Chapter 6. BASIC DESIGN

6.1 Equipments and Plants

6.1.1 Equipments

Construction equipment necessary for the project is for constructing irrigation canals, farm roads and river protection works, as well as for farmlands consolidation. It includes equipments required for their administration, maintenance and repair.

(1) Criteria for Selecting Equipments

The jobs to be performed in the project include excavation, loading, hauling, grading, compaction, leveling and digging. Listed below is equipments commonly used in construction works

TABLE 6.1 CONSTRUCTION EQUIPMENT BY OPERATION

Operation	Construction Equipments
Excavation	Power shovel, Backhoe, Dragline, Clamshell, Wheel loader, Bulldozer ripper, Breaker
Loading	Power shovel, Backhoe, Dragline, Clamshell, Wheel loader, Bucket wheel excavator
Excavation, Loading	Power shovel, Backhoe, Dragline, Clamshell, Wheel loader, Bucket wheel excavator
Excavation, Hauling	Bulldozer, Scrapedozer, Scraper
Hauling	Bulldozer, Dump truck, Conveyer
Grading	Bulldozer, Motor grader
Compaction	Bulldozer, Tamping roller, Vibratory roller, Road roller, Vibrating plate compactor, Rammer, Tamper bulldozer
Land grading	Bulldozer, Motor grader
Trench Excavation	Trencher, Backhoe

A commonly used method of construction was adopted in formulating the

plan for selecting the equipments. The conditions listed below were taken into full consideration in selecting them.

Machines to be selected shall:

a) satisfy the quality precision and the construction period that the work demands,
b) be durable and seldom break down,
c) be easy to maintain,
d) be easy and comfortable to operate,
e) be designed for safety against environmental problems,
f) be easy to move,
g) be inexpensive to procure, and
h) be inexpensive to run and repair.

(2) Equipment Specifications and Work Capacity

The size of the equipments should be decided rationally according to the scale and the period of the work involved. As equipments are often used in combination with other equipments, their performance should be balanced. Since equipments have a long period of life span, say, five to seven years, it is assumed that they will be used for a long time. Thus, it was decided that, since the equipments may be diverted to other works after the work of the current project is completed, they should be selected from those which are being widely used and produced in large quantities. The specifications of widely used construction equipments are shown in Table 6.2.

(3) Irrigation Facilities

1) Intake Weir

The main facilities for which cast-in-place concrete will be used are the diversion weirs for intake. They are to be located on canals 13, 14 and 19, and will require a concrete volume of 8,000 cu.m for the three sites. Adding 2,000 cu.m for canals construction, the total volume of concrete will be about 10,000 cu.m. The concrete is planned to be made in the concrete plant with a maximum capacity of 70

cu.m/day, and the ready-mixed concrete will be transported to the placing sites by truck-mixers. Construction periods will be:

- For Canal No.19 : Stage 1.2
- For Canal No.14 : Stage 2.1
- For Canal No.13 : Stage 2.2

2) Irrigation Canals

Most of canals in the project area are located on mountain flanks, making mechanized construction work difficult in most cases. Equipments shall be carefully selected, since the medium- and large-

TABLE 6.2 STANDARD EQUIPMENTS FOR CONSTRUCTION WORK

Equipment	Standard Specification
Bulldozer	Standard type 11 t, 15 t, 21 t (Operation weight) Swamp type 13 t, 16 t (- do -)
Bulldozer with Ripper	Standard type 21 t, 32 t (Operation weight except Ripper attachment)
Scrapedozer	Standard type 6.4 cu.m (Bowl capacity) Swamp type 4.0 cu.m (- do -)
Towed Scraper	9 cu.m, 12 cu.m (Struck capacity of bowl)
Power Shovel	Mechanic crawler type 0.6 cu.m (Struck capacity of standard bucket)
Backhoe	Hydraulic crawler type 0.3 cu.m, 0.4 cu.m, 0.6 cu.m (Struck capacity of standard bucket) Hydraulic wheel type 0.25 cu.m (Struck capacity of standard bucket)
Dragline and Clamshell	Mechanic crawler type 0.8 cu.m (Struck capacity of standard bucket) Hydraulic crawler type 0.3 cu.m, 0.6 cu.m (Struck capacity of standard bucket)
Tractor Shovel	Crawler type 1.3 cu.m, 1.8 cu.m (Heaped capacity of standard bucket) Wheel type 1.0 cu.m, 1.4 cu.m, 2.1 cu.m (Heaped capacity of standard bucket)
Dump Truck	6 - 6.5 t, 8 t, 10 - 11 t (Loading capacity)

sized equipments in particular will find access to the job sites difficult.

3) Construction Equipments

The following are the construction equipments selected for constructing intake weirs and irrigation canals.

Bulldozer(3 t)	: 1
Backhoe(0.04 cu.m)	: 2
Tamper	: 4
Truck mixer(2.2 cu.m)	: 2
Mortar pump(5 cu.m/hr)	: 1
Vibrator	: 2
Belt conveyer(7 m)	: 1
Power trowel	: 2

(4) Farm Roads

The demand for construction of farm roads is so strong among local farmers in the project area that they are to offer without charge the sites necessary for farm roads. Hence it has been confirmed that through mutual cooperation farmers are about to make land adjustments by themselves and expenditure for land is not requested. However, except for existing cultivated lands, in hilly areas it is difficult to obtain the soil necessary for constructing farm roads, from a viewpoint of land acquisition. Consequently, state-owned land was selected as a borrow area, and its suitability was confirmed by means of hand-auger boring. Crushed stones will be made from boulders in the riverbeds, crushed in a crushing plant which is planned to be reset to places in the vicinity of job sites.

Construction work is to be executed on all the six routes with priority A. Length of each route is given below:

- Rehabilitation
  of existing road : Site 1, L= 3.7 km (3.0 m, gravel)

- Construction

of new road	: Site 2, L= 6.8 km	(3.0 m, gravel)
	Site 3, L= 9.5 km	(- do -)
	Site 4, L= 1.75 km	(- do -)
	Site 6, L= 1.8 km	(- do -)
	Site 7, L= 3.2 km	(- do -)
	Total L= 26.75 km	

Where river protection work and farm road construction overlap, they shall be carried out simultaneously. The work on the route along the left bank of the River Dotey and that on the left bank of the upper reach of the River Paro will be executed in Stage 1; and others in Stage 2. Four of the selected borrow areas -- BA1, BA2, BA5 and BA6 will be used for construction. Construction of the second and third phases will be carried out by using the equipments to be supplied in Stage 1.1. In Stage 2, 21-ton bulldozers, 10-ton vibratory rollers and others will be additionally supplied, after which the work will be completed in two phases. Construction quantities and construction schedule are shown in Figs. 6.1 and 6.2 respectively.

(5) River Protection Works

The work is planned mainly by using gabions but in some places along the Gebiolumi River, parapets will also be used. Given the present labor shortage, boulders will be installed in to the gabions by using backhoes. In sections where discharge capacity is less than the design discharge based on the 1968 flood, the riverbeds will be widened by bulldozers and clamshells. Since river protection works are often used as farm roads, the construction plan shall be made in relation to the farm road construction plan outlined. The quantity of the work is shown in Fig. 6.1 and construction plan is shown in Fig. 6.2.

(6) Farmland Consolidation

1) Construction Procedure

The following procedure will be adopted to make construction work

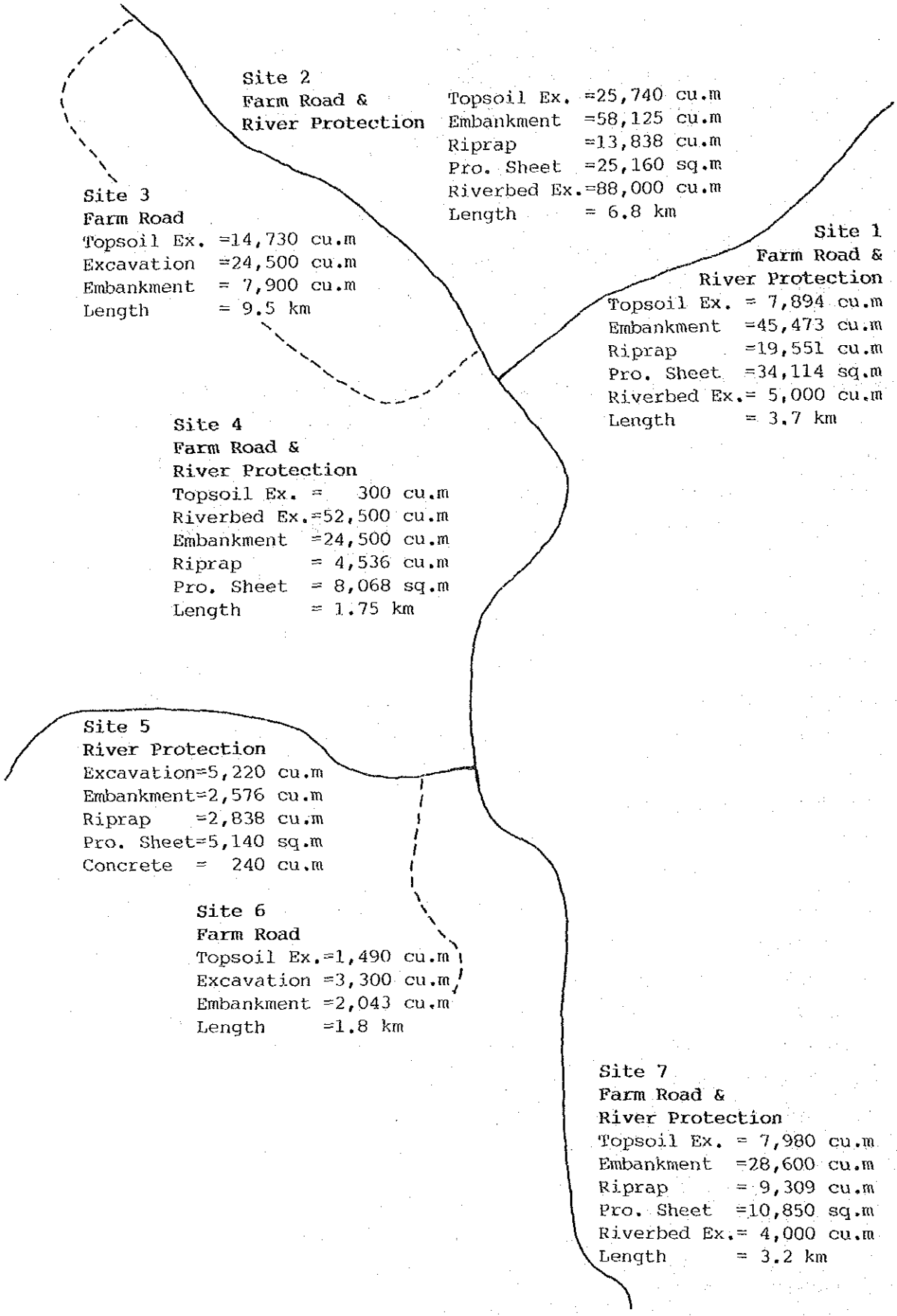
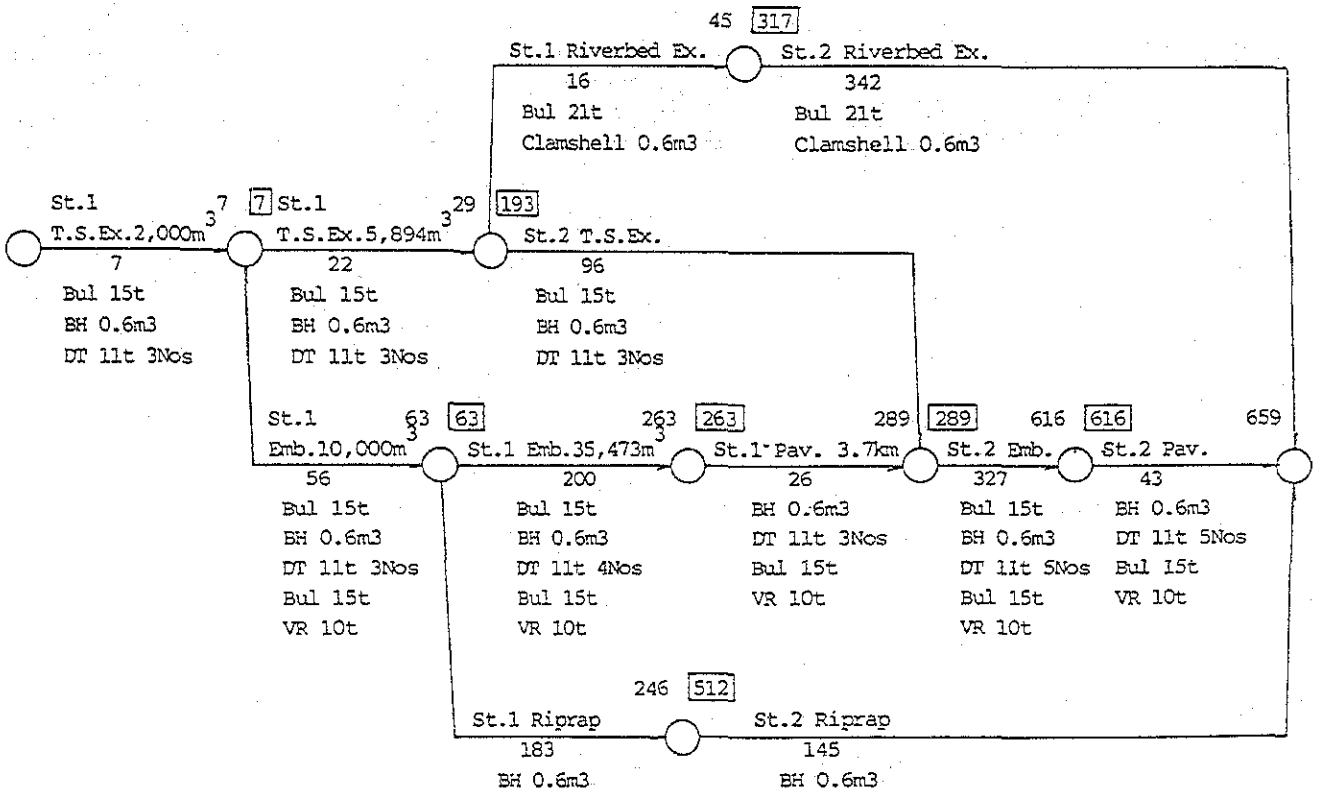


Fig. 6.1 QUANTITIES FOR FARM ROADS AND RIVER PROTECTION WORK

STAGE I



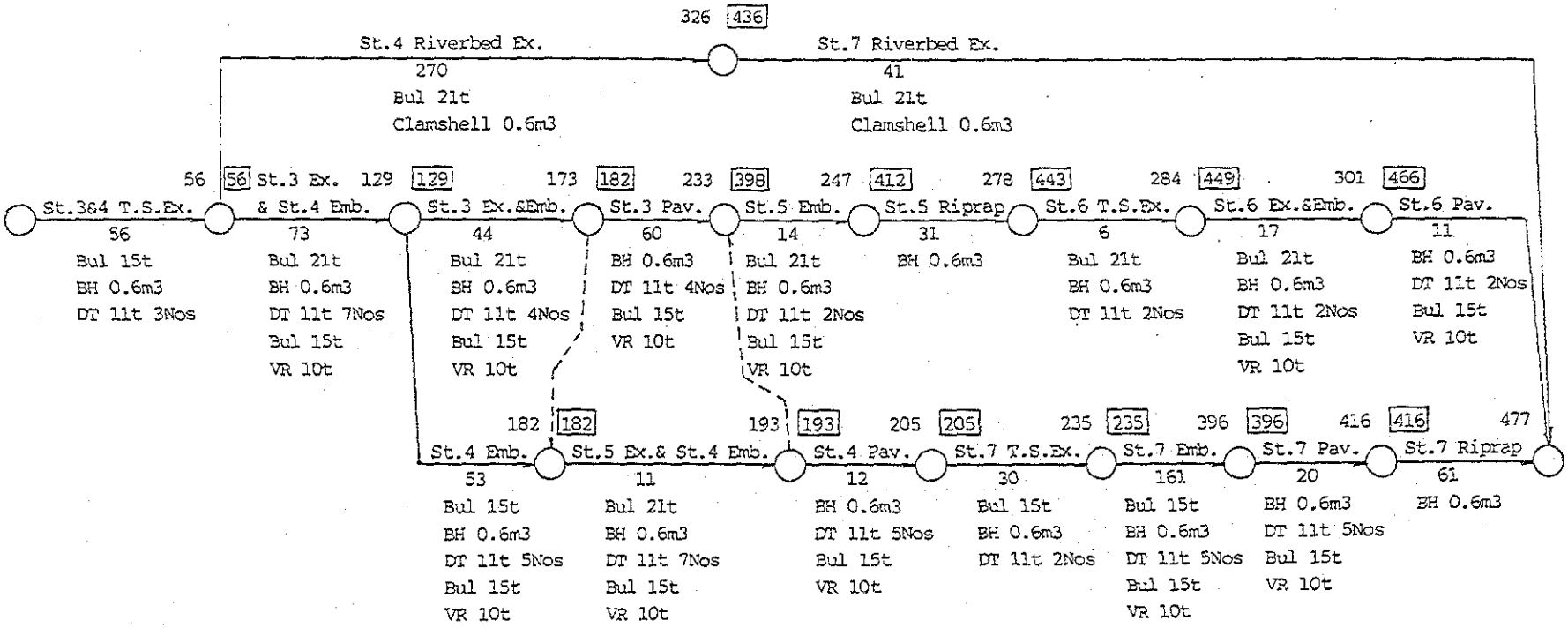
Bul : Buldozer
BH : Backhoe
DT : Dump Truck
VR : Vibration Roller

T.S.Ex. : Topsoil Excavation
Ex. : Excavation
Emb. : Embankment
Pav. : Pavement

St. : Site

Fig. 6.2a CRITICAL PATH FOR FARM ROADS AND RIVER PROTECTION WORKS - STAGE 1

STAGE II



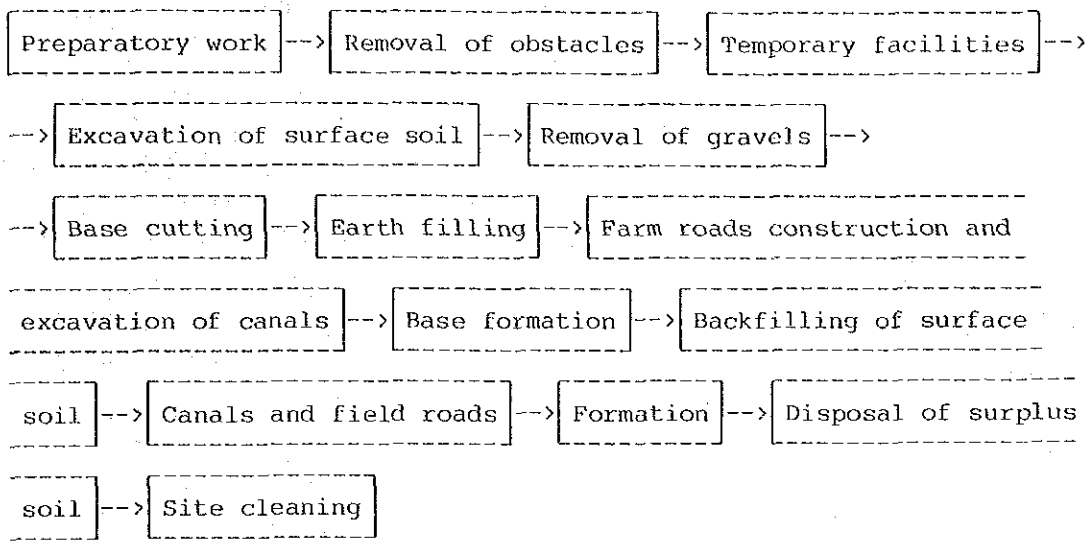
Bul : Buldozer
BH : Backhoe
DT : Dump Truck
VR : Vibration Roller

T.S.Ex. : Topsoil Excavation
Ex. : Excavation
Emb. : Embankment
Pav. : Pavement

St. : Site

Fig. 6.2b CRITICAL PATH FOR FARM ROADS AND RIVER PROTECTION WORK - STAGE 2

maximum efficiency.



In the procedure outlined above, those jobs which will be executed in the same place, like removing the topsoil, excavation and backfilling have to be executed stagewise. But those performed in different places, like construction of roads or irrigation and drainage canals, can be executed simultaneously if the necessary conditions are met.

2) Construction Equipments

Construction equipments were examined in view of the job-site conditions, the design conditions and the execution procedure. The combinations and number of equipments to be used are given below.

a) NUMBER OF CONSTRUCTION EQUIPMENTS

Work Item	Equipments to be used	Number	Remarks
Land Grading	Bulldozer	15 t 1	
	Rakedozer	15 t 1	
	Backhoe	0.35 cu.m 1	For land grading
Soil Dressing	Backhoe	0.6 cu.m 1	
	Dump Truck	11 t 4	
Carry of Gravel	Backhoe	0.6 cu.m 1	
	Dump Truck	11 t 2	
Soil Laying and Compaction for Road			
	Bulldozer	15 t	From other work
	Vibrating Roller	10 t	From road work

Excavation of Irrigation and Drainage Canal	Backhoe	0.35 cu.m	From other work
	Backhoe	0.6 cu.m	From other work

b) COMBINATION OF CONSTRUCTION EQUIPMENT

Item	Equipments to be Applied		Production
Land Grading			
Land Clearing	Rakedozer	15 t	9.4 hr/ha
Top Soil Removing	Bulldozer	15 t	47.6 cu.m/hr
Subgrade Cutting and Banking	Bulldozer	15 t	69.8 hr/ha
	Backhoe	0.35 cu.m	1.1 hr/ha
Leveling	Bulldozer	15 t	0.11 hr/ha
Gravel Removal			
Removal	Rakedozer	15 t	14.3 hr/ha
Loading	Backhoe	0.6 cu.m	31.8 cu.m/hr
Disposal	Dump Truck	11 t	20.6 cu.m/hr
Soil Dressing			
Excavation Loading	Backhoe	0.6 cu.m	37.8 cu.m/hr
Hauling	Dump Truck	11 t	10.1 cu.m/hr
Soil Laying	Bulldozer	15 t	32.3 cu.m/hr
Farm Road			
Soil Laying	Bulldozer	15 t	77.4 cu.m/hr
Soil Compaction	Vibratory roller	10 t	168.0 cu.m/hr
Crushed Stone Laying	Bulldozer	15 t	65.7 cu.m/hr
Crushed Stone Compaction	Vibrating roller	10 t	60.0 cu.m/hr
Excavation of Irrigation and Drainage Canal	Backhoe	0.35 cu.m	23.2 cu.m/hr

Equipments selected according to the evaluation in the former section, are shown in Table 6.3.

TABLE 6.3 LIST OF EQUIPMENT

Item	Specification	Unit	Stage I-1	Stage I-3	Total
Bulldozer	21 tons	no.	1	1	2
	15 tons	no.	4	1	5
	3 tons	no.	1	-	1
Rakedozer	15 tons	no.	-	1	1
Backhoe	0.6 m^3	no.	3	1	4
	0.35 m^3	no.	-	1	1
	0.20 m^3	no.	1	-	1
	0.04 m^3	no.	2	-	2
Clamshell	0.6 m^3	no.	1	-	1
Dump Truck	11 tons	no.	8	8	16
Vibrating Roller	10 tons	no.	1	1	2
Truck Mixer	2.2 m^3	no.	2	-	2
Mortar Pump	Horizontal 200m				
	Vertical 50m, 5 m^3/hr	no.	1	-	1
Compressor	7.5 m^3/min	no.	1	-	1
Jack Hammer		no.	2	1	2
Vibrator	Engine type	no.	2	-	2
Belt Conveyor	Engine type 7 m	no.	1	-	1
Tamper		no.	4	-	4
Power Trowel		no.	1	-	1
Self Loader Truck	18 tons	no.	1	-	1
Truck Crane	Maximum lifting capacity				
	20 tons, boom 20m	no.	1	-	1
Vehicle for Workshop		no.	1	-	1
Transport Truck	6x4, 11 tons; with crane	no.	2	-	2
Pickup	4x4, 2000 cc	no.	4	-	4
Service Van	4x4	no.	2	-	2
Motor Bike	170-190 cc	no.	20	-	20
Oil Tanker	3000 lit	no.	1	-	1

6.1.2 Plant Planning

(1) Precast Concrete Plant

1) Outline

This is a facility for manufacturing concrete products such as ready-mixed concrete and U-shaped concrete blocks for irrigation canals. The former is made by measuring in the designated rates of water, sand, gravel, cement and admixtures from which concrete is made, and by mixing them in a mixer.

The ready-mixed concrete made in this plant is planned to be hauled to job-sites of the intakes and irrigation canals.

2) Flow Chart and Main Equipment

The plant's arrangement and the flow chart are shown in Figs. 6.3 - 6.5. The main machinery and equipments are as follows:

a) For receiving : Cement silo, hopper for aggregate
b) For measuring : Weighing equipment
c) For mixing : Mixer
d) For plant products : Molding box, pouring device, steam curing facilities, carrier roller facilities
e) Attached equipment : Conveyer, control device, power generator, forklift, water supply facility, waste water disposal facility (pH neutralizing facility)

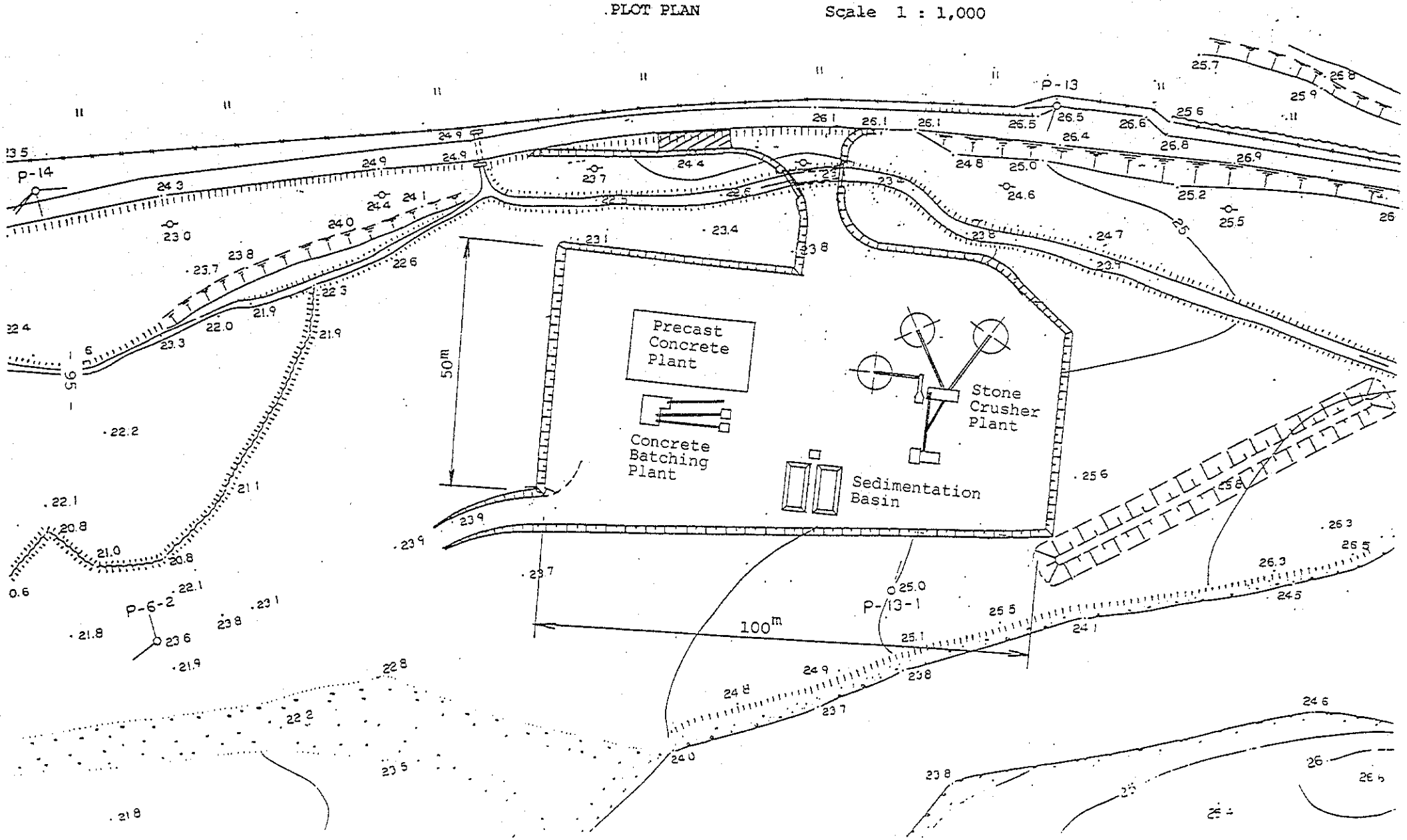
3) Evaluation of Equipment Size

QUANTITIES OF CONCRETE PLANT PRODUCTS

Usage	Standard of Flume	Quantity Required	Concrete Volume
Farm Roads	U-300, L= 600 mm	L= 1000 m, 1667 nos.	51 cu.m
Irrigation Canals	U-300, L= 600 mm	L= 1000 m, 1667 nos.	51 cu.m
	U-450, L= 600 mm	L= 1000 m, 1667 nos.	81 cu.m

Fig. 6.3 STONE CRUSHER & PRE-CASTING CONCRETE PLANT

PLOT PLAN Scale 1 : 1,000



Usage	Standard of Flume	Quantity Required	Concrete Volume
Land Consolidation	U-300, L= 600 mm	L= 3000 m, 5000 nos.	153 cu.m
	U-450, L= 600 mm	L= 1000 m, 1667 nos.	81 cu.m
Total	U-300, L= 600 mm	L= 5000 m, 8334 nos.	255 cu.m
	U-450, L= 600 mm	L= 2000 m, 3334 nos.	162 cu.m

Number of U-shaped flumes and concrete volume to be manufactured in total, provided that yield rate is 90%, will be:

- For U-300 8,334/0.9 = 9,260 pieces --> 280 cu.m
- For U-450 3,334/0.9 = 3,760 pieces --> 180 cu.m

Total 460 cu.m

A volume of ready-mixed concrete required will be:

- For canals : 2,000 cu.m
- For intake weirs : 8,000 cu.m

Total 10.000 cu.m

Concrete will be placed at maximum rate of 70 cu.m per day. Therefore, total volume of concrete to be produced will be:

- For precast concrete = 460 cu.m/(250 days x 2 years) = 0.9 cu.m/day
- for ready-mixed concrete = 70 cu.m/day

Total = 71 cu.m/day

The hourly rate will therefore be:

71 cu.m/5 hours/day = 16 cu.m/hour

Molding Box Required

Through the process of steam curing, it will take only one day for placing, curing and mold removal. Thus number of the molding box is required to be twice that of one day flume product. Assuming that operation period will be two years, the number of concrete flumes to be manufactured daily:

U-300 19 nos./day

U-450 8 nos./day

Numbers of molding boxes required:

U-300 19 nos./day x 2 = 38 nos. --> 40 nos.

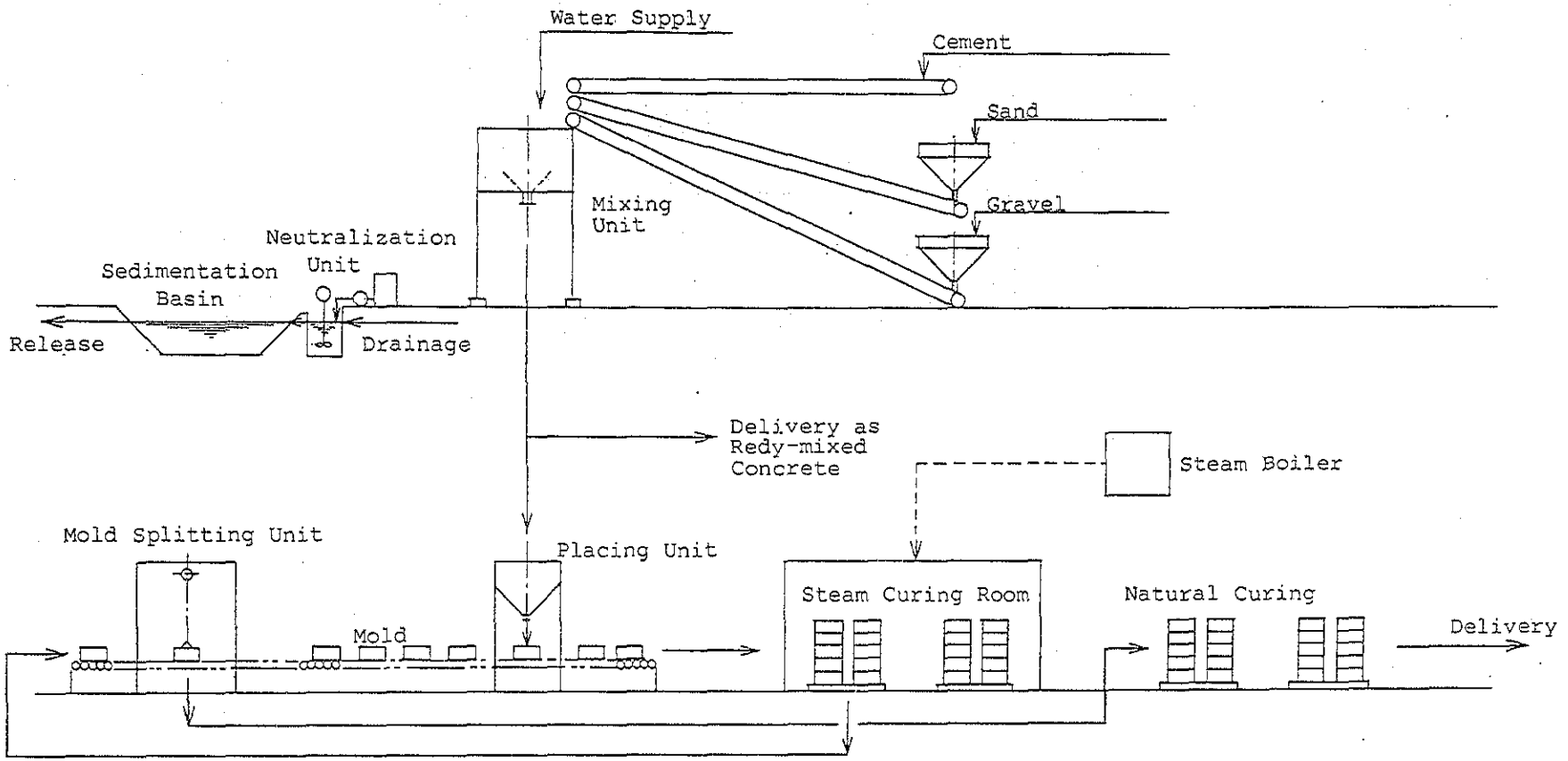


Fig. 6.4 PRECAST CONCRETE PLANT

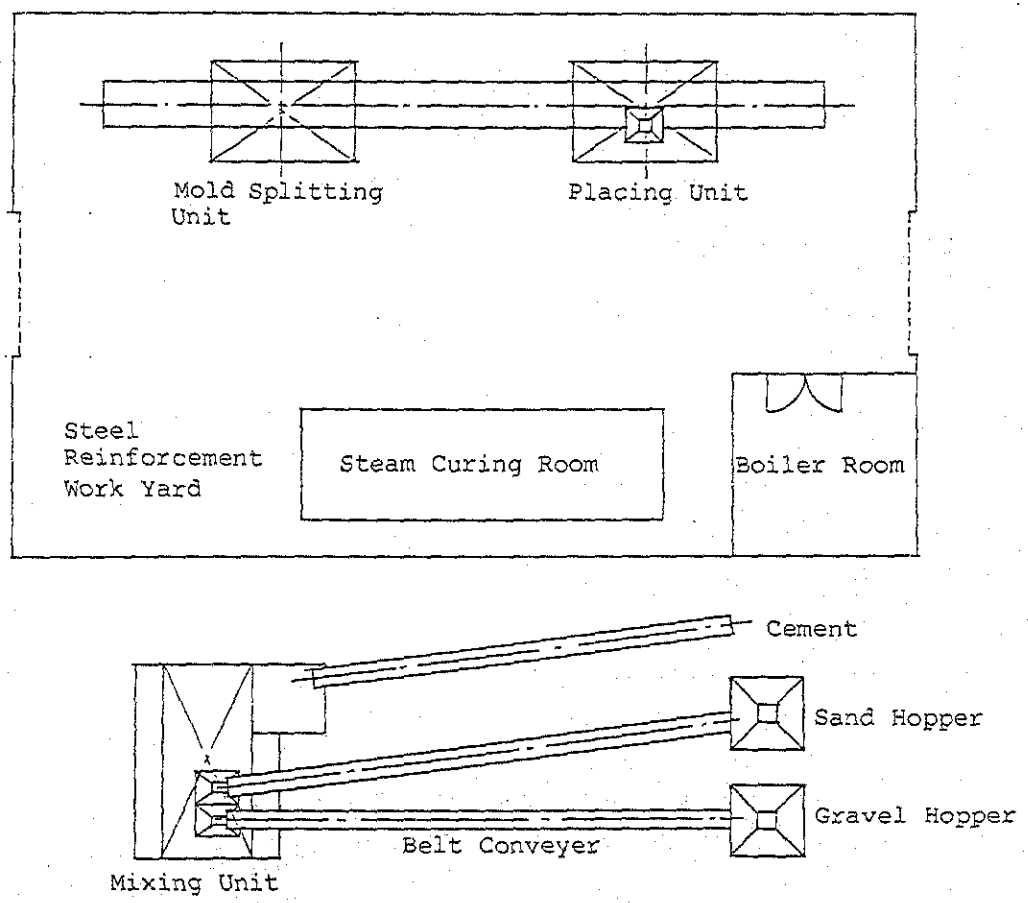


Fig. 6.5 PLAN OF PRECAST CONCRETE PLANT Scale 1:200

U-450 8 nos./day x 2 = 16 nos. --> 20 nos.

Considering the manufacturing of other type of flumes for general canals, an additional 40 molding boxes for L-600x300 flumes shall be prepared.

(2) Crushing Plant

1) Outline

This is a facility for supplying aggregates to the concrete plant and crushed stones for farm roads construction, using boulders found in abundance and obtainable in riverbeds.

2) Flow Sheet and Major Equipments

the plant's flow sheet and its layout are shown in Fig. 6.6. The main equipments are as follows:

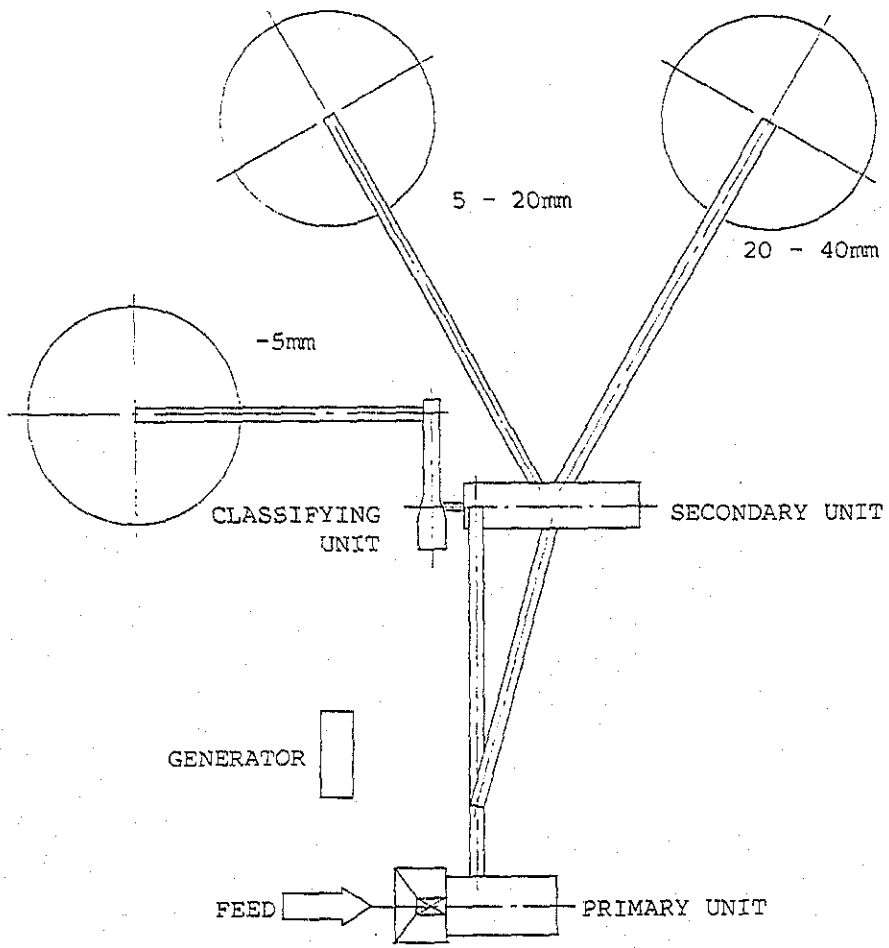
a. Crusher : Primary crusher, secondary crusher
b. Sieving machine : Vibrator screen
c. Washing machine : Sand washer
d. Feeding machine : Vibrator feeder, belt conveyer
e. Attached equipment : Control device, power generator, tractor shovel, water supply facilities, wastewater disposal facilities.

3) Evaluation of Facility Size

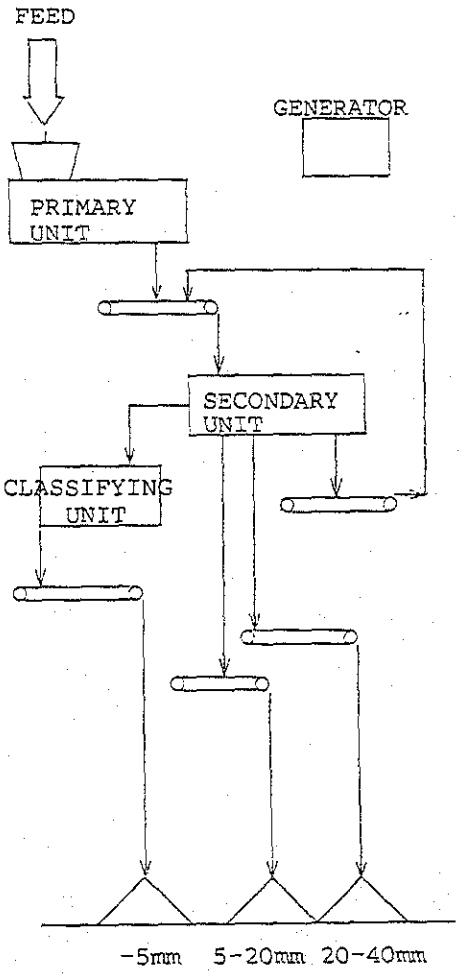
Aggregate for Ready-Mixed Concrete

- Fine aggregate (smaller than 5 mm) :
  4.5 cu.m/hr x (25/100) x 2.65 t/cu.m = 3.0 t/hr
- Coarse aggregate (5 mm - 20 mm, for precast concrete) :
  0.5 cu.m/he x (50/100) x 2.65 t/cu.m = 0.7 t/hr
- Coarse aggregate (20 mm - 40 mm, for ready-mixed concrete) :
  4.0 cu.m/hr x (50/100) x 2.65 t/cu.m = 5.3 t/hr

Total = 9.0 t/hr



LAYOUT



FLOW SHEET

Fig. 6.6 STONE CRUSHER PLANT

Plant Capacity : 9.0 t/hr x 1.1 = 10 t/hr

Crushed Stones for Farm Roads

- For upper layer of roadbed (smaller than 20 mm) : 10%
- For lower layer of roadbed (20 mm - 40 mm) : 90%
- Maximum daily output required : 42.0 cu.m/day
  Required capacity of crushing plant :
  (50.4 cu.m/day) / (5 hr/day) = 10.1 cu.m/hr
- Plant capacity : 10.1 cu.m/hr x 1.84 t/cu.m x 1.1 = 20 t/hr

Thus the size of the crushing plant will be :

- For ready-mixed concrete : 10 t/hr
- For crushed stones : 20 t/hr

One crushing plant with a total capacity of 30 t/hr will be constructed. Specifications of the selected plants is shown in Table 6.4.

(3) Environmental conservation for Plant Installation

1) Present River Water Quality

An analysis of present water quality was conducted at four places; namely, the River Paro, the River Dotey, the Dzong Bridge located down-stream of their confluence and the Shaba suspension bridge. The result is shown in Table 6.5. While the water quality differed depending on the place and time of the sampling, the following were common findings :

- Water temperature : 9.5 - 13.0 °C
- Turbidity : 1 5 ppm
- Ammonium nitrate : below 0.4 ppm
- pH : 7.5 - 8.0

According to the local residents, in and after the month of May glaciers in the mountains melt and mix with silt, which makes the river much more turbid than the above result.

2) Effect of Construction

TABLE 6.4 CRUSHING PLANT AND PRE CASTING CONCRETE PLANT

Item	Specification	Unit	Stage I-1	Stage I-3	Total
Crushing Plant	30 t/hr Crushing size 0-5mm, 5-25mm, 25-40mm	set	1	-	1
Tractor Shovel	0.34 m^3	no.	1	-	1
Batcher Plant	Forced mixing type 0.5 m^3	set	1	-	1
Pre Cast Concrete Plant	Steam curing equipment	set	1	-	1
	Fork lift 2 nos.	no.	2	-	2
	Diesel generagtor of 45 kw	no.	1	-	1
	Table vibrator	no.	1	-	1
	Form U-300x300x600 L	no.	40	-	40
	U-450x450x600 L	no.	10	-	20
	U-600x300x600 L	no.	40	-	40

TABLE 6.5a

WATER QUALITY
- FIELD TEST -

Site of Sampling	A approx.100m downstream from Dzongkhag Bridge			B approx.50m upstream from Paro Market Bridge			C approx.100m upstream from Shari Ramna Bridge			D approx.100m upstream from Shaba Suspension Bridge	
Date of Sampling	7 Apr	8 Apr	20 Apr	7 Apr	8 Apr	20 Apr	7 Apr	8 Apr	20 Apr	8 Apr	20 Apr
Time of Sampling	11:15	10:15	10:05	11:00	10:00	9:40	9:00	9:50	9:50	10:30	10:30
Weather	fine	fine	fine	fine	fine	fine	fine	fine	fine	fine	fine
Air Temperature in °C	20.5	18.0	18.0	20.5	18.0	18.0	16.0	18.0	18.0	18.0	18.0
Water Temperature in °C	13.0	11.0	12.0	13.0	12.0	12.0	9.5	10.0	10.0	12.0	12.0
Turbidity in degree	> 5	2	2	> 5	2	2	< 1	< 1	> 5	< 1	2
Colour in degree	> 10	> 10	> 10	> 10	> 10	> 10	< 2	< 2	> 10	< 2	> 10
Chemical Oxygen Demand in ppm	5	5	5	5	5	5	5	5	15	5	5
pH	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.5	8.0	8.0	8.0
NO_3 - N in ppm	0.46	0.23	0.23	0.46	0.23	0.23	0.46	0.23	0.23	0.23	0.23
NH_4 - N in ppm	1.6	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Cr^{+6} in ppm	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Fe in ppm	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total Hardness in ppm	65	65	65	65	65	65	60	60	50	65	60
Total Coliform in pieces/ml	2	> 10	1	6	7	0	0	3	9	> 10	

TABLE 6.5b

WATER QUALITY

- LABORATORY TEST -

Site of Sampling	A	B	C	D	Analytical Method
Date of Sampling	21 Apr	21 Apr	21 Apr	21 Apr	
Time of Sampling	13:00	12:50	12:40	11:45	
Weather	fine	fine	fine	fine	
Air Temperature in °C	21.0	21.0	21.0	20.0	
Water Temperature in °C	12.0	12.0	10.0	12.0	
pH	7.6	7.6	7.5	7.7	pH meter
EC in S/cm	127	135	82	121	EC meter
Cl in ppm	1.0	0.5	2.0	1.0	$AgNO_3$ titration
Na in ppm	1.2	1.3	1.0	1.3	Flame photometry
K in ppm	0.7	0.7	0.6	0.8	Flame photometry
Ca in ppm	13.6	14.5	9.6	13.9	Atomic absorption
Mg in ppm	1.8	1.9	1.1	2.0	Atomic absorption
Cu in ppm	<0.005	<0.005	<0.005	<0.005	Atomic absorption
Zn in ppm	0.05	0.03	0.02	0.02	Atomic absorption
Polychorinated Biphenyl in ppm	< 0.5	< 0.5	< 0.5	< 0.5	Gas chromatography

The basic aim of the project is to rehabilitate and construct irrigation canals, farm roads, river protection works and farmland consolidation. Thus, its impact on the natural environment should not be as big as that of a project to turn unarable lands into arable ones. However, the current project includes installation of a stone crushing plant to supply crushed stones for farm roads and precast concrete plant to manufacture concrete products such as precast concrete flume for irrigation canals. These plant will discharge suspended solids and wastewater containing alkaline into nearby rivers, so it is necessary to take appropriate treatment to minimize their effects on those rivers.

It is also necessary to avoid discomforting nearby inhabitants, by taking appropriate measures against noise, vibration, dust and the like caused by these plants.

3) Countermeasures

a. Treatment of Wastewater from the Crushing Plant

Turbid water from the plant is mainly discharged from the gravel washing process. It is estimated that about 15 cu.m of wastewater at 1,000 to 1,500 ppm of turbidity will be discharged daily. It is recommended that a natural sedimentation method to remove suspended solids and decrease the turbidity be employed since there will not be a large amount of wastewater, and it can be diluted by the original river flow with large discharge. Besides, coagulants and other chemicals are difficult to obtain. The two sedimentation tanks will have 24 hours capacity of 3.0 m in width, 5.0 m in length, and 1.5 m in depth, including 0.3 m for sludge deposit. The sludge will be removed from the two tanks alternately by a tractor shovel. As the rate of solid removal in tank is estimated at 60-65%, the turbidity of treated water will be 400 - 500 ppm. In Japan, turbidity is instructed to be less than 150 ppm in the case that wastewater daily discharge exceeds 50 cu.m/day. In this case, wastewater discharge is small as 15 cu.m/day and the river discharge is expected to be 5 cu.m/sec even in dry season. Therefore, the discharge from this plant will not induce environmental problem.

b. Treatment of Wastewater from the Concrete Plant

Turbid water from the plant is mainly discharged from the machine washing process after batching plant operation. It is estimated that 2 cu.m of wastewater at 2,000 - 3,000 ppm of turbidity with a pH value of 11 will be discharged daily. The treatment method for turbidity will be natural sedimentation, which is mentioned in crushing plant. The sedimentation tanks will be 2 nos. of 2.0 m in width, 2.0 m in length and 1.5 m in depth, including 0.3 m for sludge deposit. The pH should be neutralized by acid dosing. The neutralizing chemicals are to be imported from India. The pH value after the neutralization is projected to be 5.8 - 8.6. About 1 kg of the neutralizer (H_2SO_4) will be used per day. If a 70% concentration of surfuric acid is used, it will be 1.4 kg per day, or 350 kg per year (1.4 kg/day x 250 days/year). The surfuric acid will be diluted to 25% concentration for dosing operation in a storage tank. the dosing will be carried out by an automatic system linked to a pH meter. the quality of the treated water is expected to be 800 - 900 ppm in turbidity with a pH value of 7.0 - 8.0. In Japan, pH value is instructed to be in the range of 5.8 - 8.6. The expected value for the treated water satisfies this instruction.

c. Countermeasures for Noise, Vibration and Dust

Since the stone crushing plant and the batching plant, with the exception of the precast concrete plant, are to be installed outdoor, no particular measures will be adopted to counter the noise, vibration and dust that are generated from the plants while they are running. The impact on the residents nearby could be reduced by keeping a sufficient distance between the plant sites and their houses.

d. Monitoring System

The extent of water pollution in the rivers shall be monitored constantly by carrying out regular inspection of the river water and the wastewater from the plants in order to prevent problems of pollution. Weekly inspections will be carried out at the initial one month from the commencement of the plant operation, thereafter, the interval

of inspection will be determined from the above result. In any case, the inspection shall be carried out at least once in month.

6.1.3 Procurement Plan

The mechanization for construction work in the project, as described in Chapter 5, basically aims to carry out the work efficiently, and to cover labor shortage. A large number of various types of construction equipments and plants will be used in the project, so considering function, quality and interchangeability with existing equipments, as well as spare parts procurement, the equipments and plants will be procured in Japan and supplied to the government of Bhutan. On the other hand, local materials such as stones, cement, reinforcing steel bars and other relatively easily obtainable materials, and the manpower such as operators and workers will be procured in Bhutan.

Every possible effort will be made to implement the project successfully, including providing technical training on work execution and plant operation and management.

6.1.4 Training Schedule

(1) Operators for Construction Equipments

The AMC, Paro, has a Division of Hire Service, which lends out construction equipment together with operators to projects in various places. The Division, as shown in Annex 13, keeps 41 operators, about a half of whom will be able to work for the project. The number of construction equipment to be used for the project will amount to 50, including vehicles. It will be necessary therefore to train about 20 operators urgently.

Training Schedule

- Training period : 10 months (To commence 10 months before the construction work)

- Number to be trained : 20 operators
- Place : AMC, Paro
- Executing agency : The Ministry of Agriculture, the Government of Bhutan
- Equipment to be used for training : Existing equipments in AMC up to the arrival of new equipments, thereafter, new equipments.

(2) Management and Operation Staff for Concrete Plant

Bhutan does not have an industry processing precast concrete products for irrigation canals and river revetments, accordingly there are no suitably trained people available to work at the precast concrete plant. It is very important to recognize that the concrete plant to be constructed in the course of the project implementation will establish a new industry in Bhutan. After completion of the project, the plant shall be operated only by Bhutanese. To this end, it is considered necessary to train management staff and operators at the earliest possible stage. For this purpose it will be scheduled to train at least two candidates for 6 months prior to commissioning the plant.

Training Schedule

- Number to be trained : 2 persons
- Place : A precast concrete plant in Japan
- Training period : 6 months
- Training items
  For management staff : Manufacturing process in general, management and wastewater control
  For operator : Manufacturing operation, welding work of steel bars, steel molding work and quality control.

6.2 Farm Roads

6.2.1 Design Policy

The farm road to be rehabilitated is 3.7 km in distance extending from the Shari bridge to the Jabji suspension bridge, on the left bank of the River Dotey. The road was built in 1977 after a disastrous flood. Water flows out from the unprotected sections of the river banks when the water level is high, and causes damage to the surface of the farm road. Thus in the project, not only the surface of the road shall be repaired, but river protection works shall also be considered.

Areas in the project area where river revetment work has been carried out most extensively are along both banks of the River Dotey, protecting the national highways and the airport. For these works, the Government supplied materials of gabions, and local farmers jointly installed them.

The surface of the farm road included in the project is low-lying and in a poor condition. Thus, in addition to diverting the use the river protection work as a farm road, if the river protection bank is far from the existing farm road, rehabilitation shall be made on the existing road to keep access to the farmlands.

The farmlands are located lower than the high water mark of the Dotey, so the river protection work is necessary. Its design criteria will be based on the estimated design flood discharge during the 1968 flood.

With regard to availability of manpower, there is a serious shortage of skilled construction workers because of the Government's recent policy of gradually prohibiting foreign workers. If the need arises, the participation of local inhabitants or that of the National Work Force may have to be sought to carry out the construction works. There are four class A construction contractors in Bhutan, but they have just about the only type of construction equipments like transportation trucks. Presently therefore, they have to rent construction equipments and hire the operators from the government.

Thus, the work is scheduled to be executed using construction equipments procured for the project. During the course of the work, sediment left by past floods will be removed for land formation, in order to recover the damaged farmlands.

6.2.2 Design Condition

Because the road network is insufficiently developed in the area, the design conditions will be decided on the assumption that the farm roads will also be used as general roads in the future.

- Design speed : 30 k.p.h.
- Design load : 14 tons
- Linear criteria

Minimum curve radius	:	30 m
Minimum curve length	:	50 m
Maximum longitudinal slope gradient	:	8.0 %
Minimum longitudinal curve radius	:	250 m
Minimum longitudinal curve length	:	25 m
Maximum combined slope gradient	:	11.5 %

Regarding transition curves to force drivers to drive slowly, provision of curves is judged unnecessary because drivers in Bhutan generally drive at relatively low speeds and curves have not been provided on main national highways.

6.2.3 Basic Plan Design

(1) Route Arrangement

The farm road and the river protection works will be placed closer to the riverside than existing paddy lands. It will be decided taking into consideration 330 cu.m/sec discharge of the 1968 flood. The roads will be arranged so that the embankments of the river protection works will be used as farm roads, since this is both economical and technically efficient.

The plan is limited to the left bank of the River Dotey (108 ha of the benefited area including 73 households),but the river protection work plan will incorporate a future plan for the right bank protection.

(2) River Channel

The width of the planned riverbed shall be set at 40 m since the present average width of the Dotey River is 40 m. The depth of water will be 2.00 m, for the design flood discharge of 330 cu.m/sec. Since hydrometeorological data in the Paro area is lacking, it is not possible to determine the probability of a recurrence of 1968 flood. But it is estimated to be less than once every 50 years.

Based on the depth of the flood waters, the height of the river banks will keep clearance of 40 cm to prevent flooding of the farmland and the roads. The formation level, therefore, will be set at the flood level +0.40 m.

(3) Design

1) Routes and Distance

The road route extends 3.7 km on the left bank of the Dotey between the Shari bridge and the Jabji suspension bridge. The entire route will be repaired.

2) Structure of Road

a. Width

Since the traffic volume is estimated at 100 or less per day, the road will be single-lane 3.0 m wide. The Shari Ramna bridge and the Paro Market bridge made of reinforced concrete are each 3.6 m wide with a single lane, and the width of the existing farm road is 3.0 m, the same as the proposed width.

b. Road Shoulders

A shoulder 50 cm wide shall be provided on either side of the road to protect the main structure, to allow vehicles in trouble to make an emergency stop and to ensure safe and comfortable driving by allowing ample space on either side of the road. The shoulder shall also serve as a sidewalk for pedestrians.

c. Gradient of Bank Slopes

The banking materials are expected to be made of reddish brown soil, silty sand and fine gravel from the borrow areas of BA1 and BA2 soil. Since the banking height will be 3.0 m or lower, the gradient of the banking slope is designated 1:1.5. The gradient of the slope facing to the river will be set at 1:2.0, and the slope shall be protected by gabions. This is because the planned flood discharge velocity is relatively high at 3.12 m/sec.

d. Roadbed Layer

The roadbed's upper layer shall be made of materials that can withstand friction, stirring and shock, as well as abrasion, smashing and weathering caused by weather and so on. It shall also be of a designed composition of materials that will not easily move, and the road surface will be easy to maintain and repair. To satisfy the above requirements, crushed stones of the 20 mm size will be used.

For scattering vehicle loads and preventing the roadbed from excessive settlement, the lower layer serves as a stable layer that will withstand drainage and sudden changes in weather conditions.

The roadbed layer is determined by roadbed materials. Since roadbed materials are reddish brown soil, silty sand and fine gravels, and tamping is to be done by using a 10-ton vibratory roller, the layer shall be 30 cm thick. Thus CBR values ranging from 3 to 5 may be expected as approximate. Of these, upper roadbed layer will be 3 cm thick, and the lower 27 cm.

e. Typical Cross Section

The typical cross section decided on the basis of the results of the above considerations are shown in the attached drawing. Gabions will be 40 cm thick, and extend 3 m horizontally at the riverbed from the toe of the slope in order to protect it from erosion. Some sheet for construction work will be installed under the gabions. this is to prevent erosion of the slopes and banks by rain water and the river flow. Sodding work will be executed on the slopes of the inner sides of the embankment and the road banking which is independent from the river protection works.

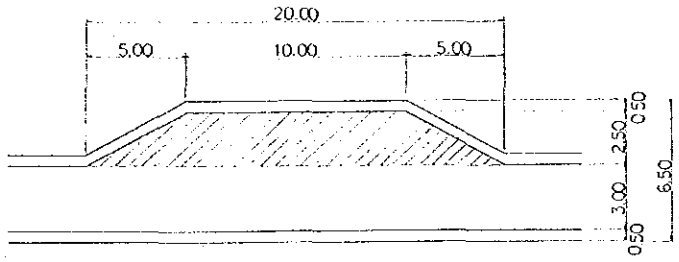
Piles will be installed in the gabions to prevent slippage. The upper end of the gabions will be protected by plain concrete and wrapped by construction sheet.

3) Appurtenant Structures

a. Turn Out

Since the road under discussion is a single-lane farm road, a turn out will be provided every 500 m intervals so as to ensure the smooth flow of traffic, such as when there is an on-coming car. The size of these turn outs are shown below.

Turnout



b. Crossing Structures

Existing structures crossing the existing farm road are listed below:

Irrigation Canals (Listed from the down reach to upper)

- Channel with cover : 70 cm wide at top and 45 cm wide at bottom, 35 cm in height
- Box : 80 cm x 100 cm
- Pipe : 30 cm in diameter
- Box : 70 cm x 80 cm
- Pipe : 30 cm in diameter
- Box : 80 cm x 30 cm

Drainage Channel (Listed from the down reach to upper)

- Pipe : 30 cm in diameter
- Box : 80 cm x 80 cm
- Box : 60 cm x 50 cm
- Box : 80 cm x 70 cm
- Box : 80 cm x 30 cm

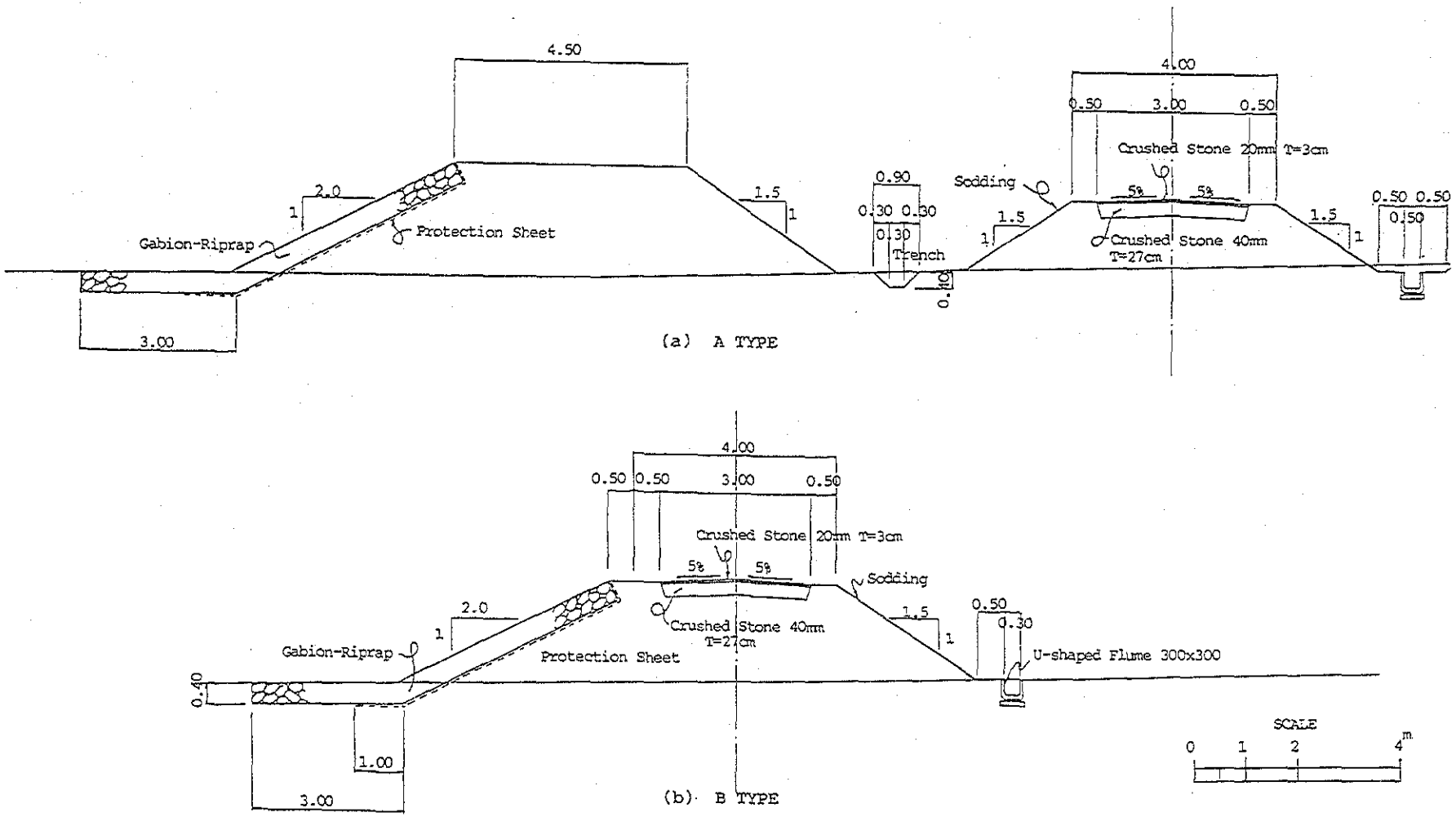
The existing structures shall be removed and replaced with corrugated steel pipes with sections wider than the existing ones. The sections of the irrigation canals shall be based on the flow of 2.5 lit./s/ha. Boxes made of reinforced concrete will be installed at both end of the corrugated steel pipes. This will be done to ensure smooth implementation of the intake rehabilitation works in the future.

4) Construction Materials

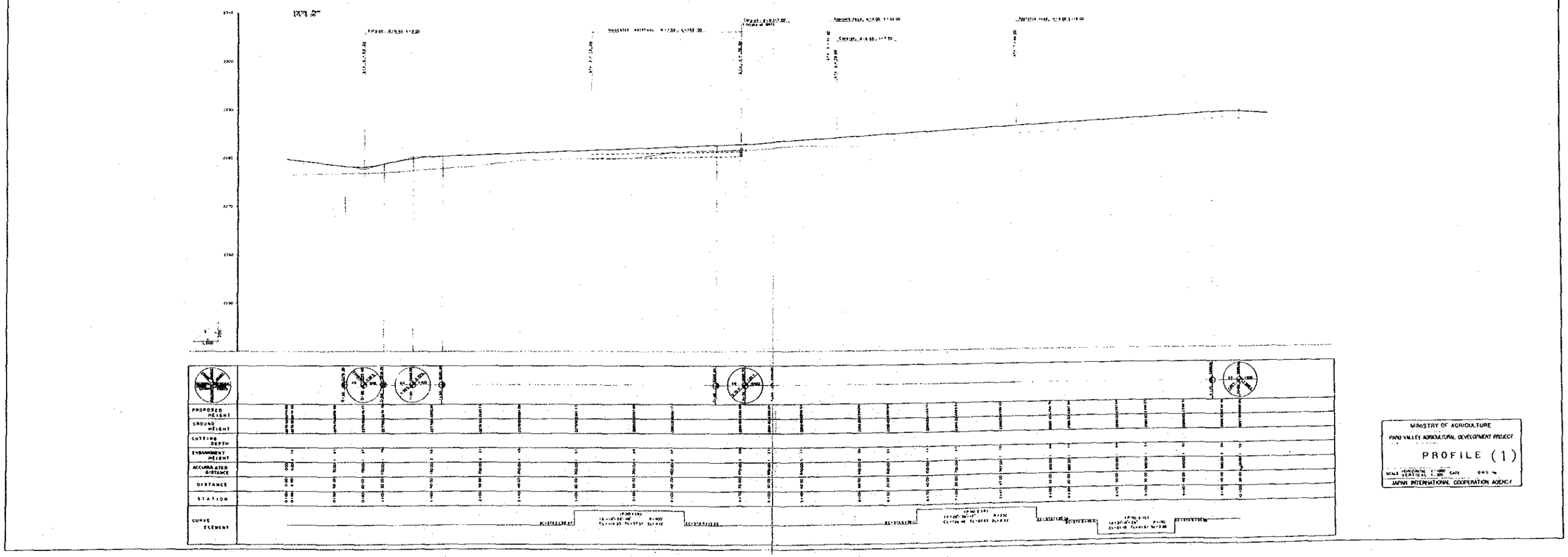
Earth is the main materials for road construction, and construction machinery is the main equipment to be prepared. Cement made in Bhutan will be used. Reinforcing steel bars and other steel materials imported from India will be used. Materials to be procured from Japan will be corrugated steel pipes and sheets for construction work.

6.2.4 Design Drawings

Design drawings for farm roads are shown in next pages.



TYPICAL CROSS SECTION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GROUND HEIGHT
CUTTING DEPTH
EMBANKMENT HEIGHT
ACCUMULATED DISTANCE
DISTANCE
STATION
CURVE ELEMENT
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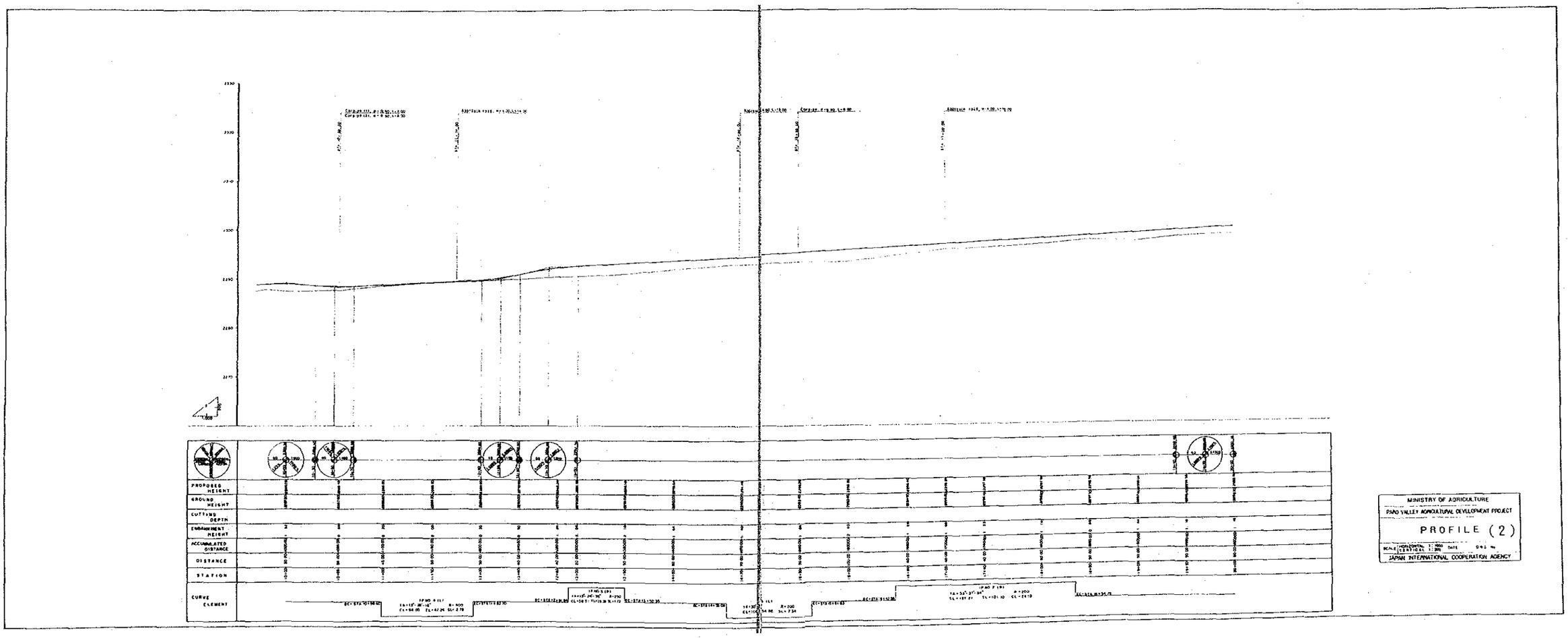
PROFILE (1)
JAPAN INTERNATIONAL COOPERATION AGENCY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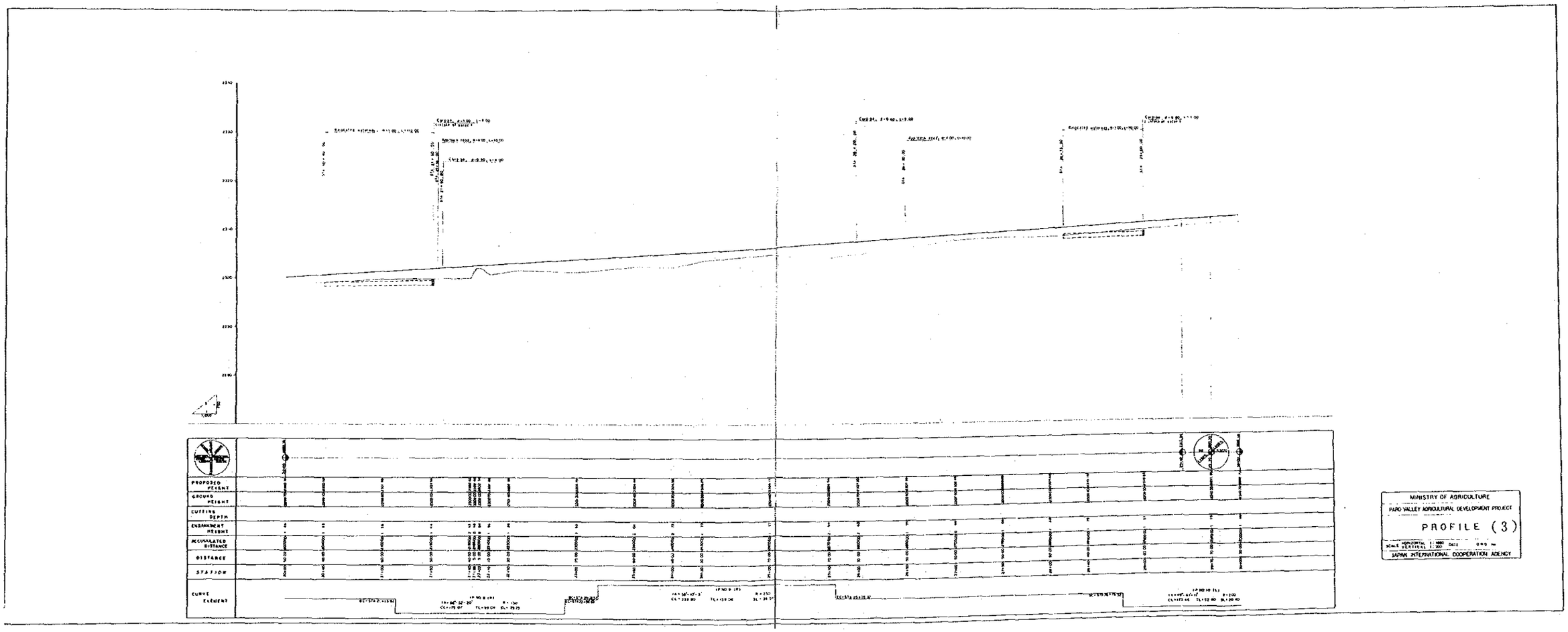
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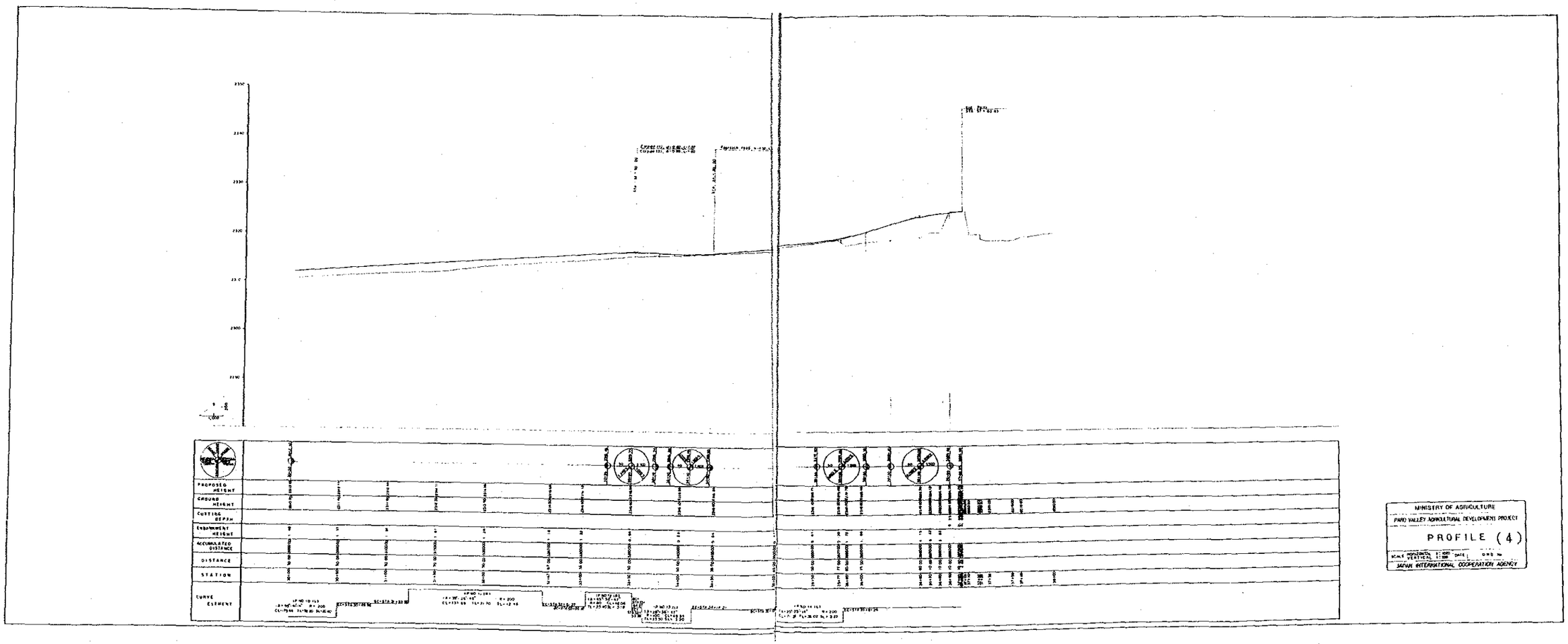
PARO VALLEY AGRICULTURAL DEVELOPMENT PROJECT
PROFILE (3)
JAPAN INTERNATIONAL COOPERATION AGENCY


PROPOSED HEIGHT
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EMBANKMENT HEIGHT
ACCUMULATED DISTANCE
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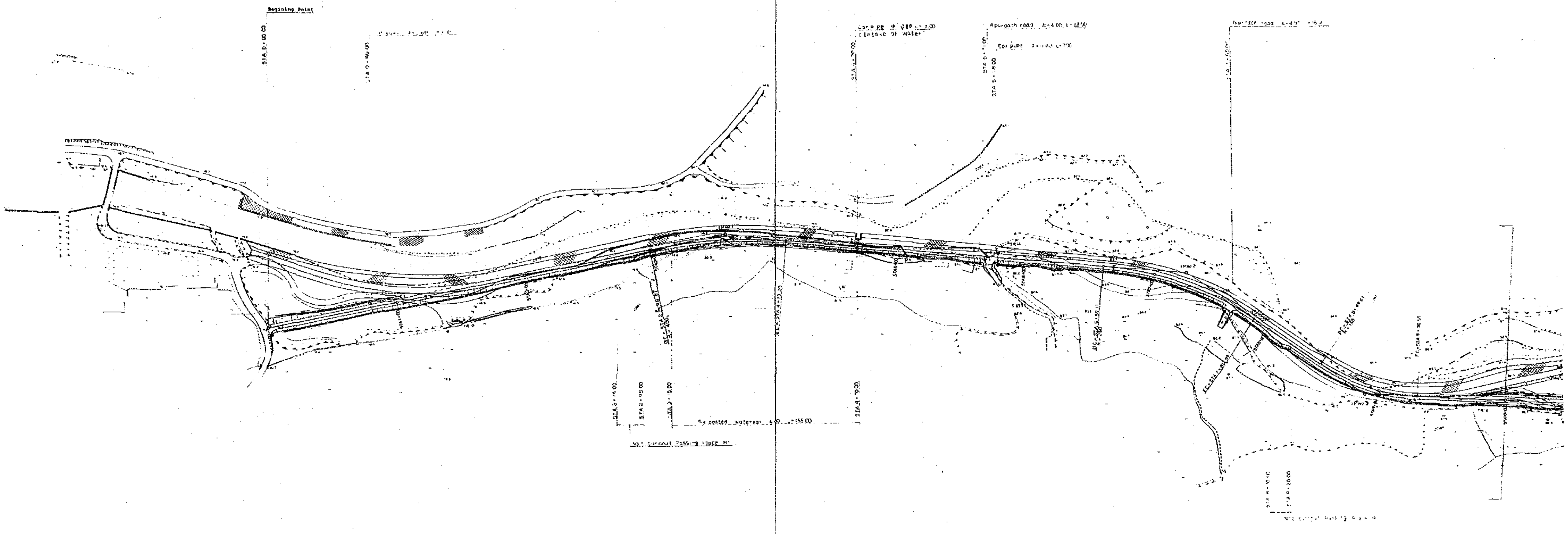
MINISTRY OF AGRICULTURE
PARO VALLEY AGRICULTURAL DEVELOPMENT PROJECT
PROFILE (4)
JAPAN INTERNATIONAL COOPERATION AGENCY

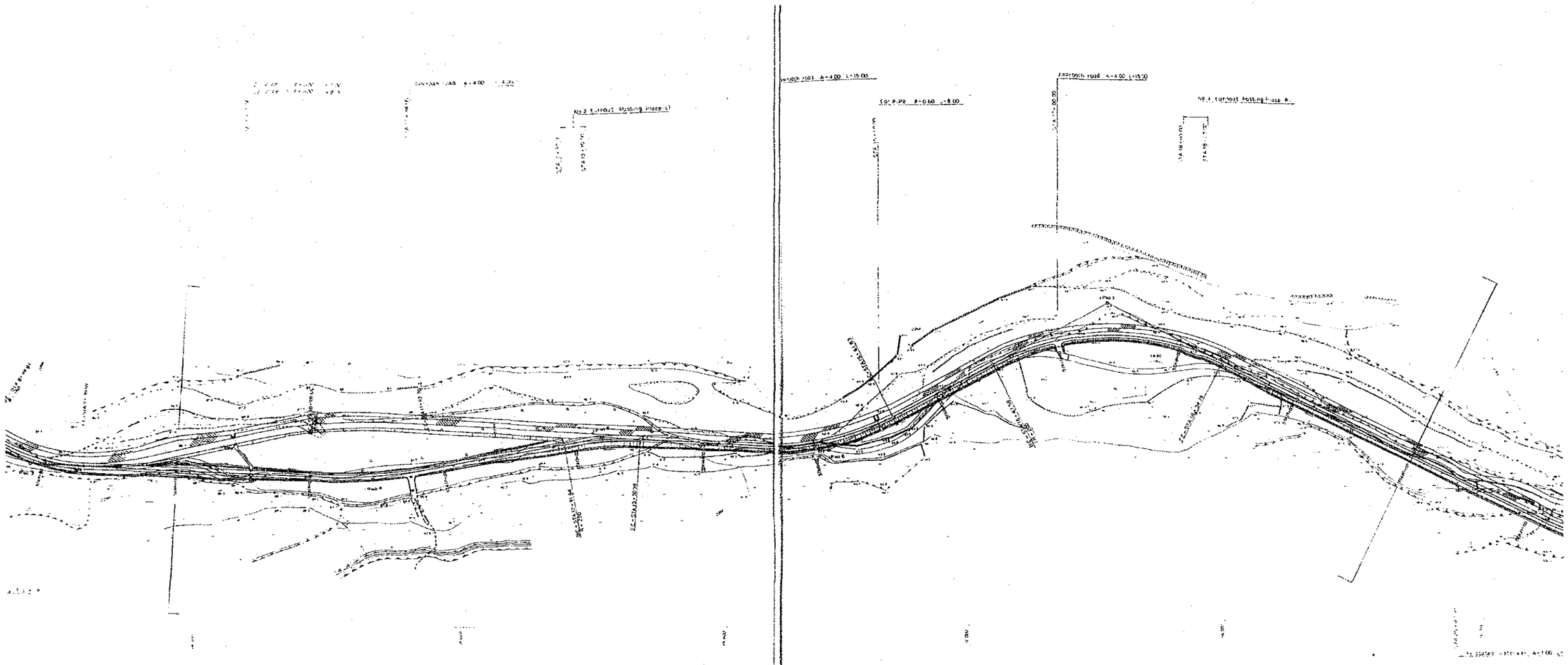


IP NO	1 (R)	2 (R)	3 (L)	4 (L)	5 (R)
I.A	16°-22'-48"	28°-59'-17"	31°-0'-29"	13°-28'-16"	13°-24'-35"
R	400	250	150	400	250
C.L	114.35	126.48	81.18	94.05	58.51
T.L	57.57	64.63	41.61	47.24	29.39
S.L	4.17	8.23	5.66	2.78	1.72
B.C	STA 2+98.87	STA 6+59.11	STA 8+49.61	STA 10+98.65	STA 12+91.84
E.C	STA 4+13.23	STA 7+85.59	STA 9+30.59	STA 11+92.70	STA 13+50.35

SCALE

0 50 100m

MINISTRY OF AGRICULTURE					
PARO VALLEY AGRICULTURAL DEVELOPMENT PROJECT					
PLANE (1)					
SCALE		DATE		DWG. No.	
JAPAN INTERNATIONAL COOPERATION AGENCY					

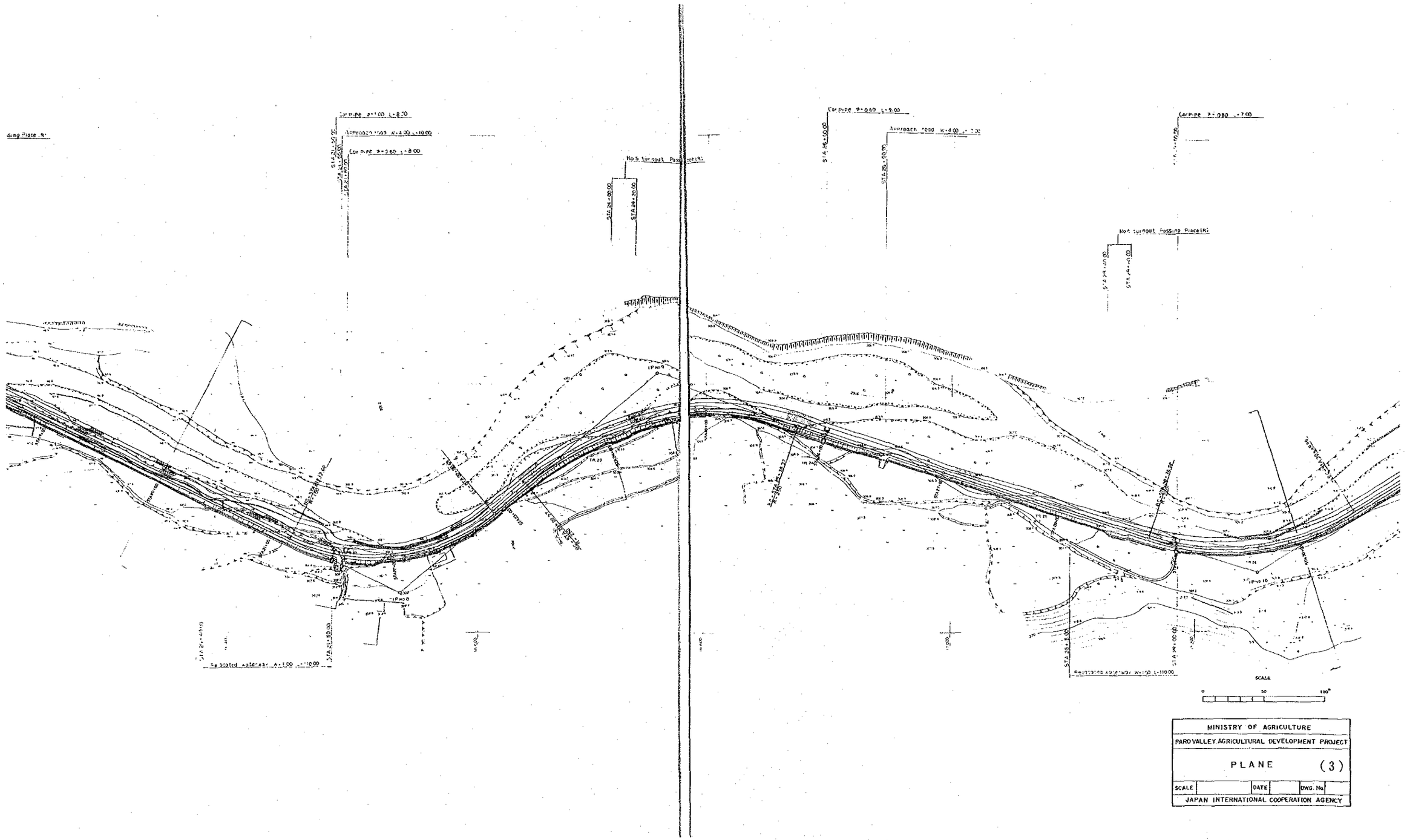


IP No.	θ (L)	T (R)	θ (L)	θ (R)
I A	30° 34' 46"	53° 31' 51"	66° 52' 40"	58° 10' 03"
R	200	200	150	250
C L	106.74	187.23	175.07	253.80
T L	54.68	101.19	99.03	139.06
S L	7.34	24.10	29.35	36.07
B C	STA14+55.09	STA16+47.58	STA23+13.62	STA23+22.57
E C	STA15+61.83	STA18+34.70	STA25+68.49	STA25+76.37

SCALE

0 50 100m

MINISTRY OF AGRICULTURE					
PARO VALLEY AGRICULTURAL DEVELOPMENT PROJECT					
PLANE (2)					
SCALE		DATE		DWG. No.	
JAPAN INTERNATIONAL COOPERATION AGENCY					



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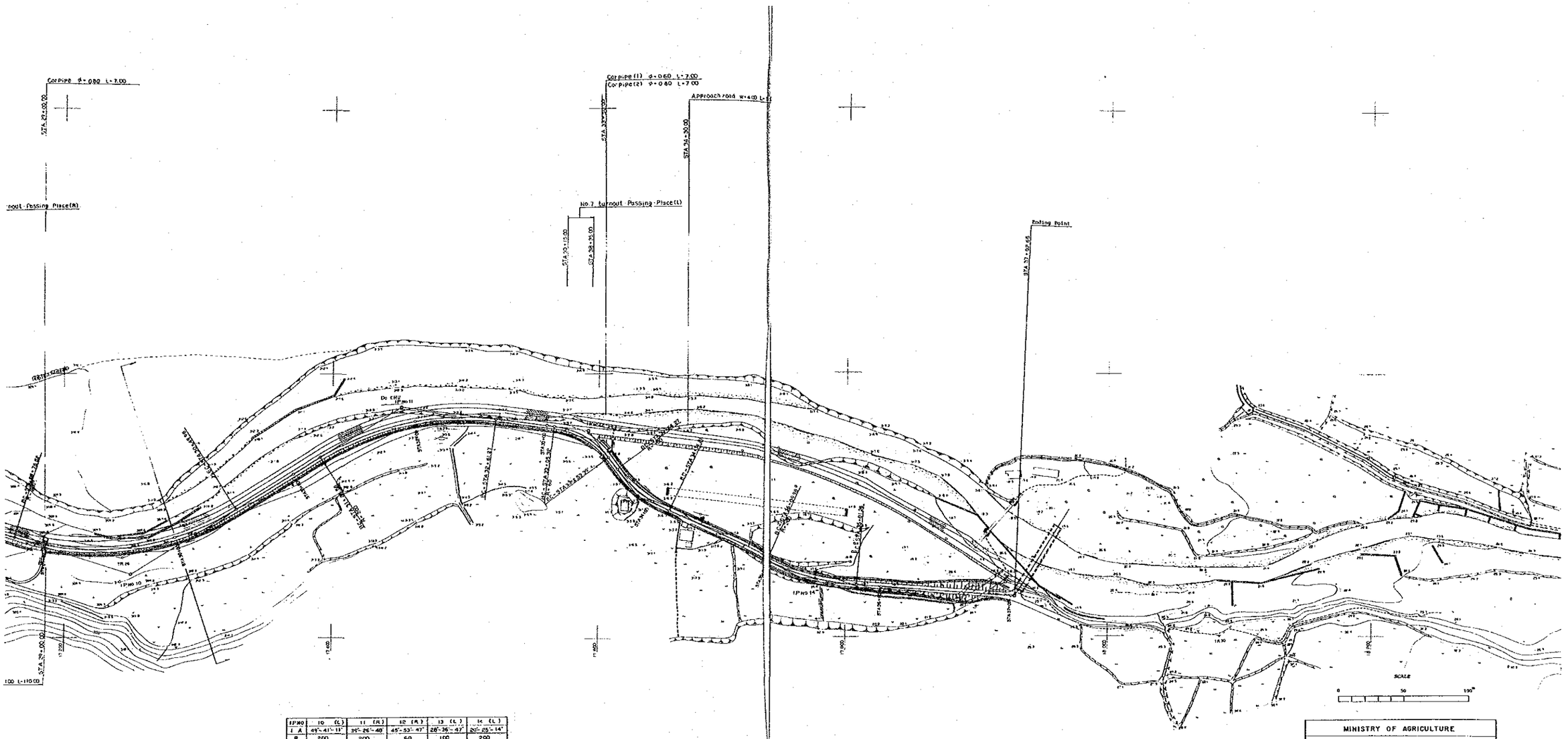
JAPAN INTERNATIONAL COOPERATION AGENCY					



IP NO	10 (L)	11 (R)	12 (R)	13 (L)	14 (L)
I A	49°-41'-11"	35°-26'-40"	45°-53'-47"	28°-36'-47"	20°-25'-14"
R	200	200	60	100	200
C L	173.44	137.69	48.06	49.94	71.28
T L	92.60	71.70	29.40	25.90	36.02
S L	20.40	12.46	5.16	3.20	3.22
B C	STA 28+76.52	STA 31+23.58	STA 33+05.32	STA 33+64.27	STA 35+09.98
E C	STA 30+49.76	STA 32+61.27	STA 33+53.38	STA 34+14.21	STA 35+81.26

MINISTRY OF AGRICULTURE			
PARO VALLEY AGRICULTURAL DEVELOPMENT PROJECT			
PLANE (4)			
SCALE		DATE	DWG. No.
JAPAN INTERNATIONAL COOPERATION AGENCY			

6.2.5 Local Condition of Construction Work

(1) Contractors and Operators

In Bhutan there are no local contractors who have construction equipments and operators, therefore, it is necessary to train the operators for equipments to be used in the project. The details of the training schedule are shown in 6.1.4. It will be difficult to use local contractors effectively due to their size as well as lack of their experience, but it will be possible that local farmers who possess their tractors in the area will take part in the project, for instance, carrying the materials. It is considered to execute this plan actively because it makes the farmers recognize the project as their owns and it has an advantage of easy mobilization.

(2) Labor force

Although the National Work Force, the domestic work force for construction, could be applied to the project because of the prohibition of the employment of foreign workers, it is planned to execute the project by employing local farmers. But it is almost impracticable to treat the local farmers as technicians, so technical instructors, who will train the farmers, are needed from around the area. On the other hand, concerning to the river protection works included in the rehabilitation of the existing farm roads, the local farmers have enough experience for the job.

(3) Other Considerations

Under the participation by local inhabitants, the members to be engaged in the project will change irregularly as time passes. It may reduce the productivity of construction, additionally, keeping the manpower will be difficult. To avoid these problems, it is necessary to select the full long-term participants among farmers concerning to the main construction works.

In the project, the crushing plant will not necessarily have to be placed only at the site of precast concrete plant on the upper River

Paro. It can be moved to the left bank of the River Dotey near the farm road site where sedimentation including stones were deposited by the past flood, so that the work will be carried out economically, by the use of material available at nearby job-sites.

6.2.6 Construction Schedule

At the same time that earth work begins on the proposed farm road and site clearance of borrow areas, the feeder road to the borrow area BA1 will be paved by crushed stones so that trafficability of the road can be kept high. The existing canals crossing the road will be replaced with corrugated steel pipes, to reduce the construction period. Road works will be executed by use of Backhoes (0.6 cu.m) for excavation and loading in the borrow area of BA1 and BA2, Dump trucks (11 tons) for hauling, Bulldozers (15 tons) for soil laying, and Vibratory roller (10 tons) for compaction. River protection works will be made of gabions. Although fabrication of armors of gabions and finishing of masonry work will be done manually, putting boulders into armors will be carried out by Backhoes (0.6 cu.m). The crushing plant will be moved, after manufacturing aggregates for precast concrete products, to the site of the River Dotey, to produce crushed stones for the road's pavement.

6.2.7 Supervision

Supervision of the farm road construction work will be carried out for the full construction period by resident engineer/s.

The services will include :

- Inspection and approval of work drawings and documents,
- Checking and advice regarding the work,
- Management of work progress and its reports,
- Issue of certificates,
- Inspection of completed work.

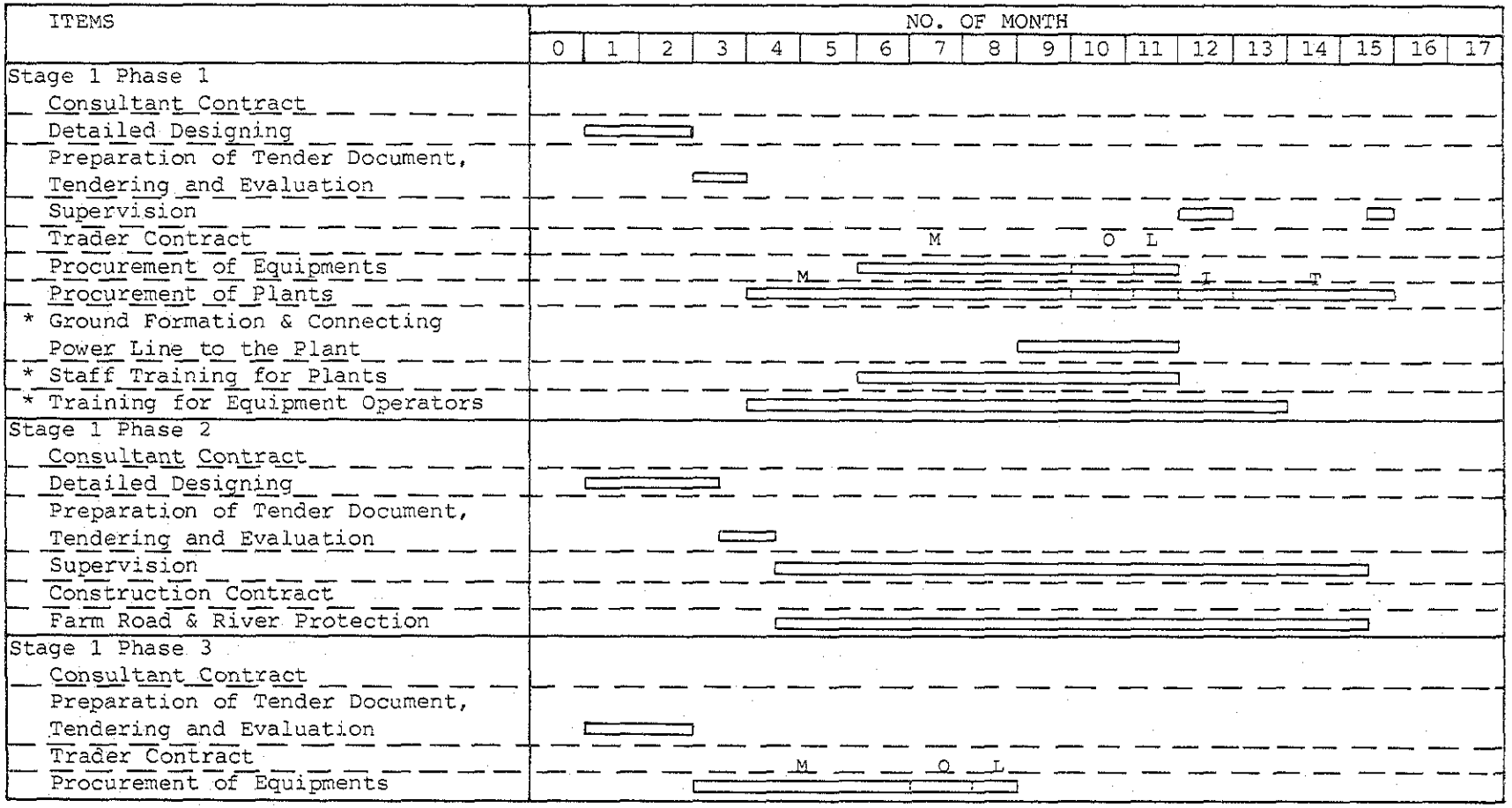
6.3 Implementation Schedule

Implementation schedule, following the consultant contract, is shown Fig. 6.7.

Implementation of the project is divided into three phases. In Phase 1, consultant contract will be made immediately after the exchange of notes. Thereafter it will take 3 months for detailed designing and preparation of tender document, tendering, evaluation and trader contract. Procurement of equipments and plants will be commenced at 4th month, which will take 8 months. Installation and operation of the plants will be conducted from 12th month. Land formation and power supply works for the plant will have to be completed up to the commence of the installation.

In Phase 2, following the consultant contract, it will take 2.5 months for detailed designing and one month for preparation of tender document, tendering, evaluation and construction contract. Construction will be commenced 3.5 months after the consultant contract and will be continued for 11 months. Training for operators shall be completed up to the commence of the construction.

In Phase 3, following the consultant contract, it will take 2 months for preparation of tender document, tendering and evaluation. Procurement of the equipments will be commenced 2 months after the consultant contract, which will take 6 months.



* — Undertakings to be taken by the Government of Bhutan

M : Manufacturing, O : Ocean Transport, L : Land Transport
I : Installation, T : Test Operation

Fig. 6.7 IMPLEMENTATION SCHEDULE

Chapter 7. PROJECT EVALUATION AND CONCLUSION

7.1 Project Evaluation

It is expected that the project will result mainly in productivity increases of (1) paddy, and (2) cash crops.

(1) Productivity Increase of Paddy

Farmlands in the project area consist of paddy fields (1,502 ha), dry lands (1,448 ha), orchards (394 ha) and vegetable gardens (156 ha); totaling 3,500 ha in the area. Of the above, it is mainly for paddy fields that a production base will be improved remarkably by implementation of the project.

The present productivity in paddy fields is 3.04 tons/ha on the average, as shown in Annex 10. On the other hand, the productivity in 1988 in a pilot farm of paddy fields recorded 6.4 tons/ha for manual transplanting, 8.3 tons/ha for machine transplanting, and 5.2 tons/ha for manual transplanting of indigenous red-rice; showing higher productivity.

As irrigation canals will be rehabilitated and water will be obtainable easily, it is expected that introduction of high-yielding varieties will be promoted. Assuming that crops would be shifted to the high-yielding paddy in the about 50% out of 1,316 ha of paddy fields covered by the project, a total product would increase by 2,210 tons, under the conditions of same productivity as that of manual transplanting in the pilot farm.

(2) Production Increase of Cash Crops

The high-yielding paddy require a longer growing period than indigenous paddy; thus the current cropping pattern will have to be changed. An increase of cultivation area of cash crops as secondary crops will not be expected much in paddy fields. By consolidation of farm roads, however, conditions of hauling to market will be improved, accordingly development of orchards and an increase of cropping areas of cash crops

in dry lands will be expected.

7.2 Conclusion

The implementation of the Paro Valley Agricultural Development Project will promote agricultural mechanization, which at present relies heavily on hired labor. It will significantly reduce the burden of paying wages, as well as make possible the conversion to a more efficient form of agriculture. The chronic shortage of water will be eliminated through provision of irrigation canals. A dramatic rise in productivity can be expected through increased yielding per unit of cultivated lands and through expansion of cropping area of cash crops. At the same time the project will result in a higher income for farmers and thus help raise their living standard. Hence, it can be reasonable that the Project will be implemented by the grant aid of the Government of Japan.

Compensation for lands will not be main constraint for the implementation of the Project, because it has been confirmed that right of way will be shifted without payment. AMC, having its own budget as well as training centre for equipments operators, will be good agency for operation and maintenance of the equipments and plants procured by the grant aid. However, the project will be implemented more effectively and more smoothly if the following items are consolidated or prepared:

7.3 Recommendations

(1) Training of Construction Equipments Operators

It is necessary to start training of construction equipments operators before the construction starts. During a period of 10 months prior to the commencement of the construction, 20 operators shall be brought together for training. The AMC, Paro shall be used as a training center. Within eight months after the training starts, most of the equipments procured for the project will have arrived at the local

sites. It shall therefore be possible to provide training by actually using those machines. Thus the trainees should be fully briefed in advance so that the training can yield maximum results. To achieve this, the Bhutanese Government will need to prepare itself fully and bring together from all over the country individuals with practical experience in machine operation.

(2) Training of Manager of Secondary Concrete Products

In Bhutan, secondary concrete products, such as concrete blocks used for waterways and river walls, are not manufactured. Consequently, all concrete pipes, even those with small diameters, and other such products all have to be imported. Moreover technical expert in the pertinent fields are non-existent. Simply carrying out this project is of course not enough to promote industry of this sort. Rather, it is essential that the Bhutanese side adopt a long-term perspective and clearly identify the needs and production goals of the country as a whole, securing and training staff and operators to realize those goals and making the necessary budgetary commitment. It is proposed that at least six months before the plants go into operation, a minimum of two candidates should be selected to undergo practical training.

The candidates will receive training in practical business matters, at a factory in Japan which manufactures concrete products similar to those planned in the project. One of the trainees shall be provided with training that focuses on the overall production process, management and wastewater treatment measures. The other shall be given practical training in, among other things, manufacturing of concrete products, welding reinforced steel bars, plant operation, maintenance of steel molds and product inspection. During manufacturing in the project, about ten staffs will be trained as the key staff of operation in the future.

(3) Farmer Organization

The farmers in the area concerned have high expectations for the project. This can be gauged, for one thing, by the active participation of their representatives in the "Paro Valley Agricultural

Development Steering Committee". However, while the farmers are at present engaged in repair works on irrigation canals, by and large, maintenance and management of irrigation canals in the project can only be described as inadequate. Moreover, the same can be said of farm roads. Maintenance and management of farm roads are in an extremely poor condition, even along the banks of the River Dotey, a part of the project area especially noted for its high productivity. Thus it is of utmost importance that the farmers be awakened to the importance of proper maintenance and management of farm roads.

In the Paro area, the implementation of the project will significantly advance the repair works on its agricultural infrastructures, but to ensure provision of adequate maintenance and management after the work is completed, it is essential that a farmer organization be formed.

In implementing the project, it is important to define the benefited area not only as a unit where benefits from existing canals are received, but as a unit where benefits from farm roads and river protection works are also taken into consideration. At the time the project is launched, efforts should be made to gain the effective cooperation of the farmers and have them participate in the project as workers, and to encourage them, while respecting their individual will, to organize themselves into maintenance and management organization.

(4) Operation and Maintenance of Construction Equipments

AMC, Paro, which will administer the construction equipments and plants procured under this project, will conduct operation and maintenance works during and after the project. However, its workshop is too small for the new procured equipments and it is advisable to extend facilities and to increase the number of technical staff for maintenance and repair. It will be recommended for the Government of Bhutan to extend and consolidate the workshop for effective utilization of the construction equipments.

ANNEX 1 MEMBER LIST OF SURVEY TEAM

Name	Speciality	Organization
Mr. Yasuhiko YAMAMOTO	Team Leader	Director of Planning Division Hokuriku Agricultural Administration Office, MAFF
Mr. Mitsuyoshi KAWASAKI	Project Coordinator	First Basic Design Study Div. Grant Aid Planning & Survey Department Japan Internationa Cooperation Agency (JICA)
Mr. Masamitsu FUJIOKA	Irrigation Enginner	Hokkaido Engineering Consultants
Mr. Kazuo MIBAYASHI	Farm Road & River Bank Protection Engineer	Hokkaido Engineering Consultants
Mr. Masao SUGAI	Plant & Construction Machinery Engineer	Hokkaido Engineering Consultants
Mr. Koki MITSUI	Geologial & Suvey Engineer	Hokkaido Engineering Consultants
Mr. Hidefumi INOUE	Cost Estimation Engineer	Hokkaido Engineering Consultants

ANNEX 2 SURVEY SCHEDULE

No.	Date	Activities
1	March 29 (Wed)	- Arrival of Study team in Delhi
2	March 30 (Thu)	- Courtesy call to Embassy of Japan. Meeting with JICA India Office.
3	March 31 (Fri)	- Arrival in Paro and shift to Thimphu.
4	April 1 (Sat)	- Courtesy call and meeting with Ministry of Agriculture.
5	April 2 (Sun)	- Arrival in Paro. Preparation for the Study.
6	April 3 (Mon)	- Courtesy call to Dzongkhag. Meeting with Steering Committee.
7	April 4 (Tue)	- General site reconnaissance of the Project Area.
8	April 5 (Wed)	- Topographic survey for existing farm road. Inventry survey for existing facilities.
9	April 6 (Thu)	- Topographic survey for existing farm road. Inventry survey for existing facilities.
10	April 7 (Fri)	- Topographic survey, inventry survey and water quality test.
11	April 8 (Sat)	- Topographic survey, inventry survey and water quality test.
12	April 9 (Sun)	- Analysis of collected data.
13	April 10 (Mon)	- Topographic survey and inventry survey. = Arrival of Team Leader and Project Coordinator in Delhi. Courtesy call to Embassy of Japan.
14	April 11 (Tue)	= Arrival of Team Leader and Project Coordinator in Thimphu. - Topographic survey and site reconnaissance.
15	April 12 (Wed)	= Courtesy call and meeting with Ministry of Agriculture. - Topographic survey and site reconnaissance.
16	April 13 (Thu)	= Arrival in Paro and site recnnaissance. - Topographic survey and inventry survey.
17	April 14 (Fri)	= Site reconnaissance and meeting with team.
18	April 15 (Sat)	= Meeting with Dzongkhag staff. - Topographic survey.

No.	Date	Activities
19	April 16 (Sun)	= Arrival in Thimphu. - Farm road survey and data analysis.
20	April 17 (Mon)	= Signing of meeting minutes with Ministry of Agriculture. - Topographic survey and borrow area survey.
21	April 18 (Tue)	= Arrival in Cilcutta. - Topographic survey for plant site and borrow area survey.
22	April 19 (Wed)	= Arrival in Bangkok. - Topographical survey, borrow area survey and interview.
23	April 20 (Thu)	= Arrival in Tokyo. - Topographic survey, water quality test and interview.
24	April 21 (Fri)	- Topographic survey, water quality test and interview.
25	April 22 (Sat)	- Meeting with Dzongkha staff.
26	April 23 (Sun)	- Preparation work for leave.
27	April 24 (Mon)	- Arrival in Delhi.
28	April 25 (Tue)	- Chief Engineer, Meeting with JICA India Office. Arrival of other engineers in Bangkok.
29	April 26 (Wed)	- Arrival in Tokyo.

ANNEX 3 MEMBER LIST OF BHUTANESE PARTY

Ministry of Agriculture	
Dasho Leki Dorji	Secretary
Department of Agriculture	
Dasho Khandu Wangchuk	Director General
MR. Tshering Dorji	Joint Director
Mr. Pem L. Dorji	Chief Planning Officer
Mr. Tseten Rabgay	Planning Officer
Planning Commission	
Dasho C. Dorji	Secretary
Steering Committee Members	
Dasho Pasang Tobgay	Dzongdag
Dasho Richen Dorji	Thrimpon
Dasho Kyoji Nishioka	Colombo Expert
Mr. Sherub Gyeltshen	Officer-in-charge, A.M.C.
Mr. B.P. Rai	P & M O
Mr. R.C. Nair	Assistant Engineer (Irrigation)
Mr. Tandin Dorji	District Agriculture Officer
Mr. Gyaltshen	Luni Village Headman
Mr. Gem Tshering	Wanchang Village Headman
Mr. Kinley Wangchuck	Lango Village Headman
Mr. Chen Tshering	Shari Village Headman
Mr. Tshe Dorji	Hore Village Headman
Mr. Tandin	Dotey Village Elder
Mr. Sonam richen	Tsento Village Elder
Mr. Dorji Tshering	Assembly Member
Counterpart	
Mr. Penden Norgay	Section Officer
Mr. Kezang Dawa	Irrigation Division
Mr. Thomas	
Embassy of Japan	
Mr. Masamichi Saigo	First Secretary
JICA India Office	
Mr. Taroh Kurabayashi	Representative

ANNEX 4 MINUTES OF DISCUSSIONS

MINUTES OF DISCUSSIONS
ON
THE BASIC DESIGN STUDY OF
THE PARO VALLEY AGRICULTURAL DEVELOPMENT PROJECT
IN
THE KINGDOM OF BHUTAN

In response to the request made by the Royal Government of Bhutan, the Government of Japan decided to conduct a Basic Design Study on the Paro Valley Agricultural Development Project (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (JICA). JICA has sent to the Kingdom of Bhutan the Basic Design Team headed by Mr. Yasuhiko Yamamoto, Director, Planning Department, Hokuriku Agricultural Administration office, Ministry of Agriculture, Forestry & Fisheries, from March 31 to April 24, 1989.

The Team had a series of discussions with the authorities concerned of the Royal Government of Bhutan and conducted a field survey in the Paro Valley.

As a result of the study, both parties have agreed to recommend to their respective Governments that the major points of understandings reached between them, as attached herewith, should be examined further towards the realization of the Project.

Thimphu, April 17, 1989.

山本恭彦

Mr. Yasuhiko Yamamoto
Leader
Basic Design Study Team
JICA

Dorji

Dasho Leki Dorji
Secretary
Ministry of Agriculture
Royal Government of
Bhutan

ATTACHMENT

1. Objective of the Project

The objective of the Project is to implement agricultural infrastructure improvements in selected gewogs of Paro Dzongkhag in support of its efforts so far made and thus to contribute to the development of infrastructure for modernization of the agriculture sector of the Kingdom of Bhutan.

2. Scope of the Study

The basic design study will be conducted in two divided phases. In the first phase, the actual conditions of agricultural infrastructure will be clarified and the information and data collected by the basic design study team will be analyzed.

On the basis of the result of the study, the team will prepare the rough improvement plan for necessary agricultural infrastructure in the Project area (it is called "Master Plan") and make basic design of (1) selected farm roads, (2) stone crushing plant and precast concrete plant, and (3) heavy machines.

In the second phase, based on the Master Plan, JICA will despatch another survey team around October, 1989 to conduct detail survey. The team will make basic design plan of the necessary facilities such as rural and/or farm roads, irrigation canals and river banks, and pilot land consolidation.

3. Executing Organization

The executing organization for the Project is the Department of Agriculture (DOA), Ministry of Agriculture and Forestry.

4. Project Sites

Proposed project sites are located at Paro Valley as shown in attached map.

5. Request of the Royal Government of Bhutan

The Study Team will convey a request of the Royal Government of Bhutan, which is listed in Annex I to the Government of Japan. The latter will make the necessary arrangement for the Project within the scope of Japanese Grant Aid Program.

6. Japanese Grant Aid Program

The Royal Government of Bhutan has understood the Japanese Grant Aid Program explained by the Team.

7. Measures to be taken by the Royal Government of Bhutan

The Royal Government of Bhutan will take necessary measures as listed in the Annex II on condition that the Grant Aid by the Government of Japan would be extended to the Project.

8. Budget and Personnel

After the completion of the Project, the Royal Government of Bhutan shall prepare the necessary budget and personnel for the operation and maintenance of facility and plants and heavy machinery.

9. Final Report

The final report of the Basic Design Study (10 copies, in English) will be submitted to the Royal Government of Bhutan before the end of August, 1989.

Annex I

IDENTIFICATION AND SCREENING OF PROJECT COMPONENTS

The Basic Design Team started its activities on 1st April, 1989 by explaining the Inception Report to the Ministry of Agriculture. Detailed discussions were held between the Ministry of Agriculture and the Team on the scope of work and clear understandings were reached between the two sides. Immediately after, the team conducted field survey with close co-operation of the counterparts including farmers representatives from the Royal Government of Bhutan. At present stage of the field investigation, the main project components screened by the Basic Design Team are as follows :

1.	Irrigation Canals	-	Table 1.
2.	Farm Roads	-	Table 2.
3.	River Bank	-	Table 3.
4.	Land Consolidation	-	Table 4.
5.	Machinery and Plants	-	Table 5.

Annex II

The necessary measures to be taken by the Royal Government of Bhutan are shown as follows :

1. To ensure land necessary for the construction of the proposed plants.

2. To ensure prompt unloading, tax exemption, customs clearance at ports of disembarkation and prompt internal transportation therein, of the products purchased under the Grant Aid.

3. To bear the following commissions to the Japanese foreign exchange bank for the banking services, based upon the Banking Arrangement.

   (1) Advising commission of authorization to pay
   (2) Payment commission

4. To exempt Japanese Nationals involved in the Project from custom duties, internal taxes and other fiscal levies which may be imposed in the Kingdom of Bhutan with respect to the supply of the products and services under the Verified Contracts.

5. To accord Japanese Nationals whose services may be required in connection with the supply of the products and the services under the Verified Contracts such facilities as may be necessary for their entry into the Kingdom of Bhutan and stay therein for the performance of their works.

6. To bear all the expenses other than those to be borne by the Grant, necessary for the execution of the Project.

7. To provide necessary data and information for detailed design.

8. To make necessary arrangement for securing skilled and/or unskilled labor as required for the implementation of the Project, taking into consideration the policy of the Royal Government of Bhutan on mechanisation of construction.

(1) IRRIGATION CANAL IMPROVEMENT PLAN

	Name of Canal	Gewog (District)	Source of Water	Canal Length km	Command area ha	Priority A	B	C	Main portions improved
1.	Shaba-Shengo	Shaba	Paro River	1.77	10.1	O			Intake weir
2.	Shing-kana	Shaba	Stream	2.30	48.6		O		Provision of material Pipe - 30 x 5 = 150 m
3.	Bathumu	Shaba	Paro River	2.31	49.0	O			Intake weir
4.	Dujey-Dinkha	Shaba	Paro River	1.78	78.6	O			Intake weir
5.	Mayu-Nemjo	Luni	Paro River	3.93	63.0			O	
6.	Serekha	Luni	Stream	2.10	66.8	O			Intake weir. Rehabilitation 300 m
7.	Jimtshe	Luni	Stream	1.08	56.7			O	
8.	Tshechukha	Wangchang/ Shaba	Paro River	1.10	93.2	O			Intake weir. Pipe line (Proposed Land Consolidation)
9.	Lungkha	Wangchang	Stream	0.69	89.7			O	
10.	Jachey (Khangkhu)	Wangchang	Paro River	3.13	43.1			O	
11.	Kampa-Thangyul	Shari	Dotey River	1.86	24.3	O			Intake weir
12.	Gisi-Chawa	Shari	Dotey River	1.50	101.3	O			Intake weir
13.	Sharimo-chu	Shari	Stream	1.23	60.8	O			Intake weir (Same Richu) pipe line system
14.	Richu	Shari	Stream	2.38	24.8	O			Intake weir (Sharimo-chu) up-stream pipe line

	Name of Canal	Gewog (District)	Source of Water	Canal Length km	Command area ha	Priority A	B	C	Main portions improved
15.	Damte-Yuwa	Shari Horey	Dotey River	2.64	162.0	O			Intake weir
16.	Thachukha	Shari Horey	Stream	1.80	16.2			O	
17.	Jangsa (Mini Hydro)	Dotey Shari Horey	River Dotey	5.264	88.7	O			3.5 km U flume or pipe
18.	Gonju	Lango	Stream	2.5	142.8			O	
19.	Chendo-Chukha	Lango	Paro River	3.0	102.3	O			Intake weir (concrete) Division Structures
20.	Guyamey-Jagathang	Lango	Paro River	3.7	121.5			O	
21.	Bamdoley	Lango	Paro River	1.92	81.0	O			Up-stream 300 m length renovation (insufficient section)
22.	Doshom-menchu	Dotey	Paro River	3.3	47.0		O		Several portion leakage 7 x 30 = 210 pipe provided.
23.	Tshokona	Dotey	Paro River	1.56	64.8		O		Rehabilitation of 200 m lining. Material supply

	Name of Canal	Gewog (District)	Source of Water	Canal Length km	Command area ha	Priority A B C	Main portions improved
24.	Chento-Shari	Chento	Paro River	2.77	32.4	O	
25.	Damphu	Chento	Stream	1.70	28.4	O	
26.	Shhezi	Chento	Stream	3.8	110.2	O	
27.	Gnyamjay	Chento	Stream	1.65	20.4	O	
	TOTAL :-			62.764 km	1827.7 ha		

Priority	Canal length km	Command Area ha
A	28.854	942.9
B	7.160	160.4
C	26.75	724.4
TOTAL:	62.764 km	1827.7 ha

(2) FARM ROAD IMPROVEMENT PLAN

Sl. No.	Starting Point	Ending Point	Road length in K.M.	Covering Benefitiary (village, colonies)	Priority A	Priority B	Priority C	Remarks
1.	Kasatakha, Dotey	Ramna, Shari.	3.4	Atsho, Chubba, Jyabji, Chasampa, Richu, Jiba.		O		Right Bank of Dotey River.
2.	Tshokhona, Dotey.	Changsima	3.4	Akshi, Kutiphu, Pachu, Damji, Changsima.	O			Existing Farm Road, Dotey.
3.	Ruchukha, Shari.	Rimdo-Tshekha, Shari.	1.8	Kempa, Rotogang, Bichukha, Tshekha, Chimsarp, Delikha.		O		Covering most advanced area.
4.	Namdu-Thangguto, Chang Nanka.	Domna and Tsokopang	0.5	Wangthangka, Domna, Shina Gyechukha, Tak-Chorten, Tsokapang.			O	Isolated area by Airport
5.	Changkha-Thang, Chong.	Jongtena	1.3	Chang, Rongna, Jongtena, Nangkha.			O	
6.	Khangku	Wanthangka	1.75	Chimina, Uchuka, Chamithanka, Khangku	O			Construction Road of River Protection

Sl. No.	Starting Point	Ending Point	Road length in K.M.	Covering Benefitiary (village, colonies)	Priority A B C	Remarks
7.	Gartsang, Woochu.	Confluence of Paro River and Woochu stream	0.65x2 = 1.3	Kashi-Tsawa, Woochu.	O O	Right Bank has high priority.
8.	Bondey-Lhakhang.	Gebji, Drugey-dingkha.	1.8	Bondey, Bondey-Gom, Drugye-Dingkha, Panbesa.	O	Transportation of Cash Crop Products.
9.	Bamdoley	Jyangsa-Phaka	6.8	Rema, Chendo-Chukha, Chendona, Bamdoley.	O	Left Bank of Paro River.
10.	Sa-Tsam Chorten	Tsento-Mitsi	12.0	Tyna-Mey, Chhizi, Jyutsu, Gynanjey, Gsimlho, Chunjey, Mitsi.		Priority pending; re-survey.
11.	Sa-Tsam Chorten	Below Petrol Pump	9.5	Geptey, Nyemjyo, Kyichu, Gonju, Jagathang.	O	Farm mechanization and transportation
12.	Chorten-Sarpa, Shaba.	Deankha, Shaba.	3.2	Botum, Serina, Chonni, Tankha, Chazam-Zampa.	O	Construction road of river protection.

(3) RIVER BANK IMPROVEMENT PLAN

Sl. No.	Name of River	Embankment Left/Right	Starting Point	Ending Point	Length in K.M.	Priority A	Priority B	Priority C	Remarks
1.	Dotey	Left	Tsokhona	Changsi-ma	3.7	O			Farm Road
2.	Dotey	Right	Chuba & Atso	Jangsa	4.3	O			
3.	Paro	Left	Bamdoley	Jangsa	0.4		O		Enough river width
4.	Paro	Left	Sengo-Tsekha	Chorten Sarpa	3.63	O	O		3.0 km priority A. 0.63 km priority B.
5.	Paro	Right	Nyemi-Zam	Khangku	1.75	O			Construction road will be Farm Road
6.	Paro	Right	Suspen-sion Bridge	Drugye-Dingkha	0.9		O		River protection 400 m River bed excavation 500 m
7.	Paro	Right	Kesa		1.5			O	Cultivation almost washed away
8.	Woochu	Left	Gart-sang	River confluence	0.9			O	
9.	Woochu	Right	Gart-sang	R. Confluence	0.9			O	
10.	Gyebzana Rongchu	Right	Chang-chu Lhakang	R. Confluence	2.05	O			River bed excavation

(4) LAND CONSOLIDATION PLAN

Sl. No.	Village	Gewog	Area for consolidation	Benefitted households	Priority A B C	Remarks
1.	Changkha-Thang below Bondey bridge	W/chang	70 acres	22 nos.	O	Flat land. Easy access high demonstrations effect.
2.	Flooded area and reclaimed area (Damji and Jukha)	Shari	75 acres	44 nos.	O	

EQUIPMENT LIST

Note : Requirement for 1 site

A. BURROW

Sl. No.	Description with specifications	Accessories/attachments	Quantity	Remarks
1.	Bulldozer 120 HP	1. Multishank Ripper 2. ROPS Canopy 3. Angle Dozer	1	
2.	Excavator 90 HP with $1m^3$ bucket capacity	1. ROPS cabin 2. General purpose bucket with side cutter 3. Clamshell 4. Slope finishing bucket	1	
3.	Wheel loader 100 HP artimlated frame	Bucket capacity 1.5^3 for 2 ton/m^3 material density.	1	
4.	Dump trucks 8-11 ton capacity	-	2	

B. QUARRY

Note : Requirement for 1 site

Sl. No.	Description with specifications	Accessories/ attachments	Quantity	Remarks
1.	Air compressor 65 HP free air delivery 7.5m^3/minute	Jackhammer Air line Drill rods Drill bit grinder	1	
2.	Wheel loader 100 HP bucket capacity - 200 m^3	1. ROPS 2. Ripper	1	
3.	Bulldozer 200 HP	1. Ripper 2. ROPS Canopy 3. Angle Dozer	1	
4.	Excavator 90 HP	1. Bucket - general purpose 2. Breaker	1	
5.	Dump trucks - 11 ton capacity	-	2	
6.	Detonating device electronically controlled	-	2	

C. FARM ROAD

Requirement for 1 construction site

Sl. No.	Description with specifications	Accessories/ attachments	Quantity	Remarks
1.	Bulldozer 120 HP	ROPS Canopy Ripper Angle Dozer	2	
2.	Towed scraper/motor grader 110 HP	-	1	
3.	Wheel Loader 110 HP	-	1	
4.	Dump trucks - 11 ton	-	2	
5.	Swamp dozer 100 HP Elevated sprocket	1. Back hoe	1	
6.	Vibratory roller - 10 ton	-	1	
7.	Excavator 55 HP	1. Cutting buckets 2. Slope finishing bucket	1 1	

D. RIVER EMBANKMENT

Note : Requirement for 1 site

Sl. No.	Description with specifications	Accessories/attachments	Quantity	Remarks
1.	Bulldozer 200 HP	ROPS Angle Dozer Rake Dozer	1	
2.	Track loader 150 HP Bucket capacity 2 m^3	Ripper ROPS	1	
3.	Excavator 200 HP Bucket 1 m^3	Buckets Breaker	1	
4.	Water pump on pneumatic wheel rubber crawler type	Suction pipe delivery 100 m (50 x 2)	1	
5.	Tipper carrier with crane 2 ton capacity	-	2	
6.	Dump trucks - 11 ton	-	2	
7.	Vibratory roller - 10 ton	-	1	

E. IRRIGATION CHANNEL CONSTRUCTION

Note : Requirement for 1 site

Sl. No.	Description with specifications	Accessories/attachments	Quantity	Remarks
1.	Excavator with blade 15 HP	Slope finishing bucket Digging bucket with side cutter.	4	
2.	Carrier with crane 2 ton capacity	-	1	
3.	Tamper	-	3	
4.	Rammer	-	3	
5.	Truck mixer dry type $2m^3$	-	1	
6.	Bulldozer with back hoe 40 HP	-	1	
7.	Power trowel	-	3	
8.	Vibrator Engine	-	2	
9.	Concrete Pump - 5.5 KW 5 m^3/hr reach - 200 m horizontal 50 m vertical		1	

F. LAND CONSOLIDATION

Note : Requirement for 1 site

Sl. No.	Description and specifications	Accessories/ attachments	Quantity	Remarks
1.	Swamp Dozer 120 HP 0.25 kg/Cm^2 ground pressure Elevated sprocket	Angle Dozer Ripper ROPS	2	
2.	Self propelled, electric operated stone picker trommel type, Stone size - 2 cm - 30 cm	Engine generator	1	
3.	Excavator 100 HP		2	
4.	Excavator 20-25 HP		2	
5.	Towed Scraper 20 ton cap.		1	
6.	Pay loader 100 HP		2	
7.	Dump trucks - 11 ton		4	
8.	Tamper		2	
9.	Rammer		2	
10.	Mud Pump		1	

G. STONE CRUSHER PLANT, PORTABLE

Sl. No.	Description with specifications	Accessories/attachments	Quantity	Remarks
1.	Primary crushing unit, Secondary crushing unit, Diesel generator with wire, control pannel, conveyers, etc. Washing arrangements, screens 30-40 ton/h Materials handling equipments, pay-loader etc.		2 units	
2.	Belt-conveyer with electric motor, 7000 x 450 - 550mm 35-40 m/hr	Distribution-box extension wire, generator (100 KVA) for emergency stand by with wheel.	10 units.	

H. PRE-CASTING CONCRETE PLANT:

Sl. No.	Description with specifications	Accessories/attachments	Quantity	Remarks
1.	Cement batching plant			
2.	Pre-casting concrete plant			
3.	Steam curing unit with boiler, compressor.			
4.	Sprinkler unit with pump, delivery hose pipe, Diesel engine.		1 unit	Details pending home office analysis.
5.	Water treatment plant with chemical treatment and related equipments.			
6.	Materials handling equipment.	Pay-loader, fork lift etc.		
7.	Steel rod processing unit			
8.	Casting mould 1 lot	(including chanal, edge block, slab, tetrapod etc.)		

I. SUPPORTED EQUIPMENTS:

Sl. No.	Description with specifications	Accessories/ attachments	Quantity	Remarks
1.	Self-loader trucks Capacity - 18 ton, Hydraulically controlled winch	Tipping outrigger, Ramps, wooden truck bed, winch	1 unit	
2.	Rough Terrain crane truck, 10-12 ton at 5m load center telescopic boom minimum 20 m length		1 unit.	
3.	Mobile workshop with tools equipments		1 unit.	
4.	Transport truck, 6x18 ton capacity with crane		2 units.	
5.	Supervision vehicles, 4x4 pick-up double cabin, 4000 cc displacement		4 units.	
6.	Service vans with tools/ equipment 4x4 type		2 units.	
7.	Motor bikes 185 cc with spares like sprocket, chain etc.		20 units.	
8.	Oil tanker for oil distribution 3000 litter capacity		1 unit.	

ANNEX 5

Notes

on

The Steering Committee Meeting

Held on 30 March, 1989

In order to further facilitate the agricultural development activities of Paro Dzongkhag, the Government of Bhutan had requested the Government of Japan for assistance in farm road construction, river bank protection works, improvement of irrigation channels and land consolidation. On 21.1.1989 the Director General of the Department of Agriculture held a meeting with the public of Paro and explained the importance of this Project. He also stated that the public had unanimously committed to His Majesty the King at a public meeting at Olathang Hotel in February, 1986. This was further reconfirmed to the steering committee members at the meeting of 30.3.1989 and 3.4.1989.

It was also reconfirmed that there would be no objection from the concerned farmers should any farm road fall into his farm-land. This was also agreeable that all benefitiary farmers would compensate the affected farmers. The following members were present:

1. Dasho Passang Tobgay, Chairman.
2. Dasho Keiji Nishioka.
3. Dasho Rinchen Dorji.
4. Mr. Sherub Gyaltshen.
5. Mr. Tandin, Dzongkhag Agri. Officer.
6. Mr. R.C. Naiyar, Dzongkhag Irrig. Officer.
7. Mr. Dorji Tshering, Shari Chimi.
8. Mr. Gyaltshen, Luni Gup.
9. Mr. Kinlay Wangchuk, Lango Gup.
10. Mr. Tshen Tshering, Shari Gup.
11. Mr. Tshering Dorji, Horey Gup.
12. Mr. Tandin.
13. Mr. Sonam Rinchen.
15. Mr. Gem Tshering, Wangchang Gup.

DZONGKHAG ADMINISTRATION

RINPUNG DZONG
PARO

ཀ ཉི་ལམ དེ་ནི་རིན་སྤུངས་སྡོང་ཁག་གི་ས་ནམས་ལམ་བསྐུལ་ཚོང་འཛིལ་མཛད་སྐྱིད་དོན་མ
རང་གཤེང་ནས་ཧ་པུན་གཤེང་དང་ཁ་ལའ་ཡི ཁྱོགས་རམ་ཞུས་ཐོག་ནས་མི་མེར་གྱོང་གསེའ་ཁ
སོ་སོར་ འབྲལ་ཐང་འགྲལ་བསྡོད་ཀྱི་ལམ་དང་ ཆུ་བྱག ཆུ་ལུང་ཉམས་བཅོས་ ས་ཆ་ཞིགས་བཅོས
བཟོ་ཆུད་འཚར་བསྐལ་བཙམས་གནང་ལོད་པ་ལས སྤྱི་ཚེས་ ༡༩–༡–༡༩ ཉིན་སོ་ནམས་ལོངས་ཀུབ་མདོ
ཆེན་སྤྱ་གྱི་ཆིབ་བསྡོད་བྱོན་སྐབས་ཤ ཞལ་འཛོམས་གནང་དོན་ཐེ་བཤིན ངེད་རང་མི་སེར་ལ་ལན་
པའི་དོན་དུ ཐྲིར་པ་ཐོ་ཡིའི་རང་དབང་ས་ཆ་ལས་ཁས་ལམ་ཁོག་གསར་དུ་ལམ་སེལ་བྱ་དགོས་བྱང
རྡང་ མི་སེར་ཁོངས་ནས་འཚར་གཤེའི་ལས་རིམ་དང་འབྲིང་དེ་ཉོག་མེད་བྱ་བཅུག་ཀྱང་མ་གཏོགས ཉོག
བཀད་ཅ་ཅ་ནས་མི་བྱེད་ཅེས་མི་སེར་ཁོངས་ནས ཤུ་མ་སྤྱི་ལོ་ ༡༩༨༦ ཟླ་ ༡ ལའི་ནང་ཐུ་ཁྲི་ཚོ་ལོ་ཐང
ཁའི་མཐོན་ཁྱིམ་ནང་གཤེང་ཞབས་ཤ ཞལ་འཛོམས་ནང་ཁྱེས་པའི་ཁས་བླངས་པར དཔེར
སྤྱི་ཚེས་ ༡༠–༡–༡༩ དང་ ༡–୧–༡༩ ཉིན་ ཀཀྱི་ཐིང་ལ་ཁྲོང་གསེའ་གི་ནས་ཆ་ཐོག་ནས་ལས་དོན་གོང་འཕེལ་ཚོགས་ཆུང
ནང་དུ་ཡང་ཐི་སེའ་ཀྱི་འཐུས་མི་དང དམང་ཚན ཚེད་ཡོ་བཅོམ་ནས་ཁྱེས་ཁྱབ

དེ་ཁར ཚེད་རོགས་གཅིག་གི་ཁྲོང་གསེའ་ནང་མི་སེར་ཀུང་པ་
ཁ་ཤས་ཀྱི་སྤྱི་དོན་ལ་ཤོན་ཐབས་པ་ཁྱིམ་པ་གཅིག་གི་ས་ཆ་ཐོག་ནས་ལས་སེལ་བྱེད་དགོས་བྱང་ཀྱི་གསོལ
སྤྱིལ་བྱང་བའི་ཆུད་འཛིན་ས་ཚན་ལྷོད་དགོས་པ་རང་བྱང་དུང་དེ་ཚོ་ཡང་ཐ་ཝིན་ལུམ་བའི་གོང་ཚད
དང་འབྲིལ་ཏེ་དཀྱུལ་ཁར་ཐྲིས་ཀྱག་ནས་ ལས་དིས་ཤན་པ་ཡོད་པའི་མི་སེར་ཐ་ཤོ་གཤེན་ཚོས་ཀུང་
དབྱལ་བགོ་ཀྱབ་སྐྱེ་འབག་ཀྱ་ཡིན་ཚུལ་ཚོགས་ཆུང་ནང་ཁྱེས་པར་ཚོགས་ཆུང་ནས་ཀུང་མི་སེར་སྤྱི་དོན་
ལ་ཤན་པའི་ལས་དོན་འབྱེད་ཀྱ་ཡིད དེ་བཞིན་བྱ་དགོས་པར་ཆ་འཛོག་མཛད་ཀྱག

འདྲ་གཉིས་པ

๗ རིན་སྤྲངས་རྫོང་ཁག་ཡང་ཐུམ་ཚོགས་ཆུང་ཤིང་ ๒๧ བའི་གློས་ཆོད་ཀོག་གྲངས་ ๧ བའི་རིམ་ཙང་ ๐๗ པའི་ཁངས་ཁུར་ཚོགས་པ་ཞིས་ཀྱི་ཆིས་ ๓-๒-๨๑ ལ་ཉིན་བཅུ་བའི་མཚན་དུས་གཅིག་འཁོད།

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๑) དྲགོས་ རྫོང་བདག་

๒) " ཁྲིམས་དཔོན་

๓) " ཉི་ཟླ་ཀ་

๔) " ཤེས་རབ་

๕) རྫོང་ཁག་འཆར་གཞིའི་རྩྭ་པ་ཀུ་དུ་བཏི་

๖) སོ་ནམས་འགོ་དཔོན་ དུ་མཁྱེན་

๗) ཆུ་ལུར་འཁོ་དཔོན་ ན་ཚང་

๘) དོན་སྐྱེ་དམང་གི་ཚབ་ དུ་མཁྱེན་

๙) བཙན་སྐྱེ་དགང་གི་ཚའུ་ བསོད་ནམས་རིན་ཆེན་

๑๐) ཚན་བོང་ཤིད་པོ་ ཀུན་ལེགས་དབང་ཕྱུག

๑๑) ལྷགས་གཉིས་ཤིད་པོ་ རྒྱལ་མཚན་

๑๒) ཐུང་ཙང་ཤིད་པོ་ མགོན་པོ་ཆེ་རིང་

๑๓) དོས་ཤར་ཤིད་པོ་ བཙན་ཆེ་རིང་

๑๔) ཤར་པ་སྐྱེ་མེ་ རྡོ་རྗེ་ཆེ་རིང་

๑๕) ཐུམ་རལ་ཤིད་པོ་ ཆེ་རིང་རྡོ་རྗེ་

ཆོས་ཀྱི་ཀློང་པ་

པ་གངས་སྐྱིལས་ཀུག་

DZONGKHAG ADMINISTRATION

RINPUNG DZONG
PARO

(๓)

ཤལ་འཛོམ་འགྲམ་མི་མཚན་པོ

๑)	དྲུགོམ་པ་མངམ་སྐོམས་ཀུལ་		ཆོགམ་བཞི་དབུ་འཛིན	
๒)	དྲུགོམ་	རི་གཞོ་ཀ	འགྲམ་མི	
๓)	དྲུགོམ་	དིན་ཆེན་རྡོ་རྗེ	••	
๔)	དྲུགོམ	ཀེས་རབ	••	
๕)	མོ་ནམས་འགོ་དབོན	ཏ་མཁྱེན	••	
๖)	ཆུ་ཡང་འགོ་དབོན	ཤར་མི་ན་ཡར	••	
๗)	ཀྱི་སེར་འགྲམ་མི་	རྡོ་རྗེ་ཐི་དིང	::	ཤར་བཞི་ཀྱི་མི
๘)	མི་སེར་ཆིབ་པོ	ཀུལ་མཚན	००	ལུགས་ཉིད་ཆིབ་པོ
๙)	•• ••	ཀུན་བཟང་དབང་ཕྱུག	••	ལམ་གོང་ཆིབ་པོ
๑๐)	•• ••	པཙན་ཐི་དིང	••	དོས་ཤར་ཆིབ་པོ
๑๑)	•• ••	ཐི་དིང་རྡོ་རྗེ	••	ཀུམ་རལ་ཆིབ་པོ
๑๒)	•• དམང་ཚབ	ཏ་མཁྱེན	••	དོས་ཐྲིང་དམང་ཚབ
๑๓)	•• ••	བསོད་ནམས་དིན་ཆེན	••	པཙན་རྐོག་རམང་ཚབ
๑๔)	•• ཆིབ་པོ	མགོན་ཐི་དིང	••	ཕྱང་ཅང་ཆིབ་པོ

ANNEX 6 MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1986

Date	January Max.Temp. in °C	January Min.Temp. in °C	January Rainfall in mm	Date	February Max.Temp. in °C	February Min.Temp. in °C	February Rainfall in mm
1	16	-2	-	1	16	-2	-
2	10.5	-2.5	-	2	17	-3	-
3	17	0.0	-	3	15	1	-
4	15	1	-	4	16	2	-
5	16	-1	-	5	15	1	-
6	20	-4	-	6	15	-1	-
7	20	-4	-	7	16	-2	-
8	29	-4	-	8	15	-2	-
9	24	-2	-	9	17	-1	-
10	18	-4	-	10	16	-2	-
11	16	-5	-	11	19	-3	1.2
12	15.5	-4	-	12	20	-2	-
13	12.5	-5	-	13	16	-2	-
14	15.0	-3	-	14	16	-2	-
15	24.0	-2	-	15	16	-1	-
16	10.0	-2	-	16	16	-1	-
17	10.0	-2	-	17	16	-1	-
18	14.0	-1	-	18	15	2	-
19	13.0	-1	-	19	16	-1	-
20	14.0	-5	-	20	15	-5	-
21	14.0	-4	-	21	21	-3	-
22	15.0	-3	-	22	20	1	-
23	16.0	-3	-	23	20	1	-
24	19.0	-3	-	24	20	-2	-
25	15	-1	-	25	20	-2	-
26	17	-3	-	26	20	-2	-
27	16	-3	-	27	20	-2	-
28	17	-3	-	28	18	-2	-
29	19	-3	-				
30	17	-2	-				
31	17	-2	-				

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1986

March				April			
Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm	Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm
1	17	-1	-	1	20.0	3.0	2.4
2	17	-1	-	2	20.0	4.0	9.2
3	17	-1	-	3	20.0	4.0	1.2
4	16	-2	-	4	16.5	5.0	2.8
5	16	2	-	5	15.0	4.0	3.4
6	14	1	-	6	14.0	5.0	3.4
7	16	3	-	7	15.0	4.0	-
8	15	3	-	8	15.0	5.0	-
9	16	2	-	9	15.0	5.0	-
10	16	2	-	10	17.0	6.0	-
11	15	2	-	11	17.0	10.0	1.0
12	20	5	-	12	21.0	8.0	-
13	20	5	2.4	13	21.0	8.0	-
14	21	5	2.8	14	21.0	11.0	-
15	21	4	-	15	23.0	13.0	-
16	20	3	-	16	25.0	12.0	-
17	20	-1	-	17	25.0	7.0	-
18	20	-1	-	18	27.0	6.0	-
19	19	-1	-	19	21.0	5.0	-
20	18	1	1.6	20	21.0	4.0	-
21	18	-1	-	21	22.0	4.0	2.4
22	19	0.9	-	22	24.0	3.0	-
23	19	2	-	23	26.0	4.0	-
24	19	1	-	24	24.0	7.0	1.2
25	21	1	-	25	20.0	11.0	-
26	21	1	-	26	19.0	11.0	-
27	21	0	-	27	22.0	6.0	4.0
28	26	3	-	28	20.0	9.0	1.0
29	21	7	-	29	17.0	5.0	3.2
30	21	4	-	30	18.0	4.5	1.2
31	19	5	-				

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1986

Date	May Max.Temp. in °C	May Min.Temp. in °C	May Rainfall in mm	Date	June Max.Temp. in °C	June Min.Temp. in °C	June Rainfall in mm
1	23.5	9.0	-	1	26	11	-
2	21.0	9.0	-	2	25.5	12	5.0
3	24.0	11.0	-	3	25.5	13	-
4	23.0	10.0	-	4	25.5	14	-
5	23.0	8.0	-	5	26.0	13	-
6	23.5	10.0	0.6	6	22.0	15	9.2
7	21.0	10.0	-	7	23.0	13	0.1
8	22.0	10.0	-	8	25	14	-
9	24.0	6.0	0.8	9	24	14.5	-
10	25.0	6.0	-	10	26	14.5	-
11	22.0	10.0	-	11	28	15.5	-
12	20.0	9.0	-	12	21	15.5	5.4
13	21.0	11.0	4.4	13	24.5	14	2.2
14	21.0	11.5	2.2	14	23	14.5	0.2
15	20.0	10.0	0.2	15	24	14	0.2
16	20.0	9.5	1.6	16	23	16	1.6
17	19.5	9.5	-	17	24	17	-
18	19.5	11.5	6.1	18	26	16	-
19	21.0	10.0	4.2	19	25	16.5	1.0
20	24.0	11.0	0.2	20	25.5	16	0.6
21	23.0	11.0	0.6	21	26	17.5	6.2
22	28.0	11.0	-	22	28	17	1.2
23	26.5	8.0	-	23	29	17	-
24	22.0	7.5	-	24	28	17	1.4
25	22.0	6.5	-	25	27	16	3.0
26	20.5	5.5	-	26	24	17	10.0
27	22.5	6.0	-	27	28.5	16.5	10.4
28	20.0	10.0	-	28	18	15	24.7
29	24.5	6.5	-	29	23	15	11.0
30	25.0	8.7	-	30	21	16	1.6
31	25.5	11.5	1.2				

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1986

Date	July Max.Temp. in °C	July Min.Temp. in °C	July Rainfall in mm	Date	August Max.Temp. in °C	August Min.Temp. in °C	August Rainfall in mm
1	23.5	16	0.8	1	22.5	16	-
2	23.5	16	0.2	2	20.5	16	5.0
3	24	20	-	3	23	15.5	-
4	27	18	2.2	4	28.5	14.5	4.0
5	25	17	-	5	28	14	1.2
6	26	16.5	16.0	6	28	15.5	-
7	24	18	6.0	7	29	18	-
8	25	16	25.2	8	28	16	5.0
9	25	16	2.2	9	29.5	16	-
10	26	16.5	-	10	29	14	21.8
11	25	17	-	11	27	15.5	-
12	28.5	17	2.0	12	28	15.5	7.4
13	22	17.5	-	13	26	13	1.3
14	26	17	2.8	14	26	14	-
15	24.5	16.5	2.2	15	25	16	-
16	26	17	-	16	?	?	?
17	23	17.5	1.2	17	?	?	?
18	22.5	16	4.8	18	28	16	1.2
19	25	16.5	4.0	19	28.5	16	5.8
20	25	17	20.0	20	24.5	15	11.0
21	27.5	16	2.2	21	23	16	-
22	27	15	4.2	22	23	16	3.5
23	26.5	15.5	1.2	23	23	16	4.8
24	23	16	5.2	24	25	14	1.8
25	19.5	16	17.4	25	26	15	-
26	28	18	4.0	26	26	16	-
27	22	14	-	27	27	16.5	-
28	26	15	-	28	26	14	-
29	26.5	16.5	-	29	27	15.5	-
30	22	16.5	-	30	27.5	15	-
31	24	16	24.4	31	26	16	-

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1986

Date	September Max.Temp. in °C	September Min.Temp. in °C	September Rainfall in mm	Date	October Max.Temp. in °C	October Min.Temp. in °C	October Rainfall in mm
1	26	16.5	-	1	20.5	12.5	5.9
2	27.5	16	-	2	22.5	12.5	-
3	27	14.5	4.2	3	?	?	?
4	27.5	16	5.8	4	23	7.5	-
5	25	16	-	5	21	10.5	-
6	25	15.5	10.4	6	13.5	10.2	15.3
7	25	15	-	7	13.5	12	19.2
8	25	15	-	8	22.5	10	4.1
9	25	15	3.5	9	22	10	-
10	22	14	3.4	10	21.5	14.5	-
11	18	14	28.4	11	21.5	11	0.8
12	22	15	0.5	12	?	?	?
13	21	15	-	13	19	8.5	1.6
14	23	15	-	14	16.0	9.5	1.2
15	?	?	?	15	18	5	2.5
16	23	14	4.5	16	17.5	8	-
17	22	14	-	17	14.5	5.5	-
18	26	14	-	18	19	5	-
19	26	13.5	-	19	?	?	?
20	26.5	14	-	20	21	6	-
21	25	14	0.6	21	20	6	-
22	23	13.5	3.2	22	20	6.5	-
23	23	12.5	-	23	22	4	-
24	19	12.5	3.0	24	21.5	2	-
25	23.5	12.5	3.5	25	20.5	-0.5	-
26	22	12	-	26	?	?	?
27	?	?	?	27	22	-0.5	-
28	21.5	9	29.8	28	22	0	-
29	23	10.5	-	29	20	1	-
30	20	11.5	6.8	30	20	1.5	-
				31	18	1.5	-

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1986

	November				December		
Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm	Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm
1	19	4.5	-	1	19	-2.5	-
2	?	?	?	2	20	-3	-
3	21	6	-	3	22	-3.5	-
4	21.5	7	-	4	20.5	-3	-
5	20	9	-	5	19.5	-3.5	-
6	20	3	-	6	20.5	-3	-
7	21	6	-	7	17.5	-2.5	-
8	?	?	?	8	?	?	?
9	21	3	-	9	?	?	?
10	15	10	-	10	?	?	?
11	?	?	?	11	15	-2	-
12	20	0	-	12	13	-1.5	-
13	18	3	-	13	18	-1.0	-
14	19	4	-	14	12	-1.0	-
15	19.5	1.5	-	15	13	2.0	-
16	19	4	-	16	12	-3	-
17	19	3	-	17	15	-3	-
18	18	4.5	-	18	26	-3	-
19	20	0.5	-	19	16	-1	18.0
20	?	?	?	20	16	-2	-
21	18	2.5	-	21	?	?	?
22	18	6.5	-	22	13	-4	-
23	?	?	?	23	12.5	0	-
24	19	3.5	-	24	13.5	-0.5	-
25	18	2	-	25	13	-0.5	-
26	?	?	?	26	13	-4.5	-
27	?	?	?	27	13.5	-4.5	-
28	18.5	6	-	28	13.5	-4.5	-
29	?	?	?	29	13.5	-5	-
30	?	?	?	30	12.5	-1.5	-
				31	9	-0.5	-

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1987

Date	March Max.Temp. in °C	March Min.Temp. in °C	March Rainfall in mm	Date	April Max.Temp. in °C	April Min.Temp. in °C	April Rainfall in mm
1	13	0.5	-	1	22.5	9	3.3
2	15	0.5	-	2	20.5	10	0.4
3	14	2	1.0	3	19.5	7.5	-
4	15	2	-	4	21.5	5	-
5	16.5	2.5	-	5	23.5	4.5	-
6	17	1.5	-	6	23.5	6.5	-
7	15	2.0	-	7	21.0	8.5	0.8
8	17	1.5	-	8	22	8	-
9	12	1.5	1.5	9	18	7	3.3
10	17	3.5	1.7	10	22	6	-
11	15.5	2	-	11	22	5	-
12	16	3	-	12	20	2	1.2
13	12	2	-	13	21	3.5	0.5
14	15	5	-	14	20	0.5	-
15	15	4.5	-	15	20	1.5	6.0
16	18	4.5	-	16	20	1.5	-
17	14	8	-	17	20	3.5	-
18	14.5	6	6.4	18	17.5	5	-
19	17.5	3	-	19	20	5.5	-
20	14.5	3.5	-	20	19	4	-
21	19.5	3.5	11.6	21	22.5	2	-
22	17.5	4	-	22	23.5	5.5	-
23	16.5	3.5	-	23	23	9.5	3.6
24	20.5	6	-	24	16	5.5	-
25	21	7	-	25	20	6	-
26	21.5	8.5	-	26	22	6.5	17.2
27	21	8	5.8	27	18	6	1.6
28	20	8	-	28	17	6	-
29	21	6.5	-	29	19.5	7.5	5.9
30	20	4	-	30	20.5	9.5	-
31	19.5	7.5	-				

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1987

Date	May Max.Temp. in °C	May Min.Temp. in °C	May Rainfall in mm	Date	June Max.Temp. in °C	June Min.Temp. in °C	June Rainfall in mm
1	17.5	7.5	0.5	1	27.5	15	-
2	21	6.5	-	2	21	13	6.4
3	17.5	6	-	3	20	13.5	-
4	12.5	6	12.0	4	19.5	14	-
5	15.5	3.5	1.8	5	27.0	15	-
6	17.5	6.5	-	6	27.5	16	-
7	16	5.5	-	7	28.5	14	-
8	21	10	-	8	26.5	13.5	14.8
9	21.5	11	-	9	24.5	14	1.2
10	19	10.5	2.8	10	24	14.5	3.0
11	23.5	7.5	-	11	25	15	-
12	18.5	7.5	-	12	25	15	0.2
13	24.5	8	-	13	27.5	15.5	2.2
14	24.5	6.5	-	14	27	15	-
15	25	7.5	-	15	27	16	3.2
16	20.5	7.5	-	16	26	17	2.8
17	21	9	-	17	23	15.5	-
18	20.5	7	-	18	25.5	14	-
19	25	7.5	-	19	26	14	-
20	24.5	7.5	-	20	25	15	25.9
21	25.5	10	-	21	20	15.5	4.2
22	26.5	8.5	-	22	21	16	10.0
23	25	10	-	23	25	16.5	2.4
24	24	14	-	24	20	15	4.4
25	26.5	9.5	-	25	22.5	15.5	1.2
26	25.5	7	-	26	25	16	2.2
27	25	11	-	27	23	15.5	2.8
28	26	10	-	28	24	14	0.6
29	25.5	10	1.8	29	24	15.5	1.0
30	26	11	-	30	21.5	16	2.0
31	25.5	14	-				

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1987

Date	July Max.Temp. in °C	July Min.Temp. in °C	July Rainfall in mm	Date	August Max.Temp. in °C	August Min.Temp. in °C	August Rainfall in mm
1	22	15.5	0.4	1	21	16	7.4
2	22	15.5	6.4	2	18	16	16.6
3	23	16	2.0	3	22	15.5	1.2
4	21.5	15	1.8	4	24	15	7.2
5	23.5	15.5	2.0	5	24	15	-
6	24.5	17	8.0	6	25	15	0.4
7	25	16	10.8	7	26	15	1.4
8	20.5	16	11.4	8	26.5	16.5	-
9	22	16	8.0	9	25	16.5	-
10	24	17	1.0	10	21.5	16	4.6
11	24	14	15.6	11	18.5	16	17.1
12	24.5	16	4.8	12	18	14	5.5
13	26	15.5	1.0	13	16	13	34.5
14	26.5	16	-	14	15.5	13	6.4
15	27	16.5	-	15	21.5	13	1.5
16	25	17	-	16	23	12.5	-
17	26	15.5	-	17	22.5	14.5	-
18	26	17	5.6	18	20	14.5	-
19	26	17	6.8	19	24.5	14	3.4
20	26	16	17.6	20	27	14.5	-
21	26.5	16	-	21	24.5	15.5	4.0
22	25	16	1.6	22	21.5	14.5	1.0
23	27	16	0.8	23	26	16	-
24	27.5	16	3.0	24	26.5	16.5	4.2
25	22.5	16	5.2	25	27.5	15.5	-
26	21.5	16	10.0	26	25	16.5	-
27	22	16	8.0	27	22	17	1.8
28	22	15	0.2	28	24	16.5	-
29	23	16	4.2	29	25	17	2.3
30	23.5	17	6.0	30	25	15	-
31	24.5	16	2.8	31	26	16	-

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1987

September				October			
Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm	Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm
				1	23	12	-
				2	22	12	-
				3	24	12	-
				4	21	10	-
				5	21	10	-
				6	21	12.5	-
				7	23	10	-
				8	22	11	-
				9	22	10	-
				10	21	9	-
				11	22	8	-
				12	23	6	-
				13	22	9	-
				14	23	9	-
				15	24	8	-
				16	23	8.5	-
				17	22.5	8	-
				18	23	9	1.6
				19	12.5	2	60.8
				20	20.5	7	-
				21	20	7	-
				22	20.5	8	-
				23	19	9	-
				24	20	8.5	-
				25	20	5.5	-
				26	21	5	-
				27	21	3	-
				28	20	3	-
				29	20	4	-
				30	15	5	-
				31	15	5	1.5

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1987

Date	November Max.Temp. in °C	November Min.Temp. in °C	November Rainfall in mm	Date	December Max.Temp. in °C	December Min.Temp. in °C	December Rainfall in mm
1	19.5	4	1.8	1	20	-1	-
2	19	4	-	2	19	-1	-
3	17	6	-	3	21	0	-
4	20	8	-	4	20	0	-
5	16	4	-	5	23	-1	-
6	15	2	-	6	19	-2	-
7	21	1	-	7	19	-1	-
8	23	1	-	8	17	7	-
9	23	1	-	9	17	2	-
10	23	1	-	10	19	0	-
11	22	1	-	11	17	3	-
12	22	1	-	12	17	4	-
13	22	1	-	13	19	3	1.2
14	21	2	-	14	24	-1	-
15	22	1	-	15	18	-4	-
16	21	-1	-	16	17	-3	-
17	22	-1	-	17	16	-2	-
18	21	1	-	18	18	-2	-
19	19	2	-	19	15	-4	-
20	19	2	-	20	15	-4	-
21	18	0	-	21	18	-5	-
22	20	1	-	22	17	-5	-
23	20	-1	-	23	19	-4	-
24	23	-1	-	24	8	-4	-
25	22	-1	-	25	19	-4	-
26	21	-2	-	26	20	-5	-
27	22	-1	-	27	20	-5	-
28	21	-1	-	28	18	-5	-
29	21	0	-	29	19	-5	-
30	22	0	0	30	21	-5	-
				31	20	-6	-

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1988

	January				February		
Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm	Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm
1	20	-4	-	1	16	1	-
2	20	-3	-	2	19	2	-
3	20	-3	-	3	22	-2	-
4	21	-2	-	4	22	-4	-
5	18	2	-	5	22	-5	-
6	16	1	-	6	22	-2	-
7	16	-4	-	7	20	-1	-
8	13	0	-	8	17	2	-
9	15	-4	-	9	19	-2	-
10	14	-4	-	10	20	-1	-
11	14	-4	-	11	20	-1	-
12	14	0	-	12	16	-1	-
13	19	1	-	13	15	1	-
14	16	-2	-	14	16	1	4.6
15	14	-3	-	15	16	1	2.0
16	13	-3	-	16	12	-2	2.4
17	19	-5	-	17	16	-3	-
18	19	-5	-	18	15	-2	-
19	19	1	-	19	15	-2	-
20	18	-2	-	20	20	-1	-
21	16	1	-	21	19	-2	-
22	16	1	-	22	16	1	-
23	17	2	-	23	16	0	1.4
24	16	-2	-	24	16	3	2.0
25	16	-2	-	25	13	-3	1.2
26	12	-4	-	26	15	5	-
27	16	-5	-	27	16	4	-
28	15	-5	-	28	20	-5	-
29	19	-3	-	29	20	6	-
30	17	-1	-				
31	18	-1	-				

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1988

Date	March Max.Temp. in °C	March Min.Temp. in °C	March Rainfall in mm	Date	April Max.Temp. in °C	April Min.Temp. in °C	April Rainfall in mm
1	12	1	-	1	21	3	-
2	19	-2	2.2	2	22	2	-
3	17	-1	-	3	21	3	-
4	22	1	-	4	22	2	-
5	20	3	-	5	22	5	-
6	21	3	-	6	23	6	-
7	20	4	-	7	24	9	-
8	20	4	-	8	25	10	-
9	19	8	4.0	9	25	10	-
10	13	10	-	10	25	6	-
11	20	5	-	11	25	5	2.4
12	?	?	?	12	21	7	-
13	?	?	?	13	22	9	-
14	20	2	4.2	14	22	10	-
15	19	1	10.9	15	22	5	-
16	16	8	-	16	20	4	0.1
17	14	8	-	17	22	8	-
18	22	3	-	18	14	9	2.0
19	18	3	1.1	19	14	10	0.4
20	18	6	4.0	20	23	10	-
21	15	3	-	21	22	8	-
22	16	6	-	22	22	7	1.2
23	15	5	-	23	23	10	10.8
24	18	6	-	24	16	8	0.4
25	18	7	-	25	17	8	0.2
26	19	5	-	26	21	9	2.0
27	20	5	-	27	22	10	5.2
28	15	2	3.6	28	20	8	-
29	?	?	?	29	22	8	-
30	?	?	?	30	?	?	?
31	?	?	?				

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1988

	May				June		
Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm	Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm
1	25	8	-	1	27	10	-
2	24	9	-	2	26	10	-
3	25	7	0.9	3	28	9	1.2
4	24	11	11.0	4	27	9	-
5	20	11	2.4	5	28	10	-
6	20	8	-	6	25	9	-
7	20	9	0.2	7	26	10	-
8	22	13	-	8	27	10	-
9	23	13	0.4	9	27	10	29.8
10	20	14	4.4	10	25	15	20.4
11	24.5	12.5	-	11	26	14	4.8
12	25	10.5	2.3	12	25	15	2.8
13	25	8.5	-	13	25	16	6.4
14	23	8	4.3	14	26	16	9.8
15	23	6.5	-	15	25	15	19.2
16	25	10	1.5	16	25	16	9.4
17	23.5	12.5	-	17	25	15	10.8
18	25	12.5	2.3	18	25	15	10.4
19	23.5	12.5	1.9	19	26	16	-
20	25	15	-	20	26	15	-
21	27	13	-	21	27	16	-
22	28	14	-	22	27	16	-
23	25	12	-	23	27	16	-
24	25	13	-	24	26	16	12.8
25	25	12	-	25	25	15	-
26	26	12	-	26	25	16	-
27	25	10	-	27	27	15	-
28	24	10	-	28	29	16	-
29	25	12	-	29	29	16	-
30	25	12	4.8	30	30	16	-
31	24	12	-				

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1988

Date	July Max.Temp. in °C	July Min.Temp. in °C	July Rainfall in mm	Date	August Max.Temp. in °C	August Min.Temp. in °C	August Rainfall in mm
1	29	18	4.2	1	27	15	9.2
2	29	18	-	2	20	14	0.6
3	28	18	-	3	27	17	0.6
4	26	16	3.2	4	26	16	3.8
5	26	17	14.8	5	26	16	4.4
6	23	16	8.4	6	?	?	?
7	21	17	3.8	7	?	?	?
8	24	16	3.4	8	28	17	27.0
9	24	16	3.8	9	26	17	13.8
10	23	16	3.2	10	25	17	4.4
11	25	17	6.8	11	23	17	27.8
12	26	17	3.8	12	24	17	4.2
13	26	16	6.4	13	?	?	?
14	25	16	19.2	14	?	?	?
15	25	17	2.6	15	26	16	43.0
16	25	17	3.6	16	25	18	-
17	24	16	2.8	17	25	17	2.8
18	25	17	3.6	18	25	17	1.8
19	26	16	2.4	19	25	17	3.8
20	25	17	-	20	?	?	?
21	25	18	3.2	21	?	?	?
22	26	17	9.8	22	26	17	5.6
23	25	17	-	23	25	18	4.4
24	25	18	-	24	26	18	2.4
25	26	17	-	25	23	16	4.2
26	26	15	3.8	26	24	16	4.8
27	25	15	-	27	23	16	2.4
28	26	15	-	28	?	?	?
29	26	18	2.6	29	23	17	8.4
30	26	16	-	30	22	16	2.2
31	26	15	-	31	22	17	-

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1988

	September				October		
Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm	Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm
1	27	14	-	1	?	?	?
2	27	15	-	2	?	?	?
3	27	15	-	3	25	9	0.2
4	27	15	-	4	24	11	-
5	27	15	3.8	5	26	14	7.9
6	27	15	25.0	6	25	12	-
7	22	15	3.4	7	25	11	-
8	23	16	8.4	8	?	?	?
9	21	14	38.8	9	?	?	?
10	22	15	23.8	10	25	7	-
11	24	16	-	11	25	7	-
12	26	13	-	12	26	6.5	-
13	24	16	-	13	25	7	-
14	25	14	-	14	24	10	-
15	28	11	-	15	?	?	?
16	25	13	-	16	?	?	?
17	?	?	?	17	25	6	0.3
18	?	?	?	18	24.5	4	0.2
19	?	?	?	19	25	3	-
20	?	?	?	20	19.5	3	-
21	27	11	10.0	21	23	4.5	-
22	?	?	?	22	23	4	-
23	22	15	4.0	23	22	7	-
24	?	?	?	24	25	3	-
25	26	15	-	25	24	4	-
26	25	16	1.4	26	23	3	-
27	24	15	-	27	24	2	-
28	25	15	2.8	28	21	1	-
29	22	14	6.8	29	22	1	-
30	24	10	-	30	21	1	-
				31	20.5	1	-

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1988

Date	November Max.Temp. in °C	November Min.Temp. in °C	November Rainfall in mm	Date	December Max.Temp. in °C	December Min.Temp. in °C	December Rainfall in mm
1	21	4	-	1	21	2	-
2	20	5	-	2	23	1	-
3	20	5	-	3	21	0	-
4	20	3	-	4	23	-1	-
5	19	6	6.8	5	24	-1	-
6	15	4	2.8	6	19	4	-
7	18	1	0.4	7	16	7	-
8	19	3	-	8	16	-1	-
9	19	1	-	9	15	2	-
10	16	1	-	10	16	4	-
11	19	1	-	11	18	0	-
12	20	2	-	12	18	2	-
13	21	1	-	13	16	3	-
14	21	1	1.5	14	17	3	-
15	21	0	-	15	16	1	-
16	21	1	-	16	17	1	-
17	22	1	-	17	14	-3	-
18	22	1	-	18	14	0	-
19	21	1	-	19	12	-3	-
20	21	1	-	20	16	-2	-
21	19	1	-	21	17	-2.5	-
22	18	1	-	22	14	-2.5	-
23	20	1	-	23	16	-3	-
24	20	-1	-	24	16	-3	-
25	20	-4	-	25	19	-2.5	-
26	20	-3	-	26	18	2	-
27	18	-2	-	27	12	1	16.2
28	19	-2	-	28	12	-2	-
29	18	0	-	29	13	-4	-
30	13	-5	-	30	17	-4	-
				31	18	-3	-

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1989

January				February			
Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm	Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm
				1	20	3	-
				2	16	4	-
				3	19	5	-
				4	12	6	-
				5	16	4	-
				6	16	4	-
				7	15	2	-
				8	16	0	-
				9	18	-2	-
				10	18	-3	-
				11	17	-3	-
				12	16	-5	-
				13	15	-4	-
				14	15	-2	-
				15	12	-2	-
				16	15	-2	-
				17	13	-4	-
				18	14	-3	-
				19	12	2	47.0
				20	6	3	54.0
				21	8	-1	-
				22	8	-3	7.0
				23	7	-5	2.0
				24	13	-3	-
				25	?	?	?
				26	?	?	?
				27	20	-1	-
				28	20	0	-

MONTHLY METEOROLOGICAL DATA

Station : Bondey Year : 1989

March

Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm	Date	Max.Temp. in °C	Min.Temp. in °C	Rainfall in mm
1	20	3	-				
2	20	0	-				
3	20	0	-				
4	21	-1	-				
5	19	0	-				
6	18	-1	-				
7	21	0	-				
8	22	2	-				
9	21	-1	-				
10	19	1	2.0				
11	18	2	-				
12	12	2	23.0				
13	14	3	-				
14	16	2	-				
15	16	5	3.6				
16	14	5	-				
17	15	5	4.0				
18	15	4	-				
19	17	3	1.5				
20	15	4	-				
21	19	7	-				
22	19	9	-				
23	21	6	-				
24	22	6	-				
25	22	7	-				
26	24	5	-				
27	22	4	-				
28	25	5	-				
29	22	4	-				
30	12	5	14.4				
31	17	8	-				

ANNEX 7

ROCK MATERIAL LABORATORY TEST RESULTS

Rock	Unconfined Compression Strength (kg/sq.cm)	P-wave Velocity (km/s)	Moisture Content (%)	Dry Unit Weight	Saturated Unit Weight	Absorption (%)	Effective Porosity (%)	Dynamic Elasticity (kg/sq.cm)	Soundness (%)
Biotite Gneiss	269	3.14	0.27	2.60	2.62	0.80	2.10	197×10^3	4.1
Gneiss	-	-	-	2.76	2.77	0.33	0.92	-	-
Hornfels	869	4.88	0.11	2.67	2.69	0.69	1.86	408×10^3	3.8
Marble	-	-	-	2.55	2.57	0.67	1.72	-	-

ANNEX 8

DISCHARGE RECORD AT DZONG BRIDGE

November 1987			December 1987		
Date	Gauge Reading in m	Discharge cu.m/sec	Date	Gauge Reading in m	Discharge cu.m/sec
1	1.70	8.47	1	1.49	12.66
2	1.60	9.54	2	1.49	14.22
3	1.60	10.09	3	1.49	12.09
4	1.60	9.18	4	1.50	10.74
5	1.60	8.62	5	1.49	11.93
6	1.60	7.52	6	1.49	11.60
7	1.60	9.36	7	1.49	11.93
8	1.60	15.97	8	1.47	11.99
9	1.60	14.69	9	1.47	11.83
10	1.58	14.01	10	1.47	10.55
11	1.58	12.77	11	1.47	10.87
12	1.58	12.59	12	1.47	12.63
13	1.58	10.61	13	1.47	11.19
14	1.56	10.75	14	1.47	10.03
15	1.55	11.51	15	1.45	9.71
16	1.52	13.01	16	1.40	11.77
17	1.52	11.66	17	1.40	12.16
18	1.52	10.65	18	1.40	11.77
19	1.52	11.15	19	1.40	10.88
20	1.53	12.30	20	1.40	12.20
21	1.51	13.04	21	1.40	11.17
22	1.51	10.20	22	1.40	11.47
23	1.50	11.41	23	1.40	14.20
24	1.50	11.90	24	1.40	15.00
25	1.50	10.41	25	1.40	12.94
26	1.50	10.75	26	1.40	12.20
27	1.50	10.42	27	1.40	18.62
28	1.50	10.28	28	1.40	11.77
29	1.49	10.30	29	1.40	9.70
30	1.49	10.30	30	1.40	9.12
			31	1.40	9.70

DISCHARGE RECORD AT DZONG BRIDGE

January 1988			Febrary 1988		
Date	Gauge Reading in m	Discharge cu.m/sec	Date	Gauge Reading in m	Discharge cu.m/sec
1	1.40	9.47	1	1.29	4.47
2	1.40	9.56	2	1.29	4.97
3	1.40	7.65	3	1.29	3.95
4	1.40	6.76	4	1.29	3.82
5	1.40	6.32	5	1.29	4.47
6	1.40	5.73	6	1.30	4.47
7	1.40	6.62	7	1.30	4.97
8	1.40	8.38	8	1.30	4.47
9	1.40	6.62	9	1.30	4.97
10	1.40	6.91	10	1.30	7.73
11	1.40	6.76	11	1.30	8.63
12	1.40	5.59	12	1.30	8.50
13	1.40	6.62	13	1.30	7.73
14	1.40	5.58	14	1.30	7.99
15	1.40	4.85	15	1.30	12.63
16	1.40	5.00	16	1.29	7.39
17	1.30	4.77	17	1.28	4.78
18	1.30	4.89	18	1.28	4.53
19	1.30	5.02	19	1.28	4.41
20	1.30	5.28	20	1.28	4.41
21	1.30	4.63	21	1.28	4.66
22	1.30	4.25	22	1.27	4.85
23	1.30	5.41	23	1.27	4.98
24	1.30	4.76	24	1.27	3.99
25	1.30	4.51	25	1.27	4.98
26	1.30	7.00	26	1.26	4.30
27	1.30	5.67	27	1.26	4.68
28	1.30	5.92	28	1.26	4.43
29	1.29	5.60	29	1.26	4.55
30	1.29	4.84			
31	1.29	4.72			

DISCHARGE RECORD AT DZONG BRIDGE

March 1988			April 1988		
Date	Gauge Reading in m	Discharge cu.m/sec	Date	Gauge Reading in m	Discharge cu.m/sec
1	1.26	4.68	1	1.24	6.50
2	1.25	7.56	2	1.24	6.20
3	1.25	7.18	3	1.24	5.66
4	1.25	7.92	4	1.24	6.38
5	1.25	7.67	5	1.24	6.86
6	1.25	7.67	6	1.24	6.86
7	1.25	6.94	7	1.24	6.50
8	1.25	6.58	8	1.24	6.02
9	1.25	6.58	9	1.25	6.94
10	1.25	7.31	10	1.25	7.14
11	1.25	7.92	11	1.25	6.82
12	1.25	7.67	12	1.25	7.32
13	1.25	7.79	13	1.25	6.94
14	1.25	7.30	14	1.25	6.20
15	1.24	8.04	15	1.25	6.20
16	1.24	8.55	16	1.26	7.84
17	1.24	9.88	17	1.26	7.84
18	1.24	8.07	18	1.26	6.78
19	1.24	8.07	19	1.26	7.02
20	1.24	7.71	20	1.26	7.72
21	1.24	7.95	21	1.27	8.72
22	1.24	7.56	22	1.27	8.98
23	1.24	8.30	23	1.27	8.72
24	1.24	7.70	24	1.40	10.29
25	1.24	7.00	25	1.40	12.35
26	1.24	7.70	26	1.40	12.20
27	1.24	7.80	27	1.40	12.50
28	1.24	7.35	28	1.45	14.52
29	1.24	8.19	29	1.45	15.93
30	1.24	6.93	30	1.50	20.66
31	1.24	6.74			

DISCHARGE RECORD AT DZONG BRIDGE

May 1988			June 1988		
Date	Gauge Reading in m	Discharge cu.m/sec	Date	Gauge Reading in m	Discharge cu.m/sec
1	1.49	14.04	1	1.45	10.46
2	1.49	15.04	2	1.45	10.78
3	1.48	13.90	3	1.45	11.08
4	1.48	12.90	4	1.45	10.60
5	1.45	12.96	5	1.50	16.53
6	1.45	12.96	6	1.50	16.36
7	1.45	13.27	7	1.50	15.37
8	1.45	12.96	8	1.60	21.28
9	1.45	13.11	9	1.65	21.95
10	1.45	12.81	10	1.70	23.59
11	1.45	13.90	11	1.80	27.49
12	1.45	14.86	12	1.80	28.37
13	1.47	19.34	13	1.70	25.21
14	1.50	19.34	14	2.00	33.06
15	1.50	19.34	15	1.99	32.32
16	1.55	9.24	16	2.05	37.42
17	1.55	10.98	17	2.20	44.49
18	1.70	12.90	18	2.21	43.59
19	1.65	19.64	19	2.19	44.51
20	1.65	18.20	20	2.19	37.23
21	1.55	16.40	21	1.99	31.05
22	1.50	12.06	22	1.86	27.01
23	1.50	12.22	23	1.80	28.37
24	1.45	11.55	24	1.90	28.33
25	1.45	9.99	25	2.00	36.65
26	1.45	9.99	26	1.92	36.26
27	1.45	12.81	27	1.87	28.38
28	1.45	13.90	28	1.92	25.47
29	1.50	16.55	29	1.80	26.17
30	1.50	14.21	30	1.74	24.66
31	1.50	14.21			

DISCHARGE RECORD AT DZONG BRIDGE

July 1988			August 1988		
Date	Gauge Reading in m	Discharge cu.m/sec	Date	Gauge Reading in m	Discharge cu.m/sec
1	1.70	21.98	1	2.25	49.33
2	1.79	28.13	2	2.22	49.19
3	1.72	24.64	3	2.22	39.12
4	1.90	29.76	4	2.22	41.78
5	1.90	30.72	5	2.22	36.15
6	2.10	44.47	6	2.24	50.40
7	2.22	50.08	7	2.26	66.80
8	2.23	48.40	8	2.25	59.16
9	2.10	61.94	9	2.24	60.60
10	2.25	51.31	10	2.24	52.50
11	2.23	54.57	11	2.24	52.50
12	2.22	49.19	12	2.25	60.47
13	2.25	55.84	13	2.24	55.50
14	2.23	55.16	14	2.24	41.40
15	2.23	56.65	15	2.25	59.16
16	2.23	56.65	16	2.25	63.99
17	2.23	53.07	17	2.24	52.20
18	2.24	52.50	18	2.25	54.63
19	2.23	42.64	19	2.24	49.26
20	2.22	48.01	20	2.25	55.84
21	2.25	58.55	21	2.24	48.60
22	2.25	55.50	22	2.25	55.84
23	2.25	51.91	23	2.25	51.01
24	2.23	47.71	24	2.25	64.59
25	2.23	58.44	25	2.25	67.00
26	2.24	45.60	26	2.25	58.55
27	2.23	44.43	27	2.24	68.10
28	2.23	56.06	28	2.24	51.60
29	2.24	62.40	29	2.24	46.80
30	2.22	48.60	30	2.24	53.10
31	2.22	44.45	31	2.23	45.32

DISCHARGE RECORD AT DZONG BRIDGE

September 1988			October 1988		
Date	Gauge Reading in m	Discharge cu.m/sec	Date	Gauge Reading in m	Discharge cu.m/sec
1	2.22	47.42	1	2.16	45.67
2	2.22	44.45	2	2.10	40.63
3	2.21	41.82	3	2.00	35.37
4	2.21	40.64	4	1.95	37.08
5	2.21	39.47	5	1.90	32.38
6	2.24	49.50	6	1.88	33.06
7	2.21	38.58	7	1.85	31.60
8	2.24	46.80	8	1.83	33.35
9	2.25	53.72	9	1.80	31.45
10	2.24	56.40	10	1.78	25.04
11	2.22	41.78	11	1.75	27.19
12	2.21	37.40	12	1.73	28.38
13	2.21	38.68	13	1.70	24.81
14	2.20	36.88	14	1.70	25.21
15	2.20	34.83	15	1.70	24.41
16	2.20	40.98	16	1.70	23.60
17	2.20	46.83	17	1.69	23.79
18	2.20	48.00	18	1.68	23.37
19	2.20	46.25	19	1.66	23.14
20	2.20	46.83	20	1.63	21.92
21	2.20	45.96	21	1.62	21.63
22	2.20	44.78	22	1.61	20.76
23	2.21	44.77	23	1.60	20.74
24	2.19	43.63	24	1.60	20.92
25	2.19	47.71	25	1.60	20.00
26	2.19	43.63	26	1.59	19.88
27	2.20	42.74	27	1.59	19.44
28	2.20	46.83	28	1.59	19.80
29	2.20	44.49	29	1.59	19.98
30	2.19	45.38	30	1.59	20.17
			31	1.59	19.62

DISCHARGE RECORD AT DŽONG BRIDGE

November 1988			December 1988		
Date	Gauge Reading in m	Discharge cu.m/sec	Date	Gauge Reading in m	Discharge cu.m/sec
1	1.59	19.29	1	1.40	14.56
2	1.57	19.41	2	1.40	13.83
3	1.56	18.85	3	1.89	13.51
4	1.55	18.83	4	1.39	13.66
5	1.53	18.61	5	1.39	13.51
6	1.53	18.27	6	1.40	14.51
7	1.54	18.64	7	1.40	13.83
8	1.53	18.10	8	1.40	14.12
9	1.49	17.16	9	1.40	13.83
10	1.49	17.00	10	1.40	14.12
11	1.49	17.16	11	1.39	13.51
12	1.48	16.97	12	1.38	12.77
13	1.45	16.09	13	1.38	13.65
14	1.43	15.41	14	1.38	12.62
15	1.40	15.30	15	1.38	12.19
16	1.40	15.00	16	1.37	12.04
17	1.40	15.44	17	1.37	12.04
18	1.40	15.44	18	1.37	12.04
19	1.40	15.30	19	1.37	11.90
20	1.40	15.00	20	1.36	11.60
21	1.40	14.56	21	1.36	11.32
22	1.40	14.86	22	1.36	11.18
23	1.39	14.53	23	1.35	11.31
24	1.39	14.53	24	1.35	10.90
25	1.39	14.53	25	1.35	10.76
26	1.39	14.53	26	1.36	10.90
27	1.39	14.53	27	1.38	11.48
28	1.39	14.38	28	1.38	11.19
29	1.39	14.38	29	1.38	11.76
30	1.40	15.00	30	1.37	11.33
			31	1.37	11.47

DISCHARGE RECORD AT DZONG BRIDGE

January 1989			February 1989		
Date	Gauge Reading in m	Discharge cu.m/sec	Date	Gauge Reading in m	Discharge cu.m/sec
1	1.37	11.33	1	1.29	7.77
2	1.36	10.90	2	1.28	7.82
3	1.35	10.35	3	1.28	7.44
4	1.35	10.49	4	1.28	7.69
5	1.38	10.21	5	1.28	7.56
6	1.34	9.94	6	1.27	7.11
7	1.34	9.26	7	1.27	7.73
8	1.35	9.93	8	1.26	7.27
9	1.37	10.34	9	1.26	7.52
10	1.36	9.79	10	1.26	7.52
11	1.36	10.06	11	1.26	7.27
12	1.35	9.52	12	1.26	7.27
13	1.38	11.33	13	1.26	7.15
14	1.36	9.93	14	1.25	7.19
15	1.36	9.65	15	1.25	7.43
16	1.35	9.52	16	1.24	7.11
17	1.34	8.99	17	1.24	6.99
18	1.35	8.87	18	1.25	7.07
19	1.35	9.80	19	1.26	7.64
20	1.35	9.80	20	1.27	8.03
21	1.35	9.11	21	1.28	7.56
22	1.33	8.01	22	1.28	7.56
23	1.31	8.36	23	1.29	7.52
24	1.30	8.25	24	1.29	8.16
25	1.30	8.25	25	1.28	7.56
26	1.30	8.12	26	1.32	8.48
27	1.29	8.16	27	1.30	8.12
28	1.29	8.03	28	1.30	7.47
29	1.29	7.65			
30	1.29	7.65			
31	1.29	7.52			

DISCHARGE RECORD AT DZONG BRIDGE

March 1989			April 1989		
Date	Gauge Reading in m	Discharge cu.m/sec	Date	Gauge Reading in m	Discharge cu.m/sec
1	1.50	9.28	1	1.60	14.69
2	1.50	9.09	2	1.60	14.69
3	1.50	9.28	3	1.60	14.69
4	1.50	9.09	4	1.60	14.69
5	1.50	8.90	5	1.60	14.69
6	1.50	9.09	6	1.60	14.69
7	1.50	9.86	7	1.60	14.69
8	1.50	9.86	8	1.60	14.69
9	1.50	9.28	9	1.60	14.69
10	1.54	11.96	10	1.66	15.13
11	1.54	11.15	11	1.66	15.13
12	1.54	11.75	12	1.66	15.13
13	1.54	11.96	13	1.66	15.13
14	1.54	11.96	14	1.66	15.13
15	1.54	11.96	15	1.66	15.13
16	1.54	11.75			
17	1.54	11.75			
18	1.54	13.58			
19	1.54	12.97			
20	1.54	13.17			
21	1.54	12.17			
22	1.54	12.77			
23	1.54	12.97			
24	1.60	13.45			
25	1.60	16.35			
26	1.60	13.86			
27	1.60	14.49			
28	1.60	13.66			
29	1.60	14.69			
30	1.60	15.11			
31	1.60	14.28			

ANNEX 9

LAND USE BLOCK-WISE

Gewog : Tsento 1985-86

(Area in Ha)

Sl. No.	Name of Village	Paddy Field	Dry Land	Vegetable Garden	Apple Garden	Community Pastures	Private Forest	Private Pastures	Tsheri Land	Community Forest
1.	Tsento Shari	44.265	40.439	3.805	0.329	2,001.102	34.952	-	12.797	-
2.	Ngaymay	23.314	33.962	0.837	24.692	8.094	28.183	126.744	11.004	0.804
3.	Juser	21.732	29.374	1.651	11.094	1.878	19.686	-	0.208	6.517
4.	Gymanjay	18.109	40.042	1.654	-	21.125	31.187	-	1.201	1.748
5.	Tsento Phondo	17.066	47.867	0.997	-	68.464	18.077	-	0.084	-
6.	Chunjay	16.792	54.765	1.783	-	1.384	21.962	1.294	0.372	-
7.	Zamsa	24.904	80.955	2.355	0.042	214.768	36.014	-	1.283	0.648
8.	Mitshi	19.848	76.770	1.515	5.628	129.823	9.391	-	7.835	-
	Total	186.030	404.174	13.597	41.785	2,446.638	199.452	128.038	34.783	9.717

LAND USE BLOCK-WISE

Gewog : Lango 1985-86

(Area in Ha)

Sl. No.	Name of Village	Paddy Field	Dry Land	Vegetable Garden	Apple Garden	Community Pastures	Private Forest	Private Pastures	Tsheri Land	Community Forest
1.	Shomo	38.095	37.017	2.861	1.415	665.311	85.046	-	0.560	-
2.	Ngapa	10.261	25.018	1.921	0.415	-	26.191	-	0.136	18.630
3.	Ganju	58.971	38.064	3.705	4.194	100.440	131.091	-	1.381	31.995
4.	Dhaho & Jagathang	90.911	61.356	5.039	0.210	356.095	156.524	-	3.658	-
5.	Chhuka	45.012	19.651	2.682	0.014	2.023	100.913	310.136	2.831	71.549
6.	Chendona Saydropa	67.834	20.306	4.352	52.188	6,601.057	83.888	5,234.107	6.221	106.641
	Total	311.084	201.392	20.560	58.436	7,724.926	583.653	5,544.243	14.787	228.815

LAND USE BLOCK-WISE

Gewog : Dotey 1985

(Area in Ha)

Sl. No.	Name of Village	Paddy Field	Dry Land	Vegetable Garden	Apple Garden	Community Pastures	Private Forest	Private Pastures	Tsheri Land	Community Forest
1.	Chuba	30.077	21.839	0.911	-	5.283	42.348	-	-	-
2.	Pachu	38.204	22.187	1.140	-	40.469	87.359	-	-	-
3.	Atso	25.622	25.220	0.634	-	19.019	45.435	-	-	-
4.	Phulumpa	29.650	42.491	7.220	2.023	22.506	71.099	-	-	-
5.	Jabji	18.881	9.378	2.518	-	-	20.654	-	-	-
6.	Leechu	23.236	13.230	1.462	-	296.374	50.930	-	-	-
7.	Doyekha	5.321	5.785	0.292	-	32.375	6.750	-	-	-
	Total	170.991	140.130	14.177	2.023	416.026	324.575	-	-	-

LAND USE BLOCK-WISE

Gewog : Shari 1985

(Area in Ha)

Sl. No.	Name of Village	Paddy Field	Dry Land	Vegetable Garden	Apple Garden	Community Pastures	Private Forest	Private Pastures	Tsheri Land	Community Forest
1.	Jangsa	53.568	9.491	1.699	6.896	-	59.578	16.200	2.781	-
2.	Juhha	29.059	6.454	1.022	3.583	-	23.767	-	1.119	-
3.	Shari	43.996	14.209	3.027	4.017	14.750	70.565	-	3.891	-
4.	Kempa	38.764	14.596	2.023	7.020	105.300	87.353	82.349	2.878	-
5.	Kotophu	19.222	6.472	1.728	2.443	-	19.125	-	4.357	-
6.	Jab Deshi	38.764	19.962	2.025	0.374	21.465	93.353	-	4.895	-
	Total	223.370	71.184	11.524	24.333	141.515	353.743	98.549	24.921	-

LAND USE BLOCK-WISE

Gewog : Hore 1985-86

(Area in Ha)

Sl. No.	Name of Village	Paddy Field	Dry Land	Vegetable Garden	Apple Garden	Community Pastures	Private Forest	Private Pastures	Tsheri Land	Community Forest
1.	Horekha	0.934	4.218	0.967	2.035	-	20.013	-	-	-
2.	Lingchuna	8.673	6.901	0.781	0.986	-	31.421	-	-	-
	Total	9.607	11.119	1.748	3.021	-	51.434	-	-	-

LAND USE BLOCK-WISE

Gewog : Wangchang 1985

(Area in Ha)

Sl. No.	Name of Village	Paddy Field	Dry Land	Vegetable Garden	Apple Garden	Community Pastures	Private Forest	Private Pastures	Tsheri Land	Community Forest
1.	Changakha Jangtona	69.615	36.680	5.110	21.100	1,084.932	68.718	77.112	-	-
2.	Nankha, Mandey Chintsha, Roina	27.311	38.070	8.200	11.170	128.500	77.817	94.806	-	-
3.	Dungkha	16.424	18.500	6.900	7.115	50.600	15.200	6.136	-	-
4.	Nankha	17.159	22.500	6.200	12.200	90.650	13.500	11.200	-	-
5.	Ngaymay, Changmi-hingha, Chimi-nangka, Siguna, Khanku, Jangsema, Dangchuna	34.854	24.100	8.500	10.500	35.600	17.100	15.100	-	-
6.	Taju, Geptey, Langmina, Gangtey, Dungka	35.109	10.037	6.000	17.000	25.800	18.000	15.012	-	-
	Total	200.472	150.517	40.910	175.590	1,616.082	194.335	219.366	-	-

LAND USE BLOCK-WISE

Gewog : Luni 1985

(Area in Ha)

Sl. No.	Name of Village	Paddy Field	Dry Land	Vegetable Garden	Apple Garden	Community Pastures	Private Forest	Private Pastures	Tsheri Land	Community Forest
1.	Woochu	34.587	35.355	13.436	2.263	222.577	2.491	63.012	-	-
2.	Jewphu	3.619	17.298	1.641	0.811	0.641	11.439	80.940	-	-
3.	Gapjana	22.886	23.991	4.020	2.107	1.952	0.610	19.534	-	-
4.	Dzongdakha	10.535	15.539	1.710	0.671	-	-	30.398	-	-
5.	Bondey	73.572	89.695	9.687	18.011	27.195	18.145	102.669	-	-
6.	Namjo	68.974	14.595	6.019	12.282	161.874	14.621	17.950	-	-
	Total	214.173	196.623	36.513	36.645	414.239	47.306	324.503	-	-

LAND USE BLOCK-WISE

Gewog : Shaba 1985-86

(Area in Ha)

Sl. No.	Name of Village	Paddy Field	Dry Land	Vegetable Garden	Apple Garden	Community Pastures	Private Forest	Private Pastures	Tsheri Land	Community Forest
1.	Dugeydingkha	25.178	9.426	0.658	9.597	-	41.652	178.787	-	-
2.	Gengri	17.331	81.918	1.525	2.903	-	154.193	-	-	-
3.	Tiley	16.144	34.133	2.189	0.478	-	86.496	-	-	-
4.	Bara	19.313	29.068	1.165	6.441	-	30.195	-	-	-
5.	Singkhar	24.683	22.775	2.201	10.031	80.938	47.616	-	-	-
6.	Lheling	19.827	49.667	3.492	7.356	-	55.950	-	-	-
7.	Shengo	37.327	10.959	1.287	20.675	379.889	119.766	-	-	-
8.	Niphu	9.999	34.638	3.645	4.430	-	31.786	-	-	-
9.	Gompa	15.932	-	0.955	-	-	-	17.503	-	-
	Total	186.734	272.580	17.117	51.911	460.630	567.674	196.290	-	-

ANNEX 10

GEWOG WISE PRODUCTION (WET LAND)

Area in ha/Yield in tons

Gewog	Wet Land Area in ha	Net Crop Area in ha	Paddy	Wheat	Barley	Buck Wheat	Beans Pulse	Potato	Chilli	Vegitable	Apple
Tsento	215.3	215.3	214.3 345	77.7 106	1.2 2	0.4 0.32	-	5.1 84	0.4 1.6	0.4 7	-
Lango	370.7	370.7	368.3 1001	171.6 360	20.6 43	2.4 1.92	-	34.4 510	0.4 1.6	2.0 35	-
Wangchang	305.9	305.9	302.3 1165	83.8 176	17.0 36	-	2.0 1.6	83.8 1242	0.4 1.6	3.2 56	-
Hore	53.4	53.4	51.8 141	14.2 19	0.4 0.5	-	-	12.1 180	0.8 3.2	0.8 14	-
Dotey	120.6	120.6	120.6 328	31.6 66	1.2 1.6	-	-	19.4 288	-	-	-
Shari	210.8	210.8	203.1 783	63.1 133	0.8 1.7	-	-	39.3 582	3.6 14.4	2.0 35	2.0 50
Luni	280.4	280.4	277.2 754	67.2 91	9.7 20	-	1.6 1.28	51.0 756	0.8 3.2	2.4 42	-
Shaba	202.7	202.7	199.5 769	59.1 124	12.5 26	-	4.9 3.84	45.3 672	0.4 1.6	2.8 49	-
TOTAL	1,760.0	1,760.0	1737.3 5286	568.2 1075	63.5 130.8	2.8 2.24	8.5 6.72	291.0 4314	6.9 27.2	13.8 238	2.0 50
Production in tons/ha			3.04	1.89	2.06	0.79	0.79	14.83	3.95	17.30	24.70

GEWOG WISE PRODUCTION (DRY LAND)

Area in ha/Yield in tons

Gewog	Dry Land in ha	Net Cropped in ha	Wheat	Barley	Millet	Buck Wheat	Soya Beans	Other Pulses	Mustard	Potato	Radish Turnip	Chilli
Tsento	272.4	220.6	159.0 216	10.9 15	22.3 23.1	14.6 11.5	0.4 0.3	0.4 0.3	7.3 7.4	26.7 396	1.6 48	0.8 3.2
Lango	158.2	137.2	106.0 223	4.0 8.5	13.8 143	11.3 9	0.4 0.3	8.1 0.6	1.2 1.2	15.0 222	0.8 24	0.8 3.2
Wangchang	106.0	93.5	48.6 102	6.1 13	0.4 0.42	3.6 2.9	3.2 2.6	1.2 1	2.4 2.5	36.8 546	0.8 24	0.4 1.6
Hore	50.2	41.7	26.3 36	3.2 4.4	0.8 0.84	2.0 1.6	0.8 0.6	0.8 0.6	2.4 2.5	10.5 156	0.8 24	0.4 1.6
Dotey	114.1	92.7	67.2 91	7.3 9.9	0.8 0.84	5.7 4.5	0.4 0.3	0.4 0.3	4.0 4.1	17.0 252	1.2 36	0.8 3.2
Shari	103.2	91.5	70.8 149	8.1 17	0.4 0.42	4.9 3.8	1.6 1.3	0.4 0.3	3.2 3.3	11.7 174	0.4 12	0.8 3.2
Luni	163.1	134.0	78.1 106	10.5 14.3	0.4 0.42	5.3 4.2	16.6 13	4.0 3.2	15.8 16	31.2 462	0.4 12	0.8 3.2
Shaba	245.6	214.5	129.1 272	26.3 55.3	-	23.9 18.9	31.6 25	0.8 0.6	31.6 32	32.0 474	1.2 36	0.4 1.6
TOTAL	1212.8	1025.5	685.1 1194	76.5 137.4	38.8 40.32	71.2 56.3	55.0 43.5	16.2 12.8	68.0 68.9	180.9 2682	7.3 216	5.3 20.8
Production in tons/ha			1.74	1.79	1.04	0.79	0.79	0.79	1.01	14.83	29.65	3.95

GEWOG WISE PRODUCTION (KITCHEN GARDEN)

Area in ha/Yield in tons

Gewog	Kitchen Garden Area in ha	Maize	Beans Pulse	Potato	Radish Turnip	Chilli	Vegetable	Apple	Other Fruits
Tsento	3.6	-	0.2 0.2	1.2 18	0.4 12	0.6 2.4	2.0 35	1.1 28	0.08 1.2
Lango	4.5	-	0.2 0.2	0.6 9	0.2 6	0.4 1.6	4.2 73.5	1.5 37	0.12 1.8
Wangchang	5.3	0.2 0.4	0.2 0.2	0.8 12	0.4 12	0.6 2.4	4.9 84	1.5 37	0.12 1.8
Hore	1.2	-	0.2 0.2	0.2 3	0.2 6	0.2 0.8	0.8 14	0.3 8	0.08 1.2
Dotey	2.0	-	0.2 0.2	0.4 6	0.2 6	0.2 0.8	1.4 24.5	0.7 18	0.08 1.2
Luni	3.2	0.2 0.4	0.4 0.3	0.8 12	0.2 6	0.4 1.6	2.0 35	1.1 26	0.16 2.4
Shari	3.2	0.2 0.4	0.2 0.2	0.8 12	0.2 6	0.4 1.6	1.4 24.5	1.5 37	0.12 1.8
Shaba	3.6	0.2 0.4	0.4 0.3	0.8 12	0.2 6	0.8 3.2	1.4 24.5	1.5 37	0.12 1.8
TOTAL	26.7	0.8 1.4	2.4 1.9	5.7 84	2.0 60	3.6 14.4	18.2 315	9.2 228	0.89 13.2
Production in tons/ha		1.78	0.78	14.83	29.65	3.95	17.30	26.59	14.83

GEWOG WISE ORCHARD AREA
(Including apples, walnut, peach pear, etc.)

Gewog	Area in ha
Tsento	42.5
Lango	47.8
Wangchang	48.6
Hore	32.4
Dotey	14.2
Shari	50.6
Luni	64.7
Shaba	36.4
Total	337.1

Note : 55% bearing fruit plants.
Production - 4,581.5 tons.

ANNEX 11 WAGE RATES

DEPARTMENT OF AGRICULTURE
MINISTRY OF AGRICULTURE
ROYAL GOVT.OF BHUTAN
THIMPHU : BHUTAN

No.AD/V(G) dated 25 July, 1988.

C I R C U L A R

Reproduced below is a copy of approved wage rates of difference categoreis received from the Hon'ble Dy. Home Minister, Ministry of Home Affairs, Thimphu vide his letter No.Cha/19(20)-88/5904, dated 20 May, 1988 for information and necessary action at your end please.

Sd/-
Thubten Norbu
Joint Director (A&A)

C.P.O

WAGE RATES

Chapter - 1 (Wage Rates for different Categories)

1. The Wage Rates, terms and conditions outlined below shall be applicable to all employees for recruiting and engaging unskilled and skilled persons in Bhutan who are outside the Royal Civil Service (RCSC).

2. Category		WAGE RATE Daily		Consolidate (p.m.)
I		40.-		1,200.-
II		36.-		1,080.-
III		33.-		990.-
IV		30.-		900.-
V	(National Work Force on consolidated pay)		A.	750.- (M) 650.- (F)
			B.	600.- (M) 500.- (F)
VI	(Daily wage employees)		A.	22.- (M) 20.- (F)
			B.	15.- (M) 13.- (F)

3. Wage Rates at categories V & VI above are applicable at the Dzongkhags given below :

A) above - Thimphu, Paro, Ha, Punakha, Wangdiphodrang, Bumthang.

B) above - Chukha, Samchi, Gaylegphug, Chirang, Shemgang, Samdrupdzongkhar, Tashigang, Pemagatshel, Mongar, Phuntshi and Dagana, Tongsa.

4. Guidelines for category of skilled groups is at Annexure 'A'.

CATEGORIES

Category - I

Auto Mechanic Gr.I.
Gen.Mechanic Gr.I
Lineman Gr.I
Lharib Gr.I
Plant Operator Gr.I
Carpenter Gr.I

Category - II

Auto Mechanic Gr.II
Gen. Mechanic Gr.II.
Lineman Gr.II
Lharib Gr.II
Carpenter Gr.II
Mason Gr.I
Plumber Gr.I.
Auto Electrician Gr.I
Plant Operator Gr.II.
Blacksmith
Lajabs (Work Supervisor)

Category - III

Auto Mechanic Gr.III
Gen. Mechanic Gr.III
Lineman Gr.III
Mason Gr.II
Carpenter Gr.III
Plumber Gr.II
Auto Electrician Gr.II
Sawyer Gr.I
Blaster
Wireman Gr.I
Plant Operator Gr.III

Category - IV

Sawyer Gr.II
Wireman Gr.II
Machine Operator
Cleaners

Category - V

National Work-force on consolidate pay.

Category - VI

Daily wage employees.

Sd/-
Deputy Home Minister.

Chapter - II (General Regulations):

1. All contingency staff/persons engaged on Consolidated Pay or Daily Wage basis should be employed within category (1 to VI) depending on their experience and grade of skill.

2. The level of wage rate is applicable to all throughout the Kingdom.

3. Working duration shall be 9 hours a day with one hour lunch break. The working timing shall be determined by the concerned authorities at the work-site depending on places and seasons.

4. The government approved wage rate is valid until furhter order and may be revised from time to time.

5. Persons paid on consolidated and daily wages will not be entitled for daily allowanceds (DA).

6. Carpenters (Zows) and masons (Dozows) of Gr.I taking lead responsibilities as Zopons and Dozow Lopons on any construction work shall be paid extra Nu.5/- per day.

7. This provisions will not effect the Gungda Woola wage wage rate and its Chathrim.

8. Dzongdag and Gup should certify if possible, skill grades of carpenters, masons, painters, blacksmit etc. Similarly the Technical department and other employers should also issue certificate indicating skill grade while being sent to other employers. This is for the purpose of setting skill level and category.

9. The Ministry of Home Affairs shall monitor effectiveness of the structure of Wages through the Dzongkhag and concerned employers.

Chapter - III (Facilities & Benefits)

1. The above category work force will be eligible for work compensation as approved by the National Assembly Resolution 33 (50th) Session 1979 or they shall have RICB Group Accident insurance coverage paid by the employers.

2. Medical coverage will be given as far as practical free of charge within the country and as applicable to all the citizens.

3. Rations on payment shall be made available to all the site whenever possible.

4. Materials for temporary site living accomodation (bamboo mat) may be provided free of cost if deemed appropriate otherwise they will have to make their own arrangements except where specific provisions are made in these rules and regulations.

5. Transportation shall be borne by the concerned employer or reimburse the actual bus far from the hometown to the place of work-site at the time of joining.

6. All workers of the consolidated pay category under this rules are entitled for one full day paid leave for every 6 working days. They are entitled to an leave of 15 days. Any other leave of absence will be without wage or pay.

7. When the working hours exceed the specified 8 hours of work per day, employers should ensure overtime payment for the additional hours of work at one and a half times the rates applicable to normal working hours.

Chapter - IV (Responsibilities of Employer & Employee)

1. Business and Industrial organizations shall be responsible for recruiting their own required work-force. The concerned department may assist and facilitate reqruitment of national work-force as far as possible.

2. Employers may pay to new recruits on consolidated pay an advance equivalent to one months pay at the time of initial appointment. It shall be recovered from their pay or

wage on reasonable installment basis.

3) Training or orientation courses as incentives may be arranged for deserving employees by the employers and institute facilities.

4. All employees should take adequate measures for safe working conditions and to avoid work hazards or even threat to life itself. The employer should ensure that all preventive measures are adopted.

5. Workers and employers should have contractual agreement in writing.

Chapter - V (Rules & Regulations for Recruiting Agencies):

I. There shall be a labour recuirting agency or agencies licenced or authorised by the Royal Government from time to time. They shall be guided by the rules and regulations as follows:

a) Initially there will be four recruiting agencies and more, if required operated by the government as well as in private sector.

b) All agencies shall hold licence or authorisation from the government. Licence shall be issued as per existing rules of the Trade Ministry.

c) N.W.F. may be recruited from any parts of the country.

d) No one shall be recruited against their will nor by coercion or other unfair means.

e) All recruiting agents shll hold an Identity Card and copies forw arded to the Home Ministry who will advise the Dzongkhags property.

f) The agenst shall not indulge into any activities detrimental to public interest, Law & Order and government policies.

g) The recruiting agencies may publish or publicise materials relevant to the conduct of their labour recruiting business.

h) The cost of transportation of each national worker through most direct route will be paid as at para-5 of Chapter III.

i) The Agency may also claim a recruiting fee _____ from the employer for each National Work Force recruited by it.

j) They shall recruit persons between the ages of 17 to 56.

k) A quarterly report of the persons recruited by the agency shall be submitted to the Home Ministry.

l) All agencies and employers shall adhere to the wage rate and terms and conditions prolulgated by the Government from time to time.

m) Any dispute between the Agency and Employer shall be referred to the concerned head of the Department of Ministry.

n) The dispute, if unresolved may be referred to the Home Ministry whose decision shall be final and binding.

o) Home Ministry shall monitor the performances of the recruiting agencies.

Chapter - VI

a) The above provisions will be effective from July 1, 1988.

b) This will supersede all previous circulars with effect from the date of issue of the above regulations.

Sd/-
(Dago Tshering)
Dy. Home Minister.

To ::

1. All Project/Central Schemes.
2. The Finance & Accounts, Directorate of Agriculture, Thimphu.

LABOUR WAGE CALCULATION

PARO

1. FOOD :	Breakfast	--	Nu. 10.00
	Lunch	--	Nu. 15.00
	Dinner	--	Nu. 15.00
			Nu. 40.00
2. Daily cash payment (This payment needs to be paid at least 1½ month advance in average)		--	Nu. 30.56
3. Transport		--	Nu. 4.00
			Nu. 74.56

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Above information based on interview with farmers.

Officer-in-charge,
Agriculture Machinery Centre,
Paro :: Bhutan

ANNEX 12 LIST OF MACHINERY UNDER HIRE SERVICE, 1988-89

Sl. No.	Type of Machinery Model/Make	Numbers in stock	Numbers in condition	Numbers in damage	Remarks
1.	Bulldozer D50 A17 (Komatsu)	3 Nos.	3 Nos.	Nil	
2.	Bulldozer D50 A16 (Komatsu)	2 Nos.	2 "	Nil	
3.	Bulldozer D50 A15 (Beml)	7 "	5 "	2 Nos.	
4.	Bulldozer D4E (Caterpiller)	3 Nos.	1 No.	2 Nos.	
5.	Bulldozer International TD-20	1 No.	1 No.	Nil	
6.	Bulldozer D20 (Komatsu)	4 Nos.	2 Nos.	2 Nos.	
7.	Swamp Dozer D-20P (Komatsu)	1 No.	Nil	1 No.	
8.	Excavator PC-60 (Komatsu)	2 Nos.	2 Nos.	Nil	
9.	Wheel Loader 930 (Caterpiller)	2 Nos.	1 No.	1 No.	
10.	Track Loader 960 (Caterpiller)	1 No.	1 No.	Nil	
11.	Air Compressor VT4PD (Atlas Cop)	9 Nos.	5 Nos.	4 Nos.	
12.	Isuzu Truck (Isuzu Motor)	1 No.	1 No.	Nil	
13.	Kubota Tractor L345 (Kubota)	2 Nos.9	1 No.	1 No.	
14.	V. Roller JV-32W (Komatsu)	1 No.	1 No.	Nil	
15.	Carryer RC-25 (Kubota)	4 Nos.	3 Nos.	1 No.	
16.	Hand dozer KD-IE (Kubota)	3 Nos.	2 Nos.	1 No.	
16.	Combine Harvestor NX 1300 (Kubota)	1 No.	1 No.	Nil	
17.	Combine Harvestor RX 900 (Kubota)	1 No.	1 No.	Nil	
18.	Portable power Thresher NH 700 (Kub.)	1 No.	1 No.	Nil	
19.	Reaper AK-120 (Kubota)	12 Nos.	10 Nos.	2 Nos.	
20.	Portable water pump (Kubota)	4 Nos.	3 Nos.	1 No.	
21.	Portable welding Machine	1 No.	1 No.	Nil	

Source : Agriculture Machinery Centre, Paro

ANNEX 13 LIST OF MACHINERY OPERATORS

HIRE SERVICE UNIT

AMC : Paro

Sl. No.	Name of Operators	Experience	Operators under Training	New trainees to be trained
1.	Mr. Dorji Wangdi	17 years		
2.	Mr. Santa Bahadur Rai	20 years		
3.	Mr. Jambay	18 years		
4.	Mr. C.B. Thapa	16 years		
5.	Mr. Nima Sherpa	12 years		
6.	Mr. Pema Letho	12 years		
7.	Mr. Karma Wangda	12 years		
8.	Mr. Dawa Tshering	7 years		
9.	Mr. Dorji Khandu	9 years		
10.	Mr. Thinlay	7 years		
11.	Mr. Talop Rinchen	7 years		
12.	Mr. Laxmi Prashad	7 years		
13.	Mr. Jabab Tandi	8 years		
14.	Mr. Chandra Bahadur	7 years		
15.	Mr. Tshering	8 years		
16.	Mr. Tashi Phuntsho	9 years		
17.	Mr. Tshewang	9 years		
18.	Mr. Tashi	12 years		
19.	Mr. Sangla	12 years		
20.	Mr. Dhan Bahadur	7 years		
21.	Mr. Rinzin Wangdi	5 years		
22.	Mr. Tshering Dorji	9 years		
23.	Mr. Bal Bahadur Rai	7 years		
24.	Mr. Narad Singh Ghalley	7 years		
25.	Mr. Lepo	7 years		
26.	Mr. Tandi Dorji	7 years		
27.	Mr. Ugen Rinzin	5 years		
28.	Mr. Tashi Dorji	7 years		
29.	Mr. Leki	4 years		
30.	Mr. Geyche	5 years		
31.	Mr. Kencho	2 years		
32.	Mr. Tshewang II	3 years		
33.	Mr. Chimmi Tshering	3 years		

34.	Mr. Karchung	3 years		
35.	Mr. Sangay Wangdi	2 years		
36.	Mr. Tshewang Dorji	2 years		
37.	Mr. Choeda	2 years		
38.	Mr. Sherab Tenzing	2 years		
39.	Mr. Namgay	2 years		
40.	Mr. Tashi Phuntsho	2 years		
41.	Mr. Zambay II	5 years		

ANNEX 14

ANNUAL FARM INCOME OBTAINED FROM INTERVIEW

unit : Nu. x 1000

Farm Family No.	Block	Paddy	Fruits	Potatoes	Vegetables
1	Shari	30	10	10	5
2	Shari	20	30	15	-
3	Shari	15	6	8	6
4	Shari	20	11	16	6
5	Luni	35	-	2.2	-
6	Luni	30	10	-	-
7	Luni	30	8	4	-
8	Luni	42.5	9	3	4
9	Shaba	10	-	-	1
10	Shaba	10	1	-	-
11	Shaba	30	4	2	5
12	Lango	40	12	1.5	-
13	Lango	75	3	1	1
14	Lango	65	0.6	2	-
15	Lango	50	-	2.5	-
16	Shaba	22.8	-	-	-
17	Wangchang	44	-	-	3
18	Wangchang	49.5	-	-	20
19	Wangchang	22.8	-	-	15
20	Wangchang	62.4	-	-	16
21	Shari	7.5	-	6	2
22	Shari	3	1	-	-
23	Shari	62.4	30	3	-
24	Shari	22	-	3.5	-
25	Shari	54	2	7	-
Total		952.9	136.7	86.7	84
Average		34.2	9.2	5.4	7
Percentage		73.4	11.8	7.5	7.3