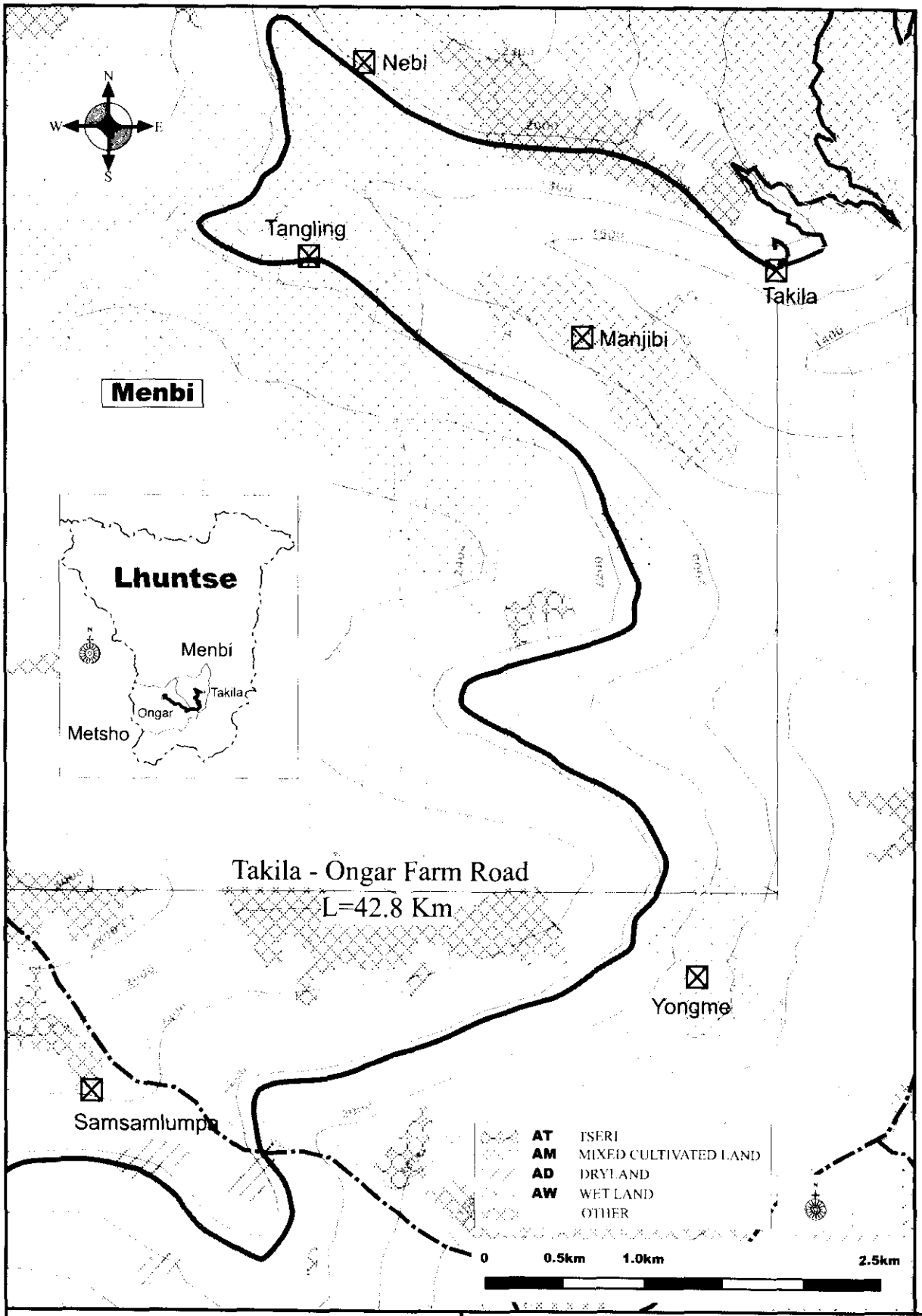
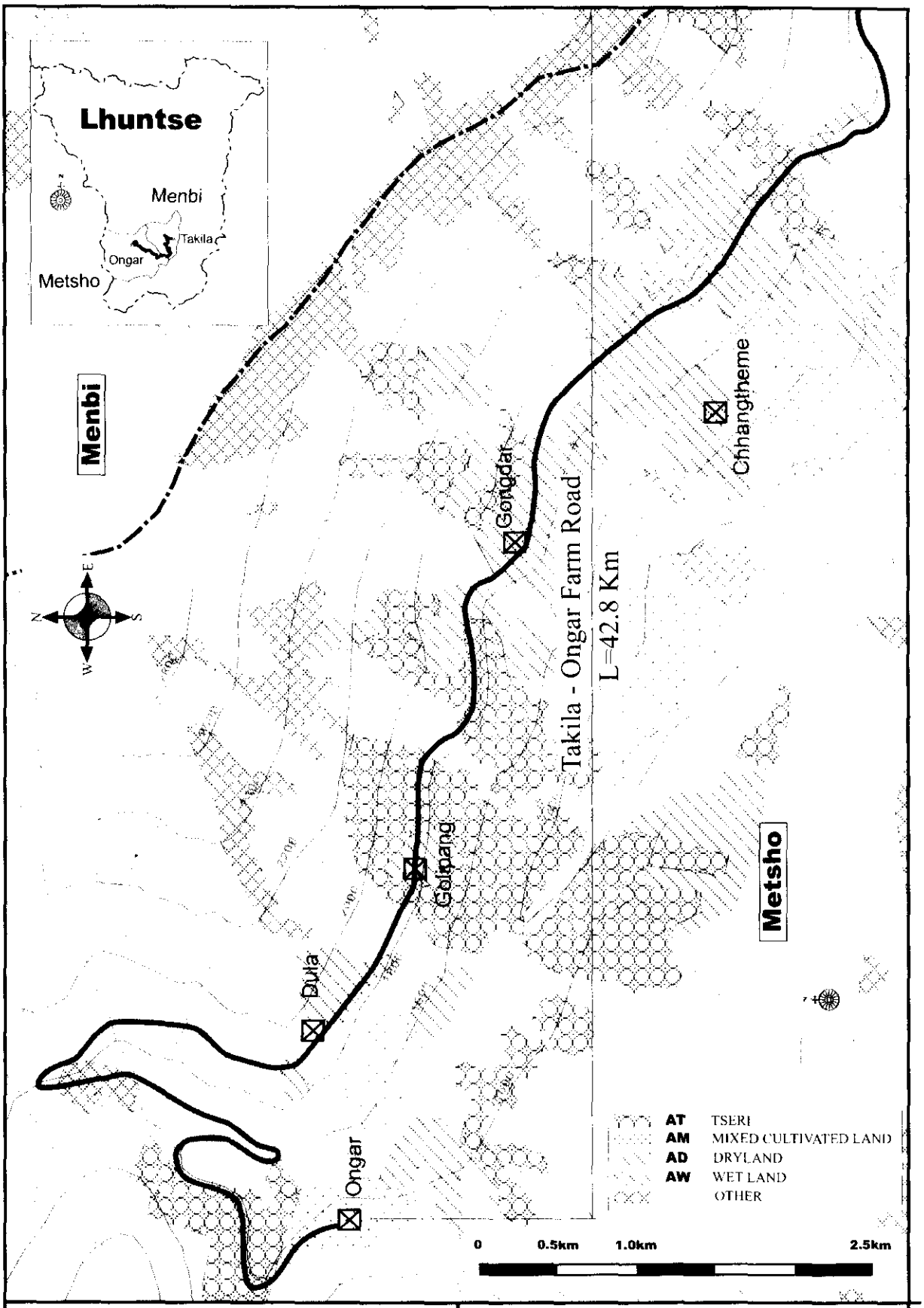


The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

Japan International Cooperation Agency (JICA)

Figure V-1

Propose Farm Road in Lhuntse (Takila - Ongar) (1/2)

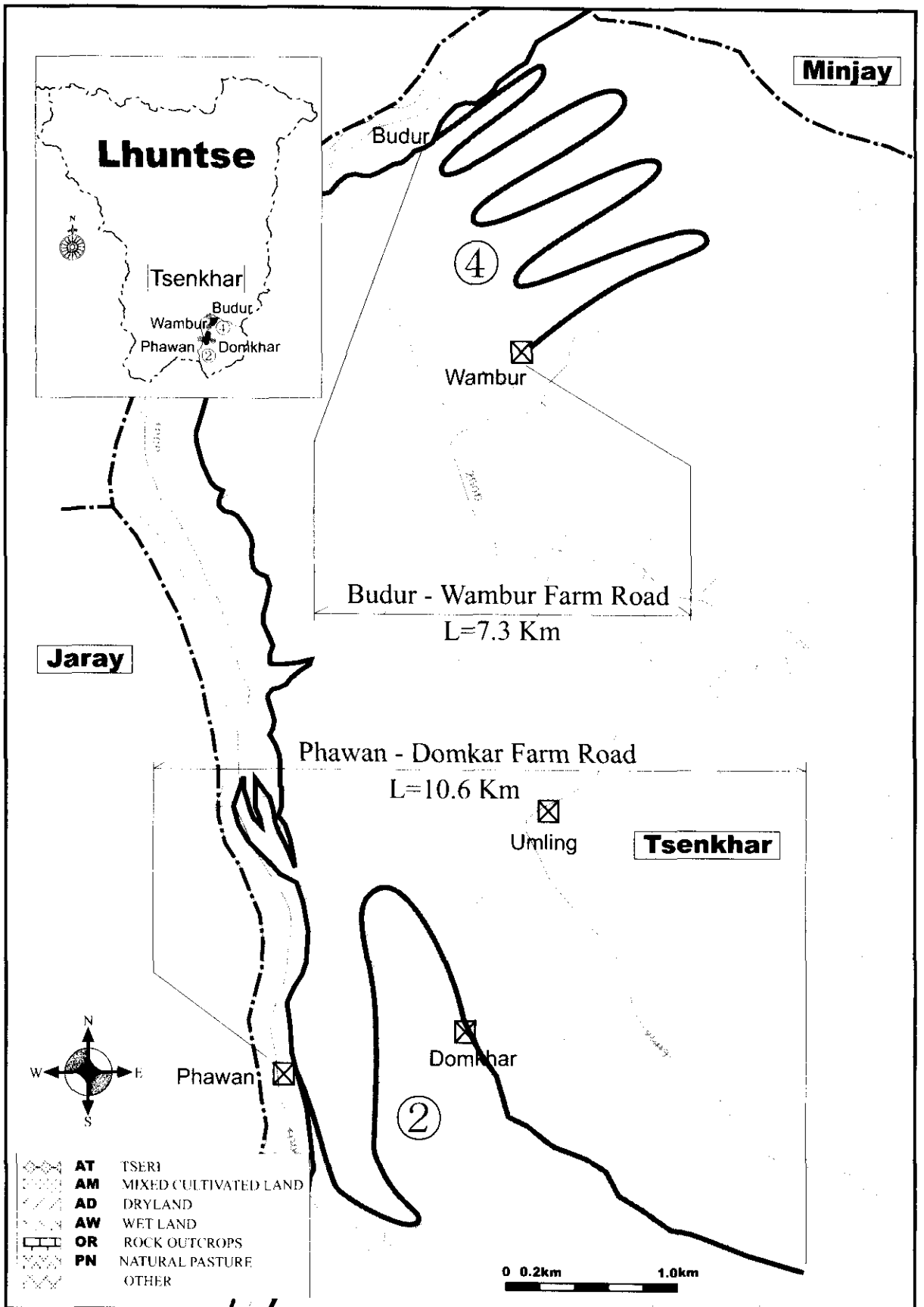


The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

Japan International Cooperation Agency (JICA)

Figure V-1

Proposed Farm Road in Lhuntse (Takila - Ongar) (2/2)

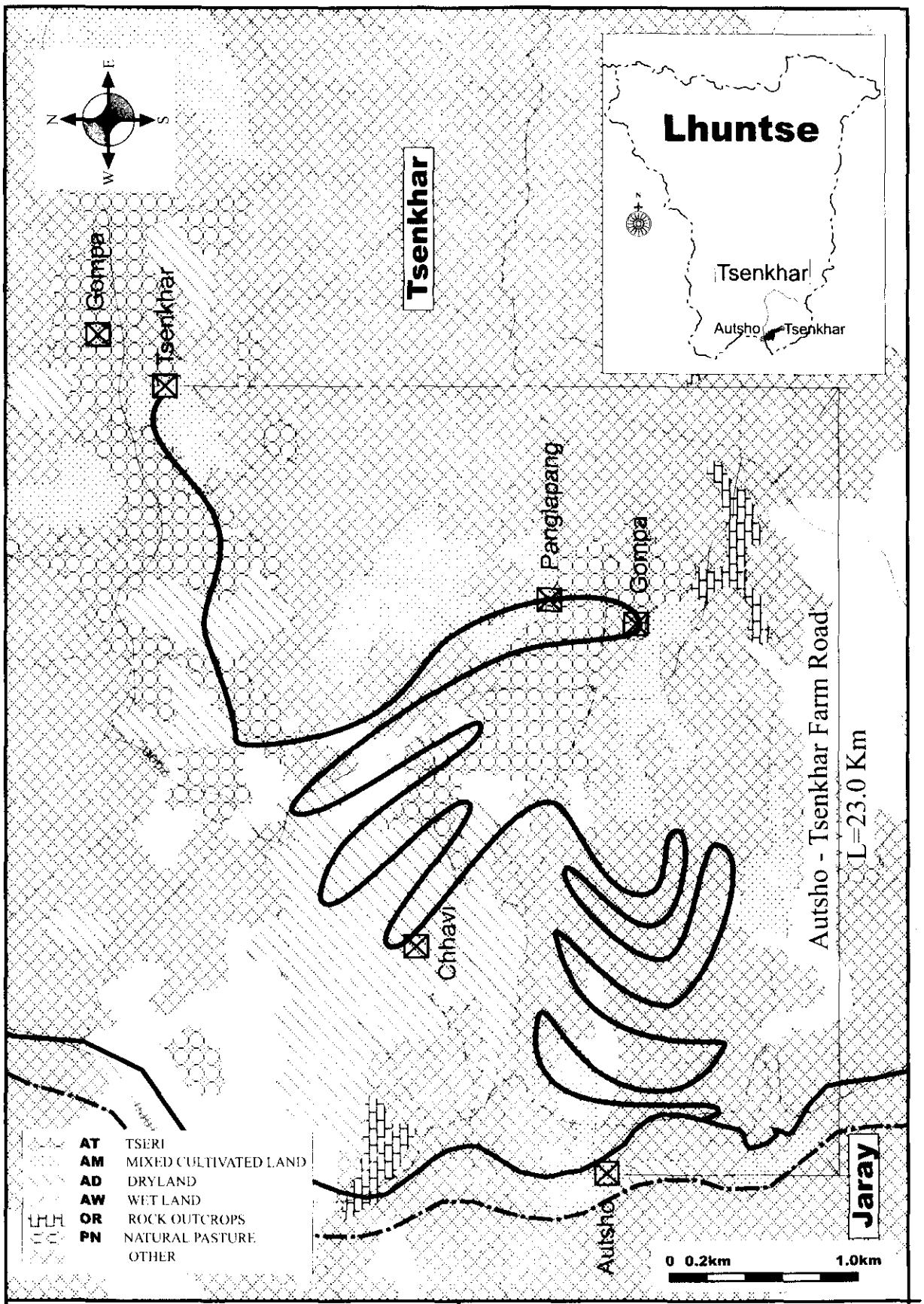


The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

Japan International Cooperation Agency (JICA)

Figure V-2

Proposed Farm Road in Lhuntse (Phawan - Domkhar)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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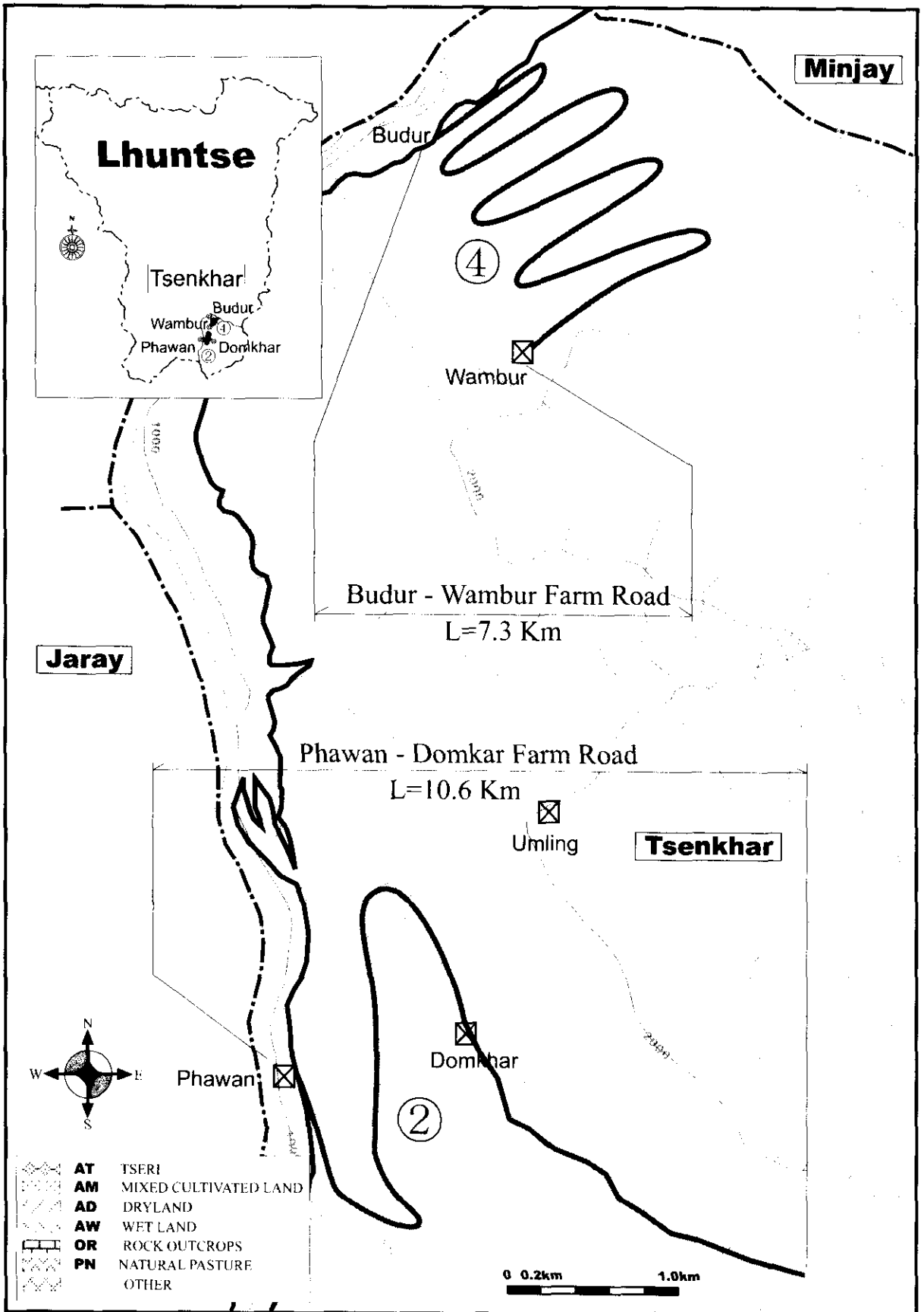
Figure V-3

Proposed Farm Road in Lhuntse (Autsho - Tsenkhar)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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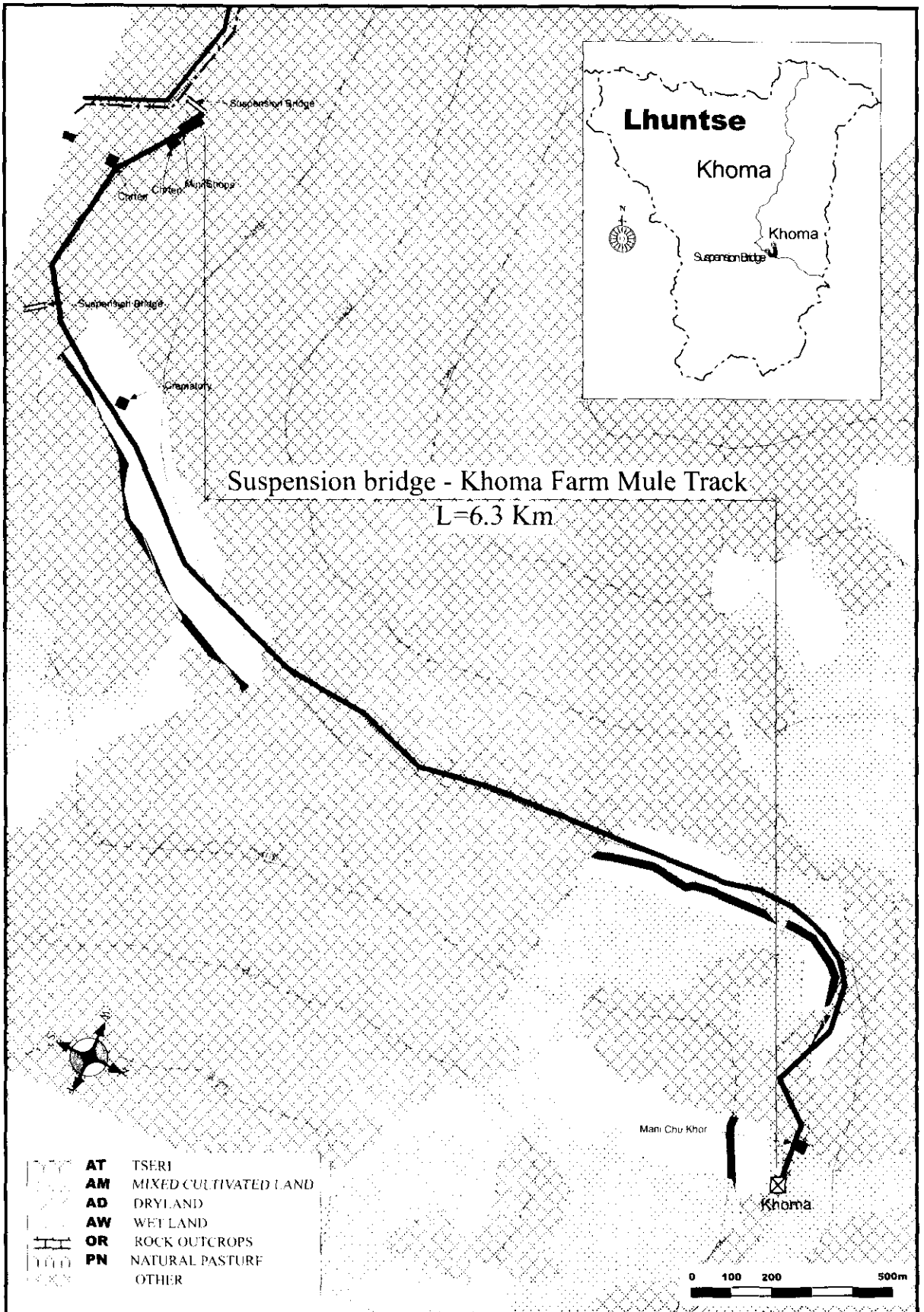
Figure V-4

Proposed Farm Road in Lhuntse (Phawan - Domkhar, Budur - Wambur)

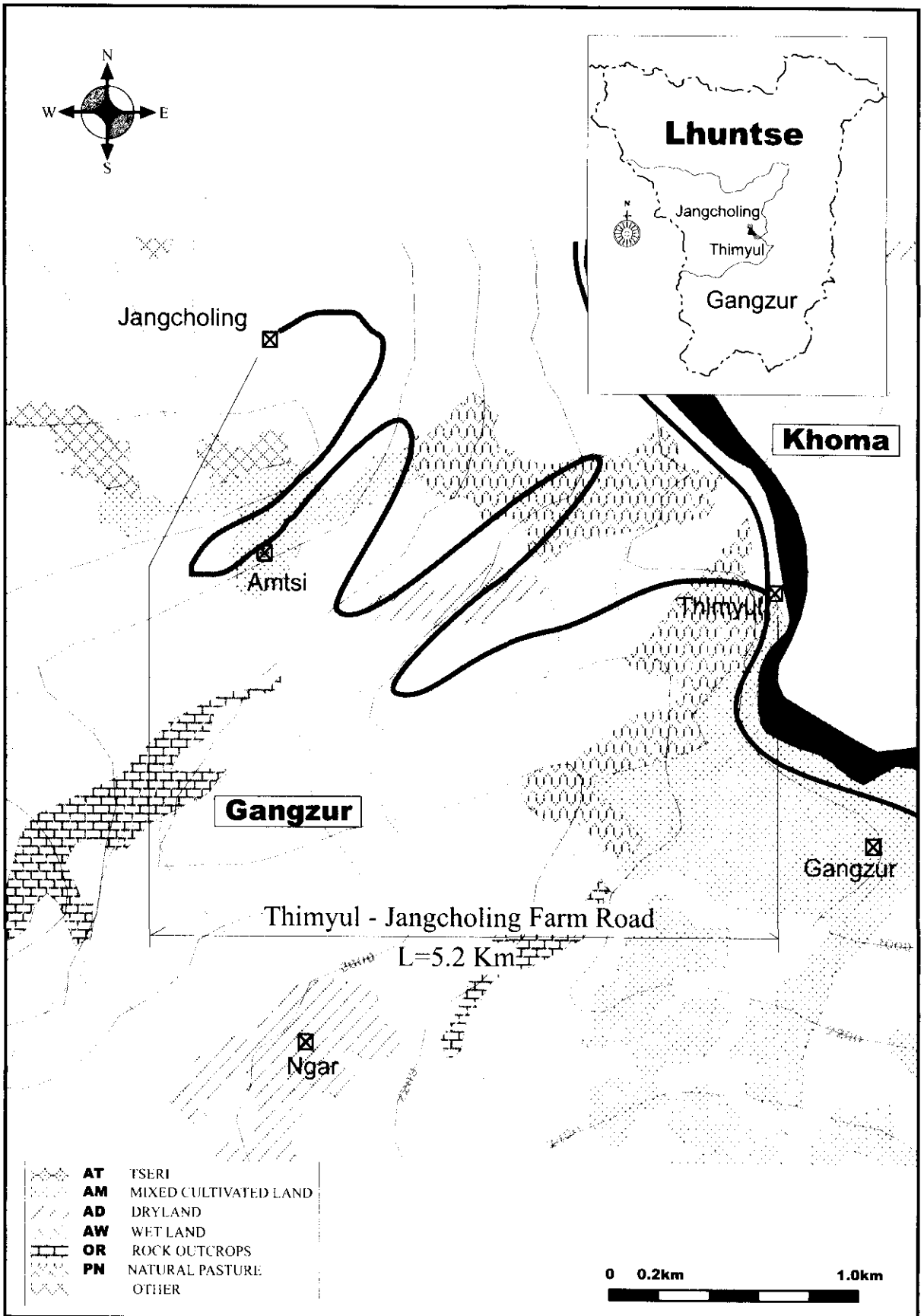


The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

Japan International Cooperation Agency (JICA)

Figure V-5

Proposed Farm Mule Track in Lhuntse (Suspention bridge - Khoma)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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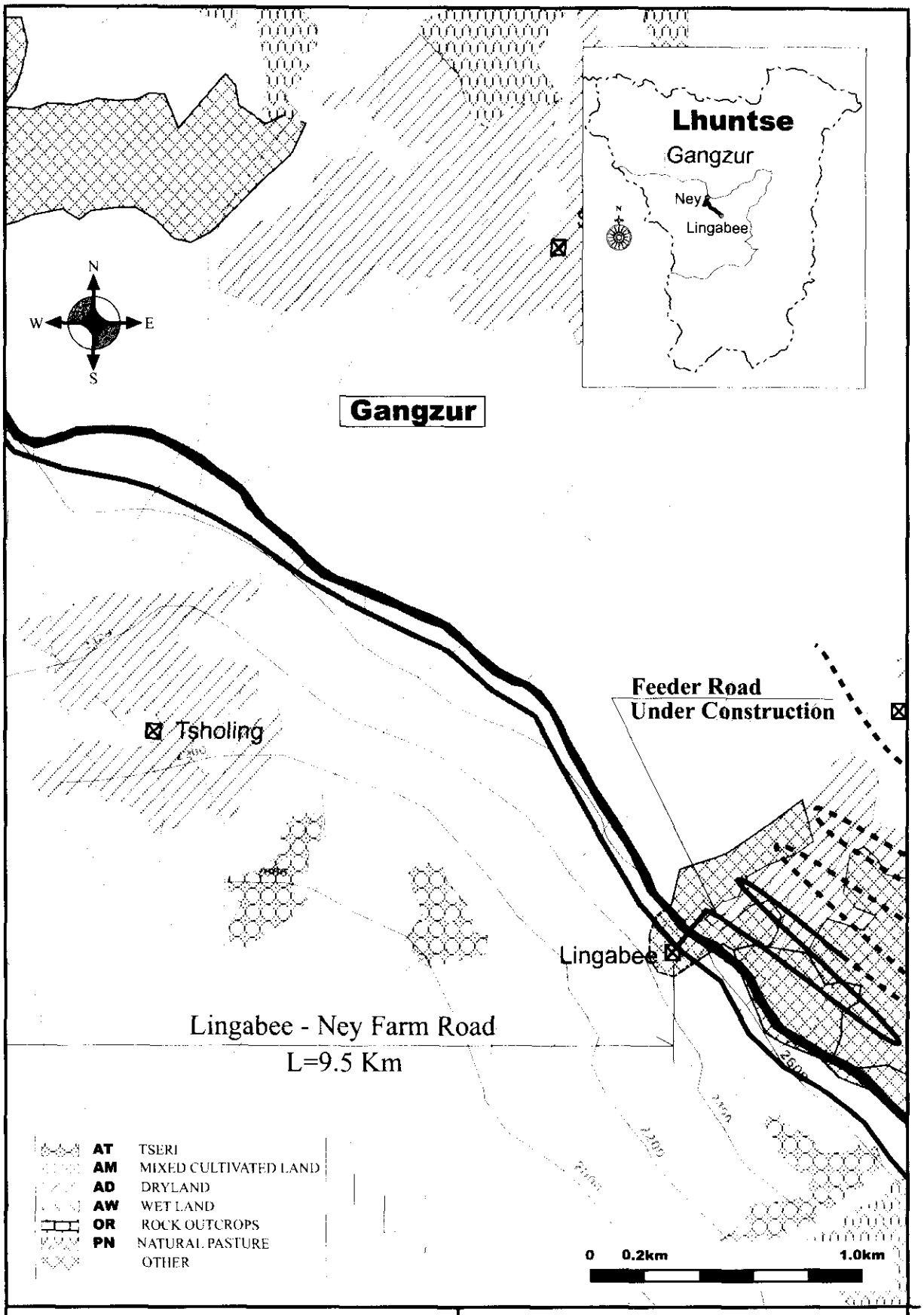
Figure V-6

Proposed Farm Road in Lhuntse (Thimyul - Jangcholing)

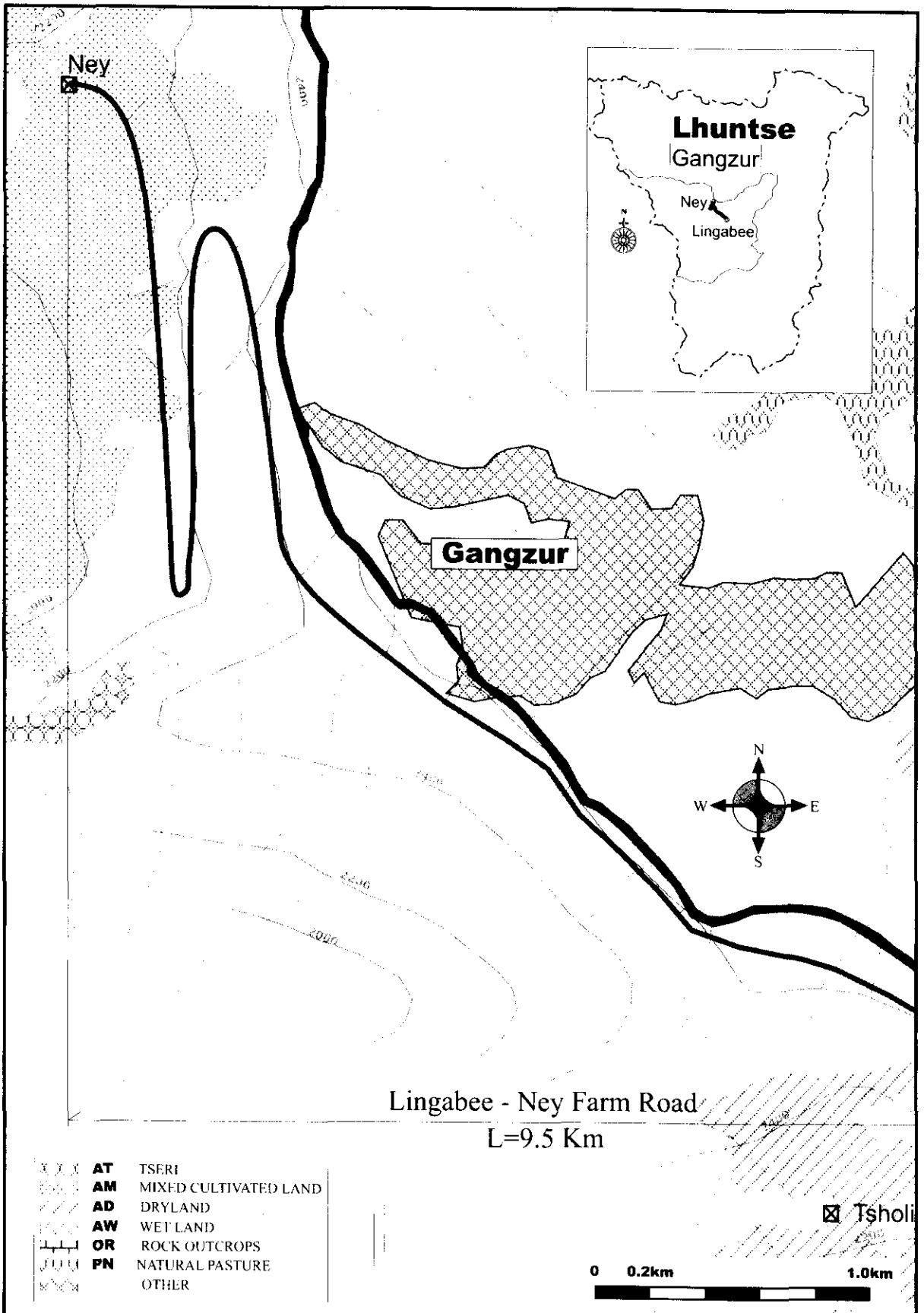


The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

Japan International Cooperation Agency (JICA)

Figure V-7

Proposed Farm Road in Lhuntse (Lingabee - Ney) (1/2)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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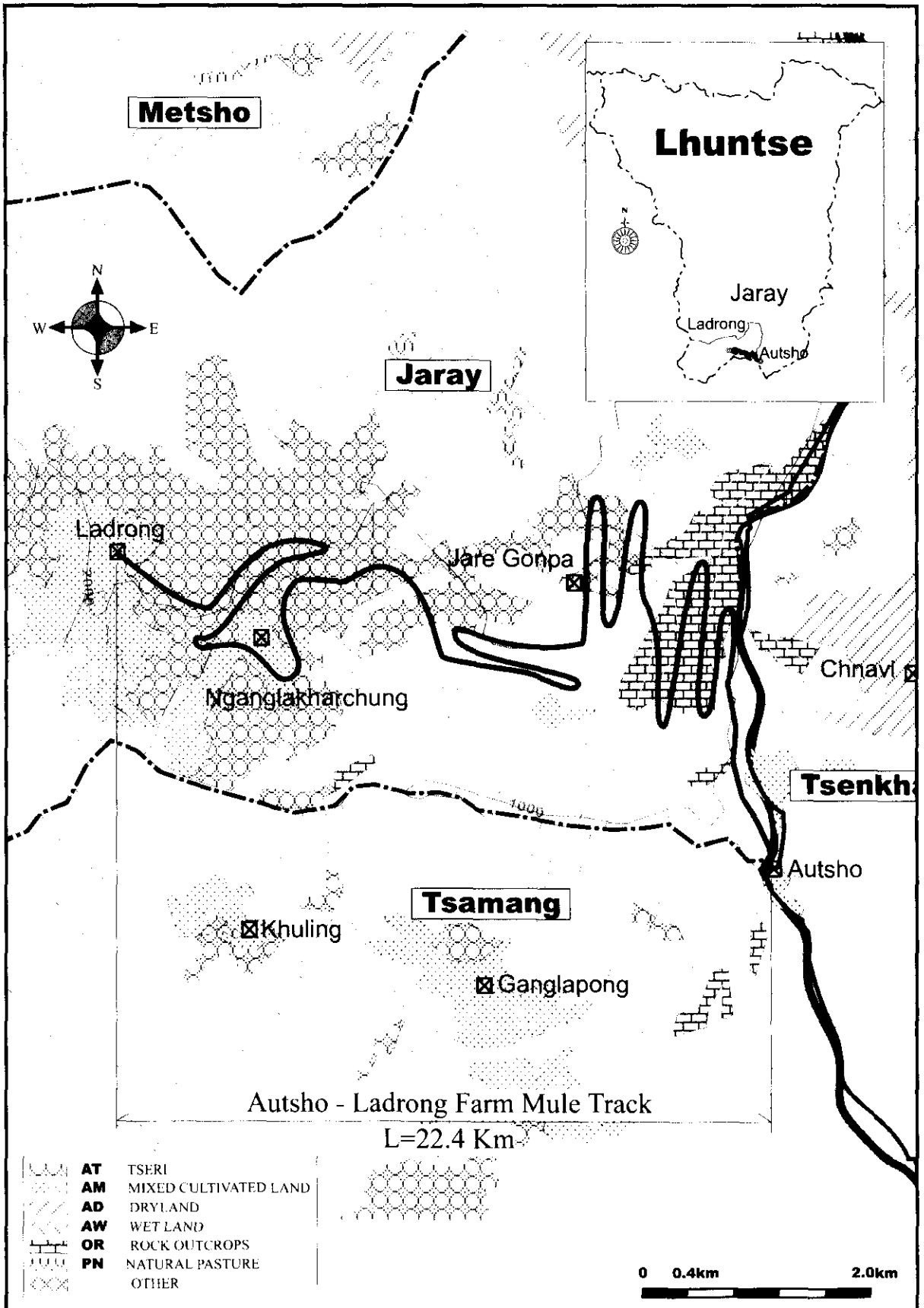
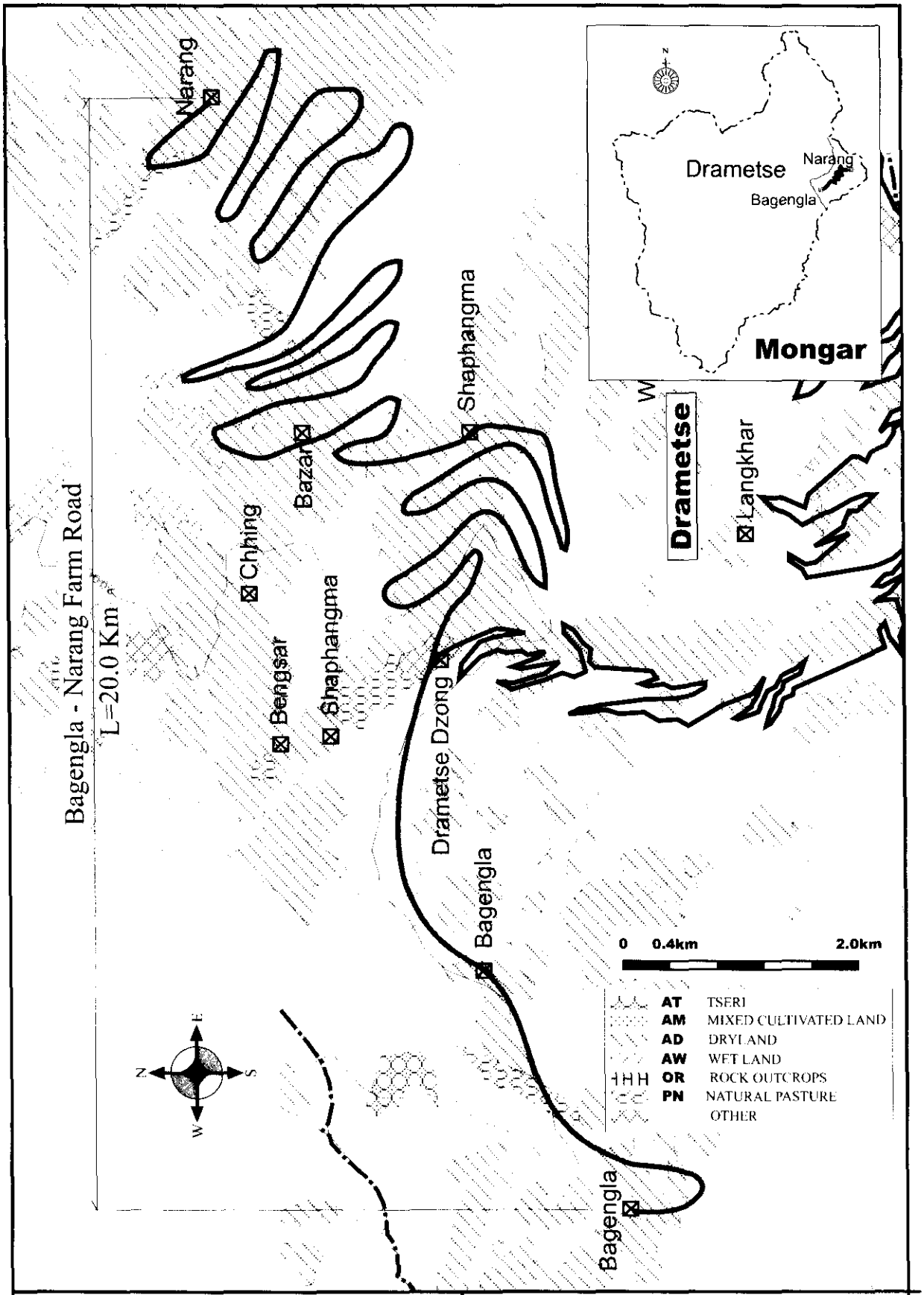
Figure V-7

Proposed Farm Road in Lhuntse (Lingabee - Ney) (2/2)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan	**Figure V-8**
Japan International Cooperation Agency (JICA)	**Proposed Farm Mule Track in Lhuntse (Autsho - Ladrong)**

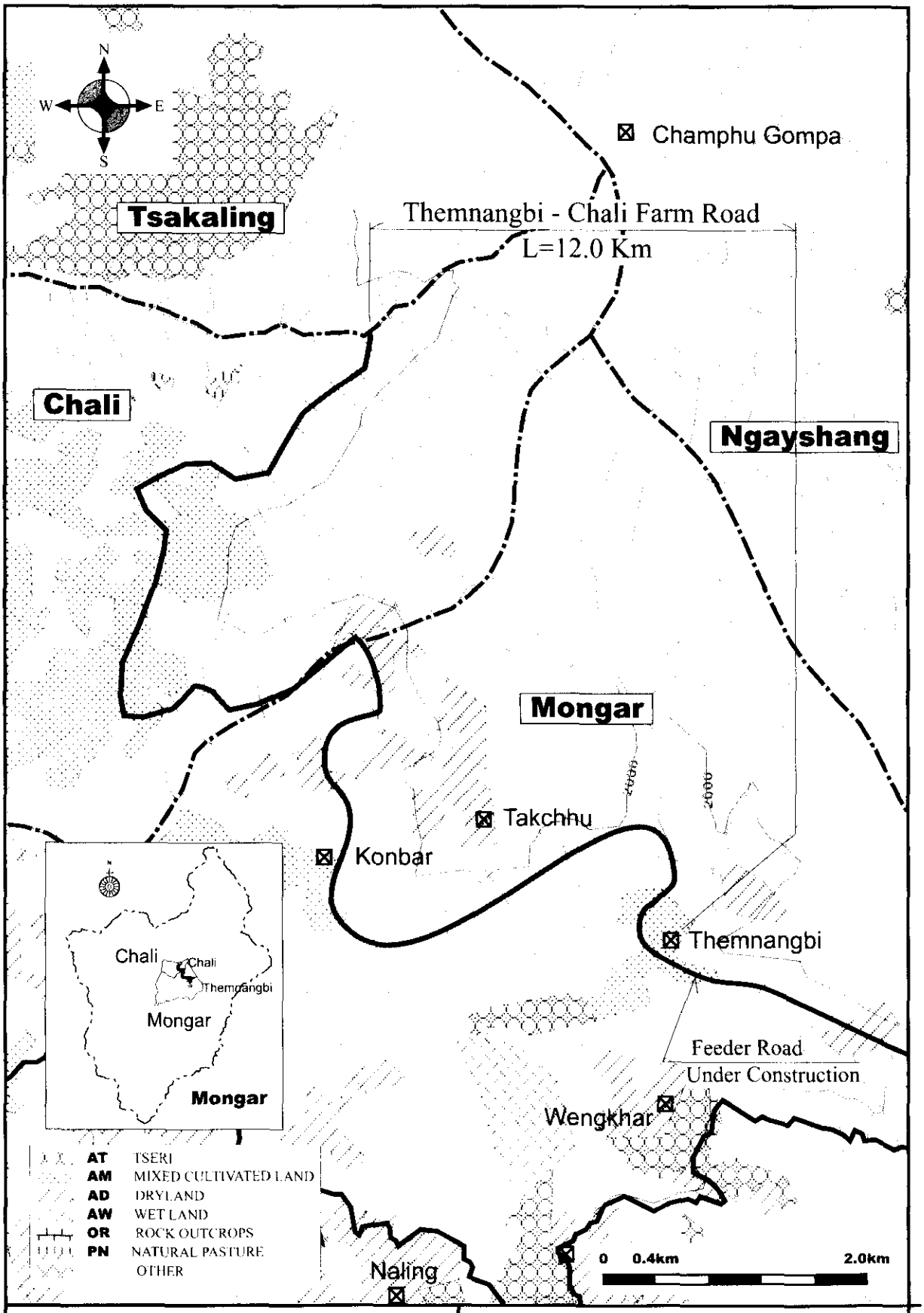


The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

Japan International Cooperation Agency (JICA)

Figure V-9

Proposed Farm Road in Mongar (Bagengla - Narang)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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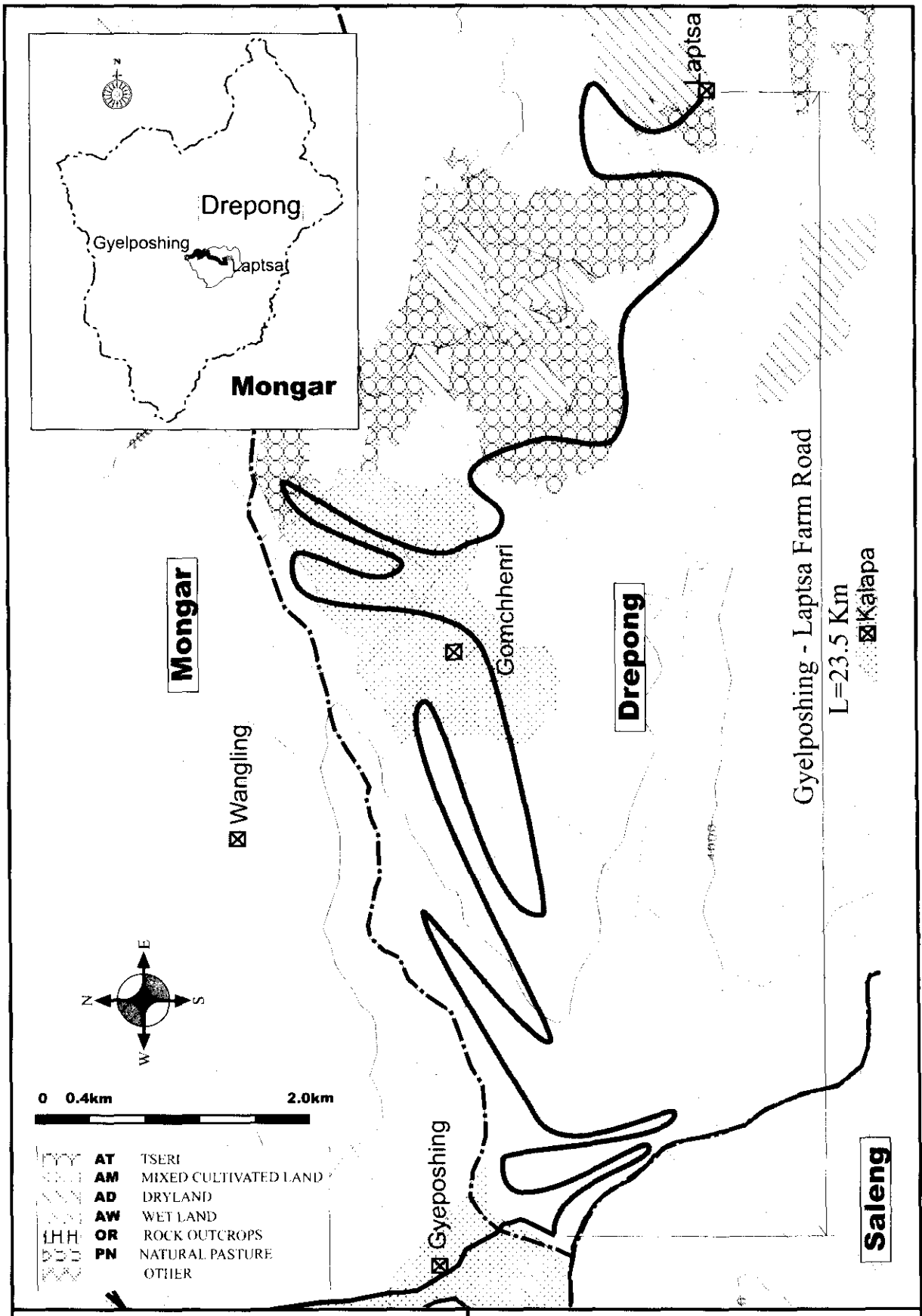
Figure V-10

Proposed Farm Road in Mongar (Themnangbi - Chali)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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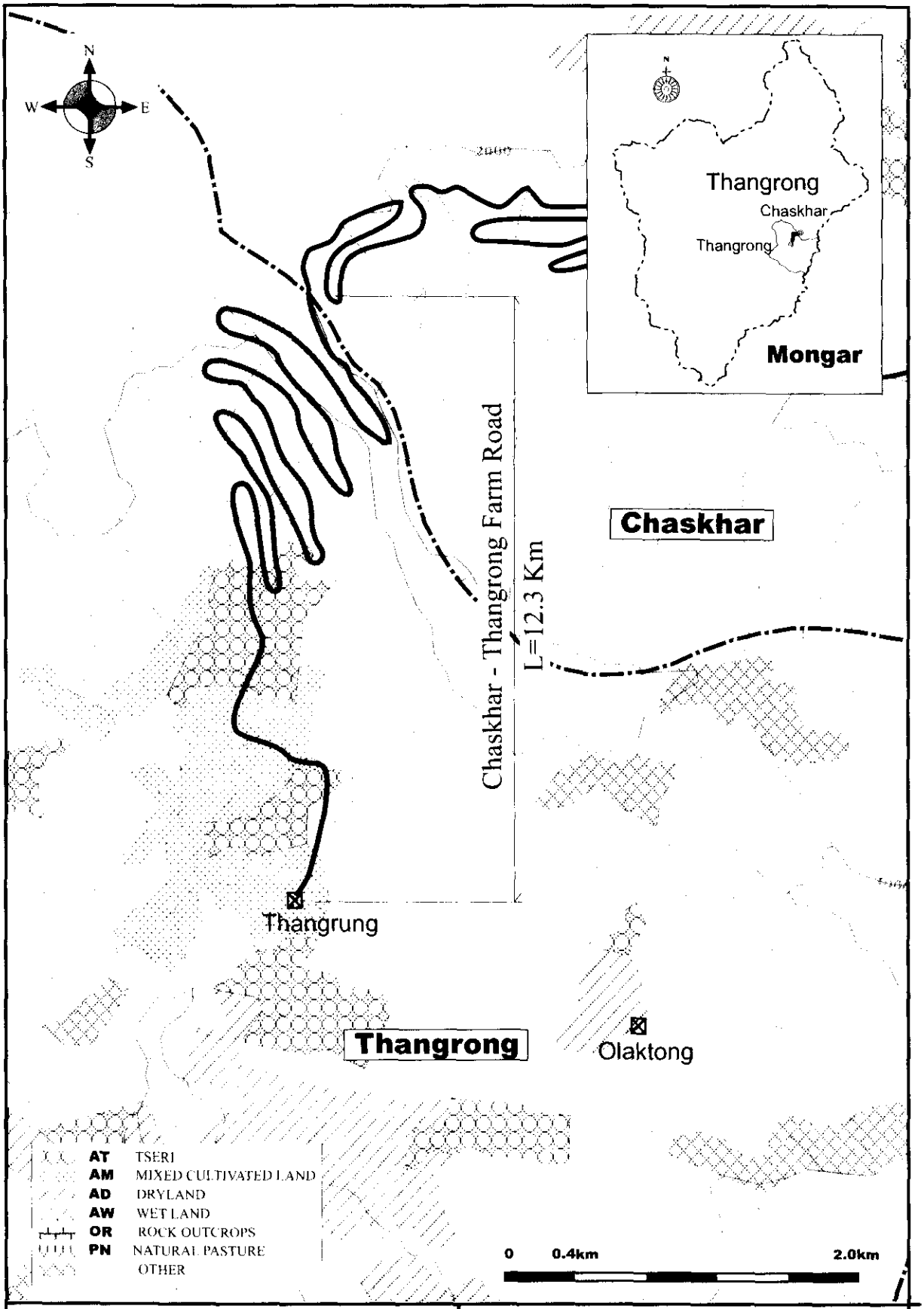
Figure V-11

Proposed Farm Road in Mongar (Gyelposhing - Laptsa)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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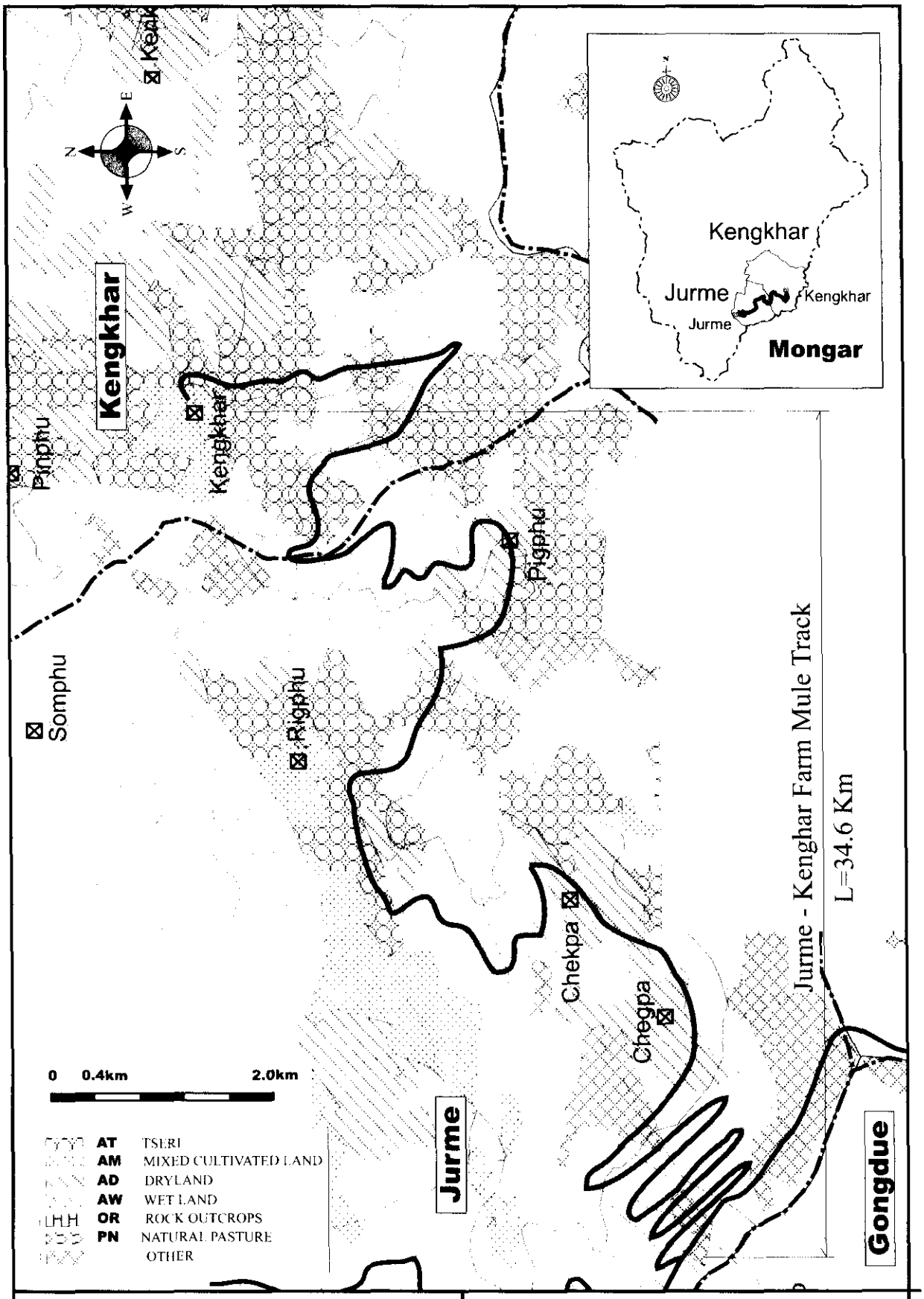
Figure V-12

Proposed Farm Road in Mongar (Chaskhar - Thangrong)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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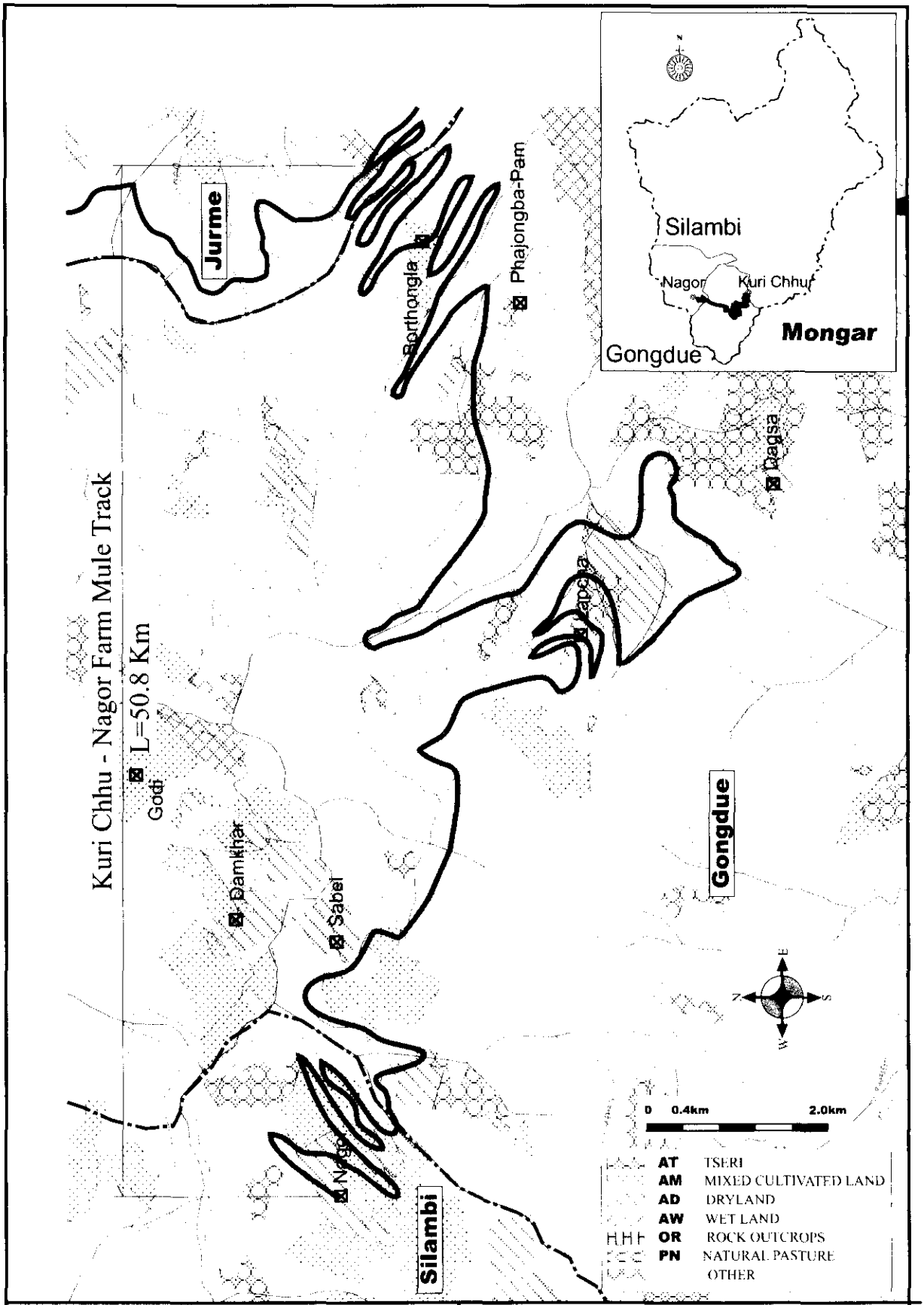
Figure V-13

Proposed Farm Mule Track in Mongar (Jurme - Kengkhar)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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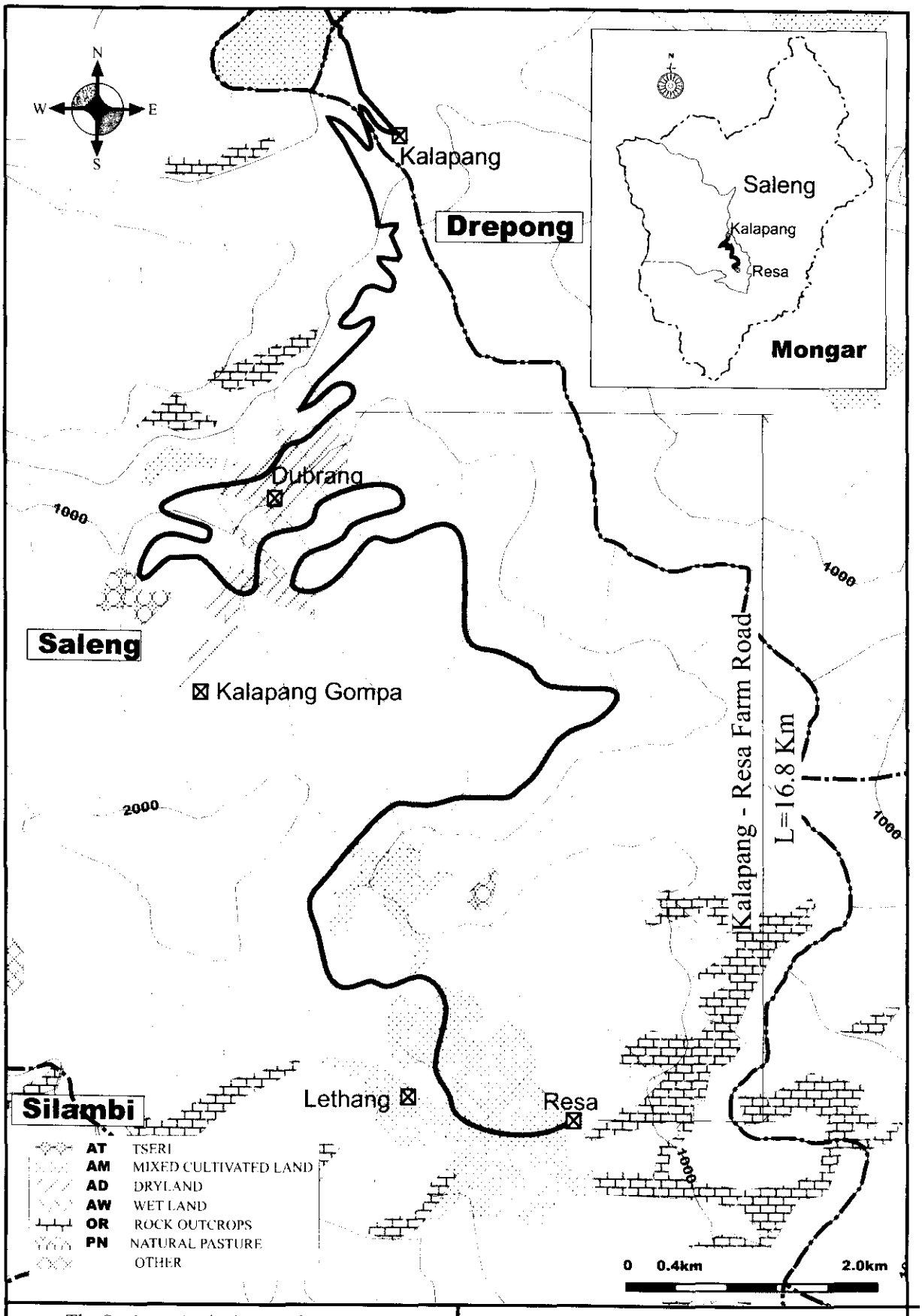
Figure V-14

Proposed Farm Mule Track in Mongar (Kuri Chhu - Nagor)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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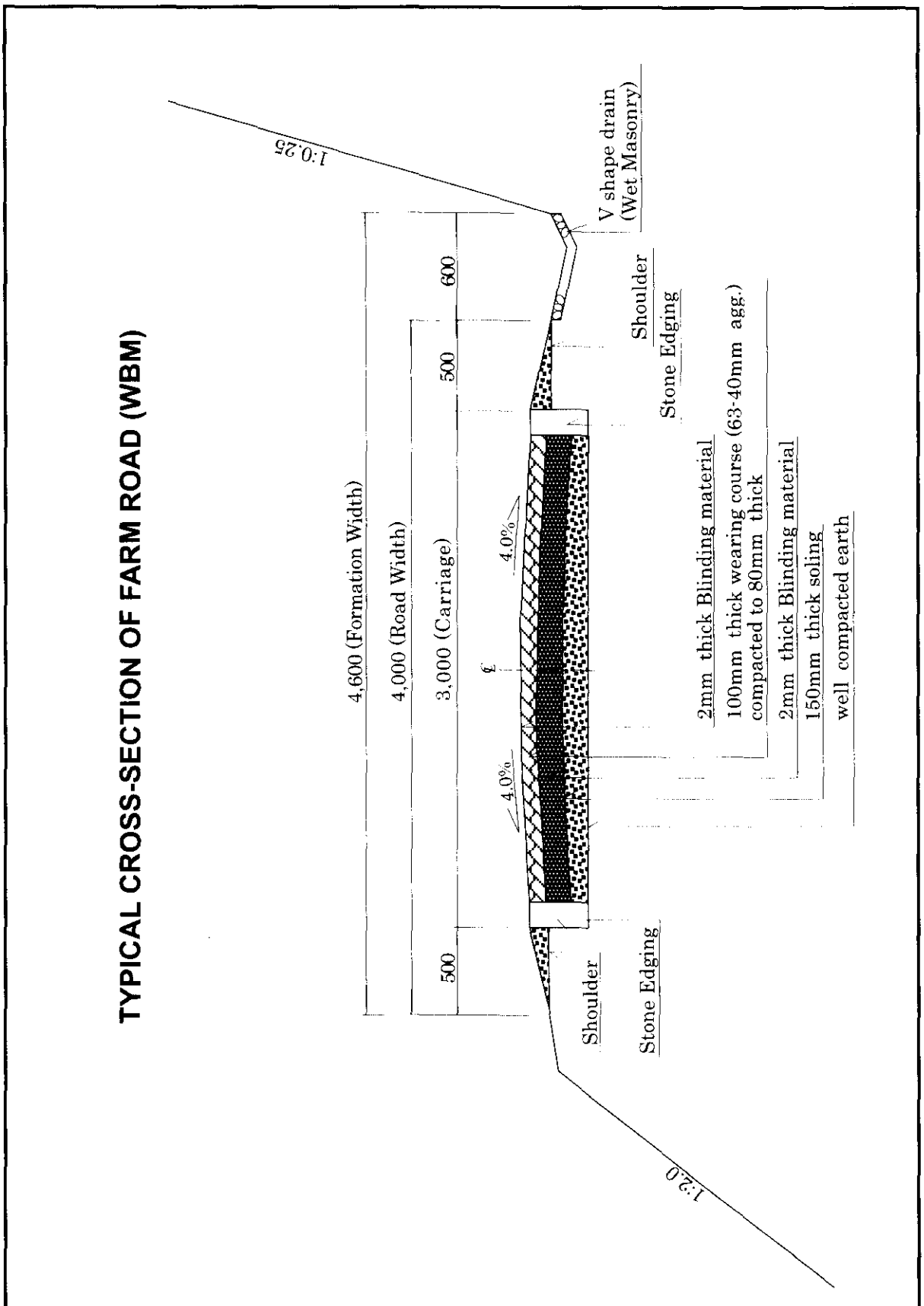
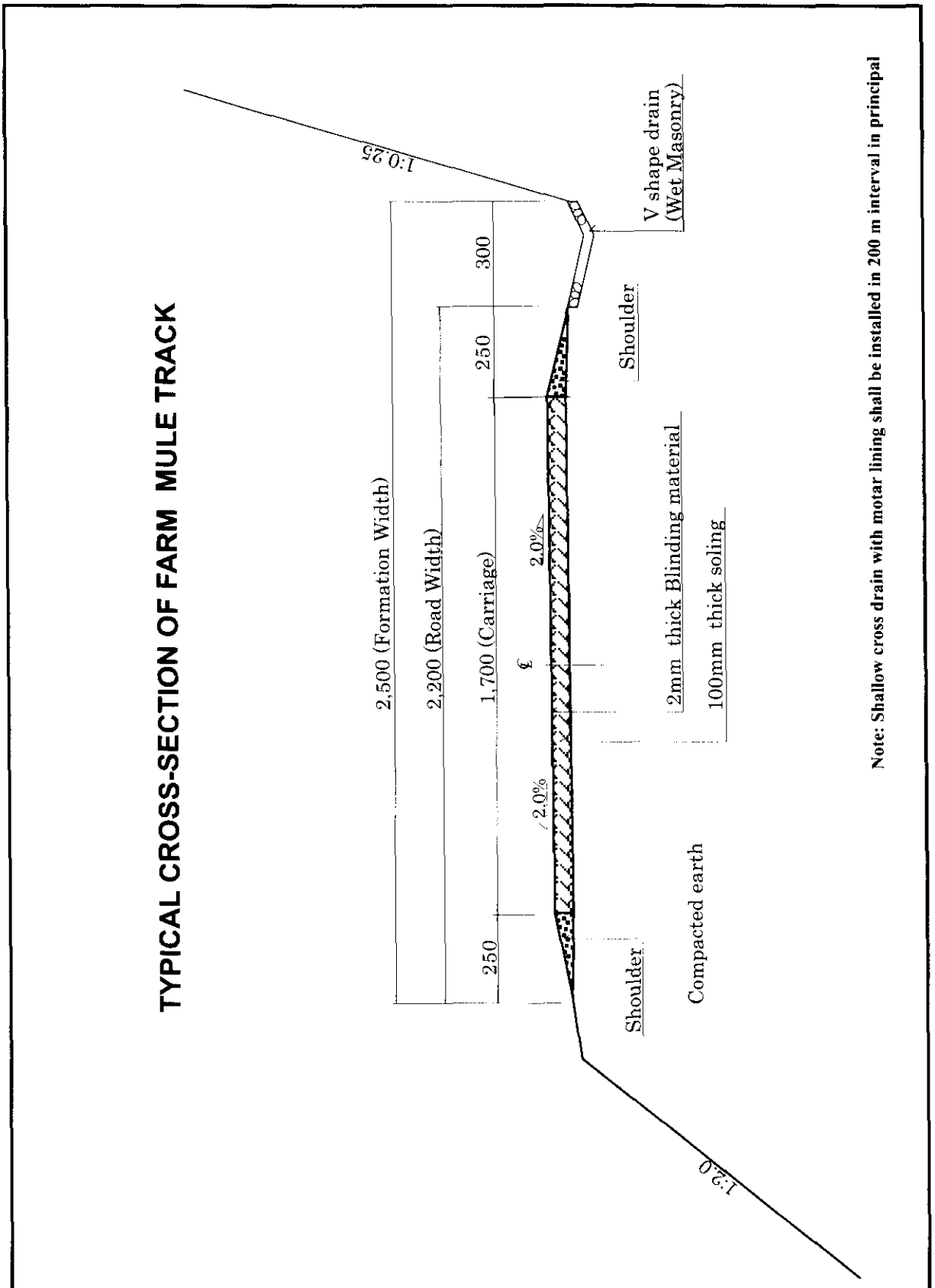
Figure V-15

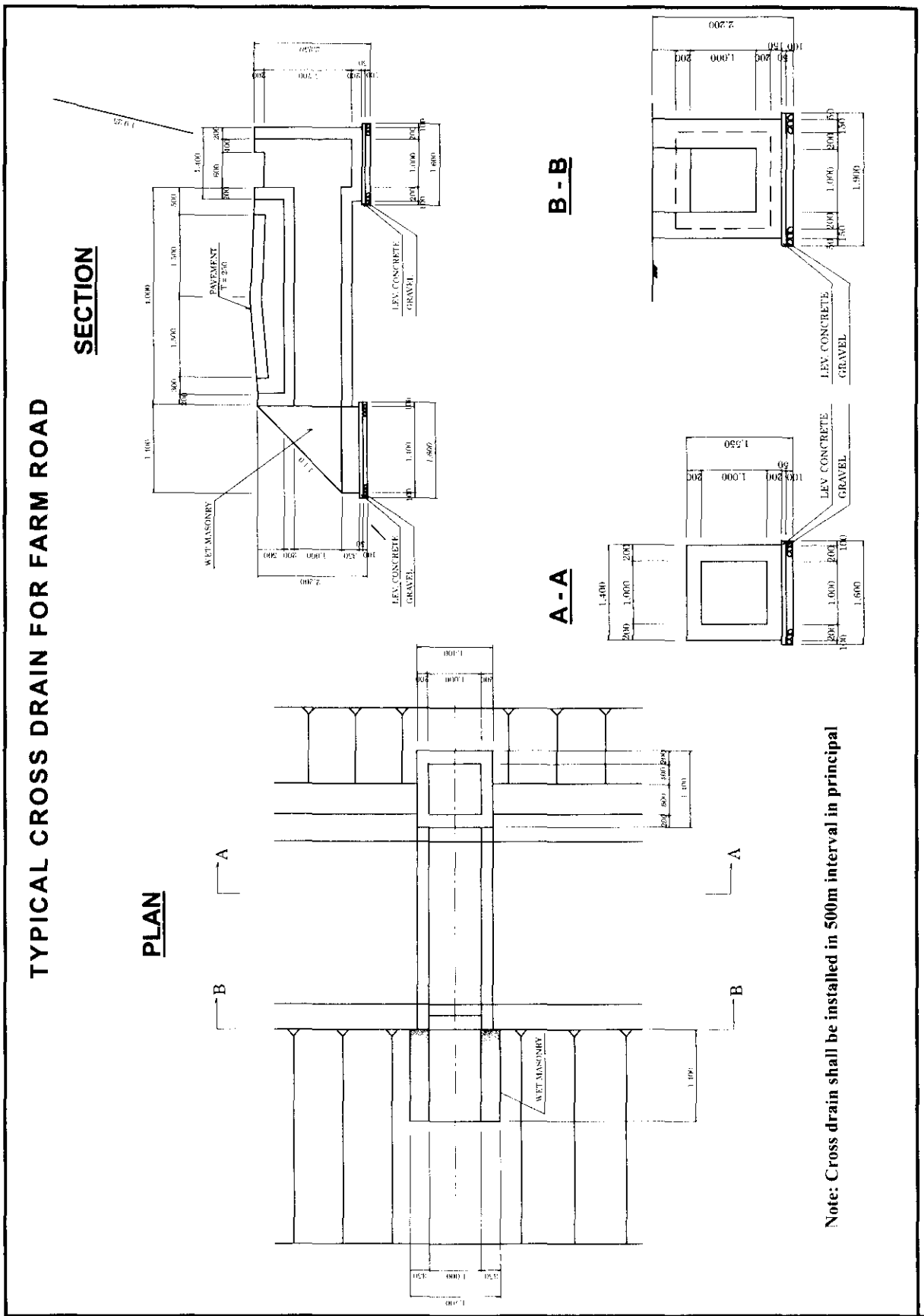
Proposed Farm Road in Mongar (Kalapang - Resa)



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan	**Figure V-16**
Japan International Cooperation Agency (JICA)	**Typical Cross-section of Farm Road (WBM)**



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan	**Figure V-17**
Japan International Cooperation Agency (JICA)	**Typical Cross-section of Farm Mule Track**

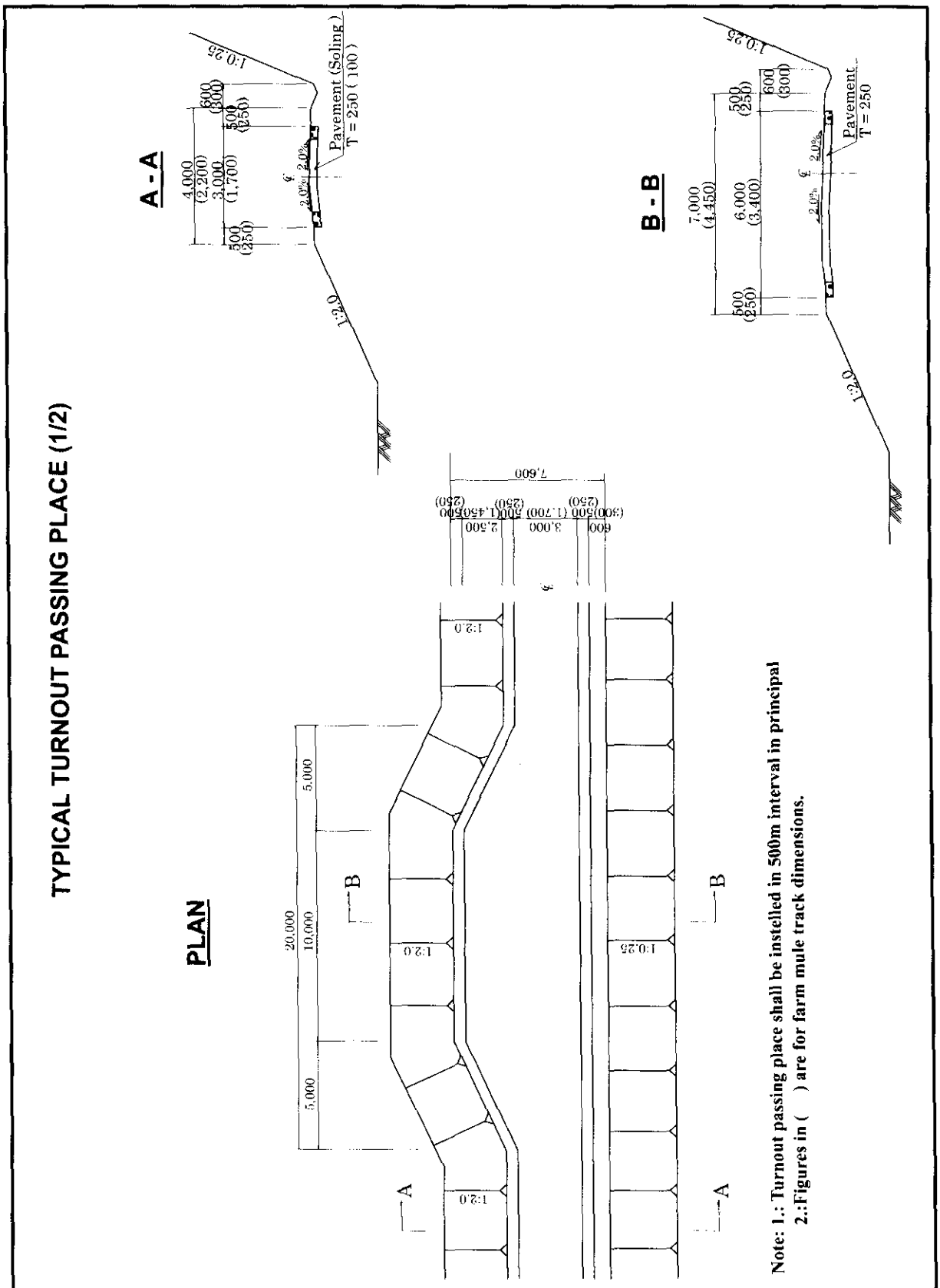


The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

Japan International Cooperation Agency (JICA)

Figure V-18

Typical Cross Drain for Farm Road



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

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Figure V-19

Typical Turnout Passing Place (1/2)

The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan	**Figure V-19**
Japan International Cooperation Agency (JICA)	**Typical Turnout Passing Place** (2/2)

TYPICAL RETAINING WALL FOR FARM ROAD

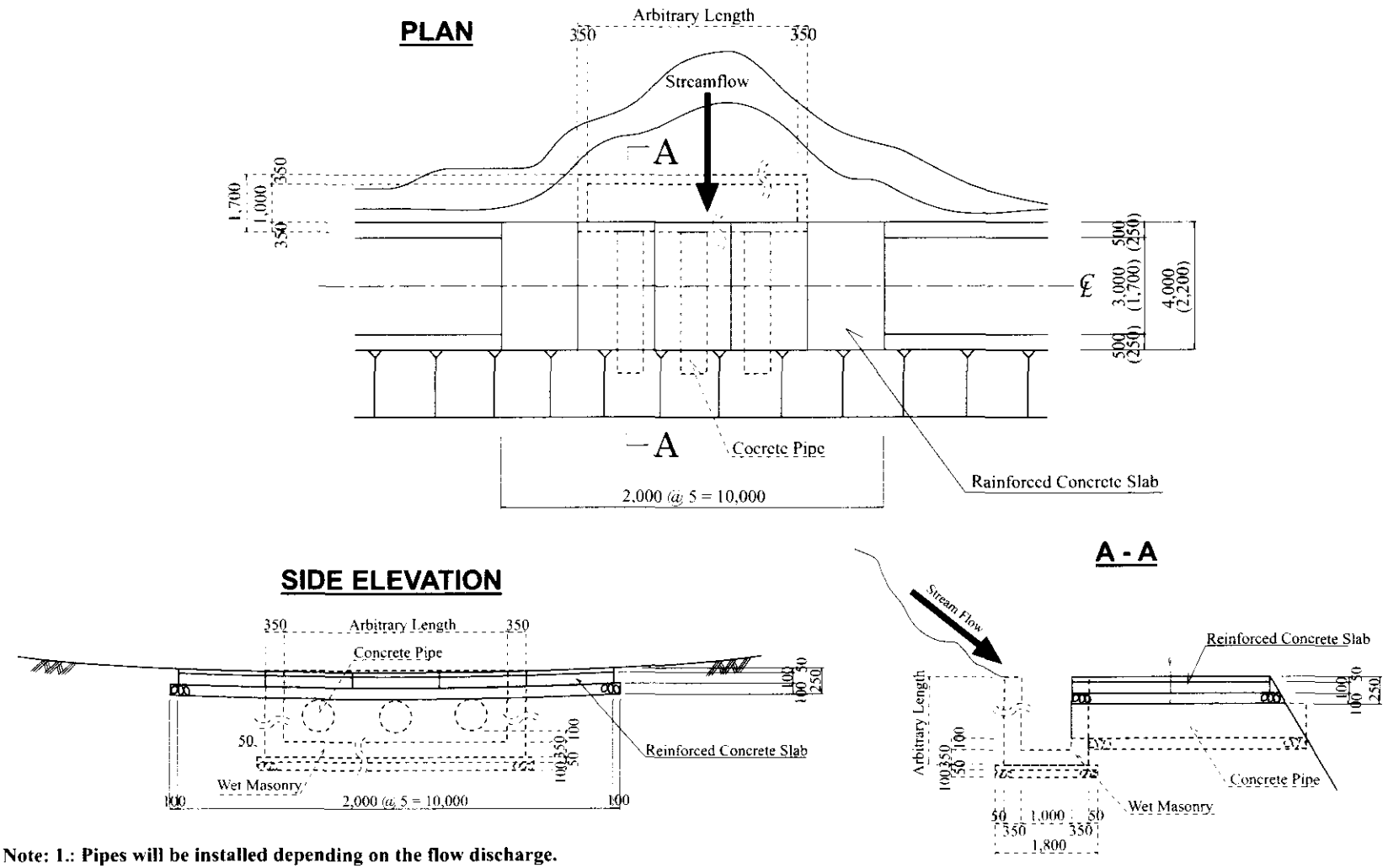
FRONT VIEW

Note : Retaining wall is not applicable in farm mule track.

SECTION A-A

The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan	**Figure V-20**
Japan International Cooperation Agency (JICA)	**Typical Retaining Wall for Farm Road**

TYPICAL CAUSEWAY



Note: 1.: Pipes will be installed depending on the flow discharge.
2.: Figure in ( ) are for farm mule track.

Japan International Cooperation Agency (JICA)

The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

Figure V-21
Typical Causeway

ANNEX-VI

CONSTRUCTION MACHINERY

ANNEX-VI

Construction Machinery

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ANNEX-VI

CONSTRUCTION MACHINERY

Chapter VI CONSTRUCTION MACHINERY AND EQUIPEMNT

VI-1.1 Construction Machinery and Equipment

Lhuntse and Mongar Dzongkhags are situated in the eastern Himalayas between Tibet to north and the Indian territories of Assam and West Bengal to the south and east, and there is a lot of hard rock and steep slopes in the Study Area.

Then, it was observed that construction machinery is indispensable for the construction of road in consideration of the environment friendly road construction method, especially in the hilly with rocky and mountainous district on the basis of the observation of the on-going road construction projects in the Study Area. Therefore, introduction of construction machinery is absolutely necessary for constructing road in terms of coping with the physical conditions and environmental aspects in the Study Area.

VI-1.1.1 Proposed Fleet Machinery including Equipment

In the Master Plan, construction machinery including equipment were decided in consideration of the following natural conditions and environmental aspects for developing farm roads in the Study Area assuming a feet machinery method as follows;

Basic Fleet Machinery and required equipment (for one fleet)

Basic fleet machinery and required equipment and their basic function are as follows;

- Bulldozer with Ripper (15 ton): Cutting, dozing, spreading leveling, compacting rock and sand etc. at the construction site
- Hydraulic Excavator with Breaker (0.6 m^3): Breaking, excavating and loading rock and sand etc. at the construction site
- Hydraulic Excavator (0.3 m^3): Excavating, loading for construction of side ditches and wall
- Dump Truck: Transportation and hauling material etc. at/behind the construction site
- Vibration Roller: Compacting material for basement
- Tamper (2 Nos.): Compacting at narrow corner of facilities and road maintenance
- Hand Breaker (4 Nos.): Crashing stone for making aggregate beneficiaries
- Jack Hammer (2 Nos.): Blasting rock at the construction point mainly
- Air Compressor: For jack hammer and hand breaker
- Wheel Loader: Dozing, loading, carrying and hauling material, etc. at/behind the construction site
- Safety Miscellaneous: Safety belt, goggle, safety cap, dust & mist respirator, gloves
- Tent (5 Nos.): For lodging operators at the construction site
- Portable Rock Drill (3 Nos.): Use for breaking rock where compressor in not reached

(2) Supporting Machinery (for the Study Area and Workshop at Bumthang)

- Cargo Truck (1 No.): Transportation for small machine and construction material
- Bulldozer (6 ton, 1No.): Spreading, leveling and compacting for road maintenance
- Fuel Tanker (1 No.): Supply of fuel to scattered construction sites
- Concrete Mixer (2 Nos.): Construction of facilities
- Total Station (1 No.): For deciding proper alignment and formation of road
- Motor Bicycle (2 Nos.): Checking sites after construction

(3) Consideration for Specification of Equipment

The following consideration for specification of equipment shall be taken up for deciding the equipment in the Master Plan.

(a) Natural Conditions to be Considered for Operation and Maintenance

The construction machinery works under the following conditions.

- Atmospheric temperature is between - (minus) 10℃ and + (plus) 35℃.
- Altitude is at maximum 4,000 m above sea level.
- Rock at the job site is hard and contains silicon.
- Fuel in Bhutan contains sulfur higher, and double fuel filters needed.
- Electricity is single phase: 220 V 50 Hz and 3-phase: 380 V 50 Hz.
- Steering wheel of the vehicle is right hand.
- The vehicle is equipped safety belt.

(b) Environment Aspect to be Considered for Operation and Maintenance

Considering environmental aspects, the following operation and maintenance for construction machinery is recommended.

- By attaching double fuel filters, the sulfide gas polluter is reduced and protects environment of the forest.
- In case of dump truck, EURO 2 standard dump truck is recommended to reduce the exhaust gas polluters.
- Considering environment aspect, it is desirable that hauling area for bulldozer and wheel loader is prepared every 50 ~ 100 m, and hauling area for dump truck is prepared every 2,000 ~ 3,000 m in order to use hauling materials at job site as far as possible.

VI-1.1.2 Tentative Machine Model and Annual Maintenance Cost

In consideration of the above, the following machinery and equipment including repairing and transportation equipment for smooth progress of the construction works and improving the function of CMU were tentatively studied and the annual maintenance cost was roughly calculated on the basis of the selected tentative machine model.

(1) Tentative Machine Model

Tentative Machine Model of Construction Machinery (Fleet: No1 ~ No.17)

Unit: 1,000 Japanese yen

No	Designation	Machine Model	Specification HP (kW)	Quantity	Estimated Price (FOB)
	Bulldozer	D65E-12	190 HP (142), Turbo, Angle-tilt		30,300

No	Designation	Machine Model	Specification HP (kW)	Quantity	Estimated Price (FOB)
1	Bulldozer	D65E-12	190 HP (142), Turbo, Angle-tilt	1	30,300
		D6RXR	175 HP (130), Turbo, Angle-tilt		
2		D37E-5	80 HP (63), Turbo, Angle-tilt	1	12,200
		D5G	90 HP (67), Turbo, Angle-tilt		
3	Hydraulic Excavator	PC200-7 JKHB1500	143 HP (107), Turbo	1	18,300
			+Breaker 1,820 kg (with chisel)	1	4,900
			+Ripper	1	1,400
		320C F22	138 HP (103), Turbo	1	
			+Breaker 1,650 kg (with chisel)	1	
			+Ripper	1	
4		PC120-6	86 HP (64), Turbo	1	12,800
		312C	90 HP (67), Turbo		
5	Dump Truck	CKB450EDN DR8	232 HP (173), 4 x 2, 8 ton (5.3 m^3)	1	7,500
		FVR32GRD (Isuzu)	227 HP (169), 4 x 2, 8 ton		
6	Vibration Roller	SV400D (Sakai)	82 HP (61), 7.2 ton	1	10,200
7	Tamper	PC60 (Sakai)	3.4 HP (2.5), 60 kg	2	170 x 2 = 340
		KP-6 (Meiwa)	3.5 HP (2.6), 60 kg		
8	Hand Breaker	(Furukawa)			
	Pick Hammer	B30-T	18.5 kg, 1.0 m^3/min	4	228 x 4 = 912
	Jack hammer	217D	20.8 kg, 2.4m^3/min, Rock drill	4	472 x 2 = 944
	Hand Breaker	(TOKU)			
	Pick Hammer	TPB-40	18 kg, 1.6 m^3/min	4	
	Jack hammer	TJ-20	18.5 kg, 2.5 m^3/min, Rock drill	2	
9	Air Compressor	PDS265S (Hokuetsu)	79 HP (59), 7.5 m^3/min, 20 A x 4	1	4,000
		DIS-275SS	84 HP(62.5), 7.8 m^3/min,20 A x 4		
10	Wheel Loader	WA120-3	85 HP (63), Turbo, 1.4 m^3	1	11,500
		910G	85 HP (63), Turbo, 1.3 m^3		
		914G	90 HP (67), Turbo, 1.3 m^3		
11	Cargo Truck with crane	CWB450PHNT ZR503	286 HP (213), Turbo, 6 x 4, Payload 15 ton, Crane: 3.2 ton	1	12,000
12	Fuel Tanker	YU41H4 (Nissan Diesel)	118 HP (88), 3,000 lit, 4 x 2	1	6,000
13	Concrete Mixer	PM-4	Diesel, 1HP (0.7), 0.12 m^3	1	1,000
14	Motor Bicycle	AG200	16 HP (12), 200 cc, Trail type	1	420
15	Safety Miscellaneous		Safety belt, Goggle, Dust & mist respirator, Leather gloves	10 set	18 x 10 = 180
16	Tent		Water proof, Size: 4 persons	5	100 x 5 = 500
17	Spare parts (No.1~No.16)		FOB (No.1~No.15) x 8 %	----	135,396 x 0.08 = 10,832

(2) Proposed Repairing and Transportation Equipment

The following equipment will be necessary to implement the Farm Road Development Plan smoothly in the equipment maintenance and equipment transportation.

Tentative Machine Model of Repairing & Transportation Equipment (No1~No.6)

Unit: 1,000 Japanese yen

No	Designation	Machine Model	Specification HP (kW)	Quantity	Estimated Price (FOB)
1	Workshop Equipment & Tools	----	Refer to attached material	1 set	30,200
2	Mobile Workshop	(Nissan Diesel) MKB210K (Nissan Diesel)	230 HP (172), 4 x 4 without Turbo 202 HP (151), 4 x 2, Turbo GVW: 10,400 kg	1	22,000

No	Designation	Machine Model	Specification HP (kW)	Quantity	Estimated Price (FOB)
3	Self Loader Truck	CWB450PH UL-150/155 (Nissan Diesel) FV515PCR (Mitsubishi)	315 HP (235), Turbo, 6 x 4, Winch: 10,000 kgf Payload: 18.74 ton 280 HP (209), Turbo, 6 x 4 Winch: Payload: 15.9 ton	1	14,500
4	Tractor & Trailer	CWB450 TLE251L-8 (Nissan Diesel)	286 HP (213), Turbo, 6 x 4 25 ton, Semi-trailer, 4 x 2 axle	1	16,500
5	Repair Workshop	----	① (6 m x 15 m) x 4 bays 1 bay with pit ② 1st floor: Tools & Parts stock 6 m x 8 m x 3.5 m ③ 2nd floor: Office room ④ Toilet: 4.5 m x 5.2 m	1	100,000
6	Spare parts (No.1~No.3)	----	FOB: (No.1~No.4) x 8%	----	83,200 x 0.08= 6,656

(3) *Estimated Annual Cost for the Equipment*

Estimated annual cost of fuel and oil, and maintenance and repair for the tentative construction machinery and repairing and transportation equipment shown above were roughly calculated based on the standard of Ministry of Land, Infrastructure and Transportation of Japan in consideration of the annual machinery working hour in Bhutan as follows;

(a) Estimated Annual Cost of Fuel and Oil

Estimation of Annual Cost of Fuel and Oil for Construction Equipment (No.1~No.12), & Repairing & Transportation Equipment (No.13~No.15)

(* Gasoline)

No	Designation	Specification (kW)	Quantity / fleet	Fuel and Oil Consumption ① =(Lit/kW-H)x(H/year)/unit	Fuel and Oil Consumption ① x (Total units)
1	Bulldozer (with ripper)	134	1	0.188 x 134 x 707 = 17,811	17,811
2	*ditto (without ripper)*	*60*	1	*0.188 x 60 x 329 = 3,711*	3,711
3	Hydraulic Excavator	104	1	0.188 x 104 x 616 = 12,044	12,044
4		63	1	0.188 x 63 x 616 = 7,296	7,296
5	Dump Truck	179	1	0.054 x 179 x 763 = 6,829	6,829
6	Vibration Roller	61	1	0.155 x 61 x 280 = 2,647	2,647
7	Tamper	2.8	2	0.310 x 2.8 x 336 = 282	*564
8	Air Compressor	59	1	0.595 x 59 x 546 = 19,167	19,167
9	Wheel Loader	63	1	0.156 x 63 x 420 = 4,128	4,128
10	Cargo Truck with crane	239	1	0.054 x 239 x 637 = 8,221	8,221
11	Fuel Tanker	93	1	0.054 x 9 3 x 532 = 2,672	2,672
12	Concrete Mixer	0.7	1	0.495 x 0.7 x 413 = 143	143
13	Mobile Workshop	155	1	0.038 x 155 x 532 = 3,133	3,133
14	Self Loader Truck	239	1	0.038 x 239 x 532 = 4,832	4,832
15	Tractor & Trailer	216	1	0.076 x 216 x 511 = 8,389	8,389
(Total) Construction Equipment (No.1~No.12)			1 fleet	Diesel oil: 84,669 lit Gasoline: 564 lit	
(Total) Repairing & Transportation Equipment (No.13~No.15)			each 1	Diesel oil: 16,354 lit	

Note: Annual operating hour = that shown in Table of the following (C) reference x 0.7

(1) Basis of Cost Estimation

1) Fuel efficiency per hour of operation (Lit/kW-H) included oils for daily maintenance and periodical maintenance is based on the standard of Ministry of Land, Infrastructure and Transportation of Japan.
2) Considering the number of annual machinery working hour, annual machinery working month is 8.5 months, because the construction machinery in Bhutan can not work in rainy season (from June to September). Therefore, annual machinery working hour in Bhutan has been set at 0.70 times of those of the standard of Ministry of Land, Infrastructure and Transportation of Japan.
3) Price of diesel oil: 17.89 Nu./lit
4) Price of gasoline: 25.10 Nu./lit
5) Price of lubricating oil (engine oil) SERVO 93.00 Nu./lit
CRB PLUS 101.00 Nu./lit
CTZ 113.00 Nu./lit
6) Electricity charge: 0.80 Nu./kWh

(2) Annual costs by Equipment

1) Construction Equipment (No.1~No.12)

- Diesel oil = 84,669 lit x 17.89= 1,514,728 Nu.
- Gasoline =564 x 25.10=14,156 Nu.

2) Repairing & Transportation Equipment (No.13~No.14):

- Diesel oil = 16,354 lit x 17.89= 292,573 Nu.

(b) Estimated Annual Maintenance and Repair Cost

Estimation of annual maintenance and repair cost for Construction Equipment (No1~No.13), & Repairing & Transportation Equipment (No.14~No.16)

Unit: 1,000 Japanese yen

No	Designation	Specification (kW)	Quantity ①	Coefficient of Maintenance & Repair per 1 unit-year ②	③ = ① x ②
1	Bulldozer	134	1	36,300 / 11.9 x 0.39 = 1,190	1,190
2		60	1	14,640 / 11.9 x 0.39 = 480	480
3	Hydraulic Excavator	104	1	29,520 / 8.5 x 0.32 = 1,111	1,111
4		63	1	15,360 / 8.5 x 0.32 = 578	578
5	Dump Truck	179	1	9,000 / 9.0 x 0.42 = 420	420
6	Vibration Roller	61	1	12,240/11.2 x 0.28 = 306	306
7	Tamper	2.8	2	204 / 5.2 x 0.35 = 14	28
8	Hand Breaker				
	Pick Hammer	---	4	274 / 5.2 x 0.28 = 15	60
	Jack Hammer		2	566 / 5.2 x 0.28 = 30	60
9	Air Compressor	59	1	4,800 / 12.2 x 0.25 = 98	98
10	Wheel Loader	63	1	13,800 / 11.3 x 0.42 = 513	513
11	Cargo Truck with crane	239	1	14,400 / 10.0 x 0.28 = 403	403
12	Fuel Tanker	93	1	7,200 / 10.0 x 0.28 = 202	202
13	Concrete Mixer	0.7	1	1,200 / 8.9 x 0.35 = 81	47
14	Mobile Workshop	155	1	26,400 / 10.0 x 0.28 = 739	739
15	Self Loader Truck	239	1	17,400 / 10.0 x 0.28 = 487	487
16	Tractor & Trailer	216	1	19,800 / 10.0 x 0.28 = 554	554
	(Total) Construction Equipment (No.1~No.13)		1 fleet	5,496	

(Total) Repairing & Transportation Equipment (No.14~No.16)	each 1	1,780	

Note: 1) Coefficient of maintenance and repair cost:
Based on the machine cost calculation formula of the Ministry of Land, Infrastructure and Transportation of Japan.
2) Considering the number of coefficient of maintenance & repair, annual machinery working month is 8.5 months, because the construction machinery in Bhutan can not work in rainy season (from June to September). Therefore, coefficient of maintenance & repair in Bhutan has been set at 0.70 times of those of the standard of Ministry of Land, Infrastructure and Transportation, of Japan..
3) Considering the number of years of operation of the existing machines, the service life of the machinery has been set at 1.2 times of those of the construction machinery's cost calculation table being applied in Japan
4) Maintenance and repair cost per unit-year:
= (Estimated cost of machinery: CIF) x (Coefficient of maintenance and repair) / Service life

(C) Reference

The following standard of Ministry of Land, Infrastructure and Transportation of Japan will be applied for the above.

Fuel Efficiency per Hour of Operation (lit/kW-H)

No	Construction equipment	Fuel efficiency per hour of operation (lit/kW-H)	Remarks
1	Bulldozer	0.188	
2	Hydraulic Excavator	0.188	
3	Dump Truck	0.054	Diesel engine
4	Vibration Roller	0.155	Mounting type
5	Tamper	0.310	
6	Air Compressor	0.595	
7	Wheel Loader	0.156	
8	Cargo Truck	0.054	
9	Fuel Tanker	0.054	
10	Concrete Mixer	0.495	
11	Mobile Workshop	0.054	
12	Self Loader Truck	0.054	
13	Tractor & Trailer	0.076	

Note: Based on the standard coefficients of the Ministry of Land, Infrastructure and Transportation, of Japan.

Estimation of Maintenance and Repair Cost

No	Construction equipment	Machine Life (Year)	Annual Operating Hours (H)	Coefficient of Maintenance & Repair (%)
1	Bulldozer (with ripper)	9.9	1,010	55
	(without ripper)		470	
2	Hydraulic Excavator	7.1	880	45
3	Dump Truck	7.5	1,090	60
4	Vibration Roller (Mounting type)	9.8	400	40
5	Tamper (60~100kg)	4.3	80days x 6H =480	50
6	Hand Breaker (Air type)	4.3	110days x 6H =660	40
7	Air Compressor	10.2	130days x 6H =780	35
8	Wheel Loader	9.4	600	60
9	Cargo Truck (with crane)	8.3	910	40
10	Fuel Tanker	8.3	760	40
11	Concrete Mixer	7.2	590	50
12	Mobile Workshop	8.3	760	40
13	Self Loader Truck	8.3	760	40
14	Tractor & Trailer	8.7	600	35

Note: Based on the standard coefficients of the Ministry of Land, Infrastructure and Transportation, of Japan.

VI-1.1.3 Maintenance System of Construction Machinery in MOA

The construction machinery possessing by MOA are usually maintained using the equipment and tools procured through the Paro Valley Agricultural Development Project (PVP) by CMU under DRDS of MOA, however it is not properly done. Because it has passed for more than 5 years after the PVP was completed and most of the construction machinery's lifetime including the equipment for maintenance like mobile workshop for the PVP were expired. In addition to this situation, the equipment and tools of CMU for maintenance have broken down and lost.

(1) Strengthening of Existing Organization of Central Machinery Unit (CMU)

Definitely the construction machinery will be sent for the operation and maintenance to the site, as the cooperative for farm road construction cannot take care of by their own activities for maintenance and repairing. For this, the construction machinery including the equipment being controlled by CMU, is to be properly maintained constantly. Consequently, it is proposed that CMU should appropriately manage the machinery and equipment as a part of the program of strengthening of the existing implementation system, relating to the maintenance and operation, of MOA.

Present Situation of Maintenance System of Central Machinery Unit (CMU)

No	Maintenance of equipment		Charge of	Place of repair	Record
1	Preventive maintenance	Daily check Repair of failure	Operator Mechanics Electrician	Job site (Mobile workshop) or Private sector workshop	Daily check sheet Machine history book
2		Periodical maintenance	Mechanics Electrician		Periodical maintenance check sheet
3	Repair and Adjustment	Repair	Mechanics Electrician Welder	Job site (Mobile workshop) or Private sector workshop	Machine history book
4		Rebuild of parts	Mechanics Electrician Welder	Private sector workshop	
5		Disassemble Assemble Adjustment	Mechanics Electrician		
6	Inventory of spare parts	Parts inventory Parts order	Stock house man	Stock house	Parts inventory card

(2) Strengthening Plan

The workshop for maintaining the construction machinery of MOA is planned to construct in Jakar, Bumthang and staffs of CMU have been shifted from Paro to Bumthang. Accordingly, as for the maintenance system, present system will be strengthened referring to the actual maintenance system of DOR, MOC, which is the most advanced system in Bhutan. The layout of proposed workshop in Bumthang and the tools for the workshop are shown in Fig.VI-1 and Table VI-1 respectively.

Maintenance System Plan of Central Machinery Unit (July 2002~June 2007)

No	Maintenance of equipment		Charge of	Place of repair	Record
1	Preventive maintenance	Daily check Repair of failure	Operator Mechanics Electrician	Job site (Mobile workshop)	Daily check sheet Machine history book
2		Periodical maintenance	Mechanics Electrician	Job site (Mobile workshop) or Workshop in Bumthang	Periodical maintenance check sheet
3	Repair	Repair	Mechanics	Job site	Machine history book

	and Adjustment		Electrician Welder	(Mobile workshop) or Workshop in Bumthang	
4		Rebuild of parts	Mechanics Electrician Welder	Workshop in Bumthang or Distributor's shop	
5		Disassemble Assemble Adjustment	Mechanics Electrician		
6	Inventory of spare parts	Parts inventory Parts order	Stock house man	Stock house	Parts inventory computer system

VI-1.1.4 Maintenance System and Workshop of DOR, MOC

The workshop of DOR located at Wangdi Phodrang is the largest in Bhutan and was studied for planning the workshop of CMU, MOA to be introduced to Bumthang. The details of maintenance system of DOR and construction machinery and its equipment and tools for maintenance equipped in the workshop are as follows;

(1) Present Situation of Maintenance System in Mechanical Division of DOR

Service system of construction equipment

No	Maintenance of equipment		Charge of	Place of repair	Record
1	Preventive maintenance	Daily check Repair of failure	Operator Mechanics Electrician	Job site	Machine history book
2		Periodical maintenance	Mechanics Electrician		
3	Repair and Adjustment	Repair	Mechanics Electrician Welder	Repair shop	
4		Rebuild of parts	Mechanics Electrician Welder		
5		Disassemble Assemble Adjustment	Mechanics Electrician		
6	Inventory of spare parts	Parts inventory Parts order	Stock house man	Stock house	Parts inventory computer system

Note: Daily check and periodical maintenance are checked by check sheet.
After checking, the check sheet is recorded by machine history book with other repair items every machine number.

(2) Supply System of Spare Parts

1) Regarding to necessary spare parts of workshop are requested to the Director of Mechanical Division
2) Director of Mechanical Division orders spare parts to the maker's agent in Singapore directly by facsimile. In case of the technical negotiation needed, director negotiates the technical matters with the persons concerned of the distributor in Phuentsholing.
3) Necessary terms after spare parts order is follows;
   - By sea via Kolkata: 2 ~ 3 months
   - By air via Bangkok 1 ~ 2 weeks (Emergency order)
4) Procedure of custom clearance is done at Kolkata Port according to quotation from the maker's agent in Singapore.

(3) Scale of Equipment

Considering from the experience of Mechanical Division, Construction equipment in Bhutan is recommended medium to small size machine.

(4) Machine population in DOR

About 300 units included 1st Phase from 1986 ~ 1987 and 2nd Phase from 1996 ~ 1997 (2nd Phase: total 47 units) have been procured from Japan through Grant Aid Assistance, most of units procured in 1st Phase are not workable condition at present.

(5) Hesothangkha Workshop at Wangdi Phodrang

The details of the workshop are as the following table.

Details of Workshop

Workshop	Kind of construction equipment	Machine population
1) Name: Regional Workshop	CAT equipment	37 (Phase 1&2)
2) Address: DOR. Hesothangkha	Komatsu Excavator	3 (2000)
3) Tel: 481348 / 481476	Dressa Dozer	2 (1982)
4) Fax: 481349	Atlas Compressor	5 (1988)
5) Public / Private sector: Public	Sakai Roller	3 (1988)
6) Number of employer: 183		
7) Number of service expert	Average experience years / Total member	
Engineer	10	12
Foreman	10	9
Mechanics of engine	8	6
Mechanics of chassis	10	20
Mechanics of machine tool	10	3
Welder	10	8
Electrician	8	5
8) Manpower of overhaul of component	Manpower x Days	Overhaul unit / year
Engine	2 x 3~5 days	10 units
Transmission	3 x 1 day	5 units
Torque converter	3 x 1 day	5 units
Final drive	3 x 2 days	5 units
Undercarriage	2 x 14 days	6 units
Fuel injection pump	1 x 0.5 day	40 units
9) Supply of spare parts	Parts availability: 60 %	
Quantity of inventory items	2,803 (Bulldozer: 58 %)	
Price of inventory parts each equipment	24,084,722 Nu	
10) Necessary days after ordering spare parts	Necessary days	Place of shipment
By sea	2 ~ 3 months	Singapore
By air (Emergency)	1 ~ 2 weeks	
11) Main repairing equipment		
Repairing equipment	Equipment condition	
Undercarriage welding equipment (for link, roller, idler, shoes)	Good condition & maintenance (6 units / year)	
Plate bending machine (Manufacture and reinforce of bucket, etc.)	Good condition & maintenance (Generally used through a year)	
Undercarriage pin & bush pulling equipment		
Rebuilt machine tool of engine ① Crankshaft grinding machine, ② Crankcase surfacing machine ③ Valve rebuilding machine, etc	Good condition & maintenance (5 ~ 6 units / year)	
General machine tool ① Lathe ② Boring machine ③ Milling machine, etc	Good condition & maintenance (Generally used through a year)	
Fuel injection pump testing stand	Good condition & maintenance (about 40 units / year)	

Note: 1) CAT equipment includes bulldozers, wheel loaders, hydraulic excavators, rollers and motor graders.
2) Other workshop facilities
① Workshop has 17 bay and overhead crane (5ton)
② Fuel station has fuel flashing equipment (supplied by UNDP)
③ Measuring tool: Torque wrench, hydraulic oil pressure measuring tool, etc.

④ Special tools: Port power, impact wrench, bearing pulling tool, etc.

3) Considering experience of the workshop, fuel in Bhutan contains sulfur so high, countermeasure to remove sulfur is needed for preventing failure of fuel injection pump.

VI-1.1.5 Distributor of Construction Equipment

Maintenance for construction equipment shall be carried out to take care of them in good condition all the time, and major repairing which even DOR and CMU cannot cope with it at their workshop and procuring genuine spare parts will be a constraint for the above. In Bhutan, construction equipment of Komatsu and CAT product are mainly utilized. Consequently a service center like the following distributors located in Phuentsholing could be applied for this situation including repairing and maintaining machinery and equipment made in India.

Study of the distributor of construction equipment
Continental Bhutan Enterprises (C.B.E)

Distributor	Name of maker	Kind of construction equipment	Machine population
1) Name: Continental Bhutan Enterprises	Komatsu	Construction machinery	Public sector: (37 units) Private sector: (29 units) Total: 66 units - Bulldozer - Vibration Roller - Wheel Loader - Hyd. Excavator - Motor Grader - Backhoe Loader - etc.
2) Address: Continental Bhutan Enterprises, Phuentsholing, Bhutan Manager: Mr. Padem Pakwal			
3) Tel: 00975-5-253569			
4) Fax:			
5) Head office: Continental Trading Enterprises PVT, LTD. Kathmandu, Nepal Tel: (977)-1-226083/222182 Fax: (977)-1-226285/247397			
6) Number of employer: 25			
7) Number of service expert		Average experience years / Total member	
Engineer		8	1
Foreman			
Mechanics of engine		10	1
Mechanics of chassis		10	1
Mechanics of machine tool			
Welder		12	1
Electrician		5	1
8) Manpower of overhaul of component		Manpower x Days	Overhaul unit / year
Engine		Overhauling facility is not yet enough. But it is possible to overhaul engine, transmission, torque converter, final drive, etc. Fuel injection pump requests to public company.	
Transmission			
Torque converter			
Final drive			
Undercarriage			
Fuel injection pump			
9) Supply of spare parts		Spare parts supply in local currency. Bhutan agricultural dept purchase parts in local currency.	
Quantity of inventory items		385 items (Mainly periodical parts)	
Price of inventory parts		US$40,000.00	
10) Necessary days after ordering spare parts		Necessary days	Place of shipment
By sea		45 ~ 60 days	Singapore
By air		4 ~ 7 days	
Note: Workshop built area: 223 m^3 (2,400 sqft), Yard: 3,252 m^3 (35,000 sqft), Office: 111 m^3 (1,200 sqft) Repairing equipment: Mobile workshop, Battery charger, Electric welder, Gas welder, Drilling machine, etc. Lathe is planning to buy for making pin of hydraulic excavator bucket.			

Study of the distributor of construction equipment
Tractor India Limited (T.I.L)

Distributor	Name of maker	Kind of construction equipment	Machine population
1) Name: Tractor India Limited (T.I.L) 2) Address: Tractor India Limited (T.I.L) Pelhkil House Phuentsholing, Bhutan Manager: Mr. 3) Tel: 975-525-2736 4) Fax:975-525-3004 5) Head office: TIL Ltd. 1, Taratolla Road, Garden Reach, Calcutta, 700024 Tel: (033) 469 3732/36 Fax: 469 2143/469 3731 6) Number of employer:.	CAT authorized dealer for - Bhutan - Nepal - Burma - India	Construction machinery	Total: 148 units - Bulldozer - Hyd. Excavator - Wheel Loader - Backhoe Loader - Front Shovel - Road Paver - Motor Grader - Vibration Roller - Dump Truck - etc.

7) Number of service expert (Calcutta: Workshop only)	Average experience years / Total member Service Ability of Calcutta is as follow;	
Engineer	10~16	6
Support engineer	15~20	9
Mechanics of engine		
Mechanics of chassis		
Mechanics of machine tool		
Welder		
Electrician		

8) Manpower of overhaul of component	Manpower x Days	Overhaul unit / year
Engine	Major overhauling is at Calcutta workshop.	6 ~ 8 units/ year
Transmission		
Torque converter		
Final drive		
Undercarriage		
Fuel injection pump		

9) Supply of spare parts	Spare parts supply in local currency	
10) Necessary days after ordering spare parts	Necessary days	Place of shipment
By sea	1 ~ 1.5 month: Singapore → Calcutta → Thimphu	
By air	1 week: Singapore → Bangkok → Paro	

Note:

Tables

Table VI-1 Proposed Workshop Equipment and Tools (1/6)

Item	Description	Q'ty
1. WORKSHOP EQUIPMENT & TOOLS		
1) PORTABLE GANTRY CRANE		
1-1	Portable Gantry Crane, 3 ton	1 unit/s
1-2	Sling Chain Set	1 set/s
1-3	Wire Rope Set	1 set/s
1-4	Shackle	1 set/s
1-5	Eye-Bolt	1 set/s
2) ELECTRIC WELDER & ACCESSORIES		
2-1	AC ARC Welder	1 unit/s
2-2	Welding Shield	1 pc./s
2-3	Secondary Cord (Earth Cord)	2 pc./s
2-4	Safety Holder	1 pc./s
2-5	Earth Clip	1 pc./s
2-6	Double-End Chipping Hammer	1 pc./s
2-7	Leather Glove	1 pc./s
2-8	Apron	1 pc./s
2-9	Screw Clamp, 150 mm	2 pc./s
2-10	Screw Clamp, 300 mm	2 pc./s
2-11	Grip Plier, opening 20 mm	2 pc./s
2-12	Grip Plier, opening 10 mm	2 pc./s
2-13	Cylinder Carrier	1 unit/s
3) GAS WELDER SET		
3	Gas Welder Set	1 set/s
4) AIR COMPRESSOR & IMPACT WRENCH		
4-1	Air Compressor, 9.5 kg/cm^2, 7.5 kW	1 unit/s
4-2	Air Hose, 6 mm x 10 m	2 pc./s
4-3	Air Hose, 9 mm x 10 m	2 pc./s
4-4	Air Hose, 12 mm x 10 m	2 pc./s
4-5	Hose Band, 13-20 mm	10 pc./s
4-6	Hose Band, 18-25 mm	10 pc./s
4-7	Hose Band, 23-35 mm	10 pc./s
4-8	Air Impact Wrench (1/2"sq.)	1 pc./s
4-9	Air Impact Wrench (3/4"sq.)	1 pc./s
4-10	Air Impact Wrench (1"sq.)	1 pc./s
4-11	Impact Socket Set (1/2" sq.), Metric	1 set/s
4-12	Impact Socket Set (1/2" sq.), Inch	1 set/s
4-13	Impact Socket Set (3/4" sq.), Metric	1 set/s
4-14	Impact Socket Set (3/4" sq.), Inch	1 set/s
4-15	Impact Socket Set (1" sq.), Metric	1 set/s
4-16	Impact Socket Set (1" sq.), Inch	1 set/s

Table VI-1 Proposed Workshop Equipment and Tools (2/6)

Item	Description	Q'ty
5) MECHANIC TOOL SET FOR CONSTRUCTION MACHINE		
5-1	Mechanic Tool Set	1 set/s
5-2	Tool Cabinet	1 unit/s
5-3	Socket Wrench Set,(1"sq.), Metric	1 set/s
5-4	Socket Wrench Set, (1"sq.), Inch	1 set/s
5-5	Open End Wrench, Single Head, 30-80 mm	2 pc./s
5-6	Adjustable Wrench,GiantType, 70-120 mm	1 pc./s
5-7	Adjustable Wrench,Giant Type, 38-76 mm	1 pc./s

6) MEASURING TOOLS		
6-1	Torque Wrench, 100-450 kgf.cm	1 pc./s
6-2	Torque Wrench, 400-1800 kgf.cm	1 pc./s
6-3	Torque Wrench, 1600-5600 kgf.cm	1 pc./s
6-4	Torque Wrench, 3000-8500 kgf.cm	1 pc./s
6-5	Surface Plate	1 pc./s
6-6	Outside Micrometer Caliper Set	1 set/s
6-7	Vernier Caliper, 300 mm	1 pc./s
6-8	Magnetic Base for Dial Indicator	1 pc./s
6-9	Dial Indicator	1 pc./s
6-10	Square, 150 x 100 mm	1 pc./s
6-11	V' Block, 51 x 24 x 32 mm	2 set/s
6-12	V' Block, 102 x 41 x 67 mm	2 set/s
6-13	Steel Compass, 200 mm	1 pc./s
6-14	Firm Joint Caliper For Inside, 0-300 mm	1 pc./s
6-15	Firm Joint Caliper For Outside, 0-300 mm	1 pc./s
6-16	Straight Rule, 1000 mm	1 pc./s
6-17	Measuring Tape, 20 m	1 pc./s
6-18	Standard Thickness, 0.03-1.00 mm	1 pc./s
6-19	Circuit Tester	1 pc./s
6-20	Blow-by Checker	1 set/s
6-21	Diesel Tacho Tester	1 pc./s
6-22	Compression Gauge for Diesel Engine	1 set/s
6-23	Cylinder Gauge (Bore Gauge), 50-100 mm	1 set/s
6-24	Cylinder Gauge (Bore Gauge), 100-160 mm	1 set/s
6-25	Hydraulic Test Gauge Set	1 set/s

Table VI-1 Proposed Workshop Equipment and Tools (3/6)

Item	Description	Q'ty
7) ENGINE SERVICE		
7-1	Engine Stand	1 unit/s
7-2	Hand Truck	2 unit/s
7-3	Mechanic Tool Set	1 unit/s
7-4	Tool Cabinet	1 unit/s
7-5	Valve Spring Pusher	1 set/s
7-6	Cylinder Liner Puller	1 pc./s
7-7	Piston Ring Tool, 92-110 mm	1 pc./s
7-8	Piston Ring Tool, 120-170 mm	1 pc./s
7-9	Air Valve Lapper & Rubber Cap Set	1 pc./s
7-10	Valve Lapping Compound, Coarse	4 pc./s
7-11	Valve Lapping Compound, Fine	4 pc./s
7-12	Nozzle Tester	1 unit/s
7-13	Nozzle Cleaning Kit	1 set/s
7-14	Part Cleaner	1 unit/s
7-15	Air Blow Gun, Bent Type	1 pc./s
7-16	Socket Wrench Set for Hengine Head Bolt	1 set/s

8) JACK AND LIFTING DEVICE		
8-1	Hydraulic Garage Jack, 15 ton	2 unit/s
8-2	Portable Hydraulic Jack, 10 ton	2 pc./s
8-3	Portable Hydraulic Jack, 50 ton	2 pc./s
8-4	Blocking Tool, 30 ton	2 pc./s
8-5	Blocking Tool, 10 ton	2 pc./s

9) WHEEL TYPE VEHICLE SERVICE TOOLS		
9-1	Service Creeper	1 unit/s
9-2	Tire Bead Remover, 1.6 m	2 pc./s
9-3	Tire Service Tool Set	1 set/s
9-4	Tire Lever, for Lock ring	2 pc./s
9-5	Tire Lever, Swan neck type	2 pc./s
9-6	Tire Lever, Bead braker	2 pc./s
9-7	Wheel Nut Wrench, 21 x 41mm	2 pc./s
9-8	Cold Patch for Tube Repair	2 set/s
9-9	Earth-Stick Set for Tubeless	5 set/s
9-10	Quick Rivetter for Brake Lining	1 set/s
9-11	Hydraulic Tire Removing Tool	1 set/s
9-12	Tire Pressure Gauge	2 pc./s
9-13	Air Chuck	2 pc./s

10) MASTER PIN REMOVER & INSTALLER FOR BULLDOZER		
10-1	Hand Hydraulic Pump	1 pc./s
10-2	100 ton cylinder	1 pc./s
10-3	Master pin service tool set	1 set/s

Table VI-1 Proposed Workshop Equipment and Tools (4/6)

Item	Description	Q'ty
11) BATTERY SERVICE		
11-1	Battery Hydrometer Set	1 set/s
11-2	Battey Quick Charger, 100A	1 unit/s
11-3	Battery Filler	1 pc./s
11-4	Battry Syringe	1 pc./s
11-5	Booster Cable, 200A	2 pc./s
11-6	Battery Charging Cable	1 pc./s
12) LUBRICATING SERVICE		
12-1	Portable Lubricator For Grease (Air), 16 kg	1 unit/s
12-2	Portable Lubricator For Oil (Air), 200 L	1 unit/s
12-3	High Pressure Grease Pump (Manual)	1 unit/s
12-4	Oil Bucket Pump, 20 L (Manual)	1 unit/s
12-5	Oil Filter Wrench	1 pc./s
12-6	Portable Fuel Can, 20 L	1 pc./s
12-7	Drum Pump, Manual	1 pc./s
12-8	Grease Gun, 300 cc	1 pc./s
13) ELECTRIC POWER TOOLS		
13-1	Disc Sander, 100 mm dia.	1 pc./s
13-2	Sanding Disc, 100 mm dia, #24	10 pc./s
13-3	Electric Drill, 13 mm	2 pc./s
13-4	Straight Shank Twist Drill Set, 1-13 mm	2 set/s
13-5	Abrasive Cut-off Machine, 305 mm	1 unit/s
13-6	Electric Cord Reel, 30 M	2 pc./s
13-7	Garage Lamp	1 pc./s
14) CLEANING EQUIPMENT		
14	Hot Water High-pressure Washer, 800 L/H	1 unit/s

Table VI-1 Proposed Workshop Equipment and Tools (5/6)

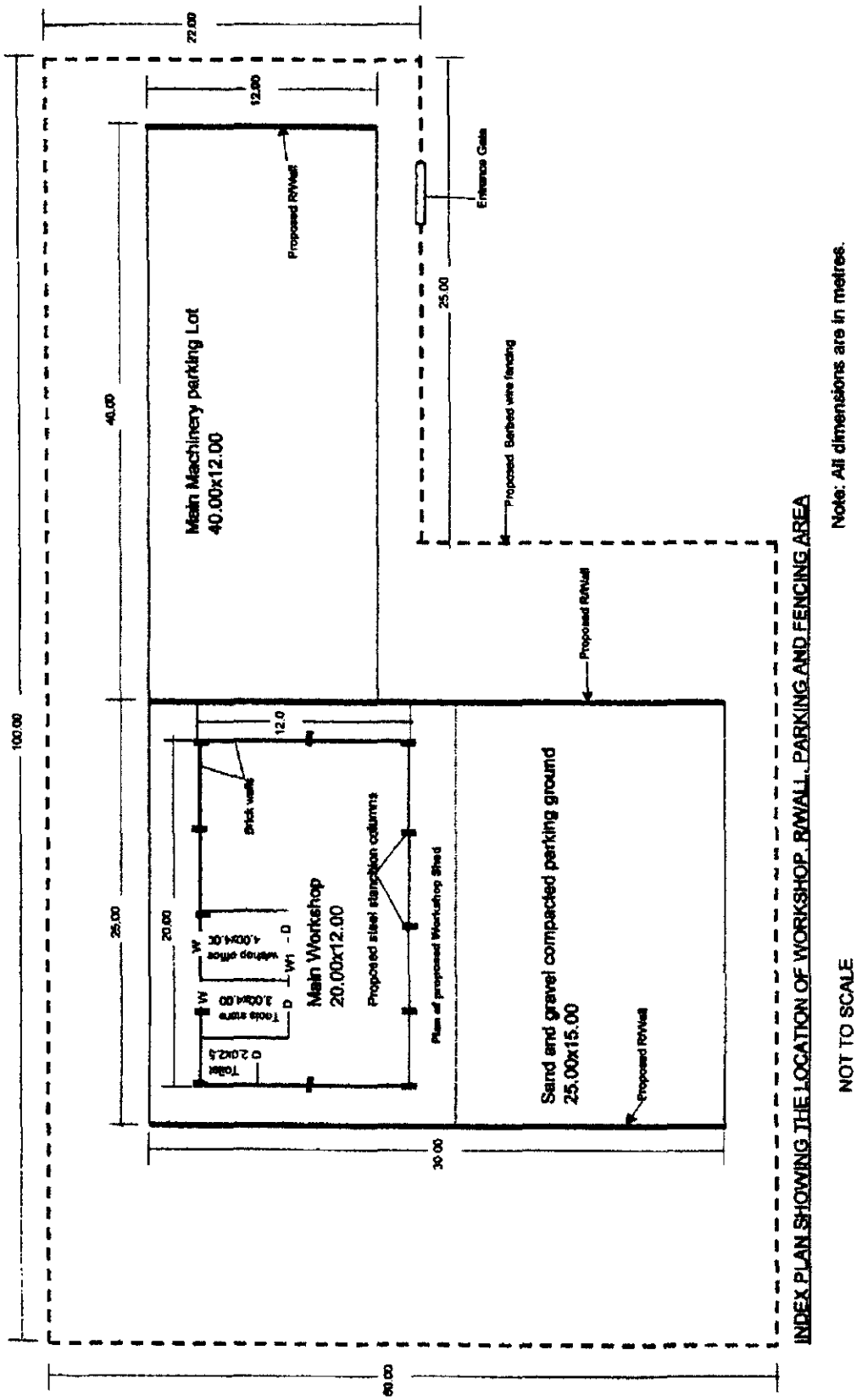
Item	Description	Q'ty
15) MISCELLANEOUS		
15-1	Hydraulic Shop Press, Manual, 55 ton	1 set/s
15-2	Hydraulic Shop Press Accessories Set	1 set/s
15-3	Spray Gun, Suction Type	1 pc./s
15-4	Suction Type Container for Spray Gun	1 pc./s
15-5	Never Seez	10 pc./s
15-6	Liquid Gasket	10 pc./s
15-7	Seal Tape,	50 pc./s
15-8	Locking Agent	10 pc./s
15-9	Cleaning Pan, 900 x 600 x 150 mm	2 pc./s
15-10	Cleaning Pan, 450 x 600 x 150 mm	10 pc./s
15-11	Cleaning Pan, 300 x 450 x 120 mm	10 pc./s
15-12	Abrasive Paper, #100, 100 sheets	1 set/s
15-13	Abrasive Paper, #120, 100 sheets	1 set/s
15-14	Abrasive Paper, #240, 100 sheets	1 set/s
15-15	Abrasive Paper, #400, 100 sheets	1 set/s
15-16	Small Lathe, Swing 460 mm, Center 1500 mm	1 units
15-17	Portable Welder, Gasoline engine, up to 3.2 mm	1 units
15-18	Bench Grinder	1 units
15-19	Work Bench, 1800 x 800 x 740 mm	2 unit/s
15-20	Engineers Vise, 125 mm	2 pc./s
15-21	Mobile Work Bench, 1200 x 800 x 740 mm	2 unit/s
15-22	Machinists Vise, 128 mm, Swibel type	2 pc./s
15-23	Bench Drill, 23 mm	1 unit/s
15-24	Drill Chuck & Handle	1 unit/s
15-25	Straight Shank Twist Drill Set, 1-13 mm	1 set/s
15-26	Taper Shank Twist Drill Set, 14-23 mm	1 set/s
15-27	Drill Press Vise	1 pc./s

Table VI-1 Proposed Workshop Equipment and Tools (6/6)

Item	Description	Q'ty
2. MOBILE WORKSHOP		
1	Mobile Workshop Chassis: Drive: 4 x 2 Engine: Diesel, about 200 PS G.V.W.: about 10.0 ton Aluminum Van Body: 5 x 2.3 x 2.0 m Equipment 1) Diesel generator/welder 10 kVA / 280 A with welding accessories 2) Oxygen - acetylene gas welding/cutting 3) Motor driven air compressor, 2.2 kW 4) Bench grinder, 205 mm 5) Hydraulic press, 10 ton 6) Portable jack, 20 ton 7) Grease lubricator 8) Oil bucket pump 9) Tire service tool set 10) Engine service equipment 11) Mechanic tool set 12) Electric hand drill, 13 mm 12) Electric disc grinder, 100 mm 13) Workbench 14) Lighting equipment 15) Jib crane, 250 kg	1 unit/s

3. SAFETY MISCELLANEOUS		
1	Safety Belt	1 unit/s
2	Goggle	1 unit/s
3	Safety Cap	1 unit/s
4	Dust mist respirator	1 unit/s
5	Leather gloves	1 unit/s

Figures



The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan	**Figure VI-1**
Japan International Cooperation Agency (JICA)	**Proposed Workshop of CMU in Bumthang**

ANNEX-VII

ENVIRONMENT

ANNEX-VII

Environment

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ANNEX-VII

ENVIRONMENT

Chapter VII-1 THREATENED, NEAR-THREATENED AND PROTECTED SPECIES

VII-1.1 Threatened, Near-threatened and Protected Species

Endangered species identified in the protected area are shown in Table VII-1 to Table VII-4, and summarized below.

Endangered Species Classified by IUCN

	Thrumshingla National Park	Bumdeling Wildlife Sanctuary	Total
Globally threatened Mammals	8	11	11
Globally threatened Birds	6	8	10
Globally threatened Insects	-	-	-
Globally threatened Plants	1	8	8
Locally Protected (FNC-95)	9	13	13

Sources: Thrumshingla National Park Conservation Management Plan 2002/03-2006/07, DOF/MOA.
Bumdeling Wildlife Sanctuary Conservation Management Plan July 2001-June 2007, DOF/MOA.
Forest and Nature Conservation Act of Bhutan, 1995, DOF/MOA.
The 2000 IUCN Red List of Threatened Species, IUCN.

Thrumshingla National Park, with an altitude range of 700 to 4,400 m, is the second major temperate park in Bhutan and protects large tracts of old-growth fir forests. Six species of globally threatened birds are found here: rofous necked hornbill (*Aceros nepalensis*), rofous-throated wren-babbler (*Spelaeomis caudatus*), Satyr tragopan (*Tragopan satyra*), beautiful nuthatch (*Sitta formosa*), Ward's trogon (*Harpactes wardii*) and chestnut-breasted partridge (*Aroborphila mandellii*). A new species for Bhutan, the wedge-billed wren-babbler (*Spenocichla humei*), was recently discovered in the park.

Bumdeling Wildlife Sanctuary, ranging from 1,400 to 6,000 m contains a rich diversity of flora and fauna as well as some of Bhutan's most scenic alpine lakes. Bumdeling Valley, located within the sanctuary is also one of Bhutan's two wintering spots for the endangered black-necked crane (*Grus nigricollis*).

Chapter VII-2 TOR FOR EA

VII-2.1 TOR for EA

The Environmental Assessment Act, 2000 (EA Act 2000) and its subsequent regulations stipulate that Environmental Assessments (EA) shall be carried out for all the activities that have potentially significant environmental impacts. The applicants are required to submit project proposal through relevant competent authorities to NEC. NEC has mandate to review project proposal submitted and decide whether the EA shall be carried out for the project or not. If the EA has to be carried out, TOR shall be prepared by applicant. The TOR must be approved by NEC. The applicants must conduct EA using the approved TOR, and submit EA report to NEC for review and issuance of Environmental Clearance.

On the other hand, NEC also could not decide whether which Programs and/or Sub-programs are required EA at this stage. Although, the procedure for project assessment shown Figure 5.8.1 (Main report) and resemble project shows that FRCP shall require EA. Draft TOR is attached in Attachment VII-1. The draft TOR was approved by NEC.

Tables

Table VII-1 Threatened, Near-threatened and Protected Species (Mammals)

Common Name *(Scientific Name)*	ThrumshingLa N.P.	Bumdeling W.S.	IUCN Classification	Locally Protected (FNC-95)	Remarks
- Asiatic wild dog (dhole) *(Cuon alpinus)*	√	√	VU C2a		
- Assamese macaque *(Macaca assmensis)*	√	√	VU A1cd		
- Capper langur *(Trachypithecus langur)*		√	EN	√	
- Goral *(Naemorhedus goral)*	√	√	CR/nt	√	
- Himalayan black bear *(Ursus thibetanus)*	√	√	VU A1cd	√	
- Himalayan musk deer *(Moschus chrysogaster)*	√	√	LR/nt	√	
- Leopard *(Panthera pardus)*	√	√		√	
- Red panda *(Ailurus fulgens)*	√	√	EN C2a	√	
- Serow *(Capricornis sumatraensis)*	√	√	VU A2cd	√	
- Snow leopard *(Unicia unicia)*		√	EN C2a	√	
- Tibetan blue sheep *(Pseudois nayaur ssp. nayaur)*		√	LR/nt		
- Tiger *(Panthera tiger)*	√	√	EN A2cd	√	

Notes: CR: Critically Endangered, EN: Endangered, VU: Vulnerable, LR: Lower Risk
FNC-95: Forest and Nature Conservation Act of Bhutan, 1995, DOF/MOA.

Source: Thrumshingla National Park Conservation Management Plan 2002/03-2006/07, DOF/MOA.
Bumdeling Wildlife Sanctuary Conservation Management Plan July 2001-June, DOF/MOA.
The 2000 IUCN Red List of Threatened Species, IUCN.

Table VII-2 Threatened, Near-threatened and Protected Species (Birds)

Common Name *(Scientific Name)*	ThrumshingLa N.P.	Bumdeling W.S.	IUCN Classification	Locally Protected (FNC-95)	Remarks
- Beautiful nuthatch *(Sitta formosa)*	√		VU C1+2a		
- Black-headed shrike babbler *(Pteruthius rufivender)*	√				
- Black-necked crane (*Grus nigricollis*)	√	√	VU C1	√	
- Blue-naped pitta *(Pitta nipalensis)*	√				
- Booted eagle *(Hieraaetus pennatus)*	√				
- Broad-billed warbler (*Tickellia hodgsoni*)	√	√			
- Brown wood owl *(Strix leptogrammica)*	√				
- Brown-throated fulvetta (*Alcippe ludlowi*)		√			
- Chestnut thrush *(Turdus rubrocanus)*	√				
- Chestnut-breasted partridge (*Arborophia mandellii*)		√	VU C1+2a		
- Dusky thrush *(Turdus naumanni)*	√				
- Ferruginous pochard (*Aythya nyroca*)		√	LR/nt		
- Himalayan monal (Monal pheasant) (*Lophophorus impejanus*)		√		√	
- Hoary-throated barwing (*Actinodura nipalesis*)	√	√			
- Palla's fish eagle (*Haliaeetus leucoryphus*)		√	VU C1		
- Raven (*Corvus corax*)		√		√	National bird
- Rufous-necked hornbill (*Aceros nipalensis*)	√	√	VU A1cd+2cd, C1	√	
- Satyr tragopan (*Satyr tragopan*)		√	NT		
- Ultramarine flycatcher *(Ficedula superciliaris)*	√				
- Ward's trogon (*Harpactus wardi*)	√	√	LR/nt		
- Wedge-billed wren babbler *(Sphenocichla humei)*	√		LR/nt		
- White-naped yuhina *(Yuhina bakeri)*	√				
- Wood snipe (*Gallinago nemoricola*)	√	√	VU C1		
- Yellow-rumped honeyguide (*Indicator xanthonotus*)		√	LR/nt		

Notes: CR: Critically Endangered, EN: Endangered, VU: Vulnerable, LR: Lower Risk
FNC-95: Forest and Nature Conservation Act of Bhutan, 1995, DOF/MOA.

Source: Thrumshingla National Park Conservation Management Plan 2002/03-2006/07, DOF/MOA.
Bumdeling Wildlife Sanctuary Conservation Management Plan July 2001-June, DOF/MOA.
The 2000 IUCN Red List of Threatened Species, IUCN.

Table VII-3 Threatened, Near-threatened and Protected Species (Insects)

Common Name *(Scientific Name)*	ThrumshingLa N.P.	Bumdeling W.S.	IUCN Classification	Locally Protected (FNC-95)	Remarks
- (Armandia cidderdalei) (Bhutanites)	√				
- Satyr (*Aulocera sawaswatti*)		√			
- Pale Hedge Blue (*Celastrina dilectus*)		√			
- Red Lacewing (*Cethosia biblis*)		√			
- Large Silverstripe (*Childrena childreni*)		√			
- (Euthalis sahadeva)		√			
- Powdery Green (*Heliophorus tamu*)		√			
- (Issoria issaea)		√			
- (lymbrenthia niphanda)		√			
- Common Forester (*Lethe insana*)		√			
- Red Tailed Forester (*Lethe sinoryx*)		√			
- (Lethe spp.)		√			
- (Limenitis dudu)		√			
- Moore's Bushbrown (*Mycalesis heri*)		√			
- Broad-banded Sailer (*Neptis sankara*)		√			
- Blue Peacock (*Papilio arcturus*)		√			
- Paris Peacock (*Papilio paris*)		√			
- (Papilio spp.)		√			
- Chestnut Tiger (*Parantica sita*)		√			
- Common Blue Apollo (*Parnassius hardwickei*)		√			
- Menetries (*Pieris melete*)		√			
- Himalayan Five-Ring (*Ypthima sakra*)		√			
- Dark blue tiger (*Tirmala septentrionis*)	√				
- Himalayan firering (*Ypthima parasakra*)	√	√			
- Indian Awlking (*Choaspes zanthopogan*)	√				
- Litac fork (*Zophoessa sura*)	√				
- Metallic cerulean (*Jamides sleeto*)	√				
- Pale wanderer (*Pareronia avafar*)	√				
- Staff sergeant (*Athyma selenophora*)	√				
- Tailed punch (*Dodona eugenes*)	√				
- Yeomah (*Cirrochora sps.*)	√				

Notes: CR: Critically Endangered, EN: Endangered, VU: Vulnerable, LR: Lower Risk
FNC-95: Forest and Nature Conservation Act of Bhutan, 1995, DOF/MOA.

Source: Thrumshingla National Park Conservation Management Plan 2002/03-2006/07, DOF/MOA.
Bumdeling Wildlife Sanctuary Conservation Management Plan July 2001-June, DOF/MOA.
The 2000 IUCN Red List of Threatened Species, IUCN.

Table VII-4 Threatened, Near-threatened and Protected Species (Plants)

Common Name *(Scientific Name)*	ThrumshingLa N.P.	Bumdeling W.S.	IUCN Classification	Locally Protected (FNC-95)	Remarks
- (Aglaia edulis)		√	LR/nt		
- (Aglaia korthalsii)		√	LR/nt		
- (Aglaia perviridis)		√	VU A1c		
- (Andrewsianthus ferrugineus)		√	BN B1+2cd		
- (Andro hemispherica)	√				
- (Androsaceae hemisphaerica Ludlow) // Primulaceae	√				
- (Androsaceae ludlowiana Handle- mazz) // Primulaceae	√				
- (Androsaceae ludlowiana)	√				
- (Bazzania bhutanica)		√	CR B1+2c		
- (Corydalis auratiaca)	√				
- Kashmir Cypress (*Cupressus cashmeriana*)		√	VU B1+2c		
- Bhutan Cypress (*Cupressus torulosa*)		√	LR/nt		National tree
- (Daphne ludlowii)	√				
- (Elatostema pusillum)	√				
- (Euphorbia griffithii Hook f) // Euphorbiaceae	√				
- (Euphorbia grifithii)	√				

Table VII-4 Threatened, Near-threatened and Protected Species (Plants)

Common Name *(Scientific Name)*	ThrumshingLa N.P.	Bumdeling W.S.	IUCN Classification	Locally Protected (FNC-95)	Remarks
- (Juncus spumosus Noltie) // Juncaceae	√				
- (Juncus spumosus)	√				
- (Kickxia papillosa)	√				
- (Kickxia papillosa) // Scrophulariaceae	√				
- (Lobelis nubigena)	√				
- (Loydia yunnanensis)				√	
- (Oreopicorhiza minima)	√				
- (Oreopicorhiza minima) // Scrophulariaceae	√				
- (Pedicularis umbricata)	√				
- (Pedicularis umbricata) // Scrophulariaceae	√				
- (Polystemma violoides Walich) // Asclepiadaceae	√				
- (Primula umbratalis Balf. & Cooperta) // Primulaceae	√				
- (Primula umbratilis)	√				
- (R. bhutanensis long & Browes lyon) // Rricaceae	√				
- (R. dalhousie var. rabdotum)	√				
- (R. kesangiae long & Rushforth) // Rricaceae	√				
- (Rhododendron bhutanense)	√				
- (Rhododendron dalhousiae var. rhabdotum)	√	√	VU B1+2c		
- (Rhododendron flickiii Davidian) // Rricaceae	√				
- (Rhododendron flinckii)	√				
- (Rhododendron kesangiae)	√				
- (Rubus sengorensis Grierson & Long) // Rosaceae	√				
- (Rubus sengorensis)	√				
- (Saxifraga harry-smithii Wadhwa) // Saxifragaceae	√				
- (Saxifraga karry-smithii)	√				
- (Saxifraga lepidostolonosa)	√				
- (Saxifraga sheriffii)	√				
- (Saxifraga sherriffii H. Smith) // Saxifragaceae	√				
- *(Saxifraga thiantha H. Smith)* // Saxifragaceae	√				
- *(Saxifraga thiantha)*	√				
- *(Sorbus insignis (Hook. f) Hedlund)* // Rosaceae	√				
- *(Sorbus insignis)*	√				
- *(Sorbus rhamnoides)*	√				
- *(Viola bhutanica)*	√				
- Agarwood *(Aquilaria malaccensis)*	√				
- Blue poppy (*Meconopsis grandis*)	√				National flower is (*Meconopsis horridula)*
- Chinese caterpillar	√				
- Ginseng (*Panax pseudo-ginseng*)	√				
- Himalayan Yew *(Taxus wallichiana)*	√				
- Yew (*Txus baccata*)	√				
- *(Scaphophyllum speciosum)*	√				
- *(Schistochila macrodonta)*	√				

Notes: CR: Critically Endangered, EN: Endangered, VU: Vulnerable, LR: Lower Risk
Source: Thrumshingla National Park Conservation Management Plan 2002/03-2006/07, DOF/MOA.
Bumdeling Wildlife Sanctuary Conservation Management Plan July 2001-June, DOF/MOA.
The 2000 IUCN Red List of Threatened Species, IUCN.

Attachment

TERMS OF REFERENCE
FOR
ENVIRONMENTAL IMPACT ASSESSMENT
FOR
THE FARM ROAD DEVELOPMENT
IN
THE LHUNTSE AND MONGAR DISTRICTS
IN
THE KINGDOM OF BHUTAN

(DRAFT)

Contents

Chapter 1 BACKGROUND

Construction of eleven (11) farm roads in Lhuntse and Mongar Dzongkhags are proposed by Ministry of Agriculture (MOA). Screening of these roads which are requested from each Dzongkhags was conducted by JICA Study Team on 2002 - 2003.

The Royal Government of Bhutan (RGoB) has given the mandate to the National Environment Commission (NEC) to review and assess the need for environmental impact assessment in relation to development projects and to scope the Environmental Impact Assessment (EIA). Bhutan's fragile mountainous environment with its rich biological diversity and its unique culture and religious background makes it imperative to carry out EIAs for any major development projects.

The main purposes of the EIA are to reveal positive and negative environmental consequences of the project to decision-makers and other interested parties, and to provide environmental background information that makes it possible to design, construct and operate the road in an environmentally sound way. The EIA takes place concurrently with technical and economic feasibility studies of the project, and in an iterative interaction with these studies in order to make it possible to incorporate environmental considerations equally and economic aspects. Thus, EIA is considered a flexible and transparent tool for ensuring environmentally sound development.

The EIA should address the proposed road project as well as potential alternatives. The alternatives could include alternative transport modes, alternative alignments and alternative designs.

The EIA should conduct to examine the balance of local needs for development plans against development impact on the ecosystem.

Chapter 2 PROJECT OBJECTIVES

The objectives of the proposed road project is to improve rural access to some of the remote villages thereby improving the socio-economic status of the rural population of Lhuntse and Mongar by providing direct and indirect benefit to the rural communities.

Chapter 3 PROJECT DESCRIPTION

The following eleven (11) farm roads construction have been screened out by JICA study team, 2002 - 2003. The results of the screening are given in the following tables. Location map of proposed farm roads are shown in Attachment-1.

Proposed Farm Road in Lhuntse Dzongkhag

Program No.	Take-off point (Village/Gewog)	Road end/Destination (Village/Gewog)	Length	Remarks
FRCP-01	Takila/Menbi	Ongar/Metsho	42.8 km	
FRCP-02	Phawan/Tsenkhar	Domkhar/Tsenkhar	10.6 km	
FRCP-03	Autsho/Tsenkhar	Tsenkhar/Tsenkhar	23.0 km	
FRCP-04	Budur/Tsenkhar	Wambur/Tsenkhar	7.3 km	
FRCP-05	Thimyul/Gangzur	Jangcholing/Gangzur	5.2 km	
FRCP-06	Lingabee/Jaray	Ney/Jaray	9.5 km	

Proposed Farm Road in Mongar Dzongkhag

Program No.	Take-off point (Village/Gewog)	Road end/Destination (Village/Gewog)	Length	Remarks
FRCP-07	Bagengla/Drametse	Narang/Drametse	20.0 km	
FRCP-08	Themnangbi/Mongar	Chali/Chali	12.0 km	
FRCP-09	Gyelposhing/Drepong	Laptsa/Drepong	23.5 km	
FRCP-10	Chaskhar/Thangrong	Thangrong/ Thangrong	12.3 km	
FRCP-11	Kalapang/Saleng	Resa/Saleng	16.8 km	

Chapter 4 PROJECT BENEFITS

The road construction will provide the necessary access for marketing of agricultural products and reduce the transportation costs of imported goods for rural people. The extension services will be enhanced as a result of improved communication. Further, it will facilitate other development activities by improved transportation system. It will encourage the people to produce more cash crops, vegetables, and even surplus food, which could be marketed outside their Gewogs. It will reduce the post harvest losses, middlemen business activities, and improve the quality of cash crops.

In brief, the overall benefit after construction of the roads will be the improvement of the rural population for education status, medical facilities, improvement of the living standard, and outlet facilities etc.

The expected beneficiaries from the each program are as follows:

Anticipated Beneficiaries

Program No.	Related Gewog	Beneficiaries		
		Total Household	Household % in total household	Population
FRCP-01	Menbi, Metsho	649	465 (71.6 %)	3,795
FRCP-02	Tsenkhar	403	202 (50.1 %)	1,494
FRCP-03	Tsenkhar	403	134 (33.3 %)	991
FRCP-04	Tsenkhar	403	67 (16.6 %)	495
FRCP-05	Gangzur	459	46 (10.0 %)	349
FRCP-06	Gangzur	459	92 (20.0 %)	699
FRCP-07	Drametse	534	481 (90.1 %)	4,232
FRCP-08	Mongar, Chali	723	323 (44.7 %)	3,551
FRCP-09	Drepong	217	206 (94.9 %)	1,627
FRCP-10	Thangrong	675	426 (63.1 %)	3,359
FRCP-11	Saleng	293	147 (50.2 %)	1,352
MTCP-01	Khoma	323	323 (100 %)	2,400
MTCP-02	Jaray	216	202 (93.5 %)	1,535
MTCP-03	Jurme, Kengkhar	644	515 (80.0 %)	4,223
MTCP-04	Gongdue, Silambi	644	147 (22.8 %)	1,352

Chapter 5 SCOPE OF WORK

This TOR has been prepared to meet the needs for an EIA and mitigation plan which are in agreement with the Environmental Assessment Guidelines for Bhutan, 1993.

The impact assessment should identify, describe and assess potentially significant adverse and beneficial environmental impacts of the road project and necessary activities imposed by the project such as extraction of construction materials, disposal of excess materials and establishment of labors' camps. The impact assessment should cover the construction period

as well as the operation period. The impacts of various alternatives should be compared and assessed against the situation of net implementing the project that is the do-nothing alternative.

The mitigation plan should identify a set of responses to potentially adverse environmental impacts, determine requirements for ensuring that those responses are made in an effective and timely manner, and describe the means of meeting those requirement should be given to roles and responsibilities of agencies charged with implementing, mitigation and monitoring, that is who is going to do the work and pay for it.

5.1 Public Consultation and Disclosure

Group potentially affected by the project shall play a role in identifying issues and ensuring that local knowledge and values are understood and taken into account. Public opinion should be taken into consideration when choosing between alternatives when deciding on the relative importance of issues, and when developing plans. However, the affected communities may need assistance to fully understand the project proposal, alternatives, potential impacts, the environmental assessment process, and articulating their concerns.

Therefore, at the start of the EIA process the EIA team should determine the most appropriate way of (i) informing the communities of the project proposal, (ii) obtaining the communities views and opinions, and (iii) disclosing the results of the EIA process, including the proposed mitigation and monitoring actions, to the communities concerned. One possible way of involving the affected groups could be through the Gewog Yargye Tshogshung (GYT) while Dzongkhag officials, Gups, chimis and tshogpas could act as facilitators. Summary information on the project and the EIA should be displayed in public at the Gewog and Dzongkhag levels. The conduct and the results of the public consultation process and the manner of disclosure shall be summarized in the EIA report.

5.2 Identification and Assessment of Impacts

Identification, description and assessment of environmental impacts should be based on observation from field investigations covering land use, topography, geology, flora and fauna in the study area that may contain environmental issues relating to the project. The field observation should be supplemented with various baseline data (maps, aerial photos, reports, scientific literature etc.), for example from the Land Use Planning Project (LUPP) under MOA. The assessment should cover both the proposed project and alternatives that have been considered, including the do-nothing alternative. It should include, but not necessarily be limited to the following aspects:

(1) Land use with particular emphasis on critical watershed areas, loss of agricultural land, replacement of settlements, and loss of ecologically valuable areas.

(2) Topography

(3) Landscape and environmental aesthetics.

(4) Geology, hydrogeology with special regard to soil erosion and landslides. Possible sites of landslides due to loose soil and landslide prone areas should be mapped. Planned earth movements should be described. Will downstream water bodies be impaired by siltation or by polluted run-off water from the road?

(5) Existing land and water rights should be included, as well as existing irrigation canals and their command areas.

(6) Ecology, flora and fauna, including a description of biotopes with relevant lists of flora and fauna. Number of trees required to be logged along with species, and, if possible,

approximate quantity in cubic meter/feet.

(7) Protected areas. Will the road project affect protected areas, nature reserves or sanctuaries?

(8) Historical and safety during construction and maintenance.

(9) Occupational health and safety during construction and maintenance.

(10) Construction camps and work sites.

(11) Socio-economy. What are the expected intentional and unintentional induced development resulting from the road? Does the road provide for reasonable service to rural residents? With respect to possible displacement of people, are provisions for property compensation and rehabilitation reasonably fair?

(12) Consequence for existing development projects, such as possible situation that may affect the existing micro-hydro plant.

(13) Resource demands.

(14) Impacts of traffic, based on an estimate of vehicle frequency.

(15) Vibration from blasting.

- Easier extraction and removal of logs for commercial purposes once road is built,
- Overgrazing by cattle without regulation on steep slope in the vicinity of road with negative impacts on slopes and drains,
- Increased soil runoff, and potential for increased incidence of fires which further augment the runoff and erosion and reduce soil moisture retention thereby increasing the seasonality of stream and river flows.

NOTE; All identified significant direct and indirect impacts should be covered by mitigation plans and actions, including monitoring measures.

5.3 Comparison of Alternatives

Based on an assessment of impacts, the environmental advantages and disadvantages of project alternatives should be compared, and alternatives should be ranked environmentally. Comparisons should relate to the do-nothing alternative, and to the greatest possible extent, the impacts should be presented in quantitative terms. Permanent effects should generally be considered more critical than temporary, and impacts that cannot easily be mitigated should similarly be considered more critical than impacts that can easily and for economical costs be mitigated.

Assessment and ranking of alternatives considering environmental advantages and disadvantages should also be applied to the alternative routes and alignments which are usually examined in the early design stages. These considerations should be documented in the EIA report.

5.4 Mitigation Plan

Based on the finding of the above evaluation, a mitigation plan should be prepared. The mitigation plan should describe in detail mitigation actions needs, estimate their costs, staffing needs, and timing for corrective measures and actions. Roles and responsibilities in relation to the actions needed should be specified in detail.

The mitigation plan should specifically include:

(1) Technical Mitigation Measures

Technical measures that are, or could be, incorporated into projected into project design and construction phase to eliminate or reduce adverse environmental impacts should be identified and described in general terms. Description and technical details should be presented for each suggested mitigation measure, including cost estimates, staffing needs, and timing for corrective measures and actions. The level of detail of the technical description should be approximately that of a preliminary design. The following aspect be specifically addressed.

- Construction technology,
- Need for blasting,
- Drainage system alongside the road,
- Types of retaining walls in major landslide areas, or any other alternatives for stabilizing slopes,
- Provision for culverts or larger drainage system for the monsoon season,
- Temporary disposal of fertile top-soil to be reserved for reclamation,
- Establish of native shrubs/trees for further prevention of landslides above and below the road,
- Land tenure, land use rights and land values,
- Raw material extraction, handling, storage and transportation,
- Disposal of excess material from construction works,
- Reclamation plan for the roadside, left quarries and disposal sites.

(2) Environment Management Plan for the Construction Phase

A draft environmental management plan for construction activities should be prepared with the purpose of incorporation of environmental terms and conditions into the road construction Tender Documents. The management plan should cover all aspects of road construction, and responsibilities should be assigned, including responsibilities for mitigation operations, emergency response procedures, supervision, financing, monitoring and reporting. Institutional capacity for implementing the plan should be reviewed and training needs assessed. Special attention should be paid to the following issues:

- Implementation of technical mitigation measured.
- Occupational health and safety issues, including labors' camps and work sites.
- Waste management, water supply, traffic, housing and services for labors.
- Possible spills or accidents resulting from use of hazardous materials such as in blasting.
- Response actions in case of accidents or under events.

(3) Operation and Maintenance Plan

A draft operation and maintenance plan-or a code of maintenance practice should be prepared. The plan/code or practice should describe maintenance procedures and assign responsibilities in relation to regular maintenance, emergency response actions, suspension, financing, monitoring and reporting. Institutional capacity for implementing the plan should be reviewed and training needs assessed.

(4) Environmental Monitoring

A monitoring program covering the construction phase as well as the operation phase of the road should be prepared, including assignment of responsibilities and an implemented schedule. The monitoring program should make sure, that the proposed mitigation plan are implemented by the agencies or companies that are in charge of road construction and road maintenance.

(5) Environmental Training

An implementation plan for environmental training of planers, designers and road workers should be prepared in accordance with finding of the training needs assessment.

(6) Estimated Costs

The costs and/or savings from the proposed mitigation plan should be estimated. (In a number of instances, the maintenance costs of not construction proper retention walls and road term prospect, such mitigation measures result in net savings).

(7) In addition to mitigation plan, a monitoring plan shall be drawn up setting out the functions, roles and responsibilities for monitoring the implementation of the mitigation action. Clear and simple monitoring reporting formats and indicators shall be prepared, reasonable monitoring frequencies set, and a budget shall be estimated for any additional costs of monitoring.

Chapter 6 REPORT FORMAT

The EIA report must be prepared in reference to the NEC sectoral guidelines, which list common environmental concerns/issues associated with various development activities. The EIA report shall ordinarily contain the following sections:

1) Title Page

The name and location of the project, the name of the proponent, the name, qualification and address of the preparer.

2) Table of Contents

The title and page number of all sections, maps, plans, tables, figures, and appendices of the environmental assessment report.

3) Terms of Reference

A copy of the Secretariat's Competent Authority's approved terms of reference for the scope of the environmental assessment and any other determination or document issued by the Secretary for the project.

4) Summary

A brief description of the project in clear, non-technical language including:

a) the name and location of the project,
b) a brief project description listing in particular any changes made to the project since the review of the previous document,
c) a list of any development permit or public financial assistance, with a summary of the current status of each application,
d) a summary of alternatives to the project,
e) a summary of potential environmental impacts of the project, and
f) a list of mitigation measures for the project.

5) Project Description

A detailed description and analysis of the nature and location of the project including:

a) the type, size, and proposed use of the project,
b) the objectives and anticipated benefits of the project,
c) a description of the physical characteristics of the project and its surroundings, illustrated with a location map and site plan at an appropriate scale and level of

detail, and

d) a timetable, approximate cost, and the methods and timing of construction of the project.

6) Alternatives to the Project

A description and analysis of alternatives to the project including:

a) all feasible alternatives, including but not limited to those indicated in the Scope,
b) the alternative of not undertaking the project (i.e., the no-build alternative) for the purpose of establishing a future baseline in relation to which the project and its alternatives can be described and analyzed and its potential environmental impacts and mitigation measures can be assessed,
c) an analysis of the feasible alternatives in light of the objectives of the proponent,
d) an analysis of the principal difference among the feasible alternatives under consideration, particularly regarding potential environmental impacts,
e) a brief discussion of any alternatives no longer under consideration including the reasons for no longer considering these alternatives, and
f) a brief description of the cleaner technology and environmental management taken into consideration while selecting the equipment and technology.

7) Existing Environment

A description and analysis of the physical, biological, chemical, economic, and social conditions of the project site, its immediate surroundings, and the region (in sufficient detail to provide a baseline in relation to which the project and its alternatives can be described any analyzed and its potential environmental impacts and mitigation measures can be assessed) including:

a) topography, geology, and soils,
b) surface and groundwater hydrology and quality,
c) air quality and noise,
d) plan and animal species and habitat,
e) traffic, transit, and pedestrian,
f) scenic qualities, open space and recreational resources,
g) culturally significant sites,
h) the built environment and human use of the project site, such as the infrastructure (i.e., water supply, wastewater treatment and/or disposal, transportation, waste management, etc.), and relevant plans (i.e., local or regional plants or infrastructure investment, economic development, growth planning and open space plans, etc.), and
i) rare or unique features (including environment and social conditions) of the project site and its immediate surroundings.

8) Assessment of Impacts

A detailed description and assessment of the negative and positive potential environmental impacts of the project and its alternatives. The environmental assessment report shall assess (in quantitative terms, to the maximum extent practicable) the direct and indirect potential environmental impacts from all aspects of the project that are within the Scope. The assessment shall include both short-term and long-term impacts for all phases of the project (e.g., acquisition, development, operation and decommissioning) and cumulative impacts of the project, any other projects, and other work or activity in the immediate surroundings and region.

9) Mitigation Measures

A description and assessment of physical, biological and chemical measures and management techniques designed to limit negative environmental impacts or to cause positive environmental impacts during development and operation of a project. The environmental assessment report shall specify in detail: the measures to be taken by the proponent to avoid, minimize, and mitigation potential environmental impacts; and the anticipated implementation schedule that shall ensure that mitigation measures shall be implemented prior to or when appropriate in relation to environmental impacts. The environmental assessment report shall also discuss alternatives to the proposed mitigation measures considered by the proponent, nothing the relative benefits and costs of these alternative mitigation measures.

10) Compliance

Compliance with relevant sectoral guidelines of best practices promulgated by the Secretariat or Competent Authorities, if any.

11) Response to Comments.

A response to each comment received on EIA report, unless the Secretariat or Competent Authority has indicated otherwise, the EIA report shall contain a copy of each comment either in this section or in a separate appendix, provided that this section clearly explains the location of each comment and the response to each comment.

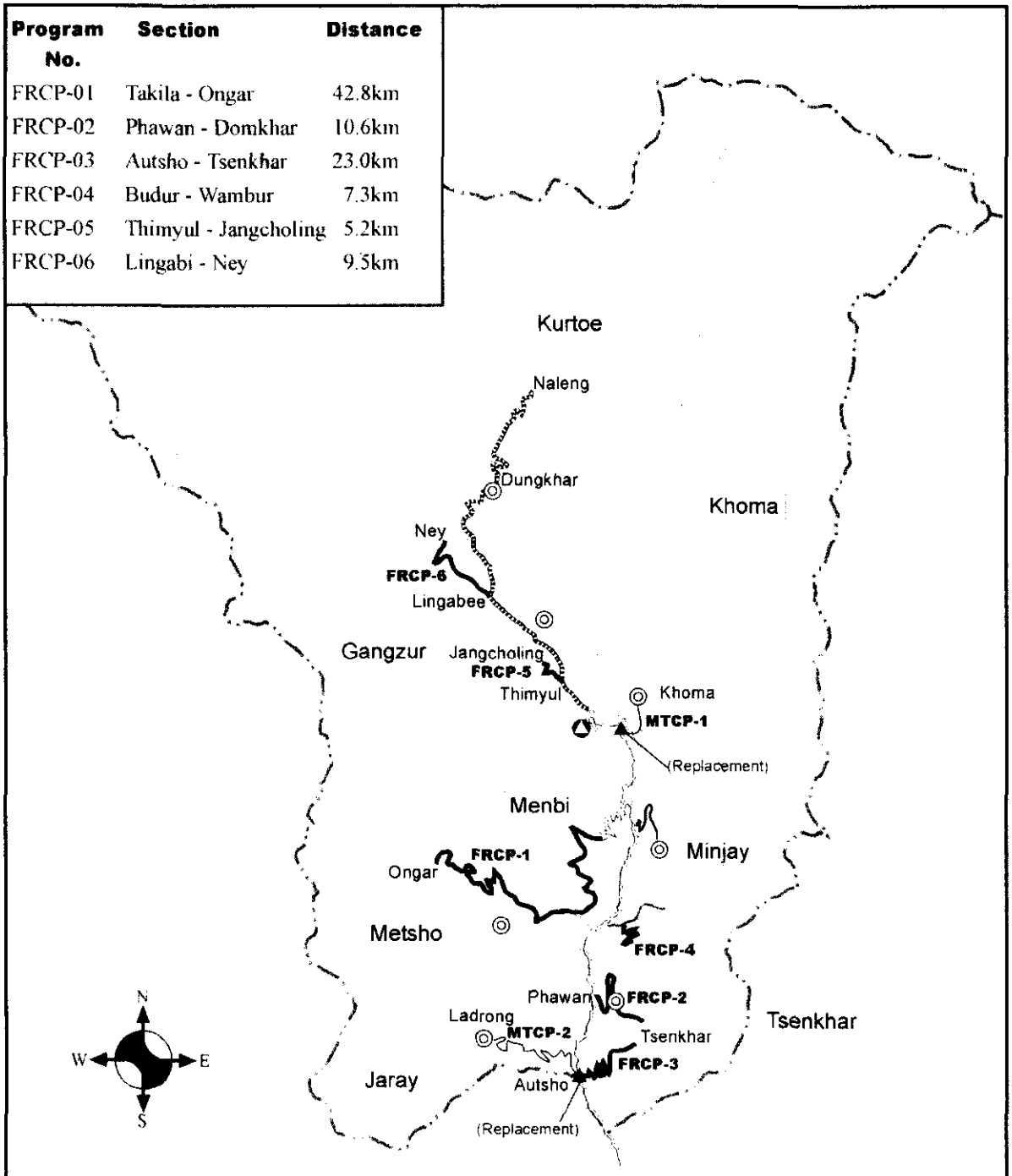
12) Appendices

A presentation of detailed technical data (e.g., traffic analysis, hydrologic calculation, modeling data), to the extent necessary to keep the main text of the EIA report clear and readable. The main texts of the EIA report shall refer to any summarize any information contained in any appendix.

Chapter 7 REPORTING AND TIMING

A draft report should be prepared and submitted to MOA two and half months from the date of award of the consultancy service/contract. Final report should be submitted not later than three weeks after receipt of comments from the NEC on the draft final report.

Program No.	Section	Distance
FRCP-01	Takila - Ongar	42.8km
FRCP-02	Phawan - Domkhar	10.6km
FRCP-03	Autsho - Tsenkhar	23.0km
FRCP-04	Budur - Wambur	7.3km
FRCP-05	Thimyul - Jangcholing	5.2km
FRCP-06	Lingabi - Ney	9.5km

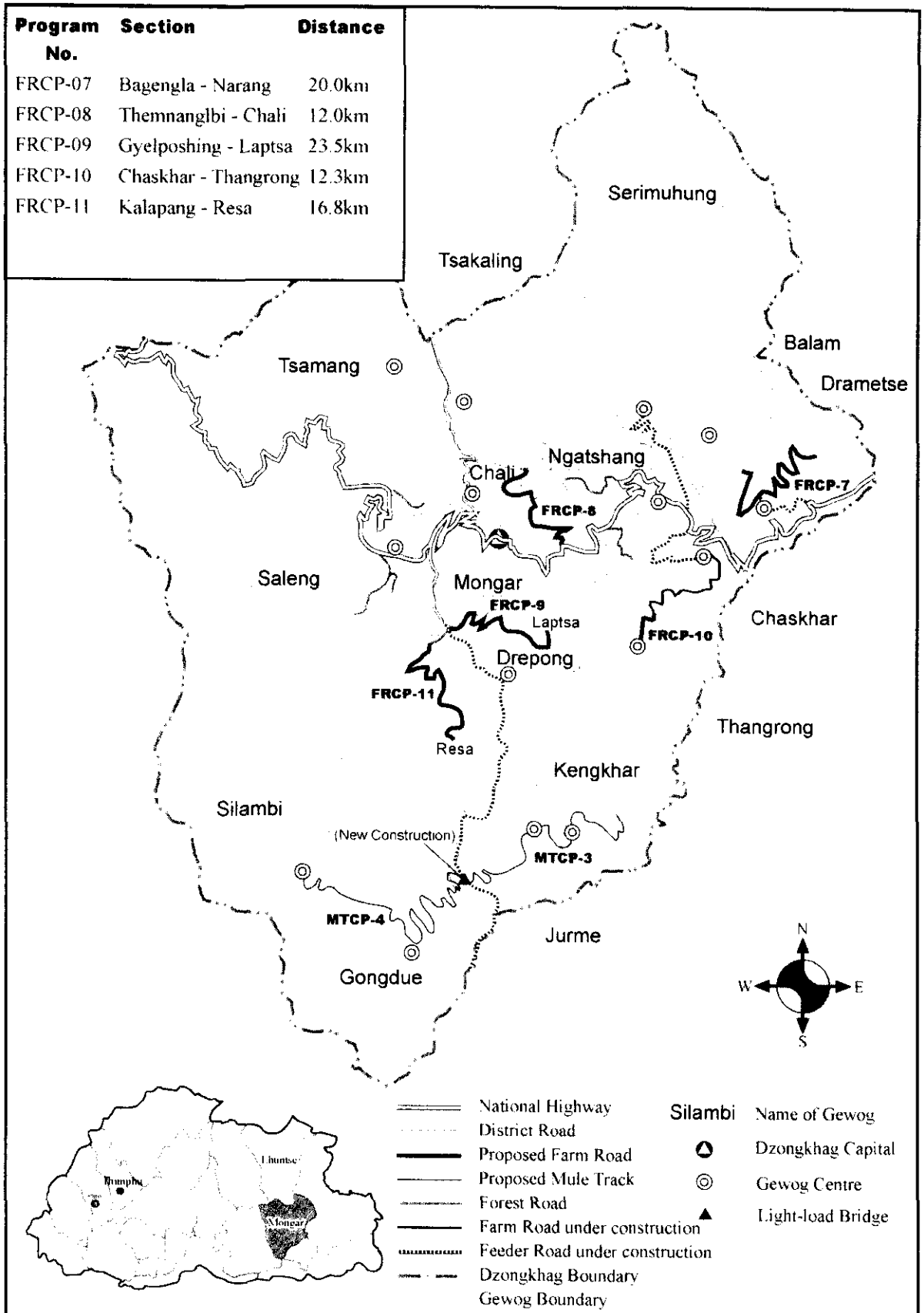


The Study on Agriculture and Farm Road Development in the Lhuntse and Mongar Districts in the Kingdom of Bhutan

Japan International Cooperation Agency (JICA)

Attachment-1 Location Map of proposed Farm Roads in Lhuntse Dzongkhag

Program No.	Section	Distance
FRCP-07	Bagengla - Narang	20.0km
FRCP-08	Themnanglbi - Chali	12.0km
FRCP-09	Gyelposhing - Laptsa	23.5km
FRCP-10	Chaskhar - Thangrong	12.3km
FRCP-11	Kalapang - Resa	16.8km



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Japan International Cooperation Agency (JICA)

Attachment-1 Location Map of Proposed Farm Roads in Mongar Dzongkhag