

CHAPTER IV

IRRIGATED MODEL FARMS

CHAPTER IV IRRIGATED MODEL FARMS

IV-1 General

JADP has been carried out jointly by HMG of Nepal and JICA since 1971. The Record of Discussions (R/D) on Japanese technical cooperation for JADP was renewed between HMG of Nepal and the Government of Japan in October, 1979, putting an emphasis on the agricultural extension of improved farming technique to small-scale farmers in Janakpur Zone and JADP has entered a new phase since then. In order to achieve the target of the said extension efficiently, "Irrigated Model Farm Scheme" under STWP has been envisaged in association with on-going IAP by JADP. The Scheme consists of four shallow tube-well model farms with a total area of 19.3 ha and a deep tube-well model farm with an area of 45.6 ha. These farms are expected to be a base of agricultural extension activities and model farms for STWP and IAP.

In response to the request of HMG of Nepal for the implementation of this Scheme, JICA dispatched the survey team in September, 1980. Subsequently, minutes on the implementation of the scheme as shown in Appendix-A were concluded between HMG of Nepal and JICA. In addition, necessary topographic survey was made for the detailed design of the Scheme together with Nepalese counterpart personnel of FIWUD and JADP.

IV-2 Location

Selection of model farm areas has been made, taking into consideration the following factors; (1) discharge of ground water, (2) demonstration effect for agricultural extension, (3) the number of landholders, (4) access and (5) drainability. Data on ground water is quoted from "the Report for Technical Guidance on the Shallow Ground Water Development and Future Activities of IAP, July in 1980" by Mr. M. Aiba.^{1/}

As a result, five model farm areas have been selected from three districts in Terai plain i.e. Sarlahi, Mahottari and Dhanusa as shown in Table -14. The areas and districts are shown in the attached location map.

^{1/}: Ministry of Agriculture, Forestry and Fisheries, Japan.

Table - 14 Irrigated Model Farms

	<u>Name of farm</u>	<u>District</u>	<u>Area (ha)</u>	<u>Tube-well</u>
1.	Iswarपुर	Sarlahi	5.6	Shallow
2.	Goshala	Mahottari	4.1	Shallow
3.	Saphy	Danusa	4.6	Shallow
4.	Sakhuwa	Dhanusa	5.0	Shallow
5.	No.5 block in IAP	Dhanusa	45.6	Deep
Total			64.9 (ha)	

IV-3 Irrigation System

IV-3-1 Cropping Pattern

Since water resources development has not been made sufficiently, rainfed cultivation has been undertaken in the Terai Plain. Major crops in the area are normal paddy, wheat and mung bean. Early paddy and maize are partly grown in the area. Under the Scheme, several cropping patterns are proposed. Principal proposed cropping pattern is normal paddy-early paddy/mung bean - wheat/maize, taking into consideration available irrigation water and present cropping pattern. Cultivations of normal paddy during rainy season and wheat/maize during dry season will be ensured by the construction of irrigation facilities and an increase of the yields will be expected. In addition, cultivation of early paddy/mung bean could be introduced under the Scheme. Present and proposed cropping patterns are shown in Figure - 6.

IV-3-2 Water Requirements

Ground water lifted by a pump from shallow tube-well or deep tube-well will be conveyed to fields through brick-lined and earthen canals. At the fields, irrigation will be made by rotation method. The design discharge is 12 ℓ /s for shallow tube-well model farm and 42 ℓ /s for deep tube-well model farm.

The water requirements for the proposed crops determined by JADP are shown in Table - 15.

Table - 15 Water Requirements

<u>Crops</u>	<u>Cultivation period (days)</u>	<u>Irrigation period(days)</u>	<u>Times of irrigation</u>	<u>Water requirements</u>
Normal paddy	120	105	-	8.64 mm/day
Early paddy	100	85	-	8.64 mm/day
Wheat	120	96	4	60 mm/time
Maize (winter)	150	125	5	60 mm/time
Maize (spring)	120	96	4	60 mm/time
Mung bean	75	50	2	60 mm/time
Tobacco	120	100	5	60 mm/time

IV-4 Shallow Tube-well Model Farm

IV-4-1 Water Source

Water source for four shallow tube-well model farms is ground water lifted from four shallow tube-wells which will be newly drilled based on Mr. M. Aiba's report. Diameter and depth of the wells are 10 inches and 40 m, respectively. Tube-well points are located in zone-2 classified by Mr. M. Aiba. A discharge of ground water is estimated at more than 10 ℓ /s and ground water surface is assumed at the depth of a few meters from the ground.

Drilling will be made by using drilling rigs to be granted by the Government of Japan. In drilling, pumping-out test will be made to verify the discharge and depth of the ground water, and design of tube-wells will be also made to install strainers.

IV-4-2 Pump House

In order to install a set of pump and engine and to store tools and fuel tank of drum can, a pump house with a floor area of 2 m x 3 m will be built around the tube-well.

The pumps for shallow tube-well model farm is horizontal shaft, centrifugal and self-priming with a diameter of 4 inches and a discharge of 1.2 m³/min. The diesel engine to be used as prime mover is a horizontal, single cylindered, water-cooled and tropicallized with the horse power of seven.

IV-4-3 Baffle Tank

In order to dissipate the energy of the flow and measure the discharge, a baffle tank will be provided beside the pump house. For the former purpose, baffle bars will be installed and for the latter purpose, the tank will be equipped with a V-notch.

IV-4-4 Irrigation Canal

Irrigation canal consists of main and branch canals. The former is rectangular brick-lined and the latter is trapezoidal earthen canal with a side slope of 1:1. Design discharge of these canals is 12 cfs and hydraulic gradient is 1/500 - 1/2,000. The velocity is 15 - 40 cm/s.

Top of the canal banks will be 30 cm and 60 cm in width and the canal bank of 60 cm will be used as farm road. The alignments of canals and roads as shown in Figure-7, 8, 9 and 10 are worked out, taking into consideration present topographic condition and road network.

The length of the canals and roads are tabled below:

Table - 16 Canals and Farm Roads

Name of model farm	Main canal (m)	Branch canal (m)	Farm road (m)
Iswārpur	135	470	135
Goshala	142	370	142
Saphy	249	550	249
Sakhuwa	198	-	570
Total	724	1,390	1,096

IV-4-5 Related Structures

Related structures such as outlet, drop, angle box and syphon structures will be provided in the main canals to convey irrigation water from the pump house to the fields. Outlet structure will be constructed so as to divert irrigation water from main canal to branch canal or from main canal to field canal. Drop structure will be

constructed so as to avoid excessive banking for the canals. At the curve point, angle box structure will be constructed to make the flow steady. A syphon structure with a length of 9.6 m will be provided at the crossing point with existing road. Precast concrete pipes with a diameter of 30 cm will be used for the syphon structure. The locations of the related structures are shown in attached Figure - 7, 8, 9 and 10.

The number of the related structures is tabled as shown below:

Table - 17 Related Structures

<u>Name of model farm</u>	<u>Outlet stru.</u>	<u>Drop stru.</u>	<u>Baffle stru.</u>	<u>Syphon stru.</u>
Iswarpur	4	1	1	-
Goshala	6	-	-	-
Saphy	6	-	2	-
Sakhuwa	8	2	-	1
Total	24	3	3	1

IV-4-6 Land Improvement

The four shallow tube-well model farms are classified into two : general type and intensive type. The former and the latter mean model farm with and without land improvement, respectively. The model farm of general type will be Iswarpur, Goshala and Saphy, and that of intensive type will be Sakhuwa area. As to the land improvement, a size of plot will be so designed as to be 50 m x 40 m equivalent to 0.2 ha on the average. A layout of the land improvement is shown in attached Figure-10.

The land improvement work consists of land levelling (5 ha) and construction of farm ridges (1490 m). Estimated earth volume is about 4,000 m³ for the land levelling and about 270 m³ for the construction of farm ridges. The land levelling will be carried out by using bulldozer, tractor shovel and tractor granted by JICA to JADP. The construction of farm ridges will be made by manual labours.

IV-5 Deep Tube-well Model Farm

IV-5-1 Water Source

The on-going IAP with a total area of 420 ha consists of 10 blocks. Among them, No. 5 block with a command area of 45.6 ha is selected as a deep tube-well model farm. Water source of No.5 block is No.5 tube-well with a depth of 130 m and a diameter of 300 mm. A general layout of IAP is shown in Figure-12.

At present, No.5 tube-well is self-flowing and the ground water is being used for an irrigation purpose. However, a discharge of the ground water is decreasing year by year. The self-flowing discharge in 1971 was 18 ℓ /s while present discharge is only 8 ℓ /s corresponding to 44 per cents. Treatment for an increase of discharge has been highly expected by farmers. Since it has been suggested by Mr. M. Aiba that use of pump could increase the discharge to 35 ℓ /s, discharge of No.5 tube-well under the scheme is estimated at 42 ℓ /s.

IV-5-2 Pump House

In order to install a set of pump and engine and to store tools and fuel tank or drum can, a pump house with a floor area of 3 m x 4.5 m will be built around the tube-well.

The pump for deep tube-well model farm is horizontal shaft and centrifugal with a diameter of 6 inches and a discharge of 2.52 m³/min. The diesel engine to be used as prime mover is a horizontal, single cylindered, water-cooled and tropicallized with the horse power of eleven. It is noted in the design of pumping equipment that self-flowing water of 8 ℓ /s can be taken even when the pump is not operated.

IV-5-3 Baffle Tank

In order to dissipate the energy of the flow and measure the discharge, a baffle tank will be provided beside the pump house. For the former purpose, baffle bars will be installed and for the latter purpose, the tank will be equipped with a V-notch. Since at present, existing walls are built around No.5 tube-well, they will be dismantled.

IV-5-4 Irrigation Canal

Under the Scheme, land improvement will not be undertaken in this area. However, since such work is expected to be undertaken, design for irrigation canals is made with due consideration of land consolidation work. The canals are straight and required water surface elevations of the canals are determined, neglecting exceptional elevated spots in the area.

Irrigation canals for deep tube-well model farm are three brick-lined main canals of No.5-1, No.5-2 and No.5-3 with a total length of 1,734 m. Main canal of No. 5 - 1 is existing one with a base width of 30 cm and a hydraulic gradient of 1/2,000. The remaining two are new canals to be constructed under the scheme. Design discharge is 42 l/s for all the canals. Existing canal of 328 m will be rehabilitated due to an increase of design discharge. The new canals with a hydraulic gradient of $\frac{1}{500} \sim \frac{1}{2,000}$ will be 1,406 m in total length and the velocity is 30 ~ 50 cm/s. An alignment of the canals is shown in Figure-11.

Either side of the canal is so designed as to be used as farm road. The lengths of these main canals and farm roads are tabled as shown below:

Table-18 Main Canals and Farm Roads

<u>Name of main canal</u>	<u>Rehabilitation (m)</u>	<u>New (m)</u>	<u>Total (m)</u>
Main canal of No.5-1	328	6	334
Main canal of No.5-2	-	700	700
Main canal of No.5-3	-	700	700
<u>Total</u>	<u>328</u>	<u>1,406</u>	<u>1,734</u>

Note: Length of farm road is equal to that of main canal.

IV-5-5 Related Structures

Related structures such as turnout, outlet, drop, and culvert structures will be provided in the main canals to convey irrigation water from the pump house to the fields. Turnout structure will be constructed so as to divert irrigation water from main canal of No.5-1 to main canals of No.5-2 and No.5-3. Outlet structure will be constructed to divert irrigation water from main canals to field canals. Drop structure will be provided so as to avoid excessive banking for the canals. No.5 block area of 45.6 ha is adjacent to Janakpur-Mahendranagar highway and both sides of the highway are natural drains. Culvert structure will be provided for crossing the drain. Locations of these structures are shown in Figure-11. The number of the related structures are tabled as shown below:

<u>Name of main canal and road</u>	<u>Turnout</u>	<u>Outlet</u>	<u>Drop</u>	<u>Culvert</u>
Main canal of No.5-1	2	-	-	-
Main canal of No.5-2	-	16	1	-
Main canal of No.5-3	-	16	2	-
Existing road	-	-	-	1
<u>Total</u>	<u>2</u>	<u>32</u>	<u>3</u>	<u>1</u>

IV-6 Construction Schedule and Cost Estimate

IV-6-1 Principal Features and Construction Schedule

Construction works of five irrigated model farms will be carried out mainly on contract basis between Resident Representative, Kathmandu Office, JICA and Nepalese contractors. Special construction works; (1) drilling of four tube-wells, (2) installation of pumping equipment, (3) levelling work of land improvement in Sakhuwa area, will be carried out on force account basis in collaboration with JADP and Nepalese authorities concerned. The principal features for the construction works of the Scheme is shown in Table-20 and construction schedule is shown in attached Table-21.

Table-20 Principal Features

Works	Shallow Tube-well				Deep
	Iswarpur	Goshala	Saphy	Sakhuwa	Tube-well No.5 block in IAP
1.* Drilling	40 m	40 m	40 m	40 m	-
2.* Installation of pumping equipment	1 set	1 set	1 set	1 set	1 set
3. Pump house	3m x 2m	3m x 2m	3m x 2m	3m x 2m	4.5m x 3m
4. Baffle tank	1 no.	1 no.	1 no.	1 no.	1 no.
5. Irrigation canals					
5.1 Main canal with farm roads	135 m	142 m	249 m	198 m (570 m) ^{1/}	1,734 m
5.2 Branch canal	470 m	370 m	550 m	-	-
6. Related structures					
6.1 Turnout	-	-	-	-	2 nos.
6.2 Outlet	4 nos.	6 nos.	6 nos.	8 nos.	32 nos.
6.3 Drop	1 no.	-	-	2 nos.	3 nos.
6.4 Angle box	1 no.	-	2 nos.	-	-
6.5 Syphon	-	-	-	1 no.	-
6.6 Culvert	-	-	-	-	1 no.
7. Land improvement					
7.1* Land levelling	-	-	-	about 4,000m ³	-
7.2 Farm ridges	-	-	-	about 270m ³	-

Notes

* : Asterisk (*) means work to be carried out on force account basis. Non-asterisk means work to be carried out on contract basis.

^{1/}: Farm road length

IV-6-2 Cost Estimates

Cost estimates for construction works of the Scheme are made on the following assumptions:

- (1) Unit prices used for the estimates are either current prices collected from Department of Public Works of Dhanusa District as of October, 1980 or calculated on the basis of the current prices.
- (2) Contract tax is 2.5 % of direct construction costs.
- (3) Land levelling costs are fuel costs for machinery and equipment.
- (4) Installation costs of pumping equipment for shallow tube-well areas are procurement costs of local-made pipes and accessories.
- (5) Installation costs of pumping equipment for deep tube-well area are procurement costs of local-made pump, engine, pipes and accessories.
- (6) Contingencies for price escalation and physical contingencies are excluded in the estimate.

The estimated costs for the construction works of the Scheme are NRS 681,140 equivalent to ¥12,507,140^{1/} as shown below:

Table - 22 Construction Costs

Works	Costs
A. Works on force account basis	
A.1 Installation of pipes and accessories for shallow tube-well model farm areas	NRS 24,140.00
A.2 Installation of pumping equipment for deep tube-well model farm area	NRS 50,890.00
A.3 Land levelling work in Sakhuwa model farm area	NRS 17,700.00
Sub-total (1)	NRS 92,730.00 <u>(= ¥1,702,715)</u>

^{1/}: US\$ 1 = NRs 11.6 = ¥213 as of November, 1980

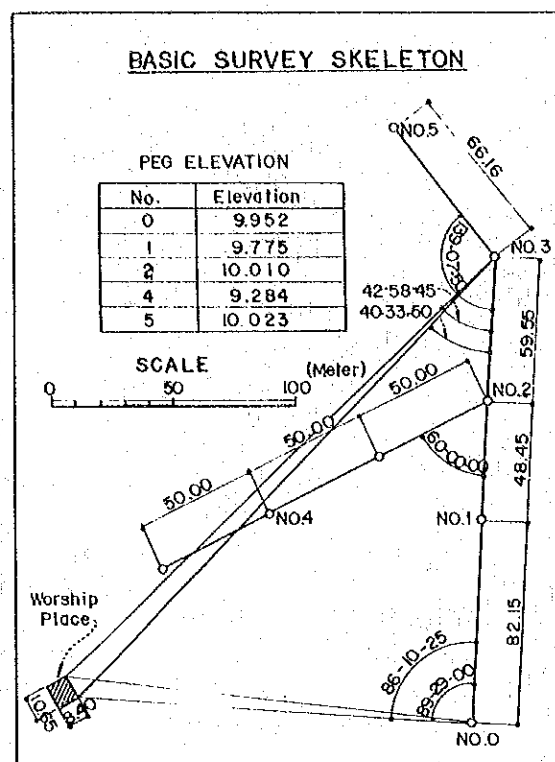
B. Works on contract basis

B-1	Iswarpur model farm	NRS 40,262.21
B-2	Goshala model farm	NRS 39,941.73
B-3	Saphy model farm	NRS 56,656.32
B-4	Sakhuwa model farm	NRS 69,283.77
B-5	No.5 block in IAP	NRS327,864.69
B-6	Temporary works	NRS 40,050.28
B-7	Contract tax	NRS 14,351.00
	Sub-total (2)	NRS588,410.00
		<u>(=¥ 10,804,425)</u>
<hr/>		
	Total	NRS681,140.00
		<u><u>(=¥ 12,507,140)</u></u>
<hr/>		

FIGURE - 6 CROPPING PATTERNS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Terdai Plain	Present	Pulses Wheat		(Fallow)				Normal paddy	Normal paddy			Pulses Wheat
	Proposed	Wheat		Maize Mung bean				Normal paddy	Normal paddy			Wheat
Iswarpur Area	Present	Wheat Pulses Maize			Early paddy			Normal paddy	Normal paddy			Wheat Pulses Maize
	Proposed	Wheat Maize		Early paddy Mung bean				Normal paddy	Normal paddy			Wheat Maize
Goshida Area	Present	Tobacco	Maize planting		Maize			Normal paddy	Normal paddy			Tobacco
	Proposed	Tobacco		Maize Mung bean				Normal paddy	Normal paddy			Tobacco
Sahy Area	Present	Pulses Wheat		(Fallow)				Normal paddy	Normal paddy			Pulses Wheat
	Proposed	Wheat		Early paddy at Maize Mung bean				Normal paddy	Normal paddy			Wheat
Sakhuwa Area	Present		(Fallow)					Normal paddy	Normal paddy			(Fallow)
	Proposed	Wheat Maize		Mung bean Mung bean				Normal paddy	Normal paddy			Wheat Maize
IAP Area	Present	Pulses Wheat Maize		(Fallow)	Early paddy			Normal paddy	Normal paddy			Pulses Wheat Maize
	Proposed	Wheat		Early paddy				Normal paddy	Normal paddy			Wheat
		A	Wheat		Mung bean Mung bean				Normal paddy	Normal paddy		
B	Wheat						Normal paddy	Normal paddy			Wheat	
C	Maize						Normal paddy	Normal paddy				Maize

Note 1. Proposed cropping rotation is A-B-A-C or A-C-A-B



I. Gross Area	5.6 ha.
II. Landholders	
(A)	Jaineel Haque
(B)	Mohammad Tauqir Mikrani
III. Principal Features of the work	
1. Canals & Farm Roads	
(a) Main Canal	135 m
MC - 1	
(b) Branch Canal	
BC - 1	120 m
BC - 2	100 m
BC - 3	110 m
BC - 4	140 m
Total (BC)	470 m
2. Related Structures	
(a) Pump house	1 No.
(b) Baffle tank	1 No.
(c) Outlet Structure	4 Nos.
(d) Angle Box Structure	1 No.
(e) Drop Structure	1 No.

LEGEND

Item	Abbreviation	Mark
Bench Mark	BM	□
Beginning Point	BP	-
Ending Point	EP	-
Main Canal	MC	—
Branch Canal	BC	—
Farm Channel to be constructed by farmers	-	—
Farm Road	FR	—
Drop Structure	DR	—
Outlet Structure	OL	—
Angle Box Structure	AB	—

NOTES

- Elevation of BM-2 is arbitrarily employed as 10.000 meters.
- The metric system is applied in both length and elevation.
- Topographic map was prepared in September, 1980 by JICA.

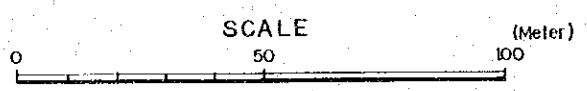
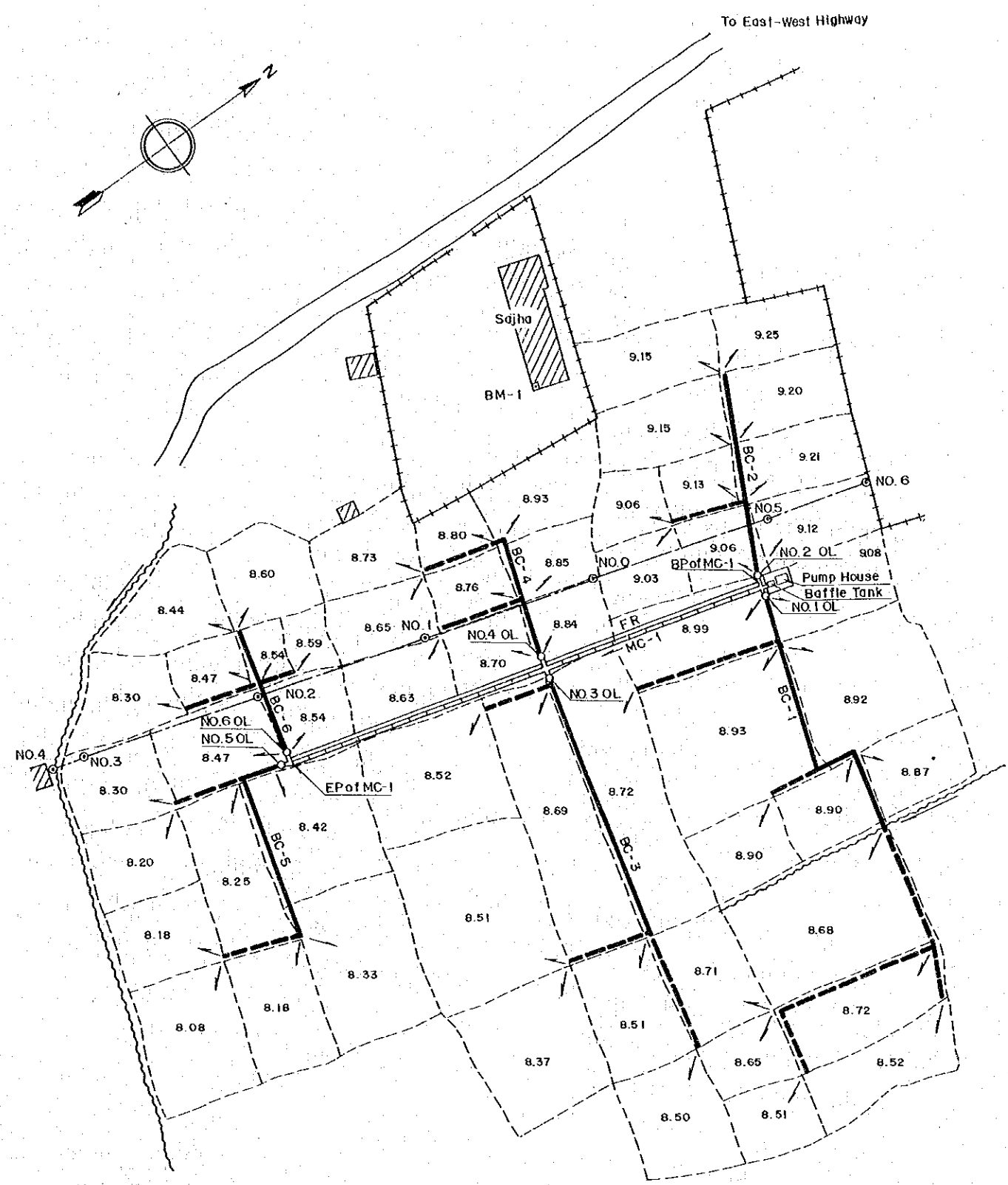
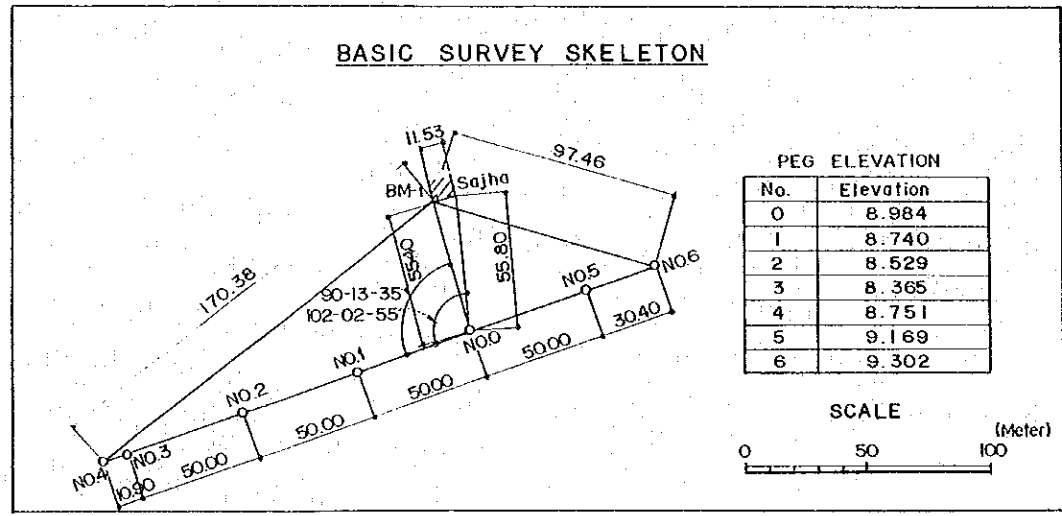


FIGURE - 7
GENERAL LAYOUT OF ISWARPUR AREA



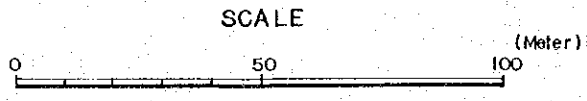
I. Gross Area	4.1 ha
II. Landholder	Mukund Prasad
III. Principal Features of the Work	
1. Canals & Farm Roads	
(a) Main Canal	MC - 1 142 m
(b) Branch Canals	BC - 1 90 m
	BC - 2 60 m
	BC - 3 80 m
	BC - 4 40 m
	BC - 5 60 m
	BC - 6 40 m
	Total (BC) 370 m
2. Related Structures	
(a) Pump house	1 No.
(b) Baffle tank	1 No.
(c) Outlet structure	6 Nos.

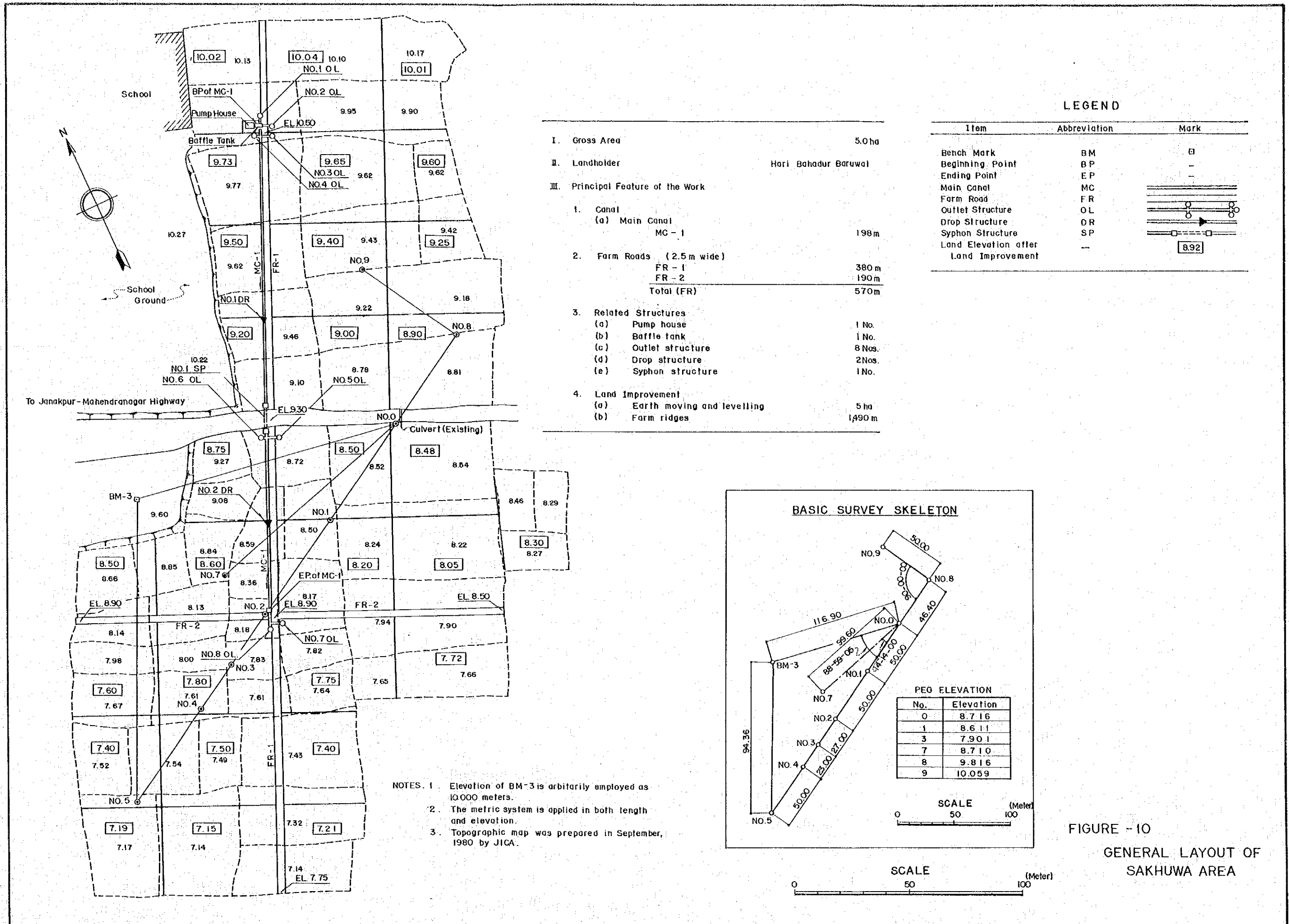
LEGEND		
Item	Abbreviation	Mark
Bench Mark	BM	□
Beginning Point	BP	—
Ending Point	EP	—
Main Canal	MC	———
Branch Canal	BC	———
Farm Channel to be constructed by farmers	—	———
Farm Road	FR	———
Outlet Structure	OL	⊕



NOTES: 1. Elevation of BM-1 is arbitrarily employed as 10.000 meters.
 2. The metric system is applied in both length and elevation.
 3. Topographic map was prepared in September, 1980 by JICA.

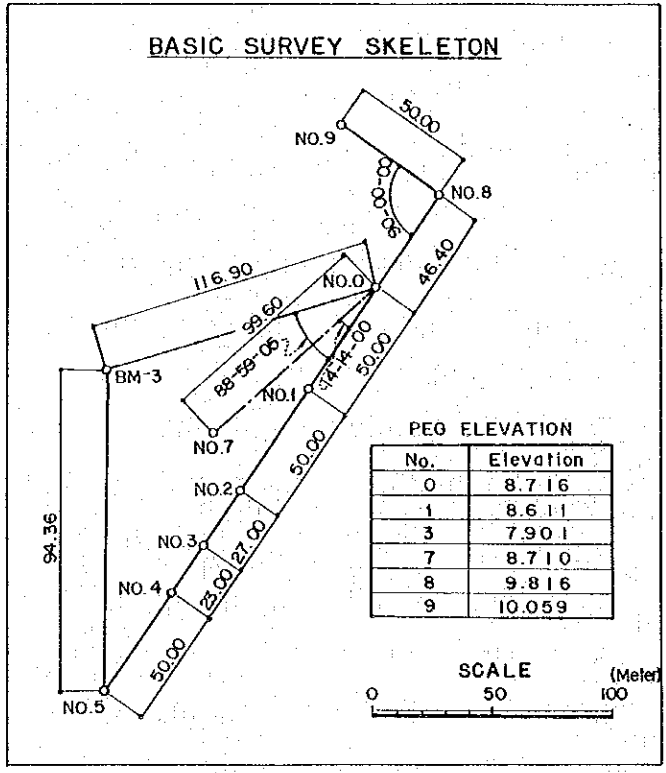
FIGURE - 8
 GENERAL LAYOUT OF GOSHALA AREA





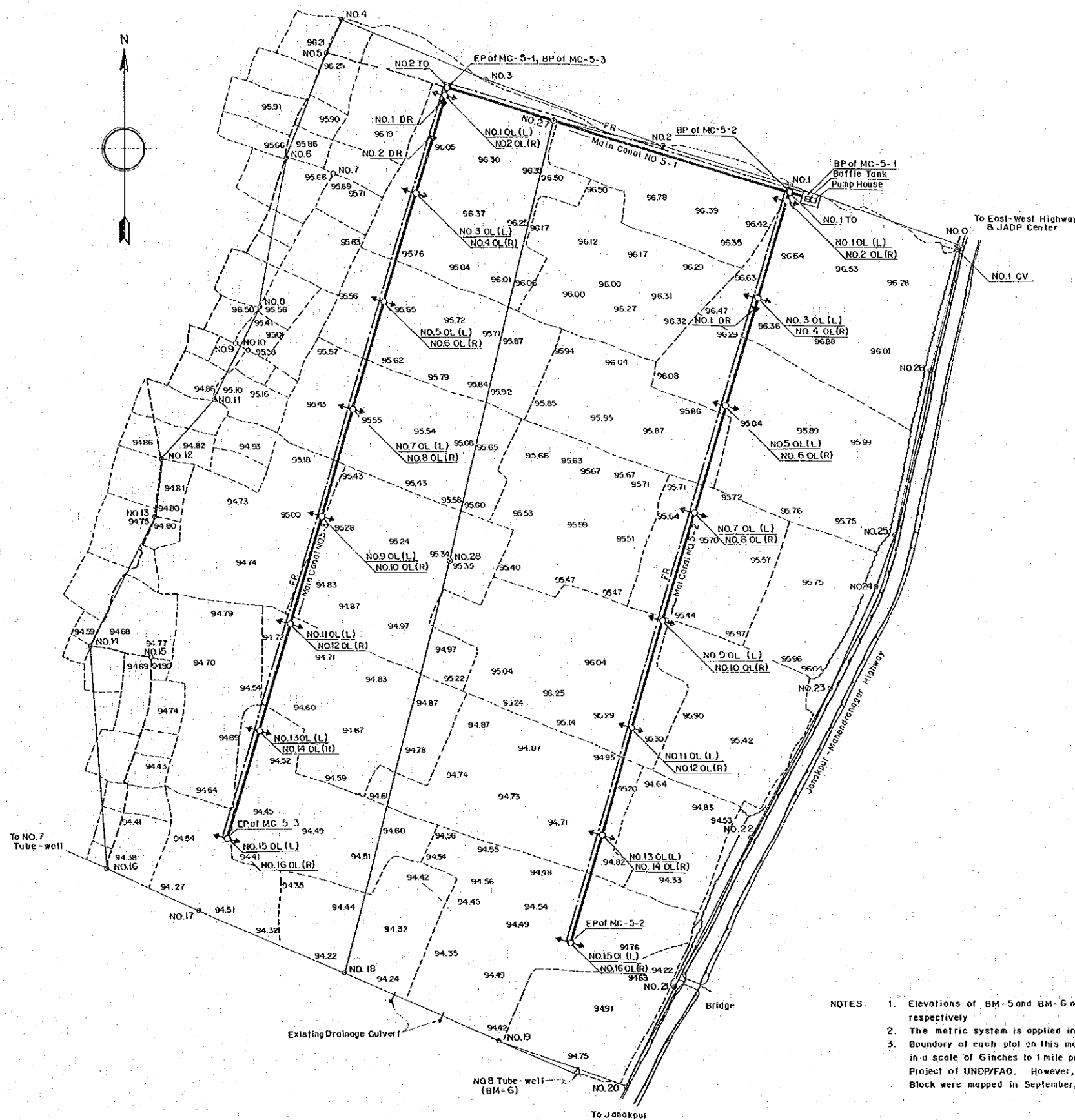
I. Gross Area	5.0 ha
II. Landholder	Hari Bahadur Baruwai
III. Principal Feature of the Work	
1. Canal	
(a) Main Canal	
MC - 1	198 m
2. Farm Roads (2.5 m wide)	
FR - 1	380 m
FR - 2	190 m
Total (FR)	570 m
3. Related Structures	
(a) Pump house	1 No.
(b) Baffle tank	1 No.
(c) Outlet structure	8 Nos.
(d) Drop structure	2 Nos.
(e) Syphon structure	1 No.
4. Land Improvement	
(a) Earth moving and levelling	5 ha
(b) Farm ridges	1490 m

Item	Abbreviation	Mark
Bench Mark	BM	□
Beginning Point	BP	-
Ending Point	EP	-
Main Canal	MC	=====
Farm Road	FR	-----
Outlet Structure	OL	○
Drop Structure	DR	○
Syphon Structure	SP	○
Land Elevation after Land Improvement	-	□



NOTES. 1. Elevation of BM-3 is arbitrarily employed as 10.000 meters.
 2. The metric system is applied in both length and elevation.
 3. Topographic map was prepared in September, 1980 by JICA.

FIGURE - 10
 GENERAL LAYOUT OF
 SAKHUWA AREA



I. Gross Area	45.6 ha.
II. Principal Features of the Work	
1. Canals & Farm Roads	
(a) Main Canal	
MC-5-1	
to be newly constructed	6m
to be rehabilitated	328m
Sub-total (MC-5-1)	334m
MC-5-2	700m
MC-5-3	700m
Total (MC)	1,734m
2. Related Structures	
(a) Pump house	1 No.
(b) Baffle tank	1 No.
(c) Turnout structure	2 Nos.
(d) Outlet structure	32 Nos.
(e) Drop structure	3 Nos.
(f) Culvert structure	1 No.

LEGEND

Item	Abbreviation	Mark
Bench Mark	BM	□
Beginning Point	BP	-
Ending Point	EP	-
Main Canal	MC	———
Farm Road	FR	———
Turnout Structure	TO	———
Drop Structure	DR	———
Outlet Structure on the Right Bank of MC	OL (R)	———
Outlet Structure on the Left Bank of MC	OL (L)	———
Culvert Structure	CV	———

PEG ELEVATION

No.	Elevation	No.	Elevation	No.	Elevation
0	96.961	10	95.962	20	94.945
1	97.199	11	95.731	21	94.594
2	97.389	12	95.526	22	94.680
3	97.670	13	95.492	23	95.915
4	97.388	14	95.612	24	95.506
5	96.532	15	95.707	25	95.767
6	96.359	16	94.492	26	96.189
7	96.235	17	94.886	27	96.916
8	96.031	18	94.910	28	95.674
9	96.016	19	95.042		

NOTES. 1. Elevations of BM-5 and BM-6 are 97.734 and 96.005 meters (Mean Sea Level), respectively.
 2. The metric system is applied in both length and elevation.
 3. Boundary of each plot on this map is drawn by an enlargement of the topographic map in a scale of 6 inches to 1 mile prepared in December, 1968 under Sunkosi Terai Project of UNDP/FAO. However, plot located around western boundary of No. 5 Block were mapped in September, 1980.

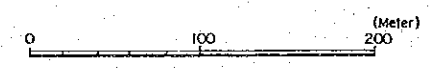
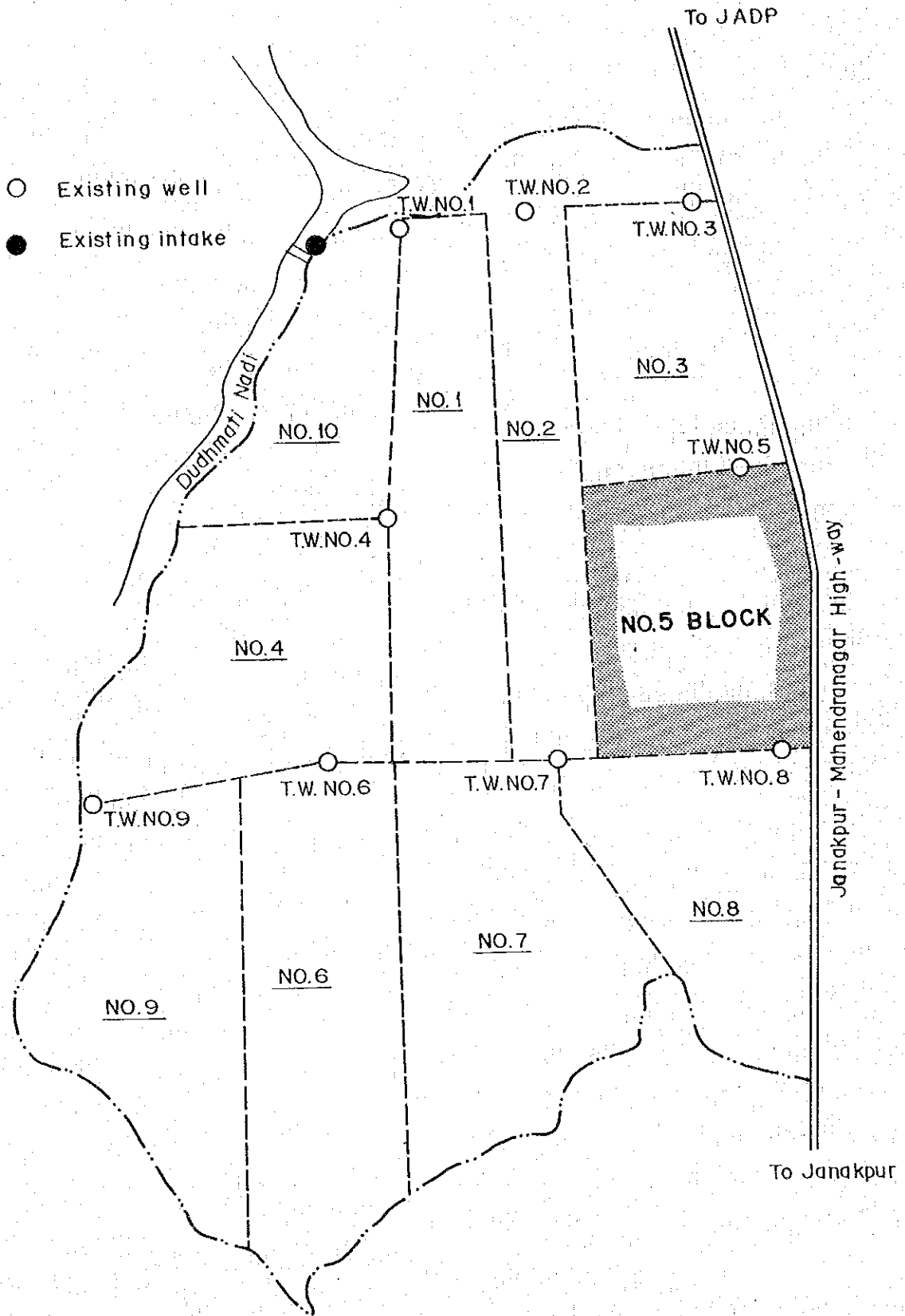


FIGURE - 11
GENERAL LAYOUT OF
NO. 5 BLOCK IN IAP

Figure-12 General Layout of IAP Area



APPENDIX

The Minutes between the Japanese Detailed Design Team and the Authorities Concerned of His Majesty's Government of Nepal for Model Infrastructure Programme

The Japan International Cooperation Agency (JICA) has intended to introduce the Model Infrastructure Programme to the Janakpur Zone Agricultural Development Project. The Programme will be financed by JICA's FY1980 budget. From Sept. 12 to 21, the JICA dispatched the Detailed Design Team, headed by Mr. Akira Mori, to Nepal for the preparation for the execution of the programme.

The following points were agreed upon between the Team and the Authorities concerned of His Majesty's Government of Nepal.

I. The Points agreed upon between the Team and the Authorities concerned of HMG of Nepal.

1. Places and Types to be implemented:

Outside IAP Area

General Type: 3 places, approximately 5 ha. each
Intensive Type: 1 place, approximately 5 ha.

IAP Area

General Type: 1 place, Block No.5 of approximately 46 ha.

2. Classification of Types

- 1) The General Type includes the installation of shallow tube-wells and the construction of irrigation facilities to enhance the potentiality of land improvement in future.
- 2) The Intensive Type includes the installation of shallow tube-wells, construction of irrigation facilities, and land improvement.

3) As for the IAP Area, the above-mentioned General Type will be applied, in addition to the installation of pumping station, to prepare for the land improvement in future.

Kathmandu, Nepal

September 19, 1980

Akira Mori
Leader,
Detailed Design Team,
Japan International Cooperation
Agency

Dr. Thakur N. Pant
Joint Secretary
Ministry of Food & Agriculture

ANNEX

The following opinions were given through the discussions between the Team and the Authorities concerned of HMG of Nepal.

1. The Nepal side hoped that the pumps would be installed in the other eight blocks of IAP Area. The Team suggested that Nepal seek for other sources of JADP for installing pumps.
2. The Resident Representative of JICA to Nepal would be in charge of the implementation of the Model Infrastructure Programme under the JICA's budget. Since the cooperation of the Nepal side is indispensable for smooth implementation, the Nepal side assured its full cooperation to the Programme.
3. The Nepal side strongly requested the assistance with the training programme of middle level technicians. To this request, the Team made clear that the JICA Headquarter took into consideration the request of the Nepal side and the opinions of the Japanese experts.

Financial Analysis with Shallow Tube-well and Pumpset No.0

ADBN's case

Acreage: 5 ha.

Year	(A) Investment cost	(B) O & M cost	(C) Incremental production cost	(D=A+B+C) Net incremental cost	(E) Annuity factor at 11%	(DxE) Present value	(F) Gross incremental benefit	(FxD) Present value
0	16,296	0	0	16,296	1.0000	16,296	0	0
1	0	8,289	10,799	19,088	0.9009	17,196	19,903	17,931
2	0	8,289	14,398	22,687	0.8116	18,413	26,537	21,537
3	700	8,289	17,997	26,986	0.7312	19,732	33,171	24,255
4	0	8,289	17,997	26,286	0.6587	17,315	33,171	21,850
5	0	8,289	17,997	26,286	0.5935	15,601	33,171	19,687
6	700	8,289	17,997	26,986	0.5346	14,427	33,171	17,733
7	0	8,289	17,997	26,286	0.4817	12,662	33,171	15,978
Total						131,642		138,971

$$B/C \text{ Ratio} = \frac{\sum (F \times E)}{\sum (D \times E)} = 1.056$$

Financial Analysis with Shallow Tube-well and Pumpset No.1

Standard type in Terai, Janakpur

Acreage: 5.0 ha

Year	(A) Investment cost	(B) O & M cost	(C) Incremental production cost	(D=A+B+C) Net incremental cost	(E) Annuity factor at 11%	(DxE) Present value	(F) Gross incremental benefit	(Fx D) Present value
0	16,000	-	-	16,000	1.0000	16,000	-	-
1	0	15,314	15,543	30,857	0.9009	27,799	42,960	38,703
2	0	15,314	15,543	30,857	0.8116	25,044	42,960	34,866
3	1,300	15,314	15,543	32,157	0.7312	23,513	42,960	31,412
4	0	15,314	15,543	30,857	0.6587	20,326	42,960	28,298
5	0	15,314	15,543	30,857	0.5935	18,314	42,960	25,497
6	1,300	15,314	15,543	32,157	0.5346	17,191	42,960	22,966
7	0	15,314	15,543	30,857	0.4817	14,864	42,960	20,694
Total						163,051		202,436

$$B/C \text{ Ratio} = \frac{\sum (F \times E)}{\sum (D \times E)} = 1.242$$

Financial Analysis with Shallow Tube-well and Pumpset No.2

Farmer's name: Jainur Mukeri Panchayat: Iswarpur
 Acreage: 7.4 ha District: Sarlahi

Year	(A) Investment cost	(B) O & M cost	(C) Incremental production cost	(D=A+B+C) Net incremental cost	(E) Annuity factor at 11%	(DxE) Present value	(F) Gross incremental benefit	(FxD) Present value
0	16,000	-	-	16,000	1.0000	16,000	-	-
1	0	28,782	15,399	44,181	0.9009	39,803	52,010	46,856
2	0	28,782	15,399	44,181	0.8116	35,857	52,010	42,211
3	1,300	28,782	15,399	45,481	0.7312	33,256	52,010	38,030
4	0	28,782	15,399	44,181	0.6587	29,102	52,010	34,259
5	0	28,782	15,399	44,181	0.5935	26,221	52,010	30,868
6	1,300	28,782	15,399	45,481	0.5346	24,314	52,010	27,805
7	0	28,782	15,399	44,181	0.4817	21,282	52,010	25,053
Total						225,835		245,082

$$B/C \text{ Ratio} = \sum (F \times E) / \sum (D \times E) = 1.085$$

Financial Analysis with Shallow Tube-well and Pumpset No.3

Farmer's name: H. B. Baliwar Panchayat: Sakhuwa
 Acreage: 4.7 ha District: Danusha

Year	(A) Investment cost	(B) O & M cost	(C) Incremental production cost	(D=A+B+C) Net incremental cost	(E) Annuity factor at 11%	(DxE) Present value	(F) Gross incremental benefit	(Fx D) Present value
0	16,000	-	-	16,000	1.0000	16,000	-	-
1	0	13,430	12,010	25,440	0.9009	22,919	34,540	31,117
2	0	13,430	12,010	25,440	0.8116	20,647	34,540	28,033
3	1,300	13,430	12,010	26,740	0.7312	19,552	34,540	25,256
4	0	13,430	12,010	25,440	0.6587	16,757	34,540	22,751
5	0	13,430	12,010	25,440	0.5935	15,099	34,540	20,499
6	1,300	13,430	12,010	26,740	0.5346	14,295	34,540	18,465
7	0	13,430	12,010	25,440	0.4817	12,254	34,540	16,638
Total						137,524		162,759

$$B/C \text{ Ratio} = \frac{\sum (F \times E)}{\sum (D \times E)} = 1.183$$

Economics of Irrigated Farms with Shallow Tube-wells and Pumps

(Unit: NRS)

Item	Case Study on Model Farm			
	Case Study No.0* (5.0 ha)	No.1** (5.0 ha)	No.2*** (7.4 ha)	No.3**** (4.7 ha)
<u>1. Fixed investment</u>				
i. Shallow Tube-well	9,596	3,000	3,000	3,000
ii. Pumpsets	7,000	13,000	13,000	13,000
iii. Spareparts for pump-set at 10% of the cost of pumpset	700	1,300	1,300	1,300
<u>Total</u>	<u>17,296</u>	<u>17,300</u>	<u>17,300</u>	<u>17,300</u>
<u>2. Operational expenditure</u>				
<u>A. Annual equivalent cost</u>				
Item	Life in years	Factor at 11% interest		
i. Shallow tube-well	10	5.889	1,630	509
ii. Pumpset	7	4.712	1,486	2,760
iii. Spareparts	3	2.443	287	532
<u>Sub-total</u>			<u>3,403</u>	<u>3,801</u>
<u>B. Maintenance cost</u>				
Item	% of the total cost			
i. Shallow tube-well	2	192	60	60
ii. Pumpset	7.5	525	975	975
<u>Sub-total</u>		<u>717</u>	<u>1,035</u>	<u>1,035</u>
<u>C. Management cost</u>				
i. Fuel, oil 1.1kg/hr. (1.5kg/hr.) ^{1/} for 1,000 hrs.		1,000 hrs.	2,017 hrs.	3,797 hrs.
		5,060	13,917	26,199
ii. Lubricants at 20% (10%) ^{2/} of item i.		1,012	1,392	2,620
iii. Labour @NRS.1.5/hr.		1,500	3,025	5,695
<u>Sub-total</u>		<u>7,572</u>	<u>18,334</u>	<u>34,514</u>
				<u>16,080</u>

Item	Case Study	Case Study on Model Farm		
	No.0* (5.0 ha)	No.1** (5.0 ha)	No.2*** (7.4 ha)	No.3**** (4.7 ha)
D. <u>Total</u> (A + B + C)	<u>11,692</u>	<u>23,170</u>	<u>39,350</u>	<u>20,916</u>
E. Cost of irrigation per hr.	11.70	11.48	10.05	11.82
F. Benefit cost ratio				
i. Annual operating cost	11,692	23,170	39,350	20,916
ii. Production cost per year	31,711	21,742	31,547	16,344
iii. Total cost/year	43,403	44,912	70,897	37,260
iv. Total annual benefit	55,971	59,100	87,100	51,440
v. Benefit cost ratio	1.29	1.31	1.23	1.38

Notes: * Case study No.0 is taken from "The Final Report of the Fourth Agricultural Credit Project" July 1980.
Agricultural Finance Corporation Limited, Bombay

Case study on Model Farm:

- ** No.1 : Development plan of typical rain-fed condition in the Terai plain.
- *** No.2 : Model Farm Scheme in Iswarpur panchayat, Sarlahi district
- **** No.3 : Model Farm Scheme in Sakhuwa panchayat, Dhanusa district

1/, 2/ are applied for No.1, No.2 and No.3.

Water Requirement, Production Cost and
Expected Production Amount by Crops

(1 ha-base)

Item	Paddy		Wheat	Maize		Mung	Tobacco	Unit
	Normal	Early		Winter	Spring			
Duration	120	100	120	150	120	75	120	days
Days of irrigation	105*	85*	4times	5times	4times	2times	5times	*days
Water requirement	8.64*	8.64*	60**	60**	60**	60**	60**	*mm/day **mm/time
Total water requirement	10,572	8,844	2,400	3,000	2,400	1,200	3,000	m ³
Expected effective rainfall	3,700	1,769	-	-	400	800	-	m ³
Water to be irrigated	6,872	7,075	2,400	3,000	2,000	400	3,000	m ³
Pump operation hours	265	273	92	115	77	15	115	hr/ha
Fuel cost	1,828	1,883	636	798	531	106	790	NRS
Lubricant	182	188	66	80	54	11	88	NRS
A. Total oil (O&M cost)	2,010	2,071	702	878	585	117	878	NRS/ha
Inputs								
Fertilizers	572	572	764	739	739	190	903	NRS
Seeds	70	70	318	40	40	100	45	NRS
B. Total	642	642	1,082	779	779	290	948	NRS
Labour								
Present	850	850	630	650	650	200	3,500	NRS
C. With project	950	950	680	720	720	200	4,000	NRS
Production cost (B+C)	1,592	1,592	1,762	1,499	1,499	490	4,948	NRS
Expected production	3.0 (3.5)*	3.0 (3.5)	2.5 (3.0)	2.8 (3.0)	2.8 (3.0)	0.5	1.0	t/ha (intensive type)
Price	1.5	1.5	1.8	1.3	1.3	4.0	13.17	NRS/kg
D. Gross income	4,500	4,500	4,500	3,640	3,640	2,000	13,170	NRS/ha
NET BENEFIT D - (A+B+C)	898	837	2,037	1,263	1,556	1,393	7,344	NRS/ha

Notes: Prices of Inputs
Fertilizer: Urea 2.47NRS/kg, TSP 3.85NRS/kg
Seeds: Paddy 2.00NRS/kg, Wheat 3.18NRS/kg
Maize 2.00NRS/kg, Mung 4.00NRS/kg
Tobacco 300.00NRS/kg

Seeds are used respectively at 35,100, 20, 25, 0.15 kg/ha.

Pump Operation, Maintenance and Production Cost (Terai Plain)

(Unit: NRS)

Crops	Present				Project				Net incremental cost			
	Area (ha)	Ferti-lizer	Seed	Labour	Total cost	Area (ha)	Fertili-zer	Seed		Labour	Pump O. & M. cost	Total cost
Normal Paddy	5.0	430	350	4,250	5,030	5.0	2,860	350	4,750	1,050	18,010	12,980
Wheat	0.5	95	159	315	569	5.0	3,820	1,570	3,400	3,510	12,320	11,751
Pulse	2.0	-	200	400	600	-	-	-	-	-	-	600
Maize	-	-	-	-	-	2.5	1,847	100	1,800	1,462	5,209	5,209
Mung	-	-	-	-	-	2.5	475	250	500	292	1,517	1,517
Total	7.5				6,199	15.0				15,314	37,056	30,857

Pump operation & maintenance cost : NRS 15,314

Incremental production cost : NRS 15,543 (37,056 - 15,314 - 6,199)

Pump Operation, Maintenance and Production Cost (Iswarpur Area)

(Unit: NRS)

Crops	Present			Project				Net incremental cost				
	Area (ha)	Ferti-lizer	Seed	Labour	Total	Area (ha)	Ferti-lizer		Seed	Labour	Pump O. & M.	Total cost
Paddy	7.4	-	518	6,290	6,808	7.4	4,232	518	7,030	14,883	26,663	19,855
Early paddy	0.9	100	63	765	928	3.7	2,116	259	3,515	7,666	13,556	12,628
Wheat	1.4	780	252	882	1,914	3.7	2,826	1,176	2,516	2,583	9,101	7,187
Maize	4.2	3,030	168	2,730	5,928	3.7	2,734	148	2,664	3,229	8,775	2,847
Mung/pulses	1.9	-	190	380	570	3.7	703	370	740	421	2,234	1,664
Total	15.9	3,910	1,191	11,047	16,148	22.2	12,611	2,471	16,465	28,782	60,329	44,181

Pump operation and maintenance cost : NRS. 28,782

Incremental production cost : NRS. 15,399

Total : NRS. 44,181

Net incremental benefit/year : NRS. 7,829 (52,010 - 44,181)

ha/year : NRS. 1,057

Pump Operation, Maintenance and Production Cost. (Goshala Area)

(Unit:NRS)

Crops	Present			Project				Net incremental cost				
	Area (ha)	Ferti-lizer	Seed	Labour	Total	Area (ha)	Ferti-lizer		Seed	Labour	Pump O. & M. cost	Total cost
Normal Paddy	4.7	-	329	4,000	4,329	4.7	2,688	329	4,465	9,447	16,929	12,600
Tobacco	4.7	1,060	210	16,450	17,720	4.7	4,244	210	18,800	4,126	27,380	9,660
Maize	4.7	-	188	3,055	3,243	2.4	1,773	96	1,728	1,404	5,001	1,758
Mung-bean	-	-	-	-	-	2.3	437	230	460	269	1,396	1,396
Total	14.1	1,060	727	23,505	25,292	14.1	9,142	865	25,453	15,246	50,706	25,414

Incremental cost: Pump Operation & Maintenance NRS 15,246
 Incremental production cost NRS 10,168

Total NRS 25,414

Net incremental benefit : NRS 17,266 (42,680 - 25,414)

Pump Operation, Maintenance and Production Cost (Saphy Area)

(Unit: NRS)

Crops	Present				Project				Not incremental cost					
	Area (ha)	Ferti-lizer	Seed	Labour	Total	Area (ha)	Ferti-lizer	Seed		Labour	Pump O&M	Total		
Early paddy or (maize)	-	-	-	-	-	2.5	1,430	175	2,375	5,177	9,157	9,157	9,157	(4,202)
Normal paddy	5.0	148	350	4,250	4,748	5.0	2,860	350	4,750	10,050	18,010	18,010	13,262	
Wheat	0.5	155	159	315	629	5.0	3,820	1,590	3,400	3,510	12,320	12,320	11,691	
Winter pulses	4.5	-	450	900	1,350	-	-	-	-	-	-	-	1,350	
Mung bean	-	-	-	-	-	2.5	475	250	500	292	1,517	1,517	1,517	
Total	10.0				6,727	15.0				19,029	41,004	41,004	34,277	(29,322)

Incremental cost

Pump operation & maintenance cost : NRS 19,029 (14,307)
 Incremental production cost : NRS 15,248 (15,015)

Net incremental benefit (5 ha) : NRS 13,383 (16,188)
 per ha/year : NRS 2,676 (3,237)

Pump Operation, Maintenance and Production Cost (Sakhuva Area)

(Unit: NRS)

Crops	Present				Project				Not incremental cost		
	Area (ha)	Ferti-lizer	Seed	Labour Total	Area (ha)	Ferti-lizer	Seed	Labour Total		Pump O&M	
Normal paddy	4.7	-	329	3,995	4.7	2,688	329	4,465	7,526	15,044	10,720
Wheat	-	-	-	-	2.4	1,833	763	1,632	1,346	5,574	5,574
Winter maize	-	-	-	-	2.3	1,700	92	1,656	1,621	5,069	5,069
Mung bean	-	-	-	-	4.7	893	470	940	427	2,730	2,730
Total	4.7			4,324	14.1				10,956	28,417	24,093

Incremental cost

Pump operation & maintenance	:	NRS 10,956
Incremental production cost	:	NRS 13,137
Net incremental benefit/year	:	NRS 15,107 (39,200 - 24,093)
ha/year	:	NRS 3,214

Pump Operation, Maintenance and Production Cost (IAP Area)

(Unit: 10³NRS)

Crops	Present				Project				Net incremental cost			
	Area (ha)	Ferti-lizer	Seed	Labour & others	Total	Area (ha)	Ferti-lizer	Seed		Labour & others	Pump O&M	Total
Paddy normal	43.7	3,758	3.06	37.14	43.96	43.0	24.60	3.01	40.75	23.64	92.10	48.14
" early	10.5	0.90	0.35	8.92	10.17	21.5	12.30	1.50	20.42	12.17	46.39	36.22
Wheat	12.0	2,268	3.82	7.56	13.65	32.4	24.75	10.30	22.03	6.22	63.30	49.65
Maize	4.2	0.80	0.17	2.73	3.70	10.6	7.76	0.42	7.63	2.54	18.35	14.65
Pulses	9.0	-	0.90	1.80	2.70	-	-	-	-	-	-	2.7
Mung	-	-	-	-	-	21.5	4.08	2.15	4.30	0.68	11.21	11.21
Total	79.4				74.18	129.0				45.25	231.35	157.17

Incremental Cost

Pump operation & maintenance : NRS 45,250
 Incremental production cost : NRS 11,192

Net incremental benefit/year : NRS 132,630 (289,800 - 157,170)
 ha/year : NRS 3,084 (132,630/43 ha)

Note: water cost/m³ is assumed at NRS. 0.08/m³.

Present and Expected Production

Crops	Area Planted (ha)		Unit Yield (t/ha)		Gross Production (10 ³ NRS)		Gross Increment (10 ³ NRS)
	Present	Project	Present	Project	Present	Project	
<u>TERAI PLAIN</u> (Cropping intensity; Present: 150%, Project: 300%)							
Normal paddy	5.0	5.0	1.7	3.0	12.75	22.5	9.75
Wheat	0.5	5.0	1.1	2.5	0.99	22.5	21.51
Pulse	2.0	-	0.3	-	2.40	-	△2.40
Maize	-	2.5	-	2.8	-	9.1	9.1
Mung	-	2.5	-	0.5	-	5.00	5.00
<u>Total</u>	<u>7.5</u>	<u>5.0</u>			<u>16.14</u>	<u>59.1</u>	<u>42.96</u>
<u>ISWARPUR AREA</u> (Cropping intensity; Present: 214%, Project: 300%)							
Normal paddy	7.4	7.4	2.3	3.0	22.5	33.30	10.80
Early paddy	0.9	3.7	2.4	3.0	3.15	16.65	13.50
Wheat	1.4	3.7	0.8	2.5	1.9	16.56	14.58
Maize	4.2	3.7	1.0	2.8	5.4	13.39	7.93
Mung/Pulses	1.9	3.7	0.3	0.5	2.0	7.20	5.20
<u>Total</u>	<u>15.9</u>	<u>22.2</u>			<u>35.09</u>	<u>87.10</u>	<u>52.01</u>
<u>GOSHALA AREA</u> (Cropping intensity; Present: 300%, Project: 300%)							
Normal paddy	4.7	4.7	2.2	3.0	15.50	21.15	5.65
Tobacco	4.7	4.7	0.5	1.0	31.02	62.04	31.02
Maize	4.7	2.4	1.2	2.8	7.33	8.74	1.41
Mung	-	2.3	-	0.5	-	4.60	4.60
<u>Total</u>	<u>14.1</u>	<u>14.1</u>			<u>53.85</u>	<u>96.53</u>	<u>42.68</u>
<u>SAPHY AREA</u> (Cropping intensity; Present: 200%, Project: 300%)							
Early paddy (Maize)	-	2.5 (2.5)	-	3.0 (2.8)	-	11.25 (9.10)	11.25 (9.10)
Normal paddy	5.0	5.0	1.5	3.0	11.25	22.50	11.25
Wheat	0.5	5.0	0.6	2.5	0.54	22.50	21.96
Winter pulses	4.5	-	0.1	-	1.80	-	△1.8
Mung	-	2.5	-	0.5	-	5.0	5.0
<u>Total</u>	<u>10.0</u>	<u>15.0</u>			<u>13.59</u>	<u>61.25</u>	<u>47.66</u>
<u>SAKHUWA AREA</u> (Cropping intensity; Present: 100%, Project: 300%)							
Normal paddy	4.7	4.7	2.4	3.5	16.9	24.7	7.8
Wheat	-	2.4	-	3.0	-	13.0	13.0
Winter maize	-	2.3	-	3.0	-	9.0	9.0
Mung	-	4.7	-	0.5	-	9.4	9.4
<u>Total</u>	<u>4.7</u>	<u>14.1</u>			<u>16.9</u>	<u>56.1</u>	<u>39.2</u>
<u>IAP AREA</u> (Cropping intensity; Present: 181%, Project: 300%)							
Normal paddy	43.7	43.0	2.08	3.0	136.3	193.0	56.7
Early paddy	10.5	21.5	1.99	3.0	31.3	97.5	66.2
Wheat	12.0	32.4	1.33	2.5	28.8	146.0	117.2
Maize	4.2	10.6	2.00	2.8	10.9	39.0	28.1
Mung and other pluses	9.0	21.5	0.40	0.5	10.8	32.4	21.6
<u>Total</u>	<u>79.4</u>	<u>129.0</u>			<u>218.2</u>	<u>508.0</u>	<u>289.8</u>

JICA