Draft Report
On
Asset Management Plan
For
Main Irrigation Canal
In
Kankai Irrigation System

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ACRONYMS

AF	:	Additional Fund
AMIS	:	Agency Managed Irrigation System
AO	:	Association Organisor
CR	:	Cross Regulator
DB	:	Division Box
DOI	:	Department of Irrigation
DTO	:	Direct Tertiary Outlet
FAO	:	Food and Agriculture Organisation
FC	:	Field Channel
FGD	:	Focus Group Discussion
GO	:	Gate Operator
HR	:	Head Regulator
IMD	:	Irrigation Managent Division
IMT	:	Irrigation Management Transfer
ISF	:	Irrigation Service Fee
IWR	:	Irrigation Water Requirement
IWRMP	:	Irrigation and Water Resources Management Project
KIS	:	Kankai Irrigation System
MIC	:	Main Irrigation Canal
NARC	:	Nepal Agriculture Research Council
SE	:	Sub-engineer
SIC	:	Secondary Irrigation Canal
SMU	:	Sub project Management Unit
TIC	:	Tertiary Irrigation Canal
TS	:	Terminal Structure
VDC	:	Village Development Committee
WMU	:	Water Management Unit
WUA	:	Water Users Association
WUG	:	Water Users Group

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1 INTRODUCTION

1.1 Project Background

The World Bank has had a long-standing role in the development of Nepal's irrigation and water resources sector. In order to continue this role, the World Bank and The Government of Nepal have signed the agreement of Irrigation and Water Resources Management Project (IWRMP) on the 31st January, 2008. The first phase of the agreement ended on June 30, 2013 and extension of one year till June 30, 2014 was done. In December 2012, the GoN requested to the World Bank to provide an additional financing of US$50 million in order to complete the original commitment of rehabilitation and internalize, institutionalize and replicate the gains made so far in both irrigation water management and agricultural practices. As a result, Additional Financing (AF) of the project signed with the start date of July 2014 and a closing date of June 30, 2018, with a credit support of US$ 30 million and Grant support of US$ 20 million. The IWRMP consists of four components as follows:

(A) Irrigation Infrastructure Development and Improvement
(B) Irrigation Management Transfer
(C) Institution and Policy Support for Improved Water Management
(D) Integrated Crop and Water Management

Among above components, the overall objective of Component B is to improve irrigation service performance and service delivery to selected irrigation systems in the Terai through the completion and consolidation of Irrigation Management Transfer (IMT) to the relevant Water Users Association (WUAs).

The management transfer to the WUAs would mean turning over the governance, management, and maintenance responsibilities in agreed upon parts of an irrigation system for sustainable use by them.

The principal outputs of Component B are envisaged as:

- Efficient and equitable irrigation service delivery by financially and institutionally sustainable WUAs;
- Improved physical performance of the selected irrigation schemes;
- Reliable bulk water service delivery by Department of Irrigation (DOI) in line with the Transfer Agreement, and
- Formation and strengthening of WUAs to become self-governing, self –financing, and self-regulating organization;

Component B is presently supporting 4 legally empowered WUAs which are responsible for the operation and maintenance of 4 existing sub-systems within 4 Agency Managed

Irrigation Systems (AMIS). These four sub-projects are Kankai Irrigation System (7,000 ha), Sunsari Morang Irrigation System Sitagunj Branch (8,000 ha), Narayani Irrigation System (Block-8) 3000 ha and Mahakali Irrigation System First Phase (5100 ha). Activities planned to achieve the goal of sustainable irrigation management concept is focused on infrastructure development, water management, institutional development and mitigation measures for social and environmental impacts on the irrigation system. The water management and WUA development works of these project supported sites is continued in the Additional Financing (AF) period of the project. With the new agreement of AF, DOI is going to implement the second phase of IMT program in Ramgunj (7800 ha) branch of Sunsari Morang Irrigation Project, Block-2 (3000 ha) of Narayani Irrigation Project and Phase-II (5700 ha) of Mahakali Irrigation Project.

This report is prepared in an attempt to part of **Stage 3: Institutional Strengthening for IMT** action plan for the implementation of IMT in Project Implementation Manual of IWRMP, and to part of TOR for TA-B under IWRMP.

1.2 Objective

The principal objective of this work is to prepare Asset Management Plan for Main Irrigation Canal in Kankai Irrigation System such that Irrigation Management Division (IMD) of Department of Irrigation for Kankai Irrigation System (KIS) and WUA of KIS is able to maintain canal for sustainable use in all irrigation season.

1.3 Scope of Works

Present works have been confined to preparation of Main Canal Asset Management Plan of KIS.

2 SUB PROJECT DESCRIPTION AND ASSETS

2.1 Historical Development

Kankai Irrigation System (KIS) was initiated in year 1970 with a loan assistance of Asian Development Bank (ADB). The construction works was implemented in two phases. The first phase was started in year 1971 to provide irrigation facilities in 5000 ha, which was completed in 1981. The second phase was started in 1980 to extend irrigation facilities to another 3000 ha; but the irrigation facilities was extended up to 2000 ha only by year 1991. Remaining 1000 ha has very limited infrastructure development up to hydraulic layer of tertiary canal. Thus total command area developed so far is 7000 ha in KIS.

2.2 Physiography

Kankai Irrigation System (KIS), lies in the eastern terai (plain) of Nepal, between the latitudes of 26 to 27 degree North and longitude of 87 to 88 degree East. The elevation of the system varies from 120 m in North to 75 m in the South. The command area of the system is surrounded by India in the South, Kankai River in the east, Krishna River in the west, and Main canal in the north. Kankai River is the source of water of the system and is of perennial type. The catchment area of the Kankai River at headworks site is 1190 sq. km. The river originates from Mahabharat Mountain Range flows down through terai plain and crosses the Indo Nepal Boarder and finally merges into River Ganges in India. The general Layout of KIS is presented in Figure 2-1 as below.

2.3 Location and accessibility

Kankai Irrigation System lies between the latitudes of 26 to 27 degree North and longitude of 87 to 88 degree East. The command area is covered by Satashidham, Shivgunj, Paanchgachhi, Mahabhara, Dharampur, Topgachhi and Baigundhura Village Development Committee (VDC) of Jhapa district. The main canal crosses E-W Highway at its head reach. The KIS is connected with gravel road throughout the command area. The head reach of command area is located within nearest city Damak and Birtamod. Nearest airport is located at Bhadrapur, some 50 km east of command area.

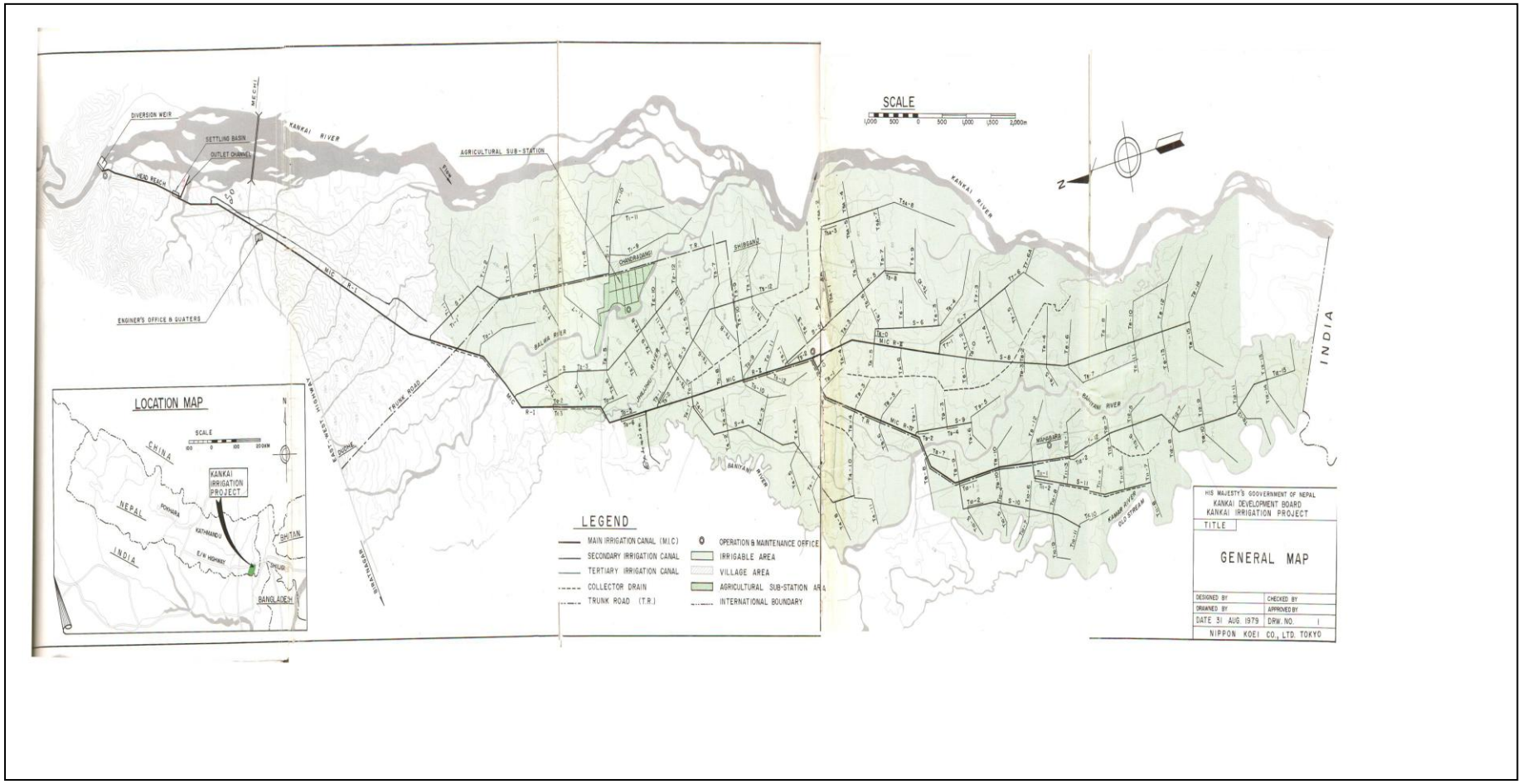


Figure 2-1: General Layout of KIS

2.4 Headworks and Irrigation Facility

Kankai Irrigation System (KIS) has fixed weir type headworks designed across Kankai River at Domukha (an historical place of religious importance) of Jhapa District. The weir is located around 3 km upstream of East-West Highway (Kakai) Bridge over Kankai River. The length and height of weir in place is 126 m and 1.84 m respectively. The undersluice located to the right bank of Kankai River along headworks axis is designed to pass upto 600 cumces discharge downstream. Main canal offtaking upstream of undersluice has idle length of 1570 m until the location of Sardare Escape structure comes along its flow course.

KIS has named main canal as Main Irrigation Canal (MIC), secondary canals offtaking from MIC as Secondary Irrigation Canal (SIC) and tertiary canals offtaking from SIC as Tertiary Irrigation Canal (TIC). The TIC is also named for Direct Tertiary Outlets (DTO) from MIC. Please refer Figure 2-2.

Kankai Irrigation System has developed its MIC into five reaches over its two phases of development. The canal network in Reach-I through Reach-IV has been developed in its first phase down up to tertiary canal level. Reach-V in KIS is extension part developed only partly in second phase. The idle length and Reach-I of MIC is concrete lined in KIS, whereas other four reaches are unlined. The design features of MIC including groups of SICs and DTOs in a given Reach of MIC is presented in Table 2-1.

The idle length of 1570 m in the head reach of MIC is although designed for 10.6 cumecs, the canal siphon in place at the head reach is however designed only for 10.15 cumecs. Therefore, designed discharge at the head of Reach-I, starting at Sardare Escape structure, is 10.15 cumecs for its total length of 11.5 km. The designed discharge in MIC at the head of Reach-II is 4.55 cumecs, whereas Reach-III and Reach-IV bifurcates at the same location in MIC with designed discharge of 1.95 cumecs each. The Reach-V bifurcates at chainage 9+886 in Reach-I of MIC have designed capacity of 7.225 as per report.

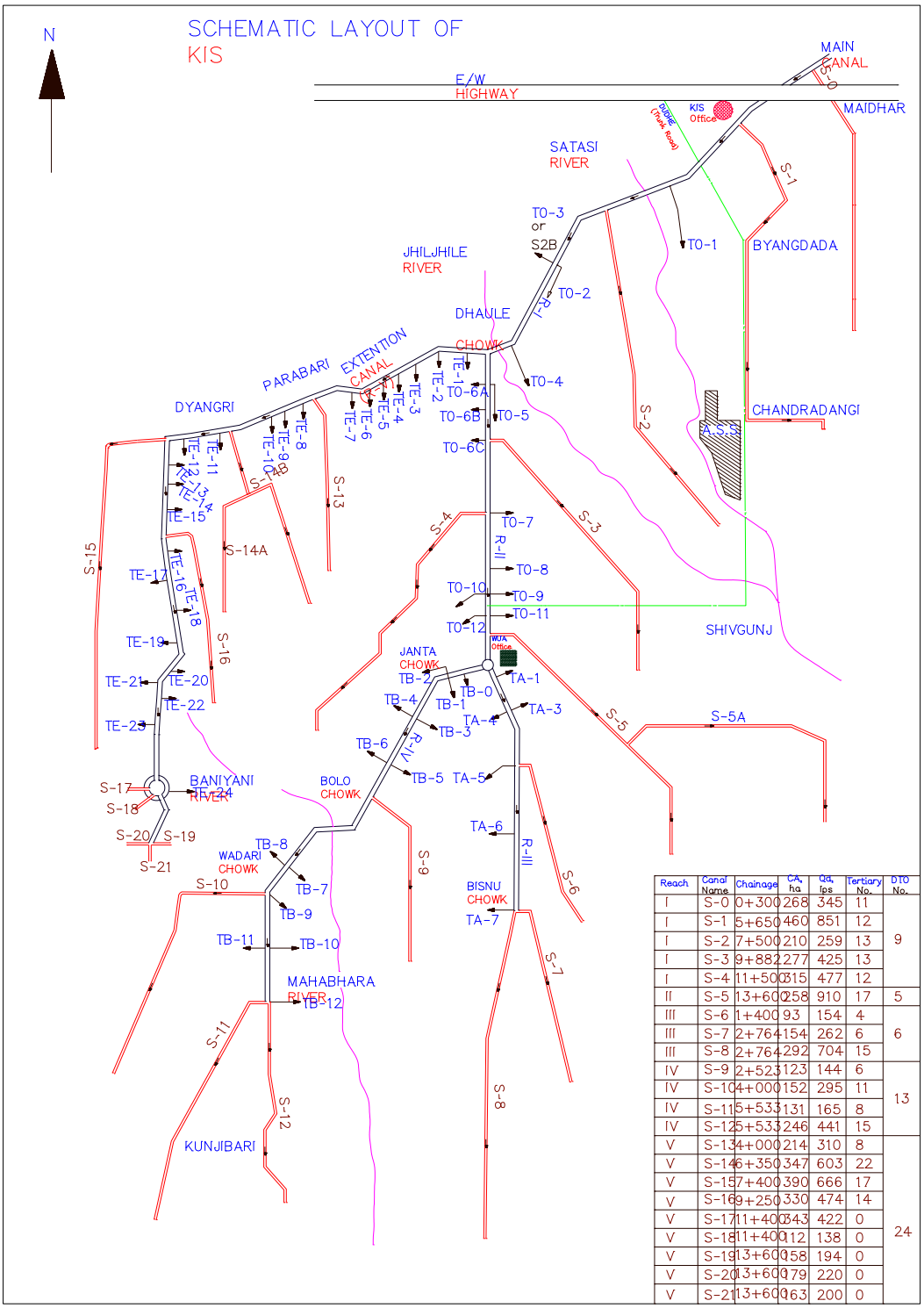
Table 2-1: MIC Design Features with offtaking SICs and DTOs

MIC Reach	Chainage in MIC	Canal Type	Length (m)	Long. Slope, m/m	Designed Discharge, m^3/sec	Name of offtaking SICs	Name of offtaking DTOs
Head Reach (Idle Length)		Concrete Lined	1570				
Reach-I	0+000	Concrete Lined	11500	1 : 1000	10.15	S0, S1, S2, S3 and S4 (5 nos)	T01 to T07 (7 nos)
Reach-II		Unlined	2600	1 : 1850	4.55	S5 (1 nos)	T08 to T012 (5 nos)
Reach-III		Unlined	2767	1 : 1540	1.95	S6, S7 and S8 (3 nos)	TA1 to TA6 (6 nos)
Reach-IV		Unlined	5533	1 : 1540	1.95	S9, S10, S11 and S12 (4 nos)	TB0 to TB12 (12 nos)

Reach-V (Extension Canal)	9+886	Unlined	11600		7.225	S13, S14, S15 and S16 (4 nos)	TE1 to TE23 (23 nos)
Reach-V (Undeveloped Length 2.2 Km)						S17, S18, S19, S20 and S21 (5 nos)	
		Reach Total	**34000**				

There area 22 SICs and 287 TICs (including 54 DTOs) in KIS. Out of which, there are 13 SICs (S0 to S12) and 31 DTOs branching off from MIC covering Reach-I to Reach-IV. Reach-V has therefore 9 SICs (S13 to S21) and 23 DTOs branching off from MIC. The design features of MIC including groups of SICs and DTOs in respective reach of MIC are categorized in Table 2-1 for reference.

Further, TICs offtaking from SIC are designed to space at an average interval of 600 m. Moreover, the Field Channel (FC), also known as supply ditch, offtaking from TIC is provisioned with precast Division Boxes (DB) at an average interval of 100m along TIC length. The command area to be covered by FC assumed in design is 10 ha. However, at most of the places the DB is found non-existing with lack of FC in majority of places. Consequently, localized breach of TICs and field to field irrigation in absence of FC are in practice in KIS even in winter irrigation season.



Reach	Canal Name	Chainage	CA, ha	Qd, lps	Tertiary No.	DTO No.
I	S-0	0+300	268	345	11	9
I	S-1	5+650	460	851	12	
I	S-2	7+500	210	259	13	
I	S-3	9+882	277	425	13	
I	S-4	11+500	315	477	12	
II	S-5	13+600	258	910	17	5
III	S-6	1+400	93	154	4	6
III	S-7	2+764	154	262	6	
III	S-8	2+764	292	704	15	
IV	S-9	2+523	123	144	6	13
IV	S-10	4+000	152	295	11	
IV	S-11	5+533	131	165	8	
IV	S-12	5+533	246	441	15	
V	S-13	4+000	214	310	8	24
V	S-14	6+350	347	603	22	
V	S-15	7+400	390	666	17	
V	S-16	9+250	330	474	14	
V	S-17	11+400	343	422	0	
V	S-18	11+400	112	138	0	
V	S-19	13+600	158	194	0	
V	S-20	13+600	179	220	0	
V	S-21	13+600	163	200	0	

Figure 2-2: Schematic Layout of KIS showing SICs and DTOs with MIC reach bifurcation

2.5 Command Area

The KIS has although developed irrigation command of 5000 ha in its first phase and 2000 ha in second phase, the IWRMP in Phase-I has revised (during F/Y 2012/13) command area with WUA of KIS while preparing for parcellary map of respective offtaking canals from MIC. The details of originally designed and revised command area of respective offtake from MIC is obtained from Sub-project Management Unit (SMU) of KIS and presented in Table 2-2 for reference.

Table 2-2: Details of Command Area and Head Duty of Offtaking Canals from MIC

Reach	Chainage in MIC	Canal Name	Designed Canal Length	Designed Command area	Revised Command area	Designed Discharge	Designed Canal Head Duty	Existing Canal Head Duty	Remarks
			Km	Ha	Ha	l/s	l/s/ha	l/s/ha	
I	0+300	S0	4.65		268	345		1.29	
I	5+650	S1	5.8	736.1	460	851	1.16	1.85	
I	6+619	T0-1		72.7	63	83	1.14	1.32	
I	7+590	S2	3.9	226.6	210	259	1.14	1.23	
I	8+397	S2B		24.8	114	150		1.32	
I	8+397	T0-2		16.6	15	19	1.14	1.27	
I	9+535	T0-4		27.8	25	32	1.15	1.28	
I	10+782	S3	3.4	372	277	425	1.14	1.53	
I	11+500	T0-7		16.6	19	19	1.14	1.00	
II	0+648	T0-8		17.7	14	20	1.13	1.43	
II	1+110	T0-9		45.5	20	52	1.14	2.60	
II	1+600	T0-11		33.8	12	39	1.15	3.25	
I	11+500	S4	4.6	417.5	315	477	1.14	1.51	
I	9+897	T0-5		10.1	8	12	1.19	1.50	
I	9+897	T0-6		37.2	21	45	1.21	2.14	
II	12+610	T0-10		22.4	31	26	1.16	0.84	
II	1+600	T0-12		27.6	53	31	1.12	0.58	
IV	0+490	TB-2		23	6	26	1.13	4.33	
IV	1+250	TB-4		28.4	10	32	1.13	3.20	
IV	1+850	TB-6		19.2	24	22	1.15	0.92	
II	2+100	S5	6.6	798	258	910	1.14	3.53	
III	1+400	S6	2.15	136.1	93	154	1.13	1.66	
III	0+050	TA-1			20	25		1.25	
III	0+700	TA-3		25.8	17	29	1.12	1.71	
III	2+764	S7	8.7	230.2	154	262	1.14	1.70	
III	2+767	S8			292	704		2.41	
IV	2+523	S9	1.2	126.5	123	144	1.14	1.17	
III	0+700	TA-4		21.7	25	24	1.11	0.96	
III	1+400	TA-5		19	18	22	1.16	1.22	
III	2+716	TA-6		22.1	20	25	1.13	1.25	
III	2+764	TA-7			27	33		1.22	
IV	0+150	TB-0		20.3	13	23	1.13	1.77	
IV	0+490	TB-1		29.3	26	33	1.13	1.27	

IV	1+250	TB-3		32.9	31	38	1.16	1.23	
IV	1+850	TB-5		33.5	51	38	1.13	0.75	
IV	2+900	TB-7		24.3	21	28	1.15	1.33	
IV	4+000	TB-9		19.6	11	22	1.12	2.00	
IV	4+850	TB-10		67.1	37	74	1.10	2.00	
IV	4+000	S10	3.23	259.3	152	295	1.14	1.94	
IV	2+900	TB-8		21.9	34	25	1.14	0.74	
IV	5+530	S11	3.2	144.4	131	165	1.14	1.26	
IV	4+850	TB-11		14.8	26	17	1.15	0.65	
IV	5+533	S12	1.11		246	441		1.79	
IV	5+533	TB-12		45.8	19	52	1.14	2.74	
V	4+000	S13			214	310		1.45	
V	0+350	TE-1			50	84		1.68	
V		TE-2			5	7		1.40	
V		TE-3			10	18		1.80	
V		TE-4			65	98		1.51	
V		TE-5			57	90		1.58	
V		TE-6			131	200		1.53	
V		TE-7			98	150		1.53	
V		TE-8			58	90		1.55	
V		TE-9			23	39		1.70	
V	6+350	S14			347	603		1.74	
V		TE-10			70	119		1.70	
V	7+400	S15			390	666		1.71	
V		TE-14			15	22		1.47	
V		TE-15			21	33		1.57	
V		TE-16			16	30		1.88	
V		TE-19			21	32		1.52	
V		TE-21			29	47		1.62	
V	9+250	S16			330	474		1.44	
V		TE-11			60	87		1.45	
V		TE-12			10	10		1.00	
V		TE-13			23	27		1.17	
V		TE-17			22	33		1.50	
V		TE-18			41	49		1.20	
V		TE-20			35	51		1.46	
V		TE-22			14	20		1.43	
V		TE-23			30	54		1.80	
V	11+400	S17			343	422		1.23	
V	11+400	S18			112	138		1.23	
V	13+600	S19			158	194		1.23	
V	13+600	S20			179	220		1.23	
V	13+600	S21			163	200		1.23	
	Total	**MIC**	**34**	**7000**	**6950**	**10150**	**1.43**	**1.44**	

It is also reported by SMU of KIS that DTO, T0-0 is renamed as S2B upon extension of command area. Also command area of DTO, T0-3 is merged to S2B SIC command in the

revision works. Further, from Table 2-2 it may be noted from the pattern of boarder shedding that DTOs have been considered operating as grouped to respective SIC in order to irrigate area bounded by common topography and hydrology. Therefore, grouping of DTOs exactly do not follow individual Reach of MIC. The Table 2-2 above also reflects that duty at the head of SICs and TIC of DTOs offtaking from MIC is originally designed at 1.14 lps/ha. The duty at the head of Reach-I in MIC for 7000 ha is observed to be 1.45 lps/ha. Moreover, the duty designed at the head of TICs offtaking from respective SIC is 1.0 lps/ha as per reports.

2.6 Flow control structure

As we know, the performance of water delivery through control structures in distribution system managed by Water Users Association (WUA) is as essential as main system managed by agency, apart from on-farm water management by farmer. In this line, flow control structure helps to solve the problem as to how water can be distributed in a more transparent and equitable manner in order to fill the institutional vacuum at the on-farm system level. It gives the water users the following benefits as:

- The time spent by water users for getting their turns for irrigation decreases several times, resulting in considerable time savings;
- Actual per unit of area water supply by layers of canal becomes more balanced and uniform showing more equity among hierarchy of canals, especially for those in tail reaches;
- Irrigation Service Fee (ISF) collection improves due to a greater satisfaction by water users, especially those in middle and tail reach;
- Crop yields increase in most TIC, especially those in middle and tail reach;
- Net income of the tail enders increase; and
- The overall number of dispute about irrigation turns declines; though dispute about water volumes increase due to fewer privileges in water supply enjoyed by the upstream water users.

The inflow to MIC Reach-I in KIS is equipped with manually operated vertical sliding gates at Sardare Escape location called Sardare Intake. There are series of manually operated vertical sliding gates as Cross Regulators (CRs) suitably placed along MIC to set target water level for discharge into respective SICs and DTOs located upstream of it. The CRs are also installed at the bifurcation of Reach-III, IV and V in MIC. Along SIC, series of CRs are also in place to control water level upstream of it in order to have desired discharge to respective lower order TIC.

There are provision of manually operated vertical sliding Head Regulators (HRs) at the intake of respective SIC and DTOs to regulate discharge through it in KIS. Further, discharge measuring structures located downstream of HR at the head of respective SIC and DTO is equipped with Parshell Flume in Reach-I to Reach-IV, except for S0 in Reach-I, of MIC. In Reach-V of MIC, only SICs starting from S14 to S16 have facility of Parshell Flume. The S13 and S17 through S21 including DTOs starting from TE1 through TE23 have only HRs regulates and measures desired/intended discharge.

There are escape structures in place along Reaches of MIC to safely dispose off not wanted irrigation water either due to sudden heavy precipitation in command area or due to maintenance that may otherwise be required at downstream reach of canal network.

There are also provisions of Terminal Structures (TS) placed suitably at the end of TIC offtaking at tail end of SIC. However, on account of lack of proper internal drainage system in place has led to breach and disruption of full or part of TIC in KIS command area over course of time. Further, there is no documentation of TSs as reported by SMU of KIS. Table 2-3 below shows list of principal flow control structures along Reaches of MIC for reference. List of hydraulic structures along MIC is tabulated in Annex-A for reference.

Table 2-3: Principal flow control structures in MIC

Reach	Chainage	Structure	Gate (WxH)	Designed Discharge, m^3/s	Canal length (Km)	Full Supply Depth (m)	Remarks
Head Reach	0+000	Diversion weir					
		Undersluice					
	0+075	CD					
	0+505	CD					
	1+183	CD					
	1+570	Silt Ejector/HR for MIC					
R-I (11.5 Km)	0+000	HR for MIC	1.55x1.8@2	10.15			
	0+016	Syphon-1	1.9x1.9x194.5	10.15			Sardare Syphon
	0+740	HR for S0	1.3x1.15	0.345	4.65		
	0+743	CR	1.5x1.8@2				
	1+239	Syphon-2	1.9x1.9x52	10.15			Banspaini Syphon
	1+600						E-W Highway Crossing
	1+662	CD					
	2+137	CD					
	3+150	CD					
	3+688	CD					
	4+690	CD					
	4+910	CD					
	5+240	Spillway		2.5			Overflow spillway No.1 (with gate)
	5+650	**HR for S1**	**1.2x1.1**	**0.851**	**5.8**		
	5+653	CR-1	1.65x1.8@2	9.2		1.598	S1 Check
	7+039	Spillway		2.5			No.1 Spillway
	7+055	Syphon-3	1.9x1.8x183	9.11			Satasi Syphon
	7+590	HR for S2	0.7x0.9	0.259	3.9		

	7+593	CR-2	1.65x1.8@2	8.77		1.47	S2 Check
	8+397	Oulet for S2B		0.15			No HR
	9+222	Spillway		3.5			No.1 bifurcation spillway (with gate)
	9+637	Syphon-4	1.9x1.8x85	8.67			Jhiljhile Syphon
	9+886	HR Left					
	9+882	HR Right	1.65x1.8@2	10			**R-V offtake (Bifurcation)**
	10+782	**HR for S3**	**1.0x0.8**	**0.425**	**3.4**		
	10+785	CR-3/DP	1.65x1.5@2	5.7		1.415	S3 Check; With Drop
	9+897	**T06**	**0.4x0.6**	**0.045**			
	11+500	**HR for S4**	**1.0x0.8**	**0.477**	**4.6**		**With Bridge (BR)**
R-II (2.6 Km)							
	13+600	**HR for S5**	**1.0x1.1**	**0.91**	**6.6**		
	13+530	CR-5	1.65x1.4@2	3.62		1.374	S5 Check
	14+060	Spillway		3.2			Overflow
	2+600	HR Left					
	14+083	HR Right	1.028x1.15@2	3.62		1.252	
R-III (2.8 Km)							
	1+400	HR for S6	0.4x0.9	0.154	2.15		
	1+430	CR-6/DP	1.5x1.1@2	1.34		0.92	S6 Check; With Drop
	2+764	HR for S7	0.7x0.9	0.262			
	2+767	CR/HR for S8/DP	1.2x1.1@1	0.704	8.7		**S7 Check; With Drop (Bifurcation)**
R-IV (5.5 Km)							
	2+523	HR for S9	0.6x0.7	0.144	1.2		
	2+526	CR-9/DP	1.5x1.1@1	1.69			S9 Check; With Drop
	2+720	Spillway		1.6			No.2 Spillway (With Gate)
	2+737	Syphon-4	1.1x1.1x108.5	1.95			
	4+000	HR for S10	0.7x0.9	0.295	3.23		
	4+030	CR-10/DP	1.2x1.15@1	1.51			S10 Check; With Drop
	5+530	HR for S11	0.7x0.9	0.165	3.2		
	5+533	HR for S12	1.2x1.1@1	0.441	1.11	0.765	**S11 Check; CR-10 (Bifurcation)**
R-V (11.4 Km)	4+000	HR for S13					
		CR				0.688	
	6+350	HR for S14					
		CR				0.575	
	7+400	HR for S15		0.666			
		CR					

	9+250	HR for S16		0.474			
		CR					
	11+400	HR for S17		0.422			
		HR for S18		0.138			
BP of Extension undeveloped area		CR					EP of R-V
	13+600	HR for S19		0.194			
	13+600	HR for S20		0.22			
	13+600	HR for S21		0.2			

The summary of MIC canal reach based on lining type is thus tabulated as below:

Name	Type	Length, m	Slope, m/m	Discharge, m^3/sec
Head Reach	Concrete Lined	1570		
Reach-1	Concrete Lined	11500	1 : 1000	10.15
Reach-2	Unlined	2600	1 : 1850	4.55
Extension Canal	Unlined	11600		7.225
Reach-3	Unlined	2767	1 : 1540	1.95
Reach-4	Unlined	5533	1 : 1540	1.95
Total Lined, m		**13070**		
Total Unlined, m		**22500**		

2.7 Land Acquired by KIS

Land acquired by KIS covering different VDCs are as follows:

S.No.	Name of VDC	Bigha	Kattha	Dhur	Equivalent hectare (Ha)	Remarks
1	Mahabhara	31	6	8.5	21.16	
2	Topgachhi	54	11	15	36.88	
3	Panchgachhi	77	16	3	52.57	
4	Shibgunj	157	16	14.5	106.65	
5	Siba Satasi (Division Office)	6	2	0	4.07	
	Total, Ha				**221.33**	

2.8 KIS Office Infrastructures

Office buildings and staff quarters in KIS at Gainde, Jhapa were reported to be constructed in AD 1991. The list is as follows:

Office buildings and Staff Quarters

S.No.	**Building**	**No. of**	**Covered**	**Total area**	**Remarks**

	detail	Buildings	Area of one unit		
1	Office Building	1	292.5 m^2	292.5 m^2	
2	Foreign Engineer's Bachelor Quarter	1	278 m^2	278 m^2	
3	Foreign Engineer's Family Quarter	2	98.45 m^2	196.9 m^2	
4	Project Engineer's Quarter	1	141.9 m^2	141.9 m^2	
5	Family Quarter A Type	3	112 m^2	336 m^2	
6	Family Quarter B Type	4	86 m^2	344 m^2	
7	Bachelor Quarter	1	405.6 m^2	405.6 m^2	
8	Guest House	1	245 m^2	245 m^2	
9	Ware House	1	300 m^2	300 m^2	
10	Generator House	1	50 m^2	50 m^2	
11	Pump House	1	25 m^2	25 m^2	
12	Guard House	1	7.5 m^2	7.5 m^2	
13	Garage	2	90 m^2	180 m^2	

Site Buildings

S.No.	Building detail	No. of Buildings	VDC	Remarks
1	Site Building at Head Work	1 (8 Room building)	Satashi-8	
2	Site Building at Sardare Syphon	1 (2 Room building)	Satashi-8	
3	Site Building at Bengdanda	1 (at distributory S_1)	Satashi-7	
4	Site Building at Dhaule Chowk	1 (Bifucation Area)	Shibgunj-4	
5	Site Building at Hawaldar Chowk	1 (at distributory S_4)	Shibgunj-3 Ghimire Chowk	
6	Site Building at	1 (2 storey building)	Panchgachhi-9	

	Janata Chowk			
		1 (1 storey building)	Panchgachhi-9	
		1 (Godown)	Panchgachhi-9	
7	Site Building at Bishnu Chowk	1 (at distributory S_7)	Panchgachhi	
8	Site Building at Tunu Basti	1 (at distributory S_8)	Mahabhara	
9	Site Building at Bolo Chowk	1 (at distributory S_9)	Panchgachhi	
10	Site Building at Odari Chowk	1 (at distributory S_{10})	Panchgachhi	
11	Site Building at Mahamara Bazar	1 (at distributory S_{11})	Mahabhara	
		1 (2 storey building)	Mahabhara	
		1 (Godown)	Mahabhara	
12	Site Building at Kunji Bari	1 (at distributory S_{12})	Mahabhara	
13	Site Building at Birana Bari	1 (at distributory S_{13})	Dharampur	
14	Site Building at Dhyangri	1 (2 storey at distributory S_{14})	Topgachhi	
		1 (Godown)	Topgachhi	
15	Site Building at Lafadi	1 (at distributory S_{16})	Baigundhura	
16	Site Building at Baigundhura	1 (2 storey at distributory S_{19})	Baigundhura	

2.9 KIS Vehicles and Equipments

The vehicle and equipments in KIS is as listed below: not in use

S.No.	Vehicles/Equipments	Number	Remarks
1	Jeep	2	Major Repairing required
2	Truck	2	Major Repairing required
3	Dozer	2	Major Repairing required
4	Tanker	2	Major Repairing required
5	Grader	1	Major Repairing required
6	Roller	1	Major Repairing required
7	Crane	1	Major Repairing

			required
8	Motor Cycle	4	Repairing Required

2.10 Goods in KIS for office operation

List below represents goods in KIS for office operation as below:

S.N.	**Goods Paarticular**	**Number**	**Remarks**
1	Scorpion Jeep	1	operational
2	Pick up	1	
3	Jeep	1	
4	Motorcycle	4	
5	Laptop	3	
6	Printer	4	
7	Multi media Projector	1	
8	Level Machine	5	
9	Tripod	8	
10	Cycle	11	
11	Currentmeter	2	
12	Invertor	6	
13	Photo copy Machine	1	
14	Desktop computor set	1	
15	Color Printer	1	
16	Mower	1	
17	GPS	1	
18	Canon Camera	1	
19	Samuns J7 mobile set	1	
20	Other furnishing items		

3 IRRIGATION SYSTEM MAINTENENCE

3.1. General

Maintenance is defined as any work required either keeping an irrigation system at or restoring to a desired performance level. The objective of maintenance, therefore, is:

- Keep the canal system in top operating and stable condition at all times in order to assure a reliable and spatially equitable supply without any interruption
- Restore the canal system to a performance level to give a reasonable output
- Maximize the life and use of structures irrigation system facilities
- Avoid high cost of maintenance at later date due to deferred maintenance

3.2. Maintenance Categories

In broad sense maintenance is categorized into two as Preventive and Corrective maintenance. The maintenance of these types are accomplished through:

1. Regular routine maintenance
2. Seasonal maintenance
3. Periodic or annual maintenance
4. Emergency maintenance

The Routine Maintenance refers to the day to day work that must be implemented to keep the system in well operating condition. They are invariably preventive maintenance functions that prevent larger and expensive problems otherwise crop up later on stage. The Routine Maintenance work is performed on a regular basis by the group of laborers employed for whole operating season. If it is carried out in a competent manner, this becomes extremely cost effective.

The Seasonal Maintenance refers to work that arises during operation in a season. This is a type of work that cannot be accomplished by the employing casual laborers or small contractor during a short closure (seasonal) of canal. Fixing a scouring of bank downstream of hydraulic structures, breach of canal banks, heavy leakage on canal and so on are some of the examples of seasonal maintenance work items. This may be preventive measure to do temporarily for certain major problem which requires to be accomplished thoroughly during periodical maintenance. This may be classified as force account works.

The Periodic Maintenance work, also referred to as Annual Maintenance work, involves the extraordinary work like replacement or heavy maintenance of hydraulic structures, excavation of large quantity of silt in canal, comprehensive repair of service road and so

on. This type of work is accomplished under the annual programme of a project during the annual long closure of the canal system.

The Emergency Maintenance refers to maintenance of such a problem which, if not taken up immediately to prevent, may cause serious damages or failure; and correction to repair of such a damage or failure which, unless prompt action is taken, may entail catastrophic problem concerning canal and farmland. For example, certain event that may entail emergency maintenance/repair are:

- Embankment failure due to sloughing or piping
- Flood or heavy rain
- Interference by farmers such as unauthorized withdrawal of by making holes into the embankment, blocking of canal, tampering vertical sliding gates and so on.
- Careless operation of irrigation facilities

3.3. Priorities Determination

The priorities of maintenance need are determined based on importance of different components of physical system of an irrigation system. There are primarily divided into following sub group:

- Conveyance system consist of MIC
- Distribution system consists of SIC
- Application system consists of TIC and Field Channel, and
- Drainage system

A general rule of determining the priority of maintenance based on the probable consequences of the lack of maintenance may be adopted as follows for Conveyance System:

Conveyance System (or off-farm canal system)

- First Priority (P-I) may cover corrective maintenance
- Second Priority (P-II) may cover preventive maintenance of MIC and corrective maintenance of Distribution system.
- Third Priority (P-III) may cover preventive maintenance of distribution system.

Distribution and Application System

The responsibility of maintenance of distribution system and application systems rest absolutely with WUA. Application system consists of following components as:

- On-farm canal system
- Farm itself

Maintenance of on-farm canal system is essential for appropriate supply and distribution of irrigation water to individual farms. Therefore, proper maintenance of farm is eventually most important for uniform distribution over the farm and efficient use of water resulting in uniform and optimum production of crops over the farm.

The maintenance work items of both the components are such that they have to be accomplished essentially on routine and periodic basis. The emergency repair works would be required only when the on-farm sub-system has been completely damaged by unmanageable flow of water as a result of any breach in of parent canal banks, or by flood and extraordinary rainfall. Therefore, certain maintenance actions in case of on-farm system follow as:

On-farm canal system

- Cleaning of weeds, silt, and other obstacles on the TIC and Field Channels (FCs); raising the banks of the TIC and FC where necessary; and stopping the water leakage through the bank of TIC and FC are the Routine Maintenance work items during the operation of the canal in any crop season. But the cleaning of weeds, silt and other obstacles, keeping the banks of TICs and FCs in desired section, as well as construction and extension of FC to prepare the On-farm canal system fpe any crop season are categorized as Periodic Maintenance work.

Farm Maintenance

- The farm maintenance involve the appropriate leveling and grading of farm for proper distribution of irrigation water over farm, and construction and maintenance of appropriate boarder of the farm to prevent outflow of water applied to the farm. Fixing of leakage through the boarder and raising boarder height, if required, fall under routine maintenance category. The other maintenance work items are accomplished as periodic maintenance.

3.4. Principles of Maintenance Actions

A certain maintenance action is required either to ensure the stability of a canal/structure or to improve pr restore the supply. Adequacy of maintenance actions should indispensably be judged in relation to the cause and effect of any occurrence requiring maintenance, keeping in view the economic and social considerations.

A preventive maintenance is regarded as solution to cause against certain possible effect. However, the need of a preventive action implies certain case in itself which must be treated for an assured maintenance. On the other hand, corrective maintenance may not always be solution to a cause as well. The cause may relate to either the physical or operational factors. In the event of any maintenance without appropriately ascertaining and tackling the cause the recurrence of the event becomes inevitable.

The cost of maintenance in general should be related to the output and outcome. However, a social issue of subsistence may occasionally override an economic consideration. For instance, the rehabilitation of canal bank breached during a rainy

season cannot be deferred to the dry season closure period in favor of a cheaper solution at the cost of crops production by farmers. Thus, social consideration cannot always be regarded as subservient to an economic consideration in deciding the implementation of maintenance of an irrigation facility.

Finally, a diagnostic approach to deciding a maintenance action of cause/s (vector or scalar) leading to effect/s is required to be adopted.

The procedure to implement and execute the maintenance action may be determined by the logical steps and the personnel responsible for administration. The logical steps follows as:

- Identification of maintenance requirement
- Reporting of maintenance need
- Decision related to the maintenance action
- Execution of maintenance action
- Monitoring of executing maintenance action
- Reporting and record keeping of maintenance action

The personnels responsible for above steps related to implementation of maintenance action are:

- Senior Engineer chief of O&M unit
- An Engineer and sub engineer under O&M unit
- An engineer and sub-engineer under M&E unit

3.5. Maintenance condition of MIC

Main Irrigation Canal (MIC) of KIS is developed in two phases as Phase-I to provide irrigation facilities in 5000 ha command covering Reach-I to Reach-IV of MIC in year 1981, and as Phase-II covering Reach-V of MIC to command 2000 ha of irrigation facilities. About 11.5 km of MIC Reach-I is lined and remaining reaches is unlined. Along the lined portion with age old weephole points, however, maintenance conditions of concrete blocks are poor. At most of the places in Reach-I, block are detached due to seepage through canal banks. Along the seepage path created due to proliferation and growth of roots of trees planted over banks of the canal. The growth and proliferation of roots ruptures the structure of soil and causes bulking of soil mass in the body of embankment, creating a favourable path for seepage around the root branch. The effect is more prominent at the interface of soil and masonry if the trees are planed adjacent to a masonry structure. The bond between soil mass and the body of masonry structure depends on compaction of soil which is loosen by the growing roots. The seepage starts easily along the periphery of masonry structure and aids in easy removal of soil particles along relatively smooth and hard surface of masonry structures. The seepage eventually turn into piping resulting in breach of banks. This phenomenon is naturally expedited by further growth of trees.

In the unlined portion of MIC reaches sedimentation and berm formation as a result of high silt concentration during monsoon crop season coupled with unorganized and unmanaged operation of CRs across MIC and high invert level of DTOs have resulted soon in decreased MIC capacity. The problem of poor main irrigation canal maintenance further aggravated due to use of unauthorized outlets by farmers from banks of MIC.

Additionally, more than 30 years old major Cross Drainage (CD) siphon structures in MIC suffer from poor maintenance due to spatial and temporal regime change of crossing over drainage channel coupled with lack of adequate budget allocation over course of time.

Other hydraulic structures such as Drop (DP), CR, HR, cause way along service and gravel metallings are fairly maintained, except for Reach-V along reached of MIC.

3.6. Maintenance condition of headworks

Diversion Headworks at Domuka, Jhapa for KIS, through functioning, has been suffering from conspicuous scouring shown by exposure of sheet piles downstream of the structure. Further, wearing out of concrete carpet over weir portion led to decrease in pond water level over undersluice pocket during winter and spring crop seasons.

3.7. Maintenance activities of MIC

Maintenance activities are the functions of state of the system to be maintained, problem specifics, and maintenance time. The major inherent periodical maintenance required in MIC is to clean silt, sand and other materials transported from Kankai River. Some routine maintenance activities in MIC is summarized as below:

- Filling raincuts and rain holes when observed
- Filling holes created by burrow animals
- Cleaning weeds and other floating trash
- Replacing missing concrete block pitching as soon as it is viewed, to prevent further damages.
- Greasing moving parts of (Intakes, CR, HR and Spillway) gates
- Immediate repair of gates that have become non-operational
- Repairing excessive leakage through gates
- Repairing cracks in walls and/or replacing backfill material where water flows behind a structure.

Below is the list of certain major periodic and seasonal maintenance activities with recommended frequency per year of intervention summarized as:

Particulars	Category	Frequency	End Result	Remarks
		number of times per year		

MIC Hydraulic structures improvement	Periodic, corrective	As per need	Bulk water delivery with safety	
Repair and maintenance of gates	Periodic, corrective	2	Proper regulation and distribution of water	
Cleaning silt in canals and maintaining cross sections	Periodic, corrective	0.5	Availability of desired canal capacity	
Maintaining bank shape and cross section	Periodic, corrective	0.5	Availability of desired canal capacity and safe operation	
Removing unauthorized outlets	Periodic, corrective	As per need	Reduced water loss and better water management	
Maintaining service bank to proper section	Periodic, corrective	1	Easy mobility, safety to bank and proper canal section	
Removal of trees from and rehabilitation of canal bank	Periodic, corrective	1 Job	Stable canal bank and canal operation with safety	
Closing of seepage through canal bank	Seasonal, preventive	As per need	Reduced water loss and appropriate water management	
Maintenance of graveled service bank	Periodic, corrective	1	Easy mobility and safety to bank	

3.8. Maintenance plan for O&M

Intake of MIC is designed to pass 10.6 cumec of water throughout the year. It is anticipated that silt ejector at Sardare Intake located about 1.57 km downstream of intake would continue to perform well as it is currently operated for 1.5 days every week end (from Friday 12 noon to Sunday 6 am). It is therefore presumed that removal of silt in MIC reaches would require every 2 years interval; and now given the present condition of canal that de-silting works will be required to restore MIC reaches to its designed capacity in order to provide bulk water delivery to respective outlets from MIC. Table below proposes maintenance plan for O&M activities.

Maintenance Plan for O&M (put to annex)

S.N.	Particulars		Year-1		Year-2		Year-3		Year-4		Remarks
		Units	Progr	Actual	Progr	Actual	Progr	Actual	Progr	Actual	
1	**Physical Facilities development**										
	Drain reuse inlets and CDs	Nos.									
2	**MIC Maintenance**										
	Earthwork	Cu. m.	Yes		No		Yes		No		
	Structures	Nos									
	Breaches and Others	Nos									
	Major Damages										
3	**MIC Operation**										
a	Canal opening	Date									
	Spring Crop	15-									

		Feb									
	Summer Crop	1-July									
	Winter Crop	1-Jan									
b	Canal closing	Date									
	Spring Crop	15-Jun									
	Summer Crop	15 Oct									About 2.5 months canal is then closed
	Winter Crop	15-Feb									
c	Flow measurement	Perfomance									
	At Canal Intake	Yes/No									
	At Sardare Intake	Yes/No									
	At bifurcation to Reach-V	Yes/No									
	At bifurcation to Reach-III and IV	Yes/No									
4	**Assessment of irrigated area**										
	Spring Crop	Ha									
	Summer Crop	Ha									
	Winter Crop	Ha									
5	**Water related Disputes**										
a	At bifurcation to Reach-V										
b	At bifurcation to Reach-III and IV										
c	Direct Tertiary Outlets										
6	**Assessment of crop coverage**										
i) a	Spring Crop-1	Ha									
i) b	Spring Crop-2	Ha									
i) c	Spring Crop-3	Ha									
ii) a	Summer Crop-1	Ha									
ii) b	Summer Crop-2	Ha									
ii) c	Summer Crop-3	Ha									
iii) a	Winter Crop-1	Ha									
iii) b	Winter Crop-2	Ha									
iii) c	Winter Crop-3	Ha									
7	**Assessment of crop yield**										
i) a	Spring Crop-1	t/ha									
i) b	Spring Crop-2	t/ha									
i) c	Spring Crop-3	t/ha									

ii) a	Summer Crop-1	t/ha									
ii) b	Summer Crop-2	t/ha									
ii) c	Summer Crop-3	t/ha									
iii) a	Winter Crop-1	t/ha									
iii) b	Winter Crop-2	t/ha									
iii) c	Winter Crop-3	t/ha									
8	**Assessment of bulk water delivery**										
	Spring Crop	Cu. m.									
	Summer Crop	Cu. m.									
	Winter Crop	Cu. m.									
9	**Cropping Intensity**	%									
10	**Irrigation Intensity**	%									
11	**Annaul allotted Budget**	Nrs.									

3.9. MIC Facility O&M Cost

In deriving operation and maintenance cost of MIC system, following components of the system have been assumed as:

- Headworks comprises of operation of undersluice and intake
- Silt Ejector and MIC Reach-I intake at Sardare, and
- MIC canal system

The hydraulic structures in MIC is more than 30 years old, it is however functioning fairly good except for concrete blocks in Reach-I and Syphon structures as per report from SMU. The concrete blocks are poorly functional as a result of deferred maintenance of weep holes in place along concrete block pitching. Further, siphon structures require protection of drainage channel bank and bed due to high flood event and channel morphological change.

There is clear lack of cross section and profile data along MIC Reaches together with principal dimensions and elevation of hydraulic structures (conveyance and control) available with SMU at present. Further, no measurement of data pertaining to silt concentration along reached of MIC is in practice as yet. However, it is reported by SMU that in average of 2 years about 15 cm of silt gets deposited along MIC reaches. Therefore, 15 cm of silt deposition across about 4 m width of MIC along 22 km length of unlined canal amounting to 13200 Cu. M. is considered additionally in operation and maintenance cost. Table below represents O&M cost of items along MIC system.

Operation and Maintenance Cost of MIC

S.N.	Particulars	Type	Unit	Rate (Nrs)/unit	Freq /Nos	Months	Person month	Total amount, Nrs	Remarks
1	**Headworks**								
a	Operation of Undersluice gates: 3 nos	Spuervisor	mm	17730	1	9	9	159570	
a	Operation of Canal Intake gates: 2 nos	GOs/labour	mm	12320	4	9	36	443520	
		Labour	mm	12320	2	3	6	73920	
c	Maintenance of headworks gates (greasing/painting/minor repairs) **@50000**		year		2			**100000**	
d	Wooden log blockage and other debris clearence		LS					50000	
2	**Silt Ejector and Intake at Sardare**								
a	Operation of silt ejector gate: 3 nos	Spuervisor	mm	17730	1	9	9	159570	
b	Operation of Reach-I intake gate: 2 nos	GOs/labour	mm	12320	2	9	18	221760	
		Labour	mm	12320	2	3	6	73920	
c	Maintenance of headworks gates (greasing/painting/minor repairs) **@20000**		year		2			**40000**	
3	**Main Irrigation Canal**								
a	Raincuts during MIC operation over 36 km length.								
	Assume 1 Supervisor @ 5 km length	Spuervisor	mm	17730	7	4	28	496440	Monsoon month
	Assume 1 labour @ 1 km length	Labour	mm	12320	36	4	144	1774080	
b	Operation of MIC CR (check structure)	GOs	mm	12320	10	9	90	1108800	
c	Operation of MIC HR	GOs	mm	12320	21	9	189	2328480	
d	Operation of DTOs HR (54 nos)								
	Assume 30% of additional time for GOs in DTOs (54 nos)	GOs	mm	12320	54	3	162	1995840	
e	Operation of side spillway gates and	GOs	mm	12320	5	9	45	554400	

	syphons								
f	Maintenance of HR, CR and Spillway gates (greasing/painting/minor repairs) **@5000 per year 90**		Nos		90			**450000**	
g	Maintenance of conveyance structures for seepage and scouring		LS					**1500000**	
h	Maintenance of Service road under repair per year over 36 km length		Km	125000	36			4500000	New road about 4.5 lakh/km
i	Miscellaneous Repair (siphon etc)		LS					**2500000**	
	Sub Total							**18530300**	
	Contingency @ 5%							926515	
	Total							**19456815**	
j	MIC sediment removal @ 2 years								
	Assume 15 cm sediment deposit over 22 km MIC unlined across 4 m average width		Cu.m.	150	13200			1980000	Assume machine used

Summary to above tablr

3.10. Administrative Cost of MIC system

Below is the list of available staff and their yearly salary obtained from SMU for use in administrative cost.

Staffing Cost for MIC by Grade

S.N.	Post	Grade	Type	Total number	Monthly Salary	Yearly amount	Remarks
1	Division Chief (SDE)	G-II	Technical	1	27348.65	355532.45	
2	Engineer	G-III	Technical	4	27065.81	351855.53	
3	Admin Assist	NG-I	Admin		23823.46	309704.98	
4	Sr AO	NG-I	Technical		24251.14	315264.82	
5	Surveyor	NG-I	Technical	2	24948.79	324334.27	
6	Accountant	NG-I	Account		20023.25	260302.25	
7	AO	NG-II	Technical		**18500**	240500	
8	Supervisor	NG-II	Technical	2	17730	230490	Contract
9	Excavator		Technical	1	14670	190710	Contract

	Operator						
10	Tractor Driver		Technical	1	6500	84500	Contract
11	Dhalpa/Chaukidar		Technical/Admin	26	12320	160160	1 in monthly contract, rest in daily wages
12	Office Assistant		Admin	2	12980	168740	Contract
13	Light Vehicle Driver		Technical	1	14670	190710	Contract
	Total			**40**		**3182804.3**	

Yearly amount is taken as monthly amount*13 to account for Dasain Bonus

Darbandi in annex

Further, in the absence of historical records of office administration, below is the proposed list of annual expenditure for KIS administration as:

Administration Expenditure (Annual), Nrs

S.N.	Particular	Yearly	Remarks
1	Staffing Salary	3182804	
2	Dareness Allowance	100000	
3	Other allowances		
4	Dress	83000	
5	Water supply and Electricity	75000	
6	Communication and trunk call	48000	
7	House Rent		
8	Fuel for Vehicle	262000	
9	Operation and Maintenance	35000	
10	Insurance	45000	
11	Office expenditure	61000	
12	Other service fee	**450000**	
13	Personnel training	0	
14	Monitoring and Evaluation	191000	
15	Travel expenditure	25000	
16	Miscellaneous	25000	
17	Communication charge	43000	
18	Skill development and awareness training	100000	
	Total	**4725804.30**	

3.11. Annual Cost summary of MIC system

Below is the list of annual cost summary of O&M activities for use in budgeting requirements of MIC operation.

O&M Cost Summary

S. N.	Particulars	Cost, Nrs	Remarks
1	Headworks	827010.00	
2	Silt Ejector and Intake at Sardare	495250.00	
3	Main Irrigation Canal O&M	14708040.00	
4	Miscellaneous repair	2500000.00	
5	Contingency	926515.00	
6	MIC sediment removal @ 2 years	1980000.00	
7	Improved Water Management Activities	**1500000.00**	Proposed Lump Sum
8	Administrative cost	4725804.30	
	Total	**27662619.30**	

3.12. Annual Budget plan for MIC system

Below is the list of annual budget plan for O&M activities in MIC for KIS operation.

S.N.	Particulars	Cost, Nrs	Year-1	Year-2	Year-3	Year-4	Year-5	Remarks
1	Headworks and Sardare Intake	1322260.00	1322260.00	1322260.00	1322260.00	1322260.00	1322260.00	
2	MIC Canal Operation	14708040.00	14708040.00	14708040.00	14708040.00	14708040.00	14708040.00	
3	Miscellaneous Repair/emergency nature	2500000.00	2500000.00	2500000.00	2500000.00	2500000.00	2500000.00	
4	Contingency	1853030.00	1853030.00	1853030.00	1853030.00	1853030.00	1853030.00	
5	MIC sediment removal @ 2 years	1980000.00	1980000.00		1980000.00		1980000.00	
6	Improved Water Management Activities	1500000.00	1500000.00	1500000.00	1500000.00	1500000.00	1500000.00	
7	Administrative cost of MIC under KIS	4725804.30	4725804.30	4725804.30	4725804.30	4725804.30	4725804.30	
	Total Cost	**27,662,619.30**	**27,662,619.30**	**25,682,619.30**	**27,662,619.30**	**25,682,619.30**	**27,662,619.30**	

All the above costs are present day fixed costs. Headworks and Sardare intake costs are estimated for smooth operation and no major cost for maintenance and replacement considered. MIC desilting works is proposed be carried out every two years. Finally, timely implementation of above activities envisages no deferred maintenance and no cost over run.

Building repairs maintenance, vehicle repair maintenance……..

4 ASSET VALUATION

4.1 KIS COST RECOVERY

??????????????????????

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5 KIS ADMINISTRATIVE ORGANISATION

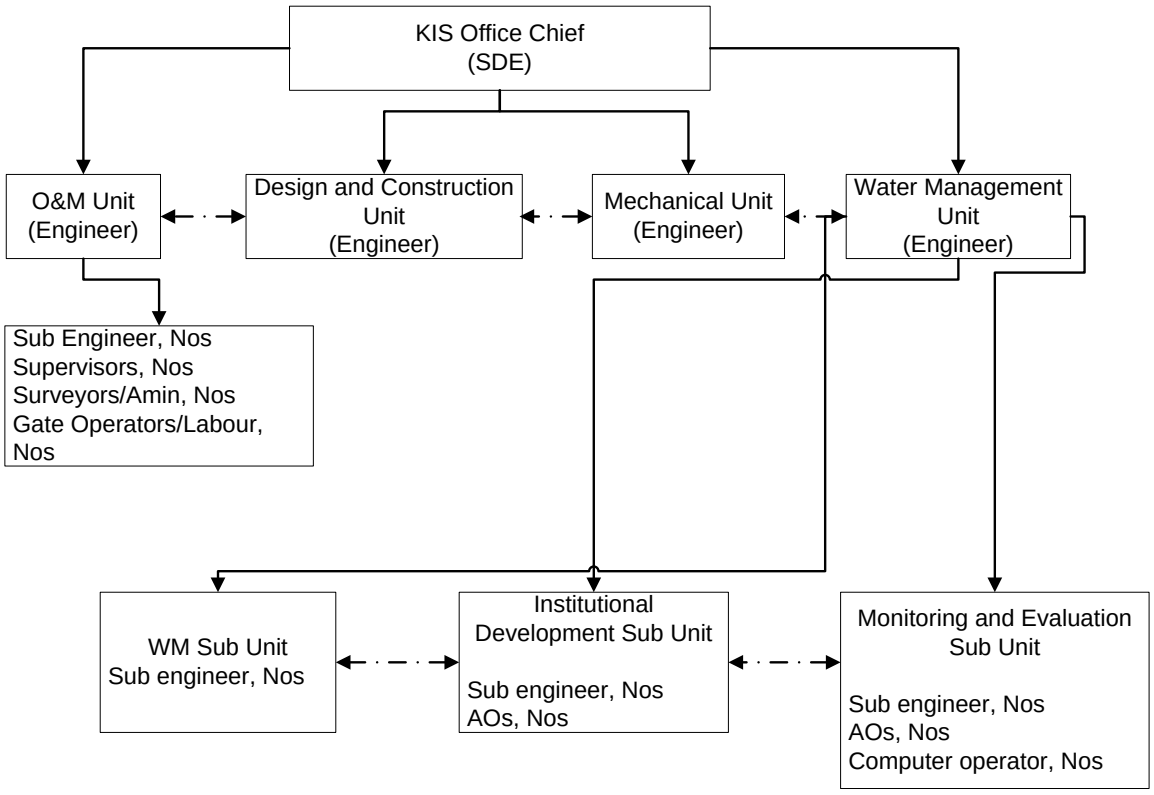

Figure 5-1: Proposed Organization Chart of KIS Office