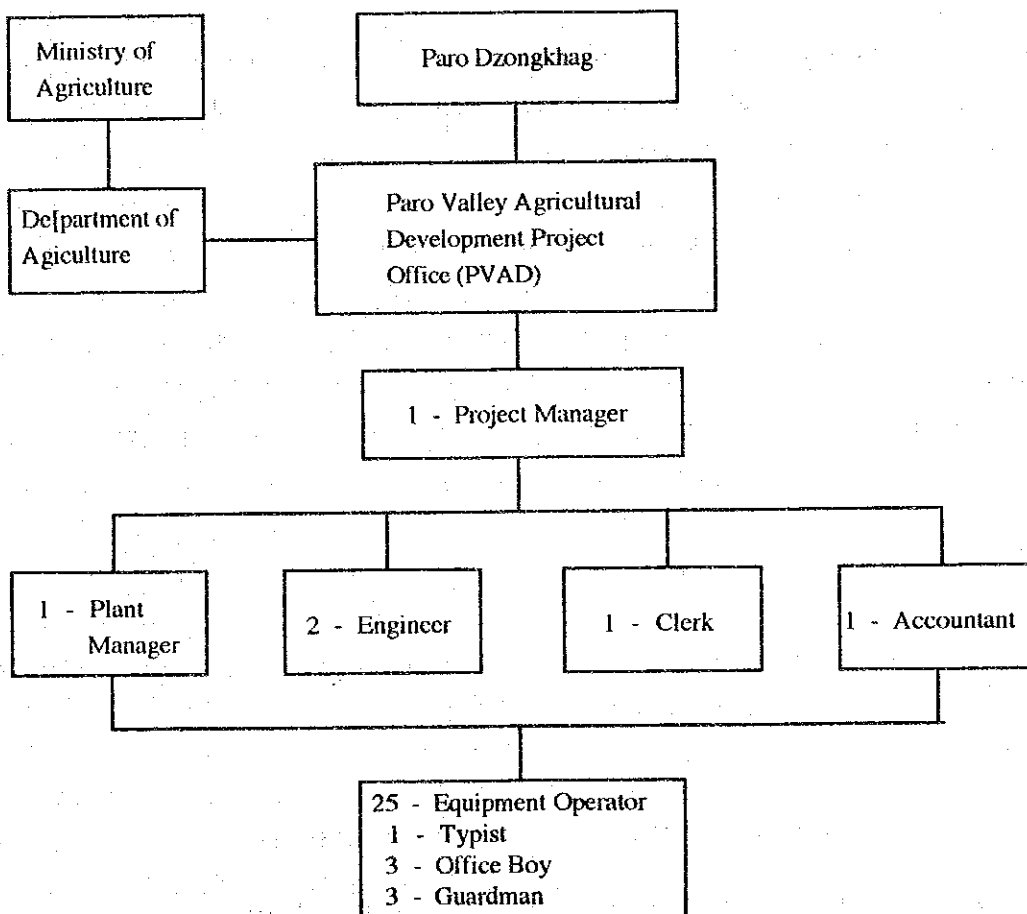


#### 4.3 Outline of the Project

##### 4.3.1 Executing Agency and Maintenance System

The executing agency of the project is the Department of Agriculture, the Ministry of Agriculture, Bhutan; and the site representative organization is the Paro Valley Agricultural Development Project Office (PVAD) located in the project area. The reconstruction work of the Jangsa Bridge is primarily under the jurisdiction of the Department of Roads (DOR); and it has been confirmed that the staff of the DOR is to work on the project.

The Ministry of Agriculture and the Department of Agriculture of the Government of Bhutan are organized as shown in Fig. 2.1. The organization and personnel of the PVAD are also shown.



#### **4.3.2 Project Proposal**

The project is composed of the construction and rehabilitation of agricultural facilities (irrigation channels, farm roads, and river protection), reconstruction of the Jangsa Bridge, and procurement of construction equipment.

##### **(1) Agricultural Facilities**

The agricultural facility work are composed of rehabilitation of 10 irrigation channels, construction of 6 farm roads, and river protection of 5 routes (4 out of 5 are to be combined with farm road work). In connection with the above, the Water Users Association (WUA) is to be established for maintenance of the irrigation facilities.

##### **(2) Reconstruction of the Jangsa Bridge**

This is the reconstruction work of the damaged Jangsa Bridge; it will facilitate implementation of the agricultural projects and maintain traffic movement and individual safety.

##### **(3) Procurement of Construction Equipment**

This aims to implement properly and promptly the above works, to construct facilities other than those provided for by the grant aid afterwards by the Bhutanese, and to maintain the facilities constructed in the current project.

#### **4.3.3 Location and Status**

The location of each facility is shown in Fig. 4.1. The proposed locations are outlined below:

##### **(1) Upstream of the Paro River (Upstream of the confluence with the Dotey River)**

In this area there are three irrigation facilities, two farm road projects (one of them is combined with a river protection project),

one river protection site and the Jangsa Bridge. The national highway runs along the right bank of the Paro River, and the Paro Market is located just downstream of the Jangsa Bridge, on the right side of the Paro River. Accordingly, farm roads play not only a role in the transportation of agricultural materials and equipment, but also one of convenience in the daily lives of the people. Protection work on the right bank of the Paro River has been comparatively well executed, since the national highway is next to it; the left bank has been eroding year by year. The above facilities are to be constructed on the flooded deposit land along the Paro River. On the left bank, there are terraced cliffs and construction work would be rather difficult.

(2) Downstream of the Paro River  
(Downstream of the confluence with the Dotey River)

In this area, five irrigation facilities, three farm road projects (two of them are combined with river protection projects) and three river protection works are proposed. The national highway passes through the Paro Market, south along hills near the right bank of the Paro River, crosses over the river at Bondey, runs further along hills near the left bank towards the south, and arrives at Chuzong, the boundary of the Thimphu Dzongkhag. The southern part of the national highway, about 1 km south of the Bondey Bridge, is situated on the river terrace, and being distant from farmlands makes the irrigation facility at Shaba Shengo and the farm road of Chorten-Sarpa-Deankha somewhat inaccessible. The international airport is around 1 km downstream from the confluence of the Paro and Dotey rivers, and from around this point, the gradient of the Paro River becomes moderate and the river also widens.

(3) Upstream of the Dotey River

Extension of the farm road and two irrigation facilities are planned in this area. Comparing this area to the downstream area where the farm road was recently constructed in the previous stage, this area does not have proper access roads. Further, public electricity has not been supplied yet and some farmers are commuting to work. Although a district road of about 3 km in length was constructed on the left side of the Dotey River, it did not reach this area. The