Table 6.15 COST ESTIMATION

	WORK ITEM		F/C	L/C	First Stage (Immediate Programme)								Second Stage												Third Stage							
					1993		1994		1995		Sub - Total		1996		1997		1998		1999		2000		Sub - Total		2001		2002		2003		200	
					F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	
(A) Observation	(1) Rainfall Observation	Manual Raingauge		Manual Gauge / Foundation				660		660	0	1,320		210		210		200		200		200	0	1,020		210		210		200		
		Tipping Bucket Type	Raingauge / Recorder / Data Logger	Manual Gauge / Foundation			6,370	600		400	6,370	1,000	1,960	200	1,960	200	1,960	200	1,960	200	1,960	200	9,800	1,000	1,470	330	980	200	980	200		
		Weighing Type	Raingauge / Recorder	Manual Gauge / Foundation			192				192	0	192	130	192	130	192	130	192	130	192	130	960	650								
		Spare Inst. / Parts etc.	Spare Parts	Repair / Manual Gauge			656				656	0	215	130	215	130	215	130	215	130	215	130	1,075	650	147	90	98	90	98	90		
	(2) Water Level Observation	Staff Gauge		Plate / Foundation				126		234	0	360		324		324		288		288		396	0	1,620								
		Float-type	Recorder / Data Logger	Gauge Well / Gauge House / Clearing / Repairing			1,108	13		97	1,108	110	831	4,146	831	2,648	831	2,648	554	2,648	554	2,270	3,601	14,360								
		Pressure-type	W.L. Gauge / Data Logger	Protection Pipe / GI Pipe			1,524	121		242	1,524	363	1,016	242	508	121	508	121	508	121	1,016	242	3,556	847								
		Peak Water Level Gauge		GI Pipe / Foundation							0	0											0	0		450		450		450		
		Survey Instrument	Level / Transit				2,250				2,250	0											0	0								
		Spare Inst. / Parts etc.	Spare Parts / Data Logger				681				681	0	1,057		1,006		1,006		874		366		4,309	0	157							
	(3) Discharge Measurement	Single Winch		Tower / Cable / Winch / Cablecar / Foundation				3,094			0	3,094		663								663	0	1,326		1,768		1,547		5,967		
		Double Winch	Double Winch / Suspention Wire	Operation House / Anchor Block / Wire			10,576	5,970			10,576	5,970	9,254	6,790	7,932	5,820	7,932	5,820	7,932	5,820	2,644	1,940	35,694	26,190								
		Propeller-type Current Meter	Body / Weight / Counter				15,490				15,490	0	3,580										3,580	0								
		Price-type Current Meter	Body / Weight / Counter				2,580				2,580	0	5,160										5,160	0								
		Spare Inst. / Parts etc.	Spare Parts				1,807				1,807	0	874										874	0								
	(4) Sediment Observation	Point Integrated Sampling	Sampler Bottle / Tubidity Meter				6,352				6,352	0											0	0								
		Depth Integrated Sampling	Sampler Bottle / Tubidity Meter				1,105				1,105	0	1,525										1,525	0								
		Spare Inst. / Parts etc.	Spare Parts				746				746	0	153										153	0								
	(5) Water Quality Observation	Field Test Kit									0	0		110		110		110		110		110	0	550		110		110		110		
		Sensor									0	0	828										828	0	552		552		552		552	
	(6) Basic Station	Office		Building				1,110		740	0	1,850											0	0								
Sub - Total (A)					0	0	51,437	11,694	0	2,373	51,437	14,067	26,645	12,945	12,644	9,693	12,644	9,647	12,235	9,647	6,947	6,281	71,115	48,213	2,326	2,958	1,630	2,607	1,630	7,017	552	
(B) Analysis of Sediment and Water quality	(1) Sediment Analysis	Sediment Labo.	Laboratory Equip.				1,220				1,220	0	172										172	0								
	(2) Water quality Analysis	Water quality Labo.	Laboratory Equip.								0	0			832								832	0	832							
Sub - Total (B)					0	0	1,220	0	0	0	1,220	0	172	0	832	0	0	0	0	0	0	0	1,004	0	832	0	0	0	0	0	0	0
(C) Management of Facility	(1) Maintenance of Station	Regional Workshop	Repair Equip. and Tools	Repair Tools / Building / Furnitures							0	0	556		556								1,112	0								
	(2) Repair of Equip.	Central Workshop	Repair Equip. and Tools	Repair Tools			1,108				1,108	0											0	0								
	(3) Current Meter Calibration Facility		Calibration Equip.	Calibration Tank			21,073	3,998		2,665	21,073	6,663											0	0								
Sub - Total (C)					0	0	22,181	3,998	0	2,663	22,181	6,663	556	0	556	0	0	0	0	0	0	0	1,112	0	0	0	0	0	0	0	0	0
(D) Data Processing and Management	(1) Data Collection	Telemetry	Telemetry Equip.	Building / Foundation							0	0											0	0								25,641
	(2) Data Processing	Data Logger System	Reader / Memory Card				4,954				4,954	0	3,328		540		540		540		540		5,488	0	540		540		540		540	
Sub - Total (D)					0	0	4,954	0	0	0	4,954	0	3,328	0	540	0	540	0	540	0	540	0	5,488	0	540	0	540	0	540	0	26,181	
(E) Data Quality Improvement and Training	(1) Staff Training	Invitation of Foreign Expert					9,192		18,384		27,576	0	13,788		13,788		9,192		9,192		9,192		55,152	0	11,490		11,490		8,791		8,791	
		Training in Manufacture					733		733		1,466	0	733				733				733		2,199	0	733				733			
		Attendance of International Cource					366		366		732	0	366		366		366		366		366		1,830	0	366		366		366		366	
	(2) Training Center		Computer Equip./ Observation Inst / Building	Building / Furniture / Land 5,000 m2			20,477	33,349	28,121	8,866	48,598	42,217											0	0								
Sub - Total (E)					0	0	30,768	33,349	47,604	8,866	78,372	42,217	14,887	0	14,154	0	10,291	0	9,558	0	10,291	0	59,181	0	12,589	0	11,856	0	9,890	0	9,157	
(F) Computer System	(1) Design and Programming				3,129		8,344	2,500	6,258	2,500	17,731	5,000											0	0								6,258
	(2) Computer Instrument						3,951		5,550		9,501	0									1,533		1,533	0								3,808
	(3) Soft Wear						1,942		3,281		5,223	0											0	0								2,925
	(4) Furnitures and Installation						350		350	500	700	500											0	0								
	(5) Staff Training								5,215		5,215	0											0	0								5,215
Sub - Total (F)					3,129	0	14,587	2,500	20,654	3,000	38,370	5,500	0	0	0	0	0	0	0	0	1,533	0	1,533	0	0	0	0	0	0	0	0	18,206
Sub - Total (A+B+C+D+E+F)					3,129	0	125,147	51,543	68,258	16,904	196,534	68,447	45,588	12,945	28,726	9,693	23,475	9,647	22,333	9,647	19,311	6,281	139,433	48,213	16,287	2,958	14,026	2,607	12,060	7,017	54,096	
Administration and Engineering Service					13,799	0	24,137	1,556	19,537	517	57,473	2,073	3,928	436	2,184	243	2,055	228	2,018	224	1,377	153	11,562	1,285	599	67	430	48	827	92	3,621	
Contingency and Reserve					0	0	5,326	7,356	1,865	2,161	7,191	9,517	1,535	1,942	729	1,454	659	1,447	639	1,447	451	942	4,013	7,232	185	444	109	391	109	1,053	1,673	
Staff Training						0		1,003		281	0	1,284		307		146		132		128		75	0	787		37		22		22		
Grand - Total					16,928	0	154,610	61,458	89,660	19,863	261,198	81,321	51,051	15,630	31,638	11,535	26,189	11,454	24,990	11,446	21,139	7,451	155,007	57,517	17,071	3,505	14,564	3,068	12,995	8,183	59,390	
Price Escalation							6,184	5,531	7,316	3,736	13,501	9,267	6,374	4,611	5,374	4,748	5,674	6,170	6,630	7,750	6,679	6,170	30,731	29,448	6,292	3,287	6,165	3,233	6,241	9,633	32,038	1
Grand - Total (With Escalation)					16,928	0	160,794	66,989	96,976	23,599	274,698	90,588	57,426	20,242	37,013	16,283	31,863	17,624	31,620	19,196	27,818	13,621	185,739	86,965	23,363	6,792	20,730	6,301	19,236	17,816	91,428	1
O. M. R. (Operation, Maintenance and Replacement)					0	0	2,326	997	3,267	1,400	5,593	2,397	4,122	1,767	4,645	1,991	5,168	2,215	5,714	2,449	6,192	2,654	25,842	11,075	6,546	2,805	6,873	2,945	7,215	3,092	8,585	

Table 6.15 COST ESTIMATION

(Unit : 1,000 NRs)

	F/C	L/C	First Stage (Immediate Programme) 1993 F/C	1993 L/C	1994 F/C	1994 L/C	1995 F/C	1995 L/C	Sub - Total F/C	Sub - Total L/C	Second Stage 1996 F/C	1996 L/C	1997 F/C	1997 L/C	1998 F/C	1998 L/C	1999 F/C	1999 L/C	2000 F/C	2000 L/C	Sub - Total F/C	Sub - Total L/C	Third Stage 2001 F/C	2001 L/C	2002 F/C	2002 L/C	2003 F/C	2003 L/C	2004 F/C	2004 L/C	2005 F/C	2005 L/C	Sub - Total F/C	Sub - Total L/C	Grand - Total F/C	Grand - Total L/C	Grand - Total F/C+L/C
Raingauge		Manual Gauge / Foundation				660		660	0	1,320		210		210		200		200		200	0	1,020		210		210		200		200		200	0	1,020	0	3,360	3,360
Bucket Type	Raingauge / Recorder / Data Logger	Manual Gauge / Foundation		6,370	600		400		6,370	1,000	1,960	200	1,960	200	1,960	200	1,960	200	1,960	200	9,800	1,000	1,470	330	980	200	980	200					3,430	730	19,600	2,730	22,330
g Type	Raingauge / Recorder	Manual Gauge / Foundation		192					192	0	192	130	192	130	192	130	192	130	192	130	960	650											0	0	1,152	650	1,802
t. / Parts etc.	Spare Parts	Repair / Manual Gauge		656					656	0	215	130	215	130	215	130	215	130	215	130	1,075	650	147	90	98	90	98	90		80		80	343	430	2,074	1,080	3,154
age		Plate / Foundation			126		234		0	360		324		324		288		288		396	0	1,620								162		144	0	306	0	2,286	2,286
e	Recorder / Data Logger	Gauge Well / Gauge House / Clearing / Repairing		1,108	13		97		1,108	110	831	4,146	831	2,648	831	2,648	554	2,648	554	2,270	3,601	14,360											0	0	4,709	14,470	19,179
-type	W.L. Gauge / Data Logger	Protection Pipe / GI Pipe		1,524	121		242		1,524	363	1,016	242	508	121	508	121	508	121	1,016	242	3,556	847											0	0	5,080	1,210	6,290
ter Level Gauge		GI Pipe / Foundation							0	0											0	0		450		450		450		270		240	0	1,860	0	1,860	1,860
nstrument	Level / Transit			2,250					2,250	0											0	0											0	0	2,250	0	2,250
t. / Parts etc.	Spare Parts / Data Logger			681					681	0	1,057		1,006		1,006		874		366		4,309	0	157										157	0	5,147	0	5,147
Winch		*Tower / Cable / Winch / Cablecar / Foundation*			*3,094*				*0*	*3,094*		*663*								*663*	*0*	*1,326*		*1,768*		*1,547*		*5,967*		*5,304*		*5,304*	*0*	*19,890*	*0*	*24,310*	*24,310*
Winch	Double Winch / Suspention Wire	Operation House / Anchor Block / Wire		10,576	5,970				10,576	5,970	9,254	6,790	7,932	5,820	7,932	5,820	7,932	5,820	2,644	1,940	35,694	26,190											0	0	46,270	32,160	78,430
-type Current Meter	Body / Weight / Counter			15,490					15,490	0	3,580										3,580	0											0	0	19,070	0	19,070
e Current Meter	Body / Weight / Counter			2,580					2,580	0	5,160										5,160	0											0	0	7,740	0	7,740
t. / Parts etc.	Spare Parts			1,807					1,807	0	874										874	0											0	0	2,681	0	2,681
egrated Sampling	Sampler Bottle / Tubidity Meter			6,352					6,352	0											0	0											0	0	6,352	0	6,352
egrated Sampling	Sampler Bottle / Tubidity Meter			1,105					1,105	0	1,525										1,525	0											0	0	2,630	0	2,630
t. / Parts etc.	Spare Parts			746					746	0	153										153	0											0	0	899	0	899
t Kit									0	0		110		110		110		110		110	0	550		110		110		110		110		110	0	550	0	1,100	1,100
									0	0	828										828	0	552		552		552		552				2,208	0	3,036	0	3,036
		Building				1,110		740	0	1,850											0	0											0	0	0	1,850	1,850
Sub - Total (A)			0	0	51,437	11,694	0	2,373	51,437	14,067	26,645	12,945	12,644	9,693	12,644	9,647	12,235	9,647	6,947	6,281	71,115	48,213	2,326	2,958	1,630	2,607	1,630	7,017	552	6,126	0	6,078	6,138	24,786	128,690	87,066	215,756
Labo.	Laboratory Equip.			1,220					1,220	0	172										172	0											0	0	1,392	0	1,392
ality Labo.	Laboratory Equip.								0	0			832								832	0	832										832	0	1,664	0	1,664
Sub - Total (B)			0	0	1,220	0	0	0	1,220	0	172	0	832	0	0	0	0	0	0	0	1,004	0	832	0	0	0	0	0	0	0	0	0	832	0	3,056	0	3,056
Workshop	Repair Equip. and Tools	Repair Tools / Building / Furnitures							0	0	556		556								*1,112*	*0*											0	0	*1,112*	*0*	*1,112*
Workshop	Repair Equip. and Tools	Repair Tools		1,108					1,108	0											0	0											0	0	1,108	0	1,108
	Calibration Equip.	Calibration Tank		21,073	3,998		2,665		21,073	6,663											0	0											0	0	21,073	6,663	27,736
Sub - Total (C)			0	0	22,181	3,998	0	2,665	22,181	6,663	556	0	556	0	0	0	0	0	0	0	1,112	0	0	0	0	0	0	0	0	0	0	0	0	0	23,293	6,663	29,956
y	Telemetry Equip.	Building / Foundation							0	0											0	0							25,641	637			25,641	637	25,641	637	26,278
ger System	Reader / Memory Card			4,954					4,954	0	3,328		540		540		540		540		5,488	0	540		540		540		540		540		2,700	0	13,142	0	13,142
Sub - Total (D)			0	0	4,954	0	0	0	4,954	0	3,328	0	540	0	540	0	540	0	540	0	5,488	0	540	0	540	0	540	0	26,181	637	540	0	28,341	637	38,783	637	39,420
of Foreign Expert				9,192		18,384			27,576	0	13,788		13,788		9,192		9,192		9,192		55,152	0	11,490		11,490		8,791		8,791		8,791		49,353	0	132,081	0	132,081
in Manufacture				733		733			1,466	0	733				733				733		2,199	0	733				733				733		2,199	0	5,864	0	5,864
ce of International Cource				366		366			732	0	366		366		366		366		366		1,830	0	366		366		366		366		366		1,830	0	4,392	0	4,392
	Computer Equip./ Observation Inst./ Building	Building / Furniture / Land 5,000 m2		20,477	33,349	28,121	8,866		48,598	42,217											0	0											0	0	48,598	42,217	90,815
Sub - Total (E)			*0*	*0*	*30,768*	*33,349*	*47,604*	*8,866*	*78,372*	*42,217*	*14,887*	*0*	*14,154*	*0*	*10,291*	*0*	*9,558*	*0*	*10,291*	*0*	*59,181*	*0*	*12,589*	*0*	*11,856*	*0*	*9,890*	*0*	*9,157*	*0*	*9,890*	*0*	*53,382*	*0*	*190,935*	*42,217*	*233,152*
			3,129		8,344	2,500	6,258	2,500	17,731	5,000											0	0							6,258				6,258	0	23,989	5,000	28,989
					3,951		5,550		9,501	0									1,533		1,533	0							3,808				3,808	0	14,842	0	14,842
					1,942		3,281		5,223	0											0	0							2,925				2,925	0	8,148	0	8,148
					350		350	500	700	500											0	0											0	0	700	500	1,200
							5,215		5,215	0											0	0							5,215				5,215	0	10,430	0	10,430
Sub - Total (F)			3,129	0	14,587	2,500	20,654	3,000	38,370	5,500	0	0	0	0	0	0	0	0	1,533	0	1,533	0	0	0	0	0	0	0	18,206	0	0	0	18,206	0	58,109	5,500	63,609
Sub - Total (A+B+C+D+E+F)			3,129	0	125,147	51,543	68,258	16,904	196,534	68,447	45,588	12,945	28,726	9,693	23,475	9,647	22,333	9,647	19,311	6,281	139,433	48,213	16,287	2,958	14,026	2,607	12,060	7,017	54,096	6,763	10,430	6,078	106,899	25,423	442,866	142,083	584,949
			13,799	0	24,137	1,556	19,537	517	57,473	2,073	3,928	436	2,184	243	2,055	228	2,018	224	1,377	153	11,562	1,285	599	67	430	48	827	92	3,621	402	596	66	6,072	675	75,107	4,032	79,139
			0	0	5,326	7,356	1,865	2,161	7,191	9,517	1,535	1,942	729	1,454	659	1,447	639	1,447	451	942	4,013	7,232	185	444	109	391	109	1,053	1,673	1,014	27	912	2,102	3,813	13,306	20,562	33,868
				0		1,003		281	0	1,284		307		146		132		128		75	0	787		37		22		22		267		5	0	353	0	2,424	2,424
Grand - Total			*16,928*	*0*	*154,610*	*61,458*	*89,660*	*19,863*	*261,198*	*81,321*	*51,051*	*15,630*	*31,638*	*11,535*	*26,189*	*11,454*	*24,990*	*11,446*	*21,139*	*7,451*	*155,007*	*57,517*	*17,071*	*3,505*	*14,564*	*3,068*	*12,995*	*8,183*	*59,390*	*8,447*	*11,053*	*7,061*	*115,073*	*30,264*	*531,278*	*169,102*	*700,380*
					6,184	5,531	7,316	3,736	13,501	9,267	6,374	4,611	5,374	4,748	5,674	6,170	6,630	7,750	6,679	6,170	30,731	29,448	6,292	3,287	6,165	3,233	6,241	9,633	32,038	11,048	6,643	10,213	57,379	37,414	101,611	76,130	177,741
Grand - Total (With Escalation)			16,928	0	160,794	66,989	96,976	23,599	274,698	90,588	57,426	20,242	37,013	16,283	31,863	17,624	31,620	19,196	27,818	13,621	185,739	86,965	23,363	6,792	20,730	6,301	19,236	17,816	91,428	19,495	17,696	17,274	172,452	67,678	632,889	245,231	878,121
placement)			0	0	2,326	997	3,267	1,400	5,593	2,397	4,122	1,767	4,645	1,991	5,168	2,215	5,714	2,449	6,192	2,654	25,842	11,075	6,546	2,805	6,873	2,945	7,215	3,092	8,585	3,679	8,947	3,834	38,166	16,357	69,601	29,829	99,429

Table 7.1 GENERAL ITEMS OF FIELD TRAINING

Person to be trained	Item to be trained	Content
Field technician	1. Precipitation Observation	• Installation, observation method, operation of instrument
	2. Water level observation	• ditto
	Data processing	
	3. Discharge measurement	• ditto (including flood measurement)
	4. Sediment observation	• Observation method, operation of instrument
	5. Inspection of the station	• Method, reporting
	6. Maintenance of instruments and facilities (including simple adjustment/ calibration of instrument)	• Method (including minor repair)
	7. Civil construction works related observation system	• Construction/Repair of facilities • Planning and Cost estimation • Design, drawing
	8. Survey	• Field practice such as levelling, cross section, theodlite survey etc. • Mapping and drawing, Survey method
Part time Observer	1. Precipitation observation	• Observation method, Operation of instrument
	2. Water level observation	• ditto
	3. Sediment Sampling	• ditto
	4. Daily inspection of the Station	• method (including minor repair)
	5. Maintenance of instruments and facilities	• method

Table 7.2 TRAINING ITEM FOR IMMEDIATE PROGRAMME (1/2)

Training Item	Training Hour				
	N	F	J	S	E
1. Introduction					
1.1 Outline of DHM	1				
1.2 Observation of DHM	1	1			
1.3 Data Processing in DHM	1		1		
1.4 Data Checking in DHM	1			1	
1.5 Analysis					1
Sub-Total	4	1	1	1	1
2. Observation					
2.1 Precipitation					
2.2.1 General	1	1			
2.2.2 Observation Network					3
2.2.3 Manual Gauge		1	1		
2.2.4 Recording Gauge (Weighting Type)		5	1		5
2.2.5 Recording Gauge (Other Type)					
2.2 Snowfall					1
2.3 Rainfall					
2.3.1 Radar					5
2.3.2 Satellite					1
2.4 Snow cover			1		
2.5 Evaluation			1		
2.6 Water Level					
2.6.1 General	1	1	1		
2.6.2 Observation Network					3
2.6.3 Manual Gauge		1	1		
2.6.4 Recording Gauge (Float Type)		5	1		
2.6.5 Recording Gauge (Other Type)					5
2.7 Discharge Measurement					
2.7.1 General	1	1	1		
2.7.2 Current Meter		5	5		
2.7.3 Float					5
2.7.4 Other Way					5
2.8 Sediment					
2.8.1 General	1				
2.8.2 Selection of site					2
2.8.3 Suspended-Sediment					
2.8.3.1 Sampling		1	1		
2.8.3.2 Sediment Concentration				5	
2.8.3.3 Suspended-Sediment Discharge					2
Sub-Total	4	21	14	5	37

Table 7.2 TRAINING ITEM FOR IMMEDIATE PROGRAMME (2/2)

Training Item	Training Hour				
	N	F	J	S	E
3. Data Processing					
3.1 Computer					
3.1.1 General Knowledge on Computer			1	1	
3.1.2 General Knowledge on Software			1	1	
3.1.3 Data Base Software				15	
3.1.4 Application Software				30	30
3.2 Procedure					
3.2.1 General				1	
3.2.2 Preliminary Data Checking				1	1
3.2.3 Data Entry				1	
3.2.4 Determination of Rating Curve				5	5
3.2.5 Estimation of Discharge				1	1
3.2.6 Data Processing Checking					5
3.2.7 Overall Checking					15
3.2.8 Final Checking					1
3.2.9 Deal with Error					1
3.2.10 Emergency Case		1		1	1
Sub-Total	0	1	3	57	60
4. Basic Knowledge					
4.1 Meteorology				5	
4.2 Statistics in Hydrology Analysis				5	
4.3 Precipitation				5	
4.4 Hydrograph				5	
4.5 Hydrologic Losses				5	
4.6 Stream Flow				5	
Sub-Total				30	
5. Analysis					
5.1 General					1
5.2 Precipitation					
5.2.1 Mean Area Precipitation					5
5.2.2 Depth-Area-Duration Analysis					5
5.2.3 Probable Maximum Precipitation					5
5.2.4 Rainfall Frequency					5
5.2.5 Rainfall Intensities					5
5.3 Stream Flow					
5.3.1 Low Flow Analysis					15
5.3.2 Flood Frequency					15
5.3.3 Runoff Relations with Rainfall					15
Sub-Total					71
6. Management					
6.1 General		1	1	1	1
6.2 How to Instruct Observer				1	
6.3 Management on System					5
Sub-Total		1	1	2	7
Grand Total	8	24	19	95	176

Note N : Newly employed staff
F : Field assistant
J : Junior hydro-meteorological assistant
S : Senior hydro-meteorological assistant
E : Engineer

Table 7.3 COST ESTIMATION FOR IMMEDIATE PROGRAMME

	WORK ITEM		F/C	L/C	1993		1994		1995		Total	
					F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
(A) Observation	(1) Rainfall Observation	Manual Raingauge		Manual Gauge / Foundation				660		660	0	1,320
		Tipping Bucket Type	Raingauge / Recorder / Data Logger	Manual Gauge / Foundation			6,370	600		400	6,370	1,000
		Weighing Type	Raingauge / Recorder	Manual Gauge / Foundation			192				192	0
		Spare Inst. / Parts etc.	Spare Parts	Repair / Manual Gauge			655				655	0
	(2) Water Level Observation	Staff Gauge		Plate / Foundation				126		234	0	360
		Float-type	Recorder / Data Logger	Gauge Well / Gauge House / Clearing / Repairing			1,108	13		97	1,108	110
		Pressure-type	W.L. Gauge / Data Logger	Protection Pipe / Gl Pipe			1,524	121		242	1,524	363
		Peak Water Level Gauge		Gl Pipe / Foundation							0	0
		Survey Instrument	Level / Transit				2,250				2,250	0
		Spare Inst. / Parts etc.	Spare Parts / Data Logger				681				681	0
	(3) Discharge Measurement	Single Winch		Tower / Cable / Winch / Cableway / Foundation				3,094			0	3,094
		Double Winch	Double Winch / Suspension Wire	Operation House / Anchor Block / Wire			10,576	5,970			10,576	5,970
		Propeller-type Current Meter	Body / Weight / Counter				15,490				15,490	0
		Price-type Current Meter	Body / Weight / Counter				2,580				2,580	0
		Spare Inst. / Parts etc.	Spare Parts				1,807				1,807	0
	(4) Sediment Observation	Point Integrated Sampling	Sampler Bottle / Turbidity Meter				6,352				6,352	0
		Depth Integrated Sampling	Sampler Bottle / Turbidity Meter				1,105				1,105	0
		Spare Inst. / Parts etc.	Spare Parts				746				746	0
	(5) Water Quality Observation	Field Test Kit									0	0
		Sensor									0	0
	(6) Basic Station	Office		Building				1,110		740	0	1,850
Sub - Total (A)					0	0	51,437	11,094	0	2,373	51,437	14,067
(B) Analysis of Sediment and Water quality	(1) Sediment Analysis	Sediment Labo.	Laboratory Equip.				1,220				1,220	0
	(2) Water quality Analysis	Water quality Labo.	Laboratory Equip.								0	0
Sub - Total (B)					0	0	1,220	0	0	0	1,220	0
(C) Management of Facility	(1) Maintenance of Station	Regional Workshop	Repair Equip. and Tools	Repair Tools / Building / Furniture							0	0
	(2) Repair of Equip.	Central Workshop	Repair Equip. and Tools	Repair Tools			1,108				1,108	0
	(3) Current Meter Calibration Facility		Calibration Equip.	Calibration Tank			21,073	3,998		2,665	21,073	6,663
Sub - Total (C)					0	0	22,181	3,998	0	2,665	22,181	6,663
(D) Data Processing and Management	(1) Data Collection	Telemetry	Telemetry Equip.	Building / Foundation							0	0
	(2) Data Processing	Data Logger System	Reader / Memory Card				4,954				4,954	0
Sub - Total (D)					0	0	4,954	0	0	0	4,954	0
(E) Data Quality Improvement and Training	(1) Staff Training	Invitation of Foreign Expert					9,192		18,384		27,576	0
		Training in Manufacture					733		733		1,466	0
		Attendance of International Cource					366		366		732	0
	(2) Training Center		Computer Equip / Observation Inst / Building	Building / Furniture / Land 5,000 m2			20,477	33,349	28,121	8,866	48,598	42,215
Sub - Total (E)					0	0	30,768	33,349	47,604	8,866	78,372	42,215
(F) Computer System	(1) Design and Programming				3,129		8,344	2,500	6,258	2,500	17,731	5,000
	(2) Computer Instrument						3,551		5,550		9,101	0
	(3) Soft Ware						1,942		3,281		5,223	0
	(4) Furniture and Installation						350		350	500	700	500
	(5) Staff Training								5,215		5,215	0
Sub - Total (F)					3,129	0	14,587	2,500	20,654	3,000	38,370	5,500
Sub - Total (A+B+C+D+E+F)					3,129	0	125,147	51,543	68,258	16,904	196,534	68,447
Administration and Engineering Service					13,759	0	24,137	1,556	19,537	517	57,473	2,073
Contingency and Reserve					0	0	5,326	7,356	1,865	2,161	7,191	9,517
Staff Training						0		1,003		281	0	1,284
Grand - Total					16,928	0	154,610	61,458	89,660	19,863	261,198	81,321
Price Escalation							6,184	5,531	7,316	3,736	13,501	9,267
Grand - Total (With Escalation)					16,928	0	160,794	66,989	96,976	23,599	274,698	90,588
O. M. R. (Operation, Maintenance and Replacement)					0	0	2,326	997	3,267	1,400	5,593	2,397

FIGURES

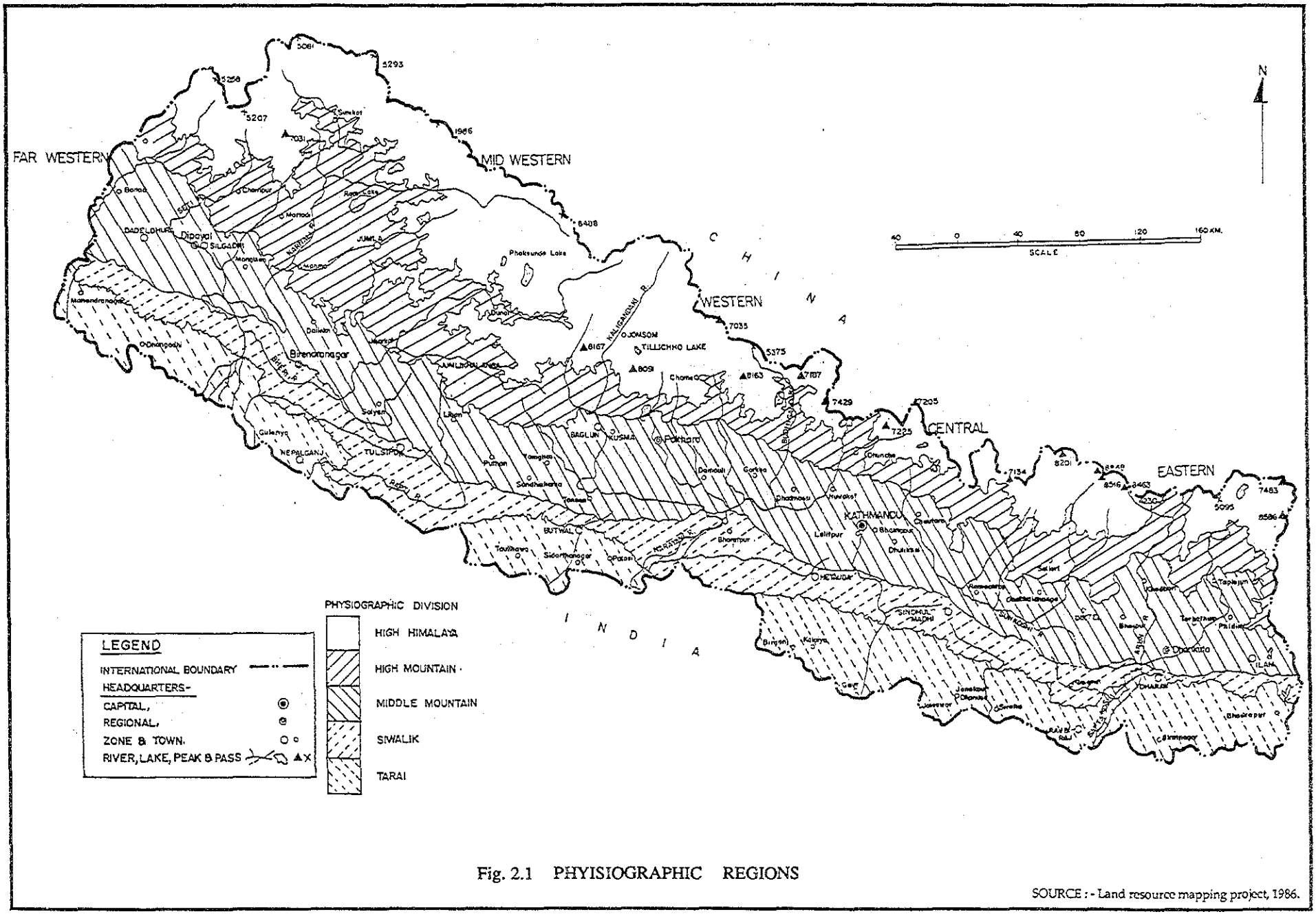
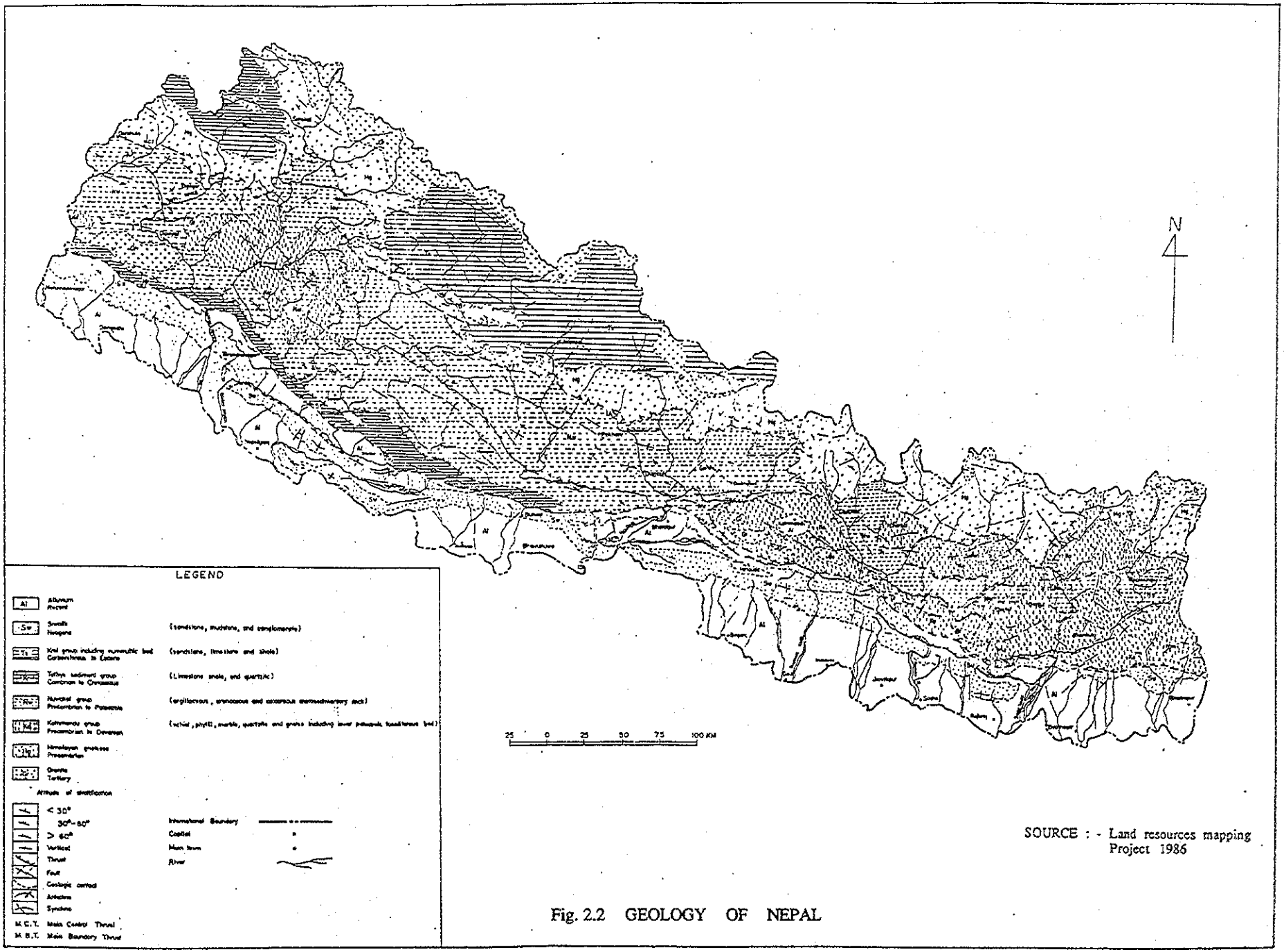


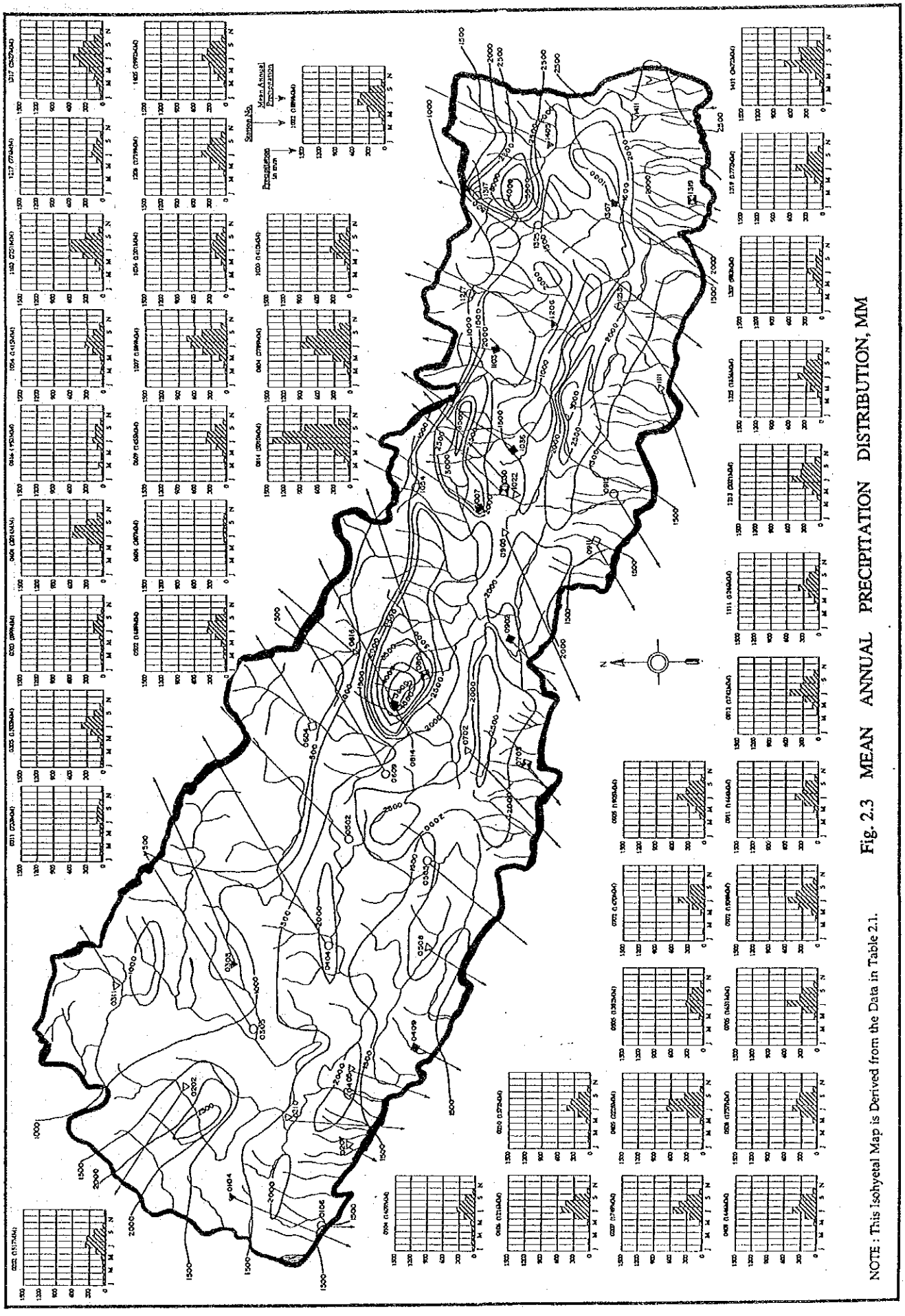
Fig. 2.1 PHYISIOGRAPHIC REGIONS

SOURCE : - Land resource mapping project, 1986.



SOURCE : - Land resources mapping Project 1986

Fig. 2.2 GEOLOGY OF NEPAL



NOTE : This Isohyetal Map is Derived from the Data in Table 2.1.

Fig. 2.3 MEAN ANNUAL PRECIPITATION DISTRIBUTION, MM

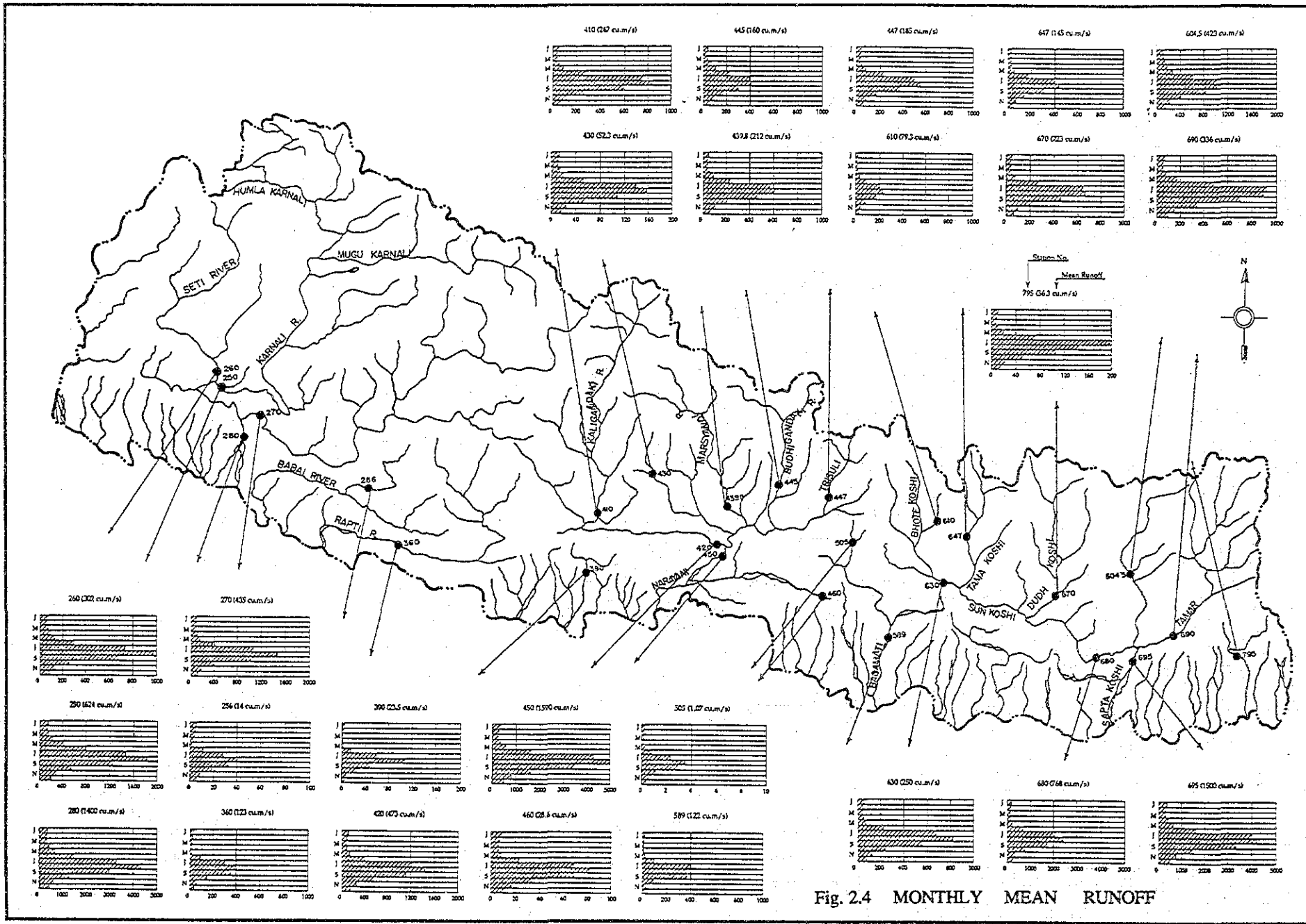


Fig. 2.4 MONTHLY MEAN RUNOFF

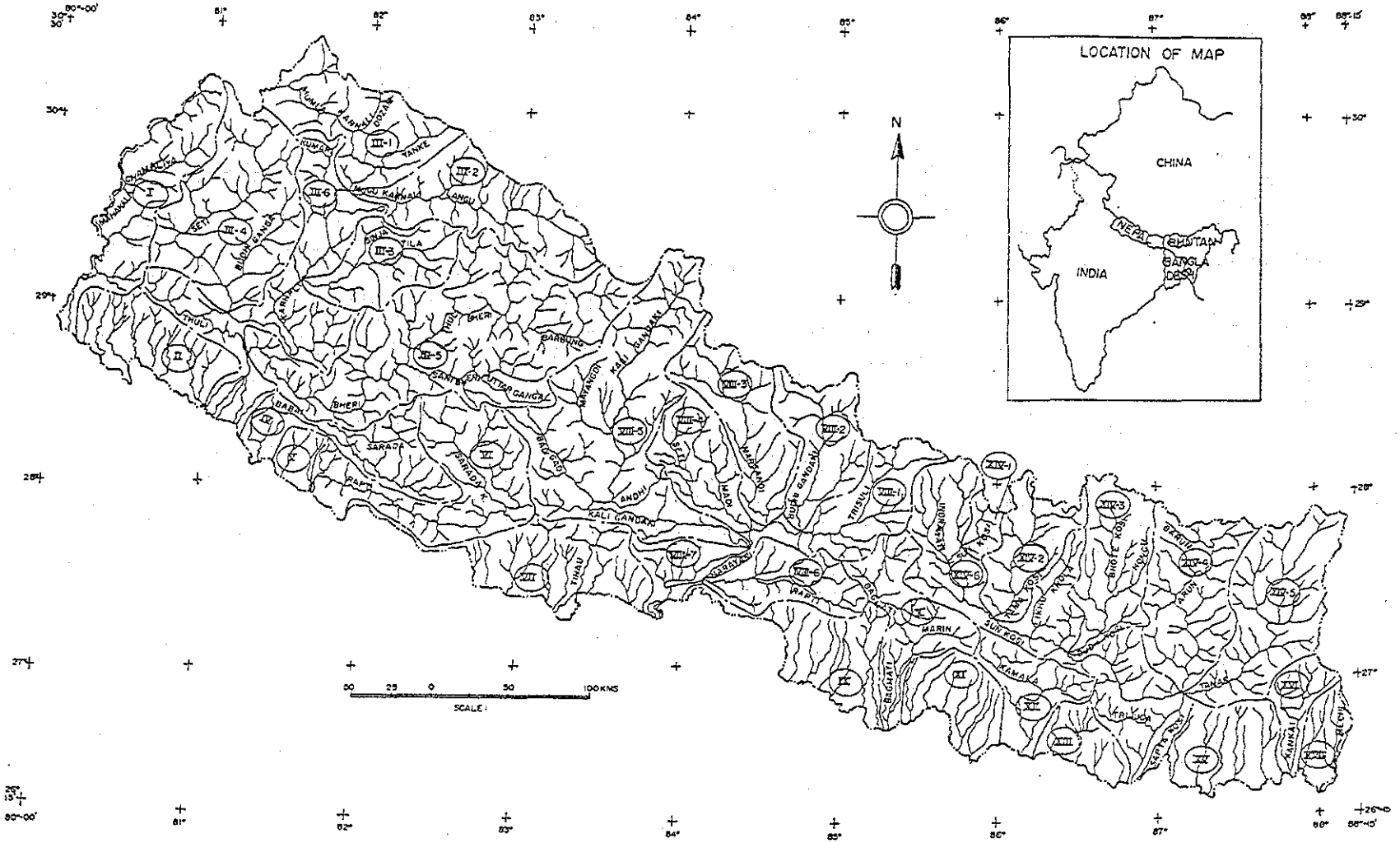


Fig. 2.5 RIVER AND RIVER BASIN IN NEPAL

NOTE : See Table 3.1 for Basin Name.

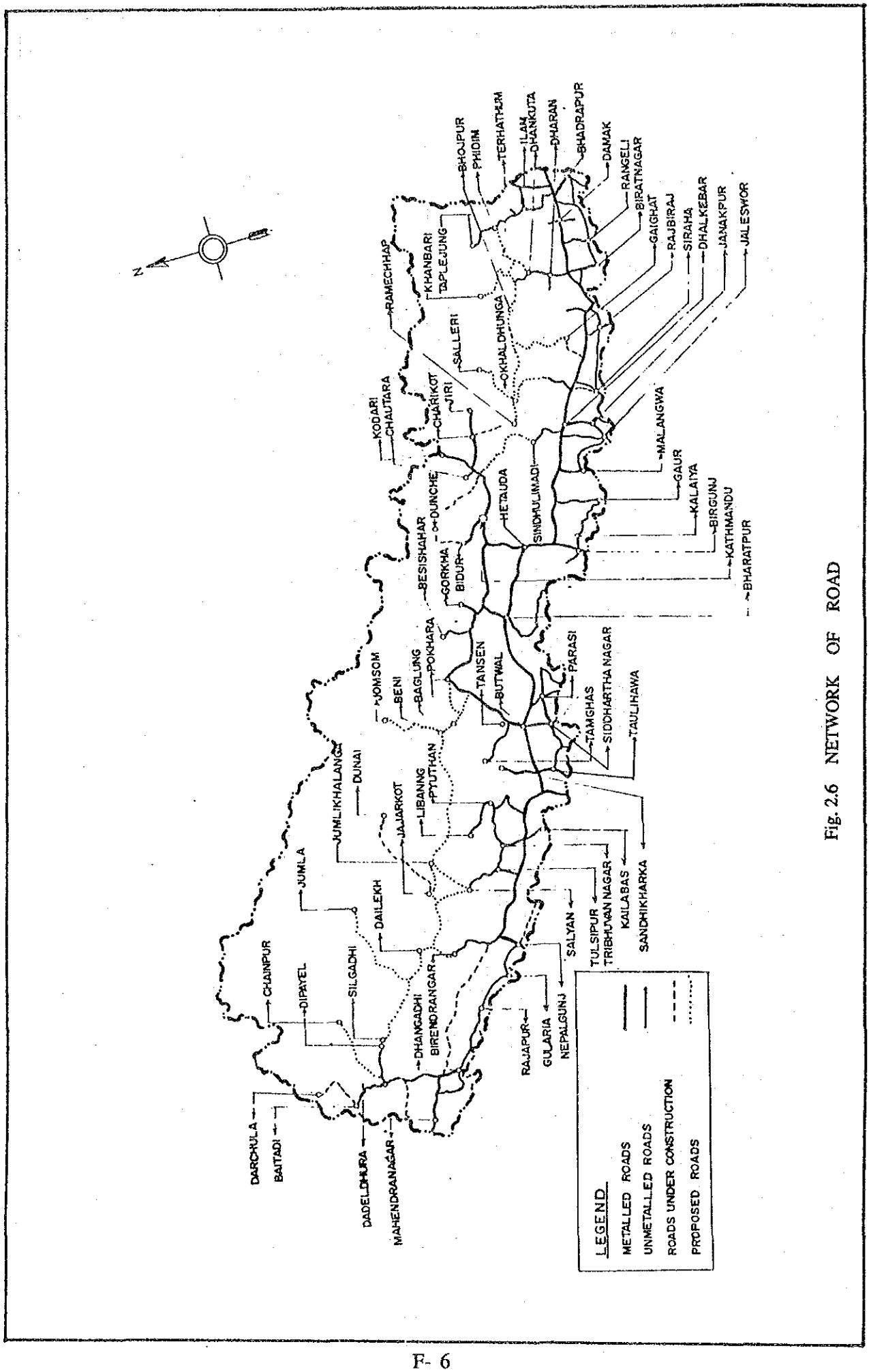


Fig. 2.6 NETWORK OF ROAD

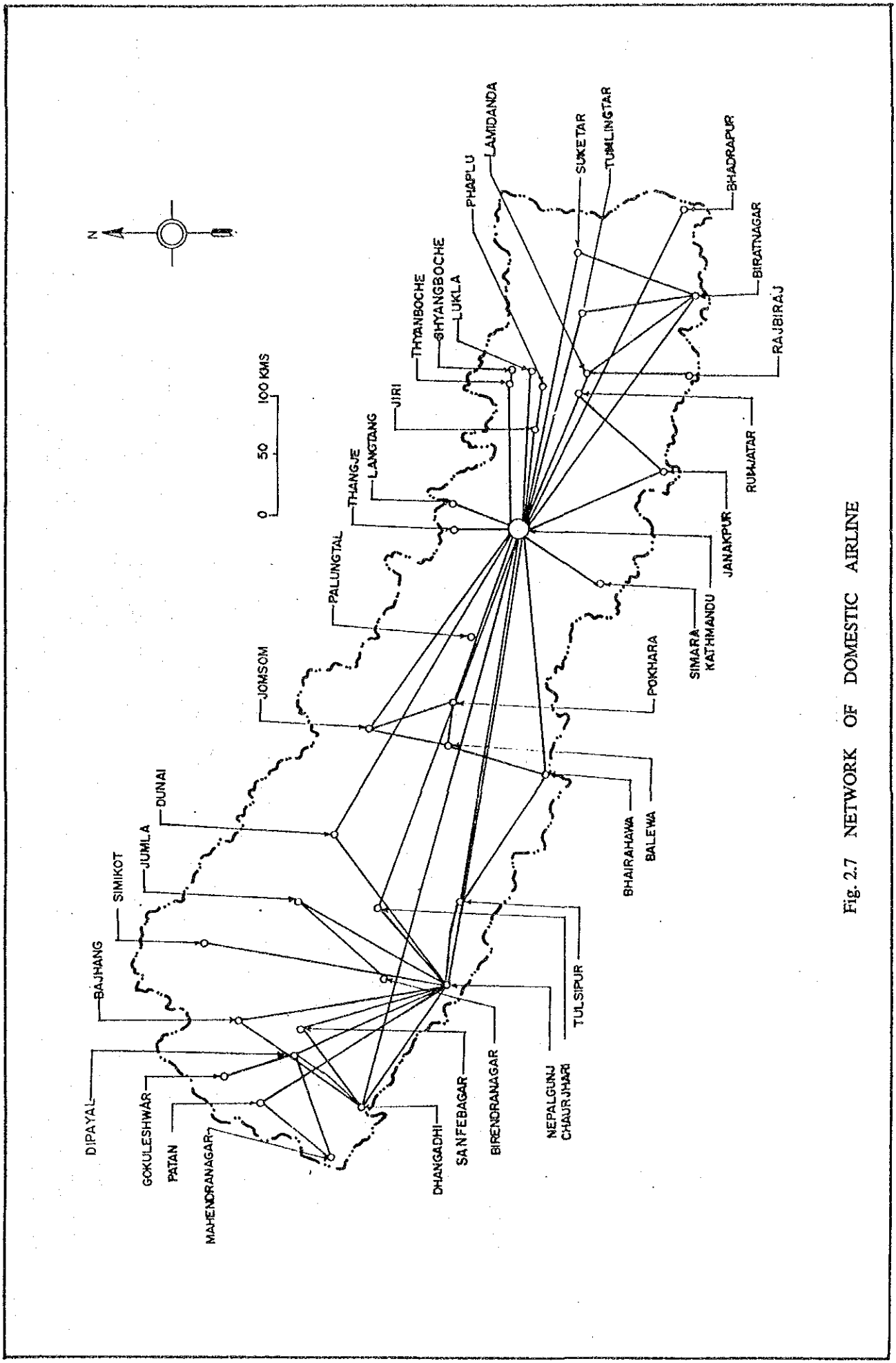


Fig. 2.7 NETWORK OF DOMESTIC AIRLINE

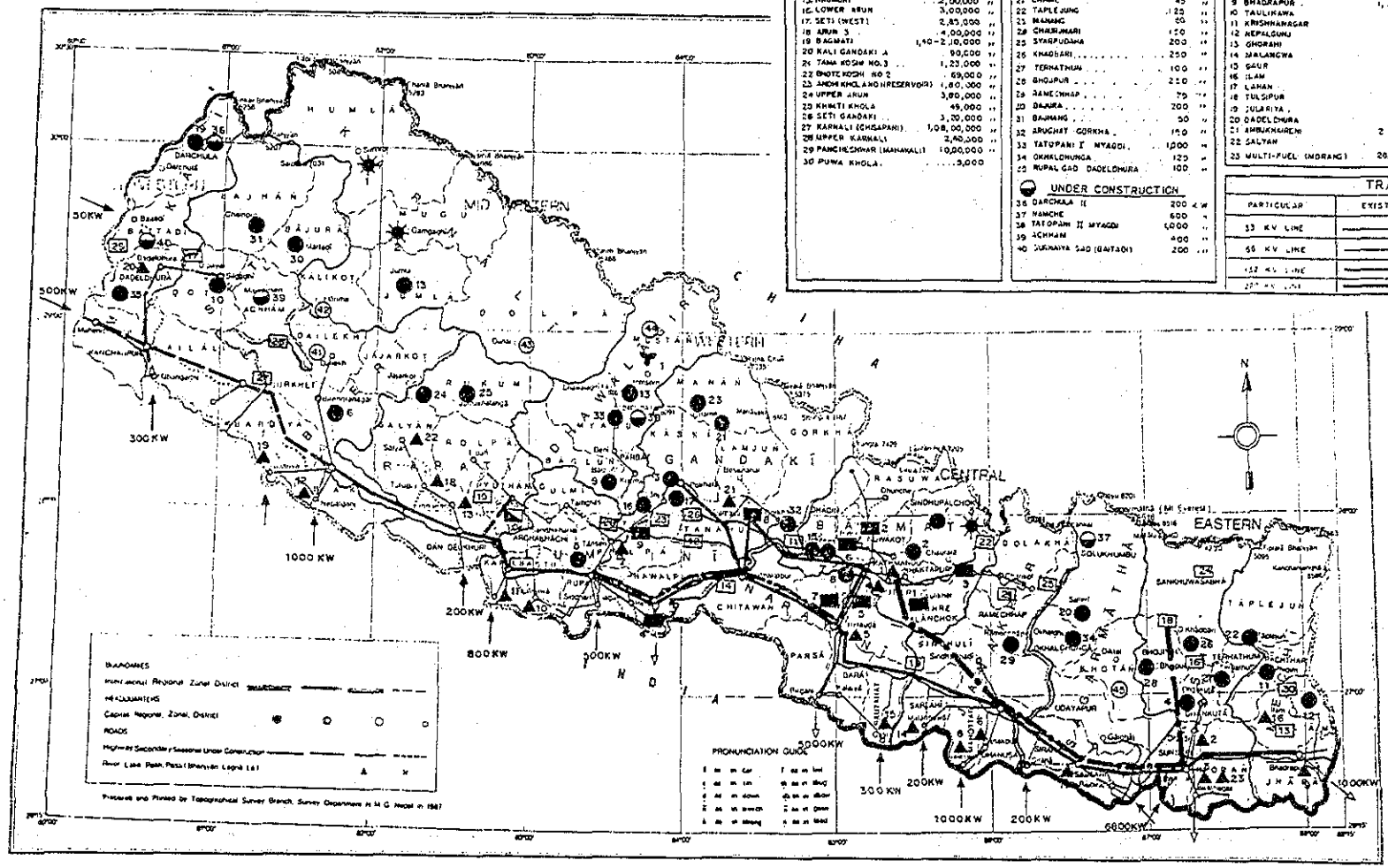
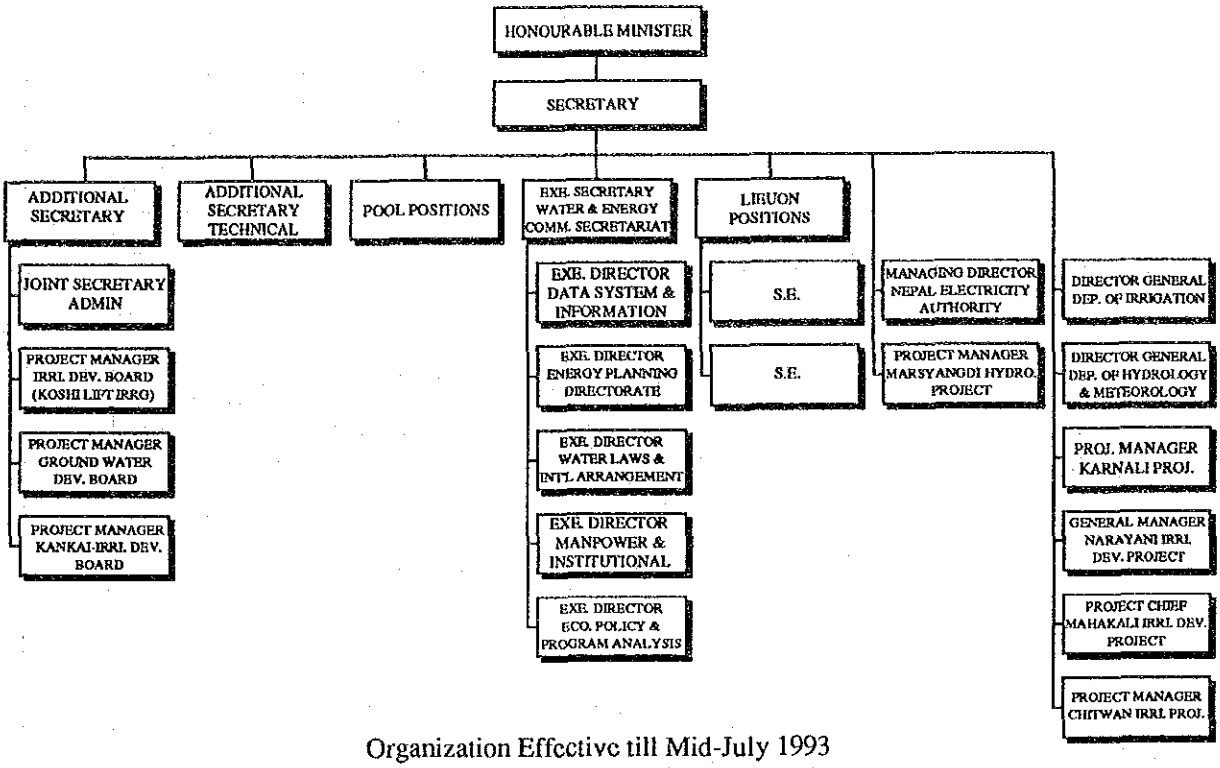
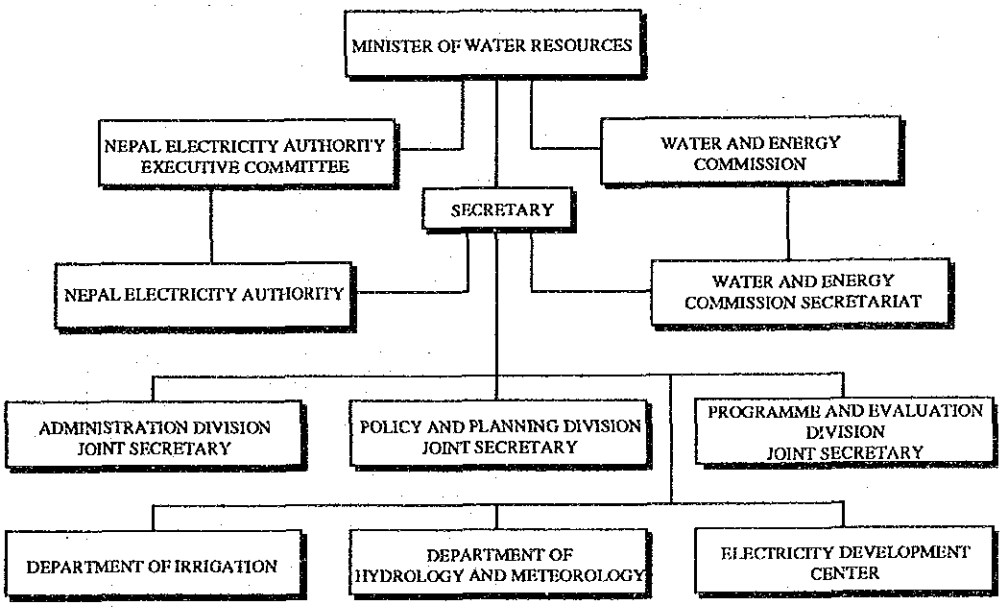


Fig. 2.8 EXISTING AND PLANNED POWER SUPPLY

(SOURCE: Nepal Electricity Authority FY 1990/91, A YEAR IN REVIEW)

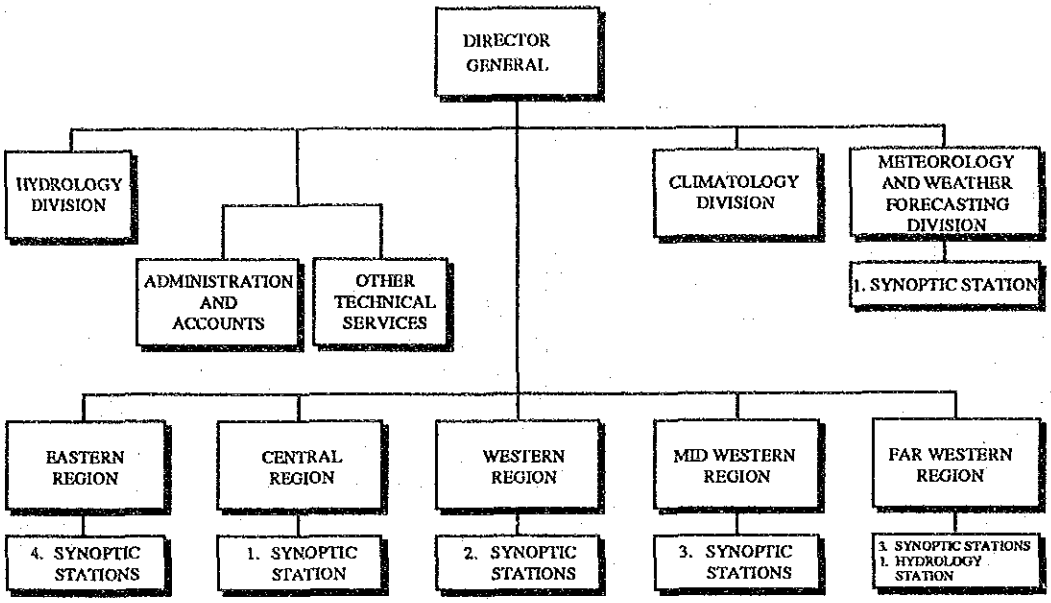


Organization Effective till Mid-July 1993

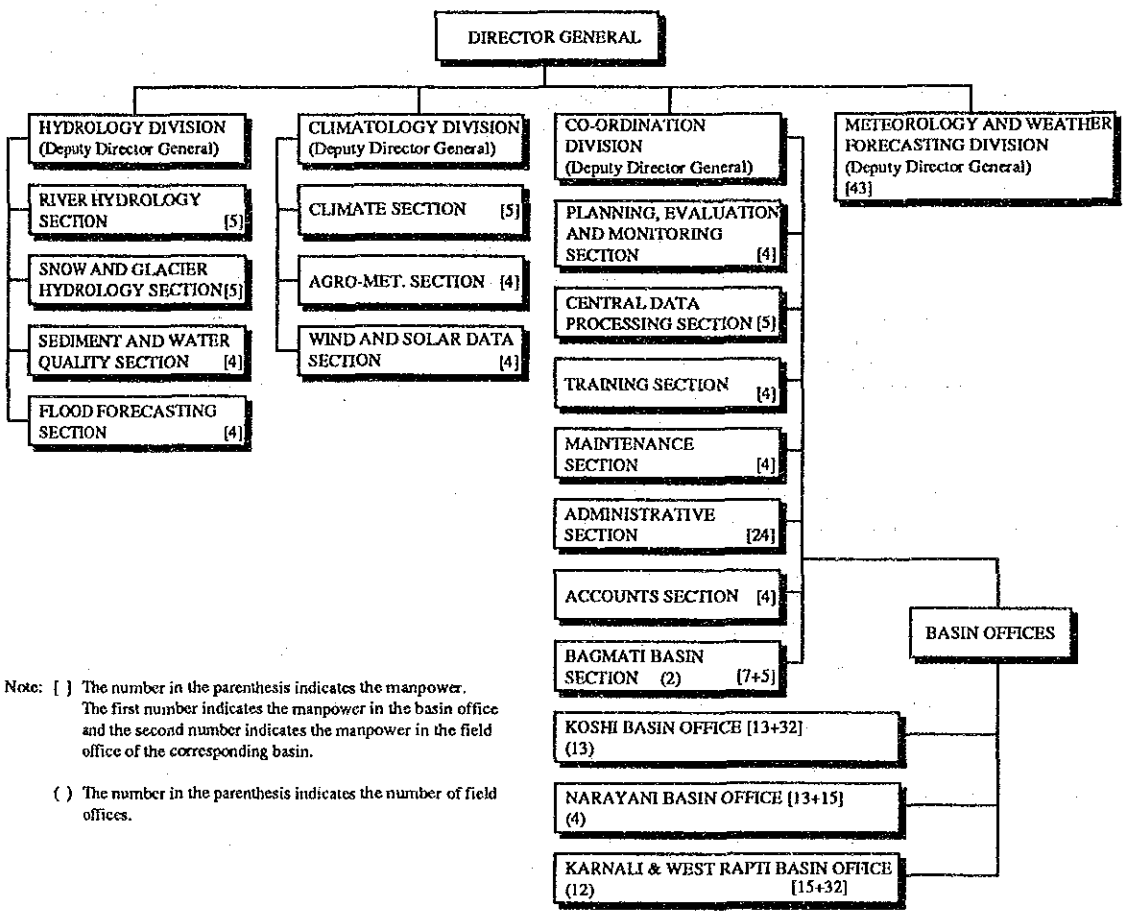


Organization Effective after Mid-July 1993

Fig. 3.1 ORGANIZATION CHART OF MINISTRY OF WATER RESOURCES



Organization Effective till Mid-July 1993



Note: [ ] The number in the parenthesis indicates the manpower. The first number indicates the manpower in the basin office and the second number indicates the manpower in the field office of the corresponding basin.

( ) The number in the parenthesis indicates the number of field offices.

Organization Effective after Mid-July 1993

Fig. 3.2 ORGANIZATION CHART OF DHM

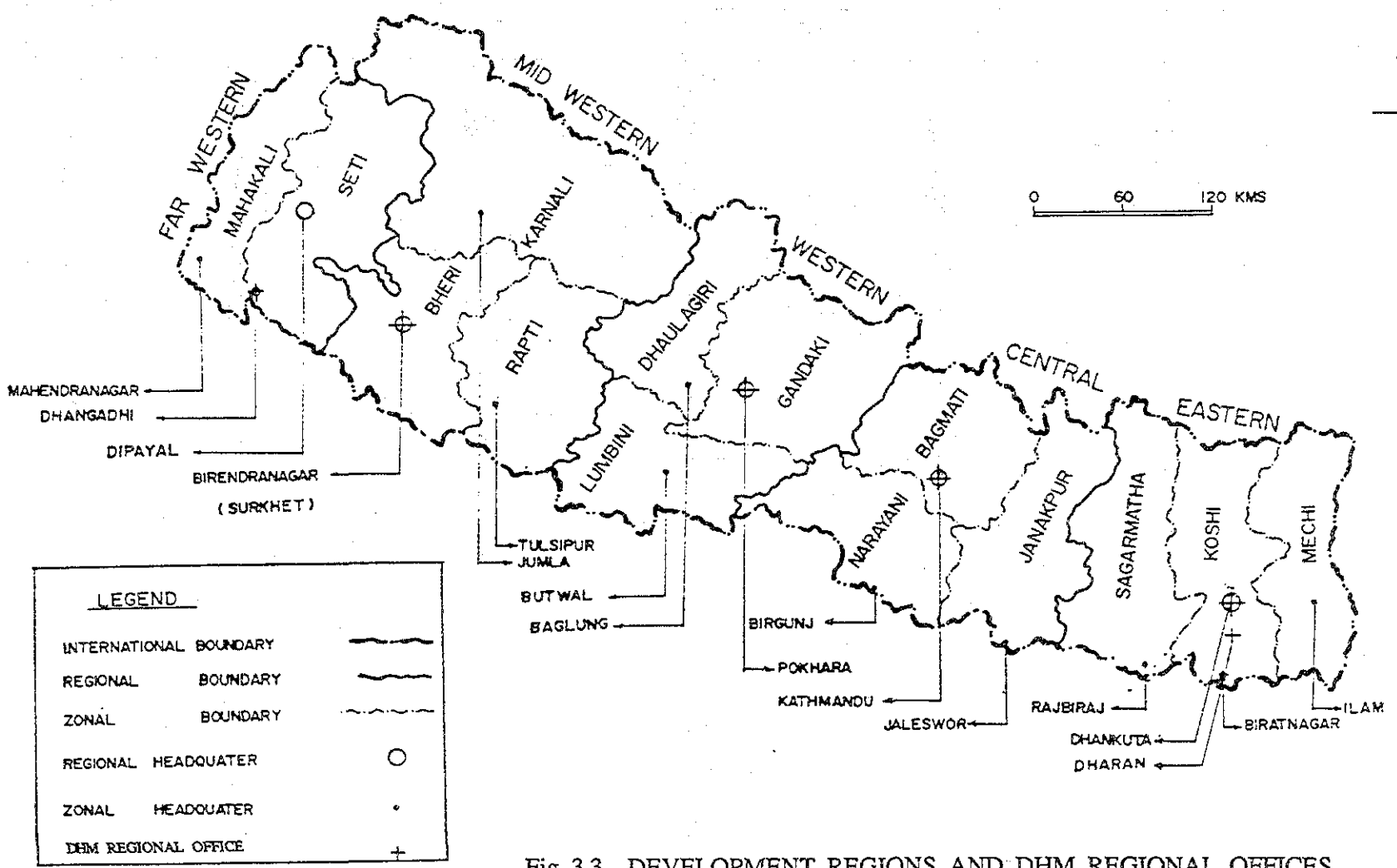


Fig. 3.3 DEVELOPMENT REGIONS AND DHM REGIONAL OFFICES

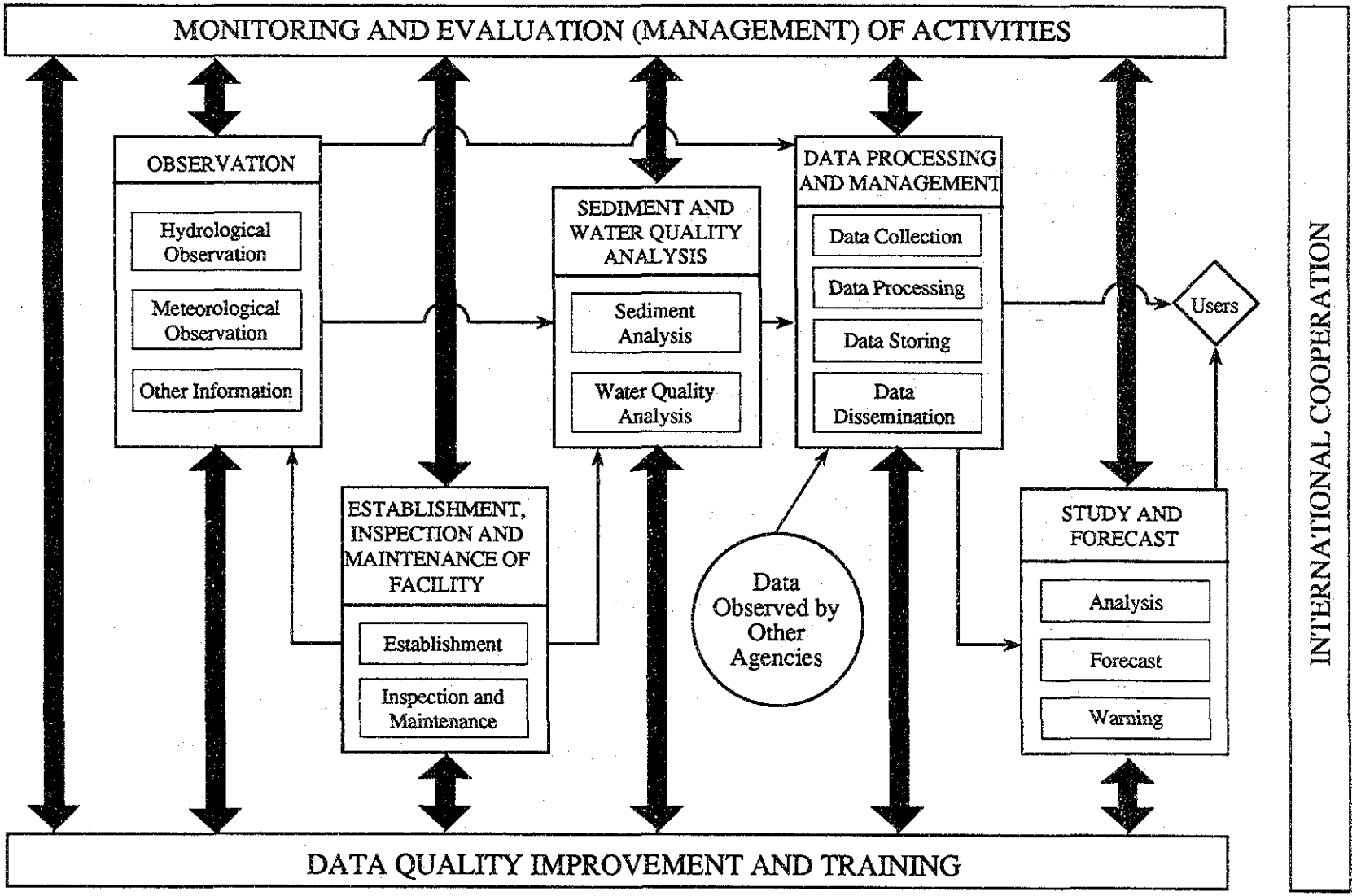


Fig. 3.4 PRESENT WORK FLOW IN DHM

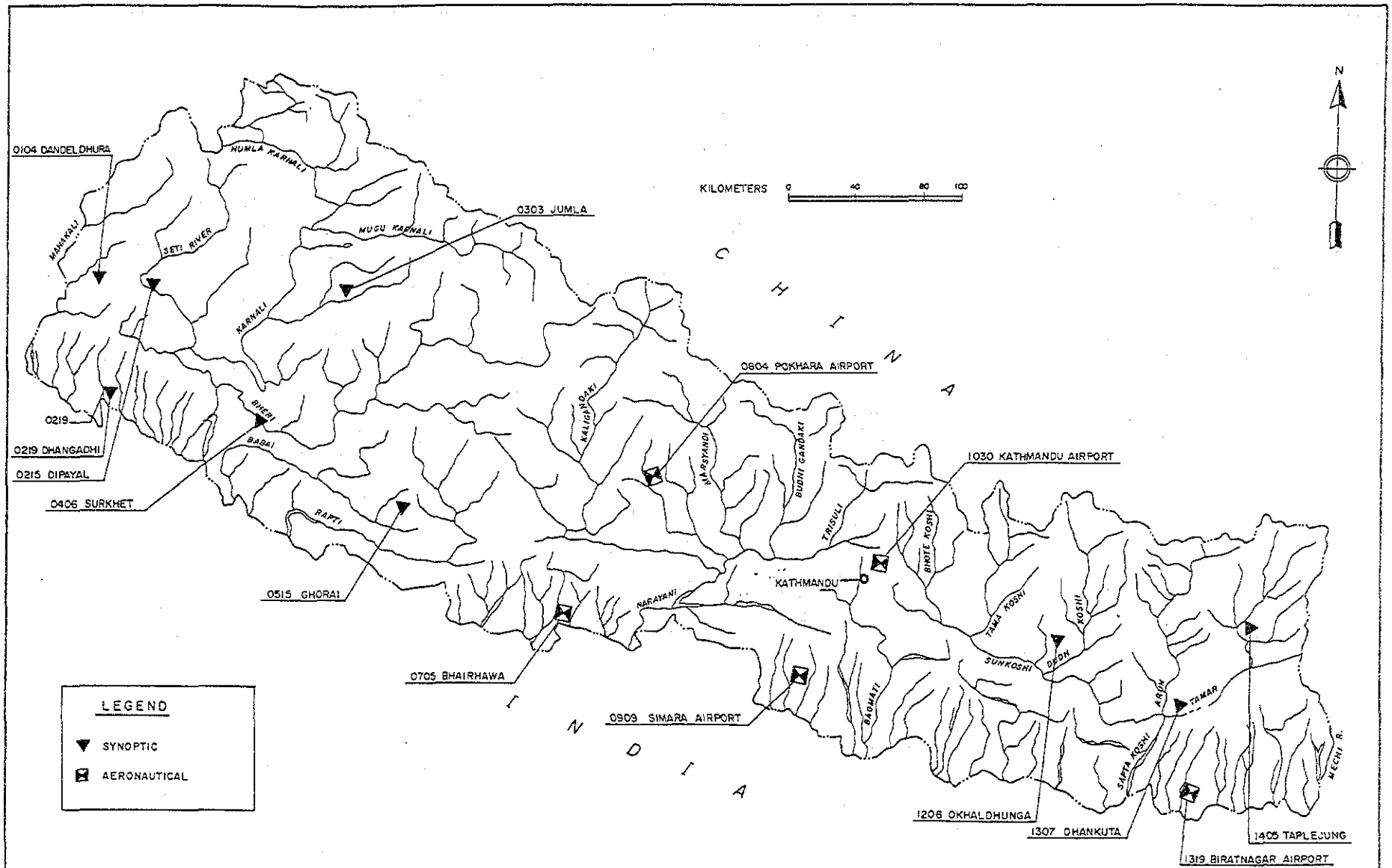


Fig. 3.5 SYNOPTIC AND AERONAUTICAL STATIONS

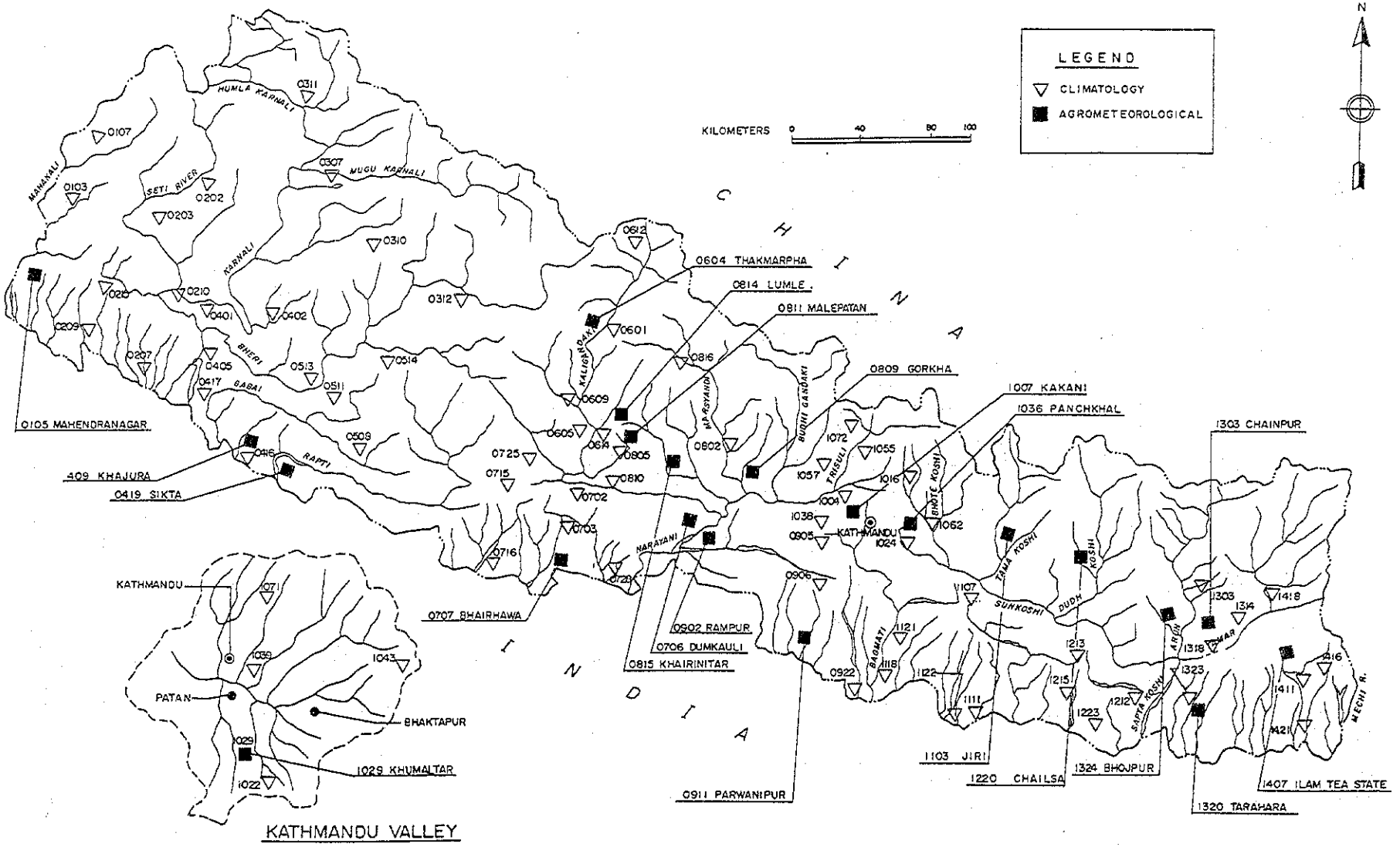


Fig. 3.6 CLIMATOLOGY AND AGROMETEOROLOGICAL STATIONS

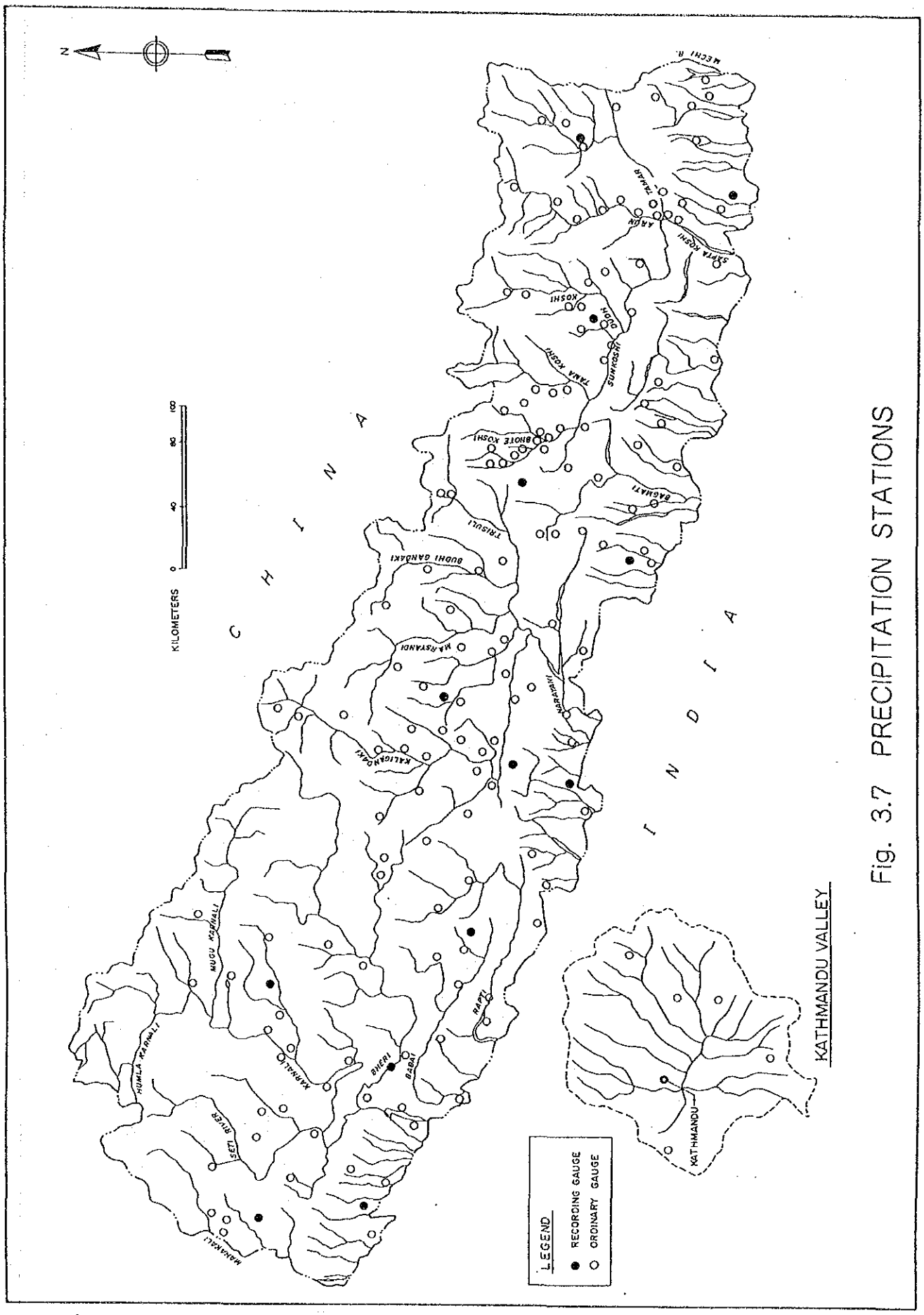


Fig. 3.7 PRECIPITATION STATIONS

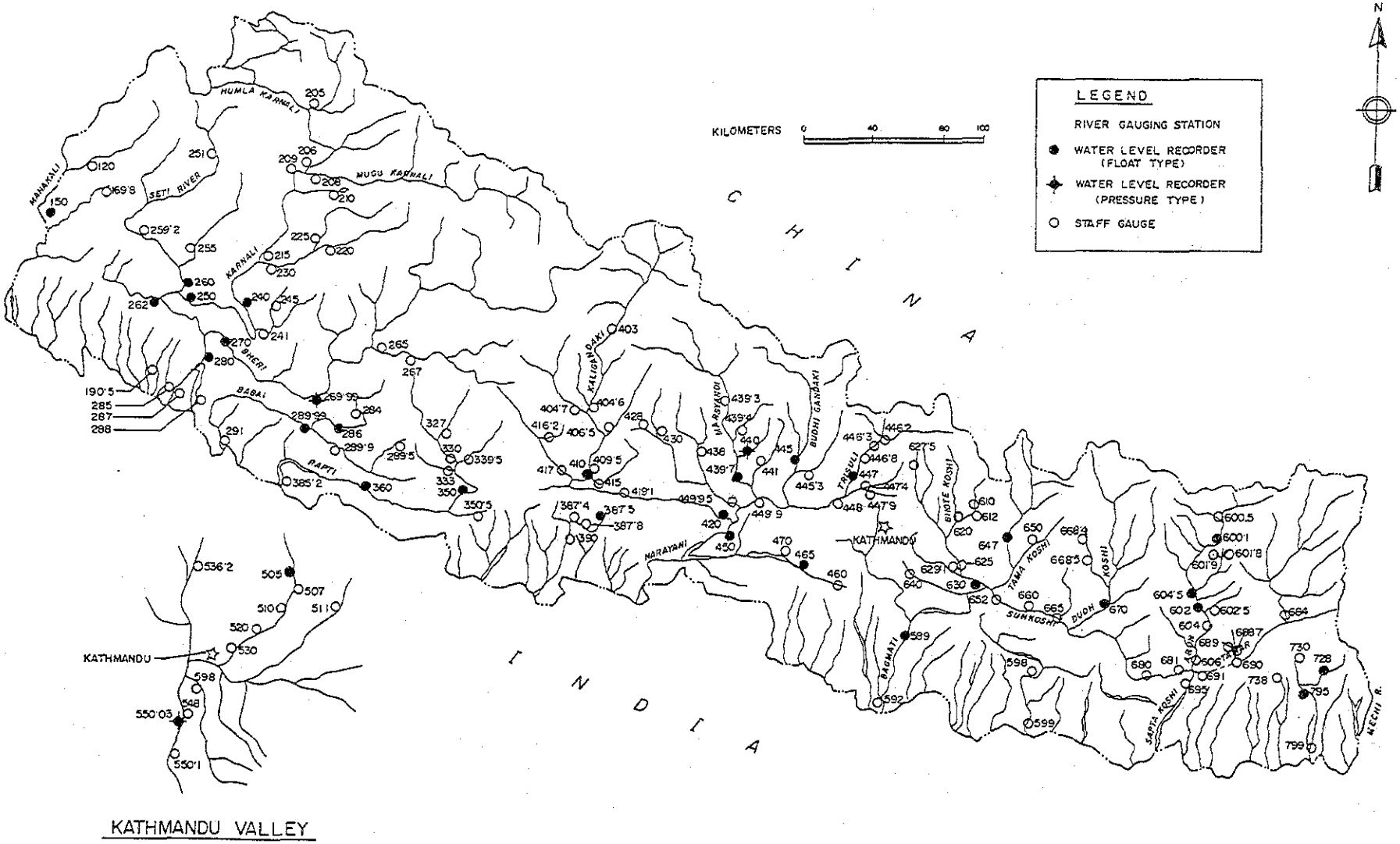


Fig. 3.8 HYDROLOGICAL NETWORK IN NEPAL

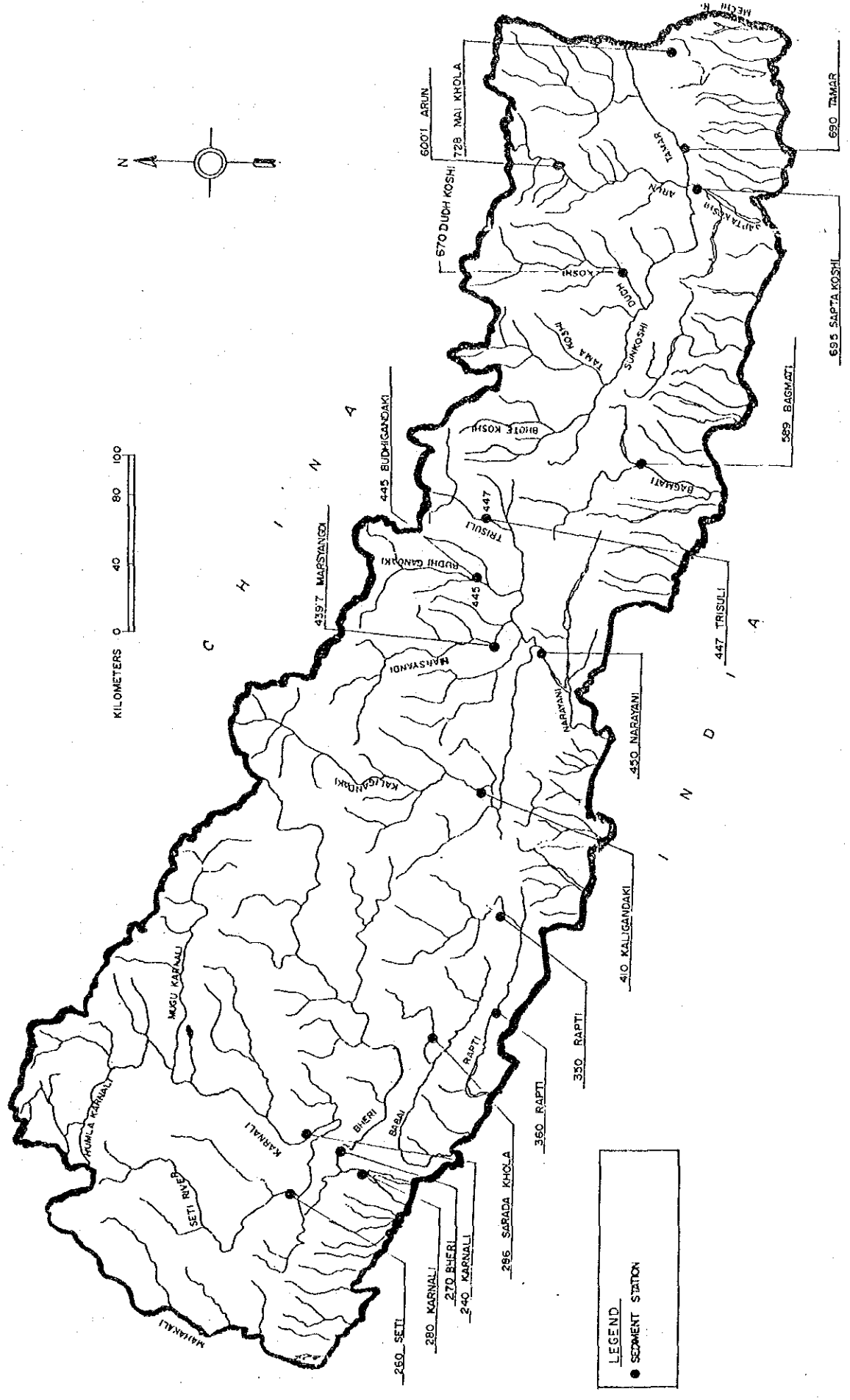


Fig. 3.9 LOCATION MAP OF SEDIMENT STATIONS

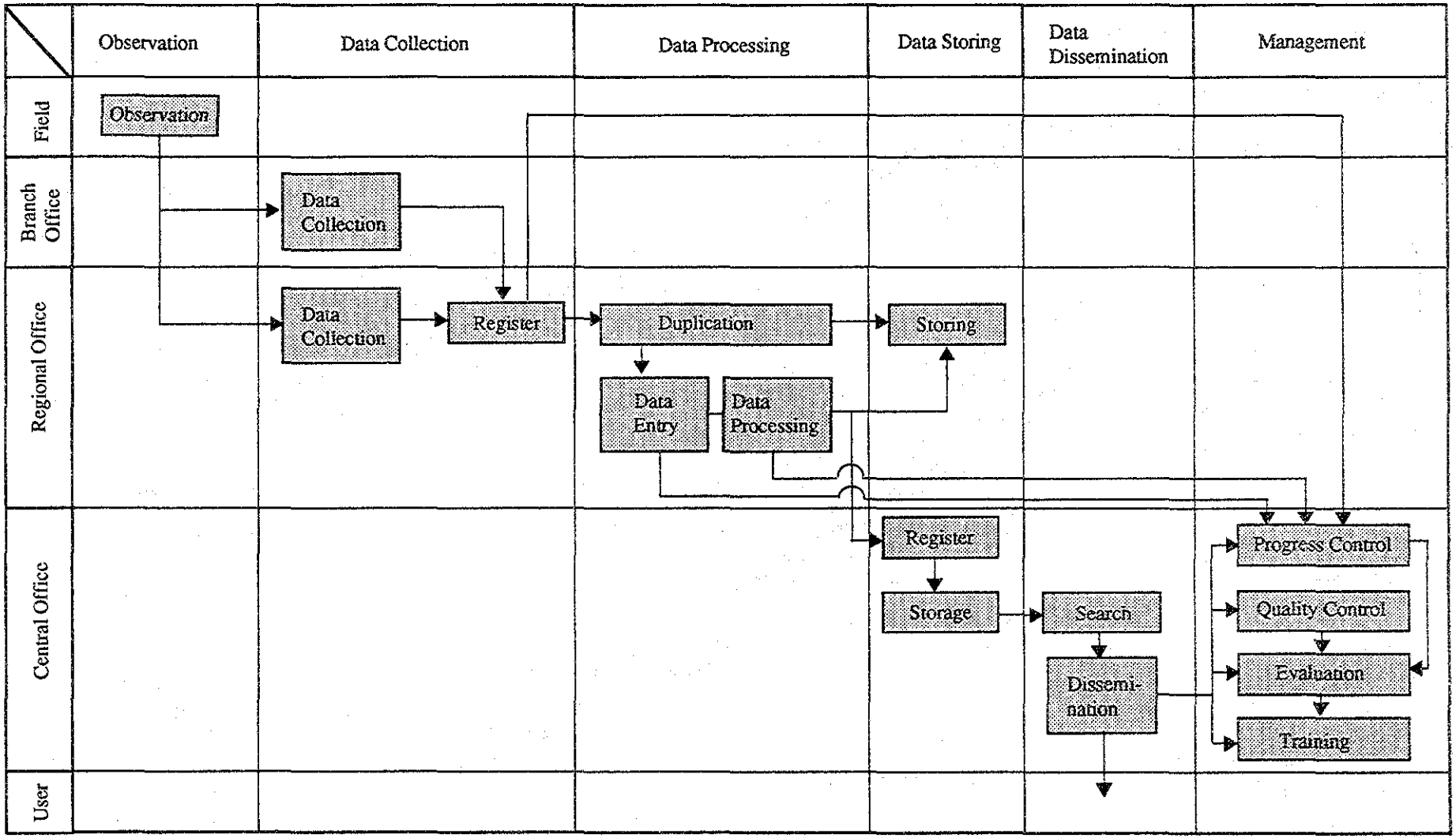


Fig 3.10 PRESENT DATA FLOW IN DHM

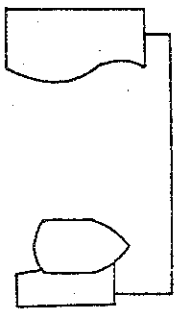
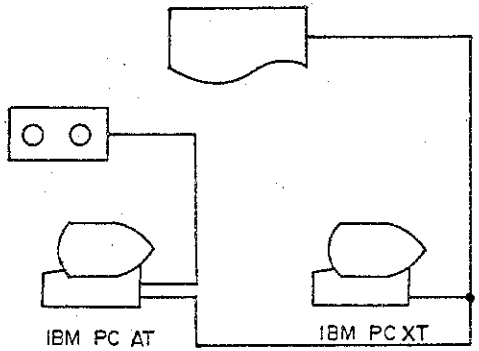
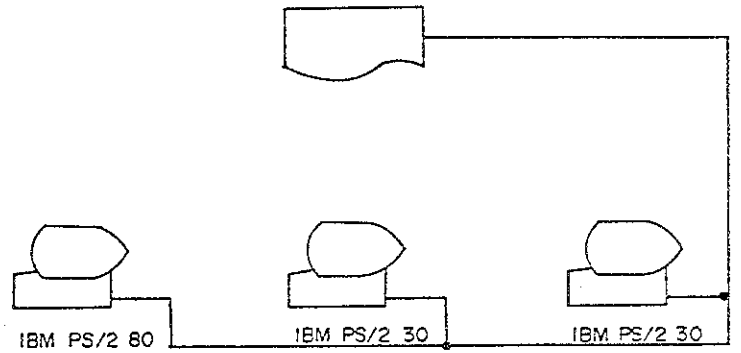
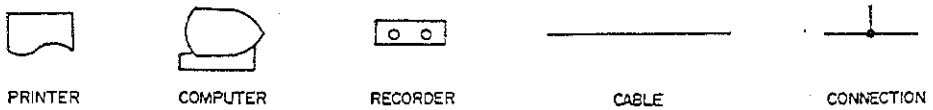
ITEM	WESTERN REGIONAL OFFICE	D H M HEADQUARTERS				
		HYDROLOGICAL DATA BASE		METEOROLOGICAL DATA BASE		
SYSTEM	 IBM PC XT	 IBM PC AT IBM PC XT		 IBM PS/2 80 IBM PS/2 30 IBM PS/2 30		
COMPUTER	IBM PC XT	IBM PC AT	IBM PC XT	IBM PS/2 80	IBM PS/2 30	IBM PS/2 30
FEATURES MPU	i 8088 (16 BIT)	i 80286 (16 BIT)	i 8088 (16 BIT)	i 80386 (32 BIT)	i 80286 (16 BIT)	i 80286 (16 BIT)
MEMORY						
—RAM	256 KB	512 KB	512 KB	1 MB	512 KB	512 KB
—HARD	30 MB	32 MB	10 MB	43 MB	NO	NO
FLOPPY	360 KB	1.2 MB	360 KB	1.44 MB	1.44 MB	1.44 MB
FUNCTION	FOR DATA BASE	FOR DATA BASE	FOR ANALYSIS	FOR DATA BASE	FOR DATA ENTRY	FOR DATA ENTRY
LEGEND	 PRINTER COMPUTER RECORDER CABLE CONNECTION					

Fig. 3.11 PRESENT COMPUTER SYSTEM

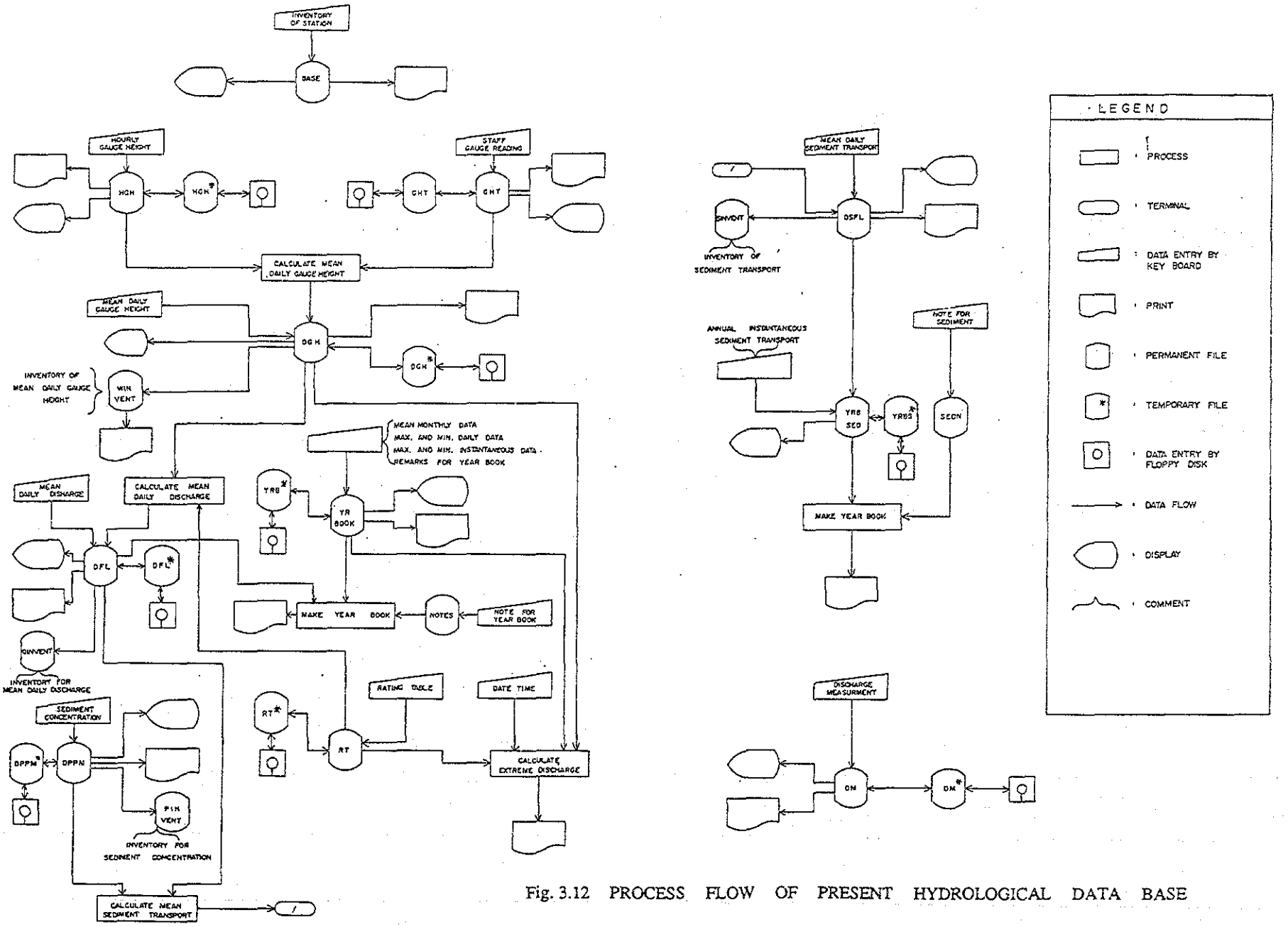


Fig. 3.12 PROCESS FLOW OF PRESENT HYDROLOGICAL DATA BASE

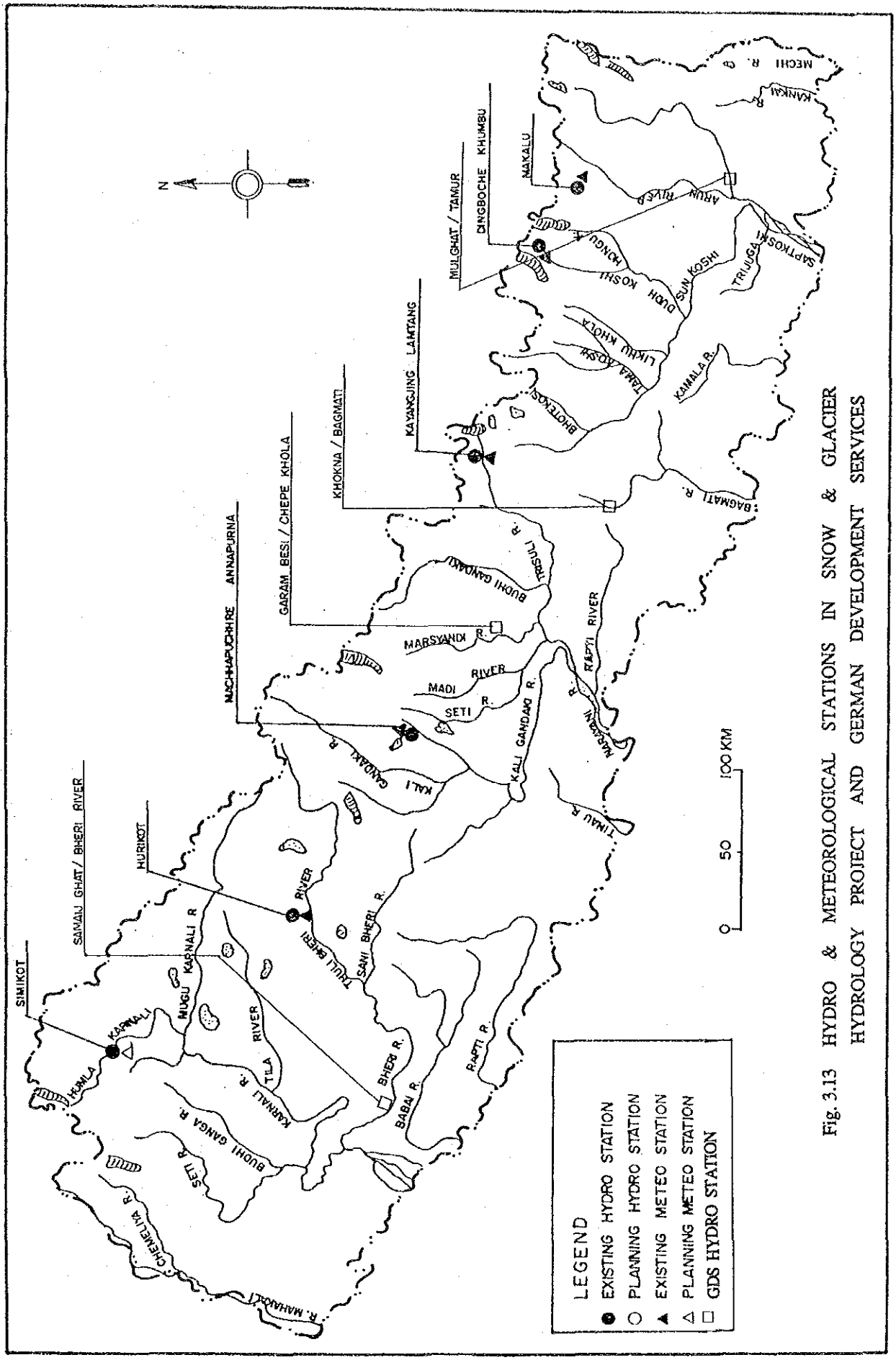


Fig. 3.13 HYDRO & METEOROLOGICAL STATIONS IN SNOW & GLACIER HYDROLOGY PROJECT AND GERMAN DEVELOPMENT SERVICES

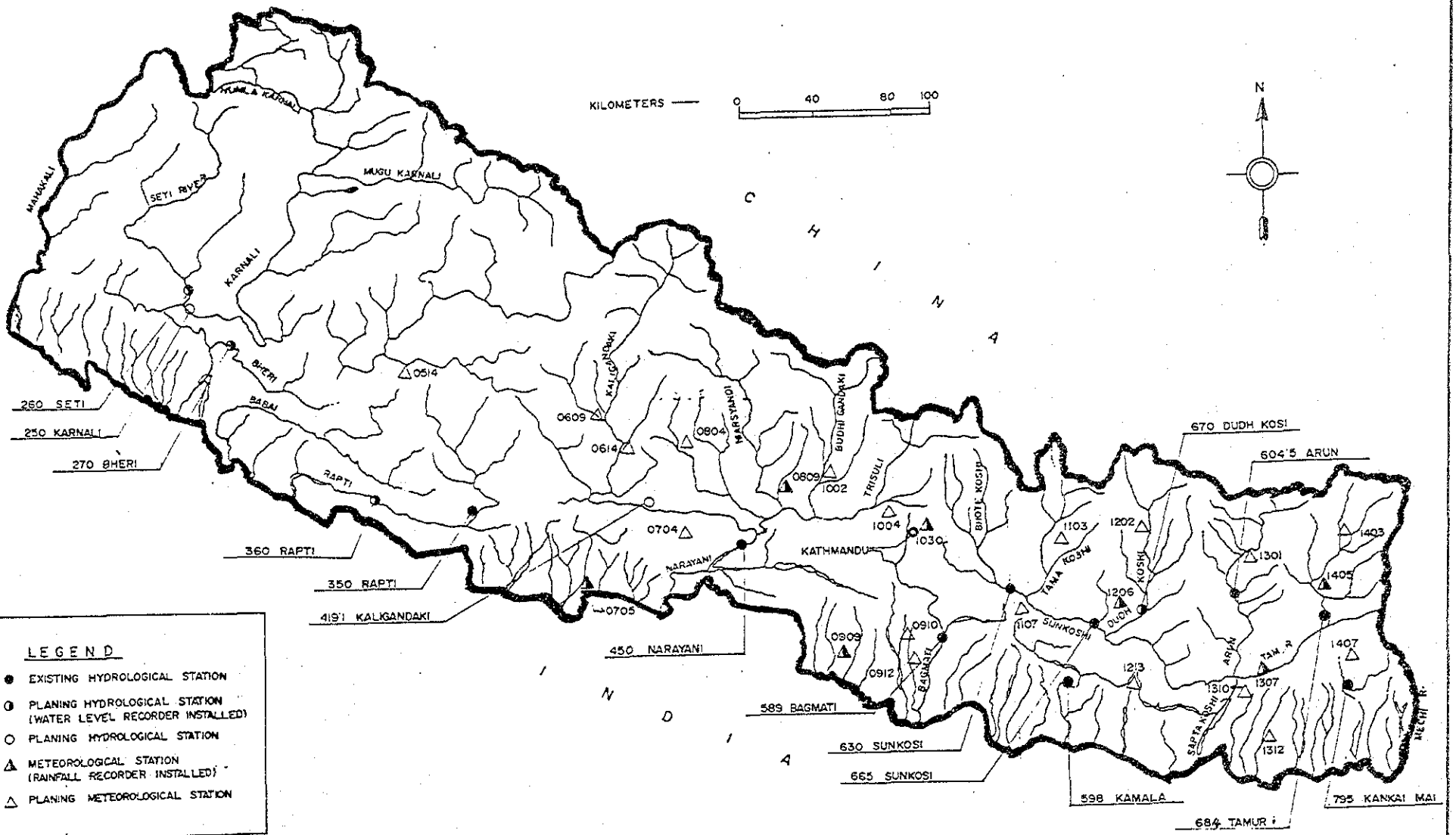


Fig. 3.14 FLOOD FORECASTNG STATIONS OF HYDRO & METEOROLOGY

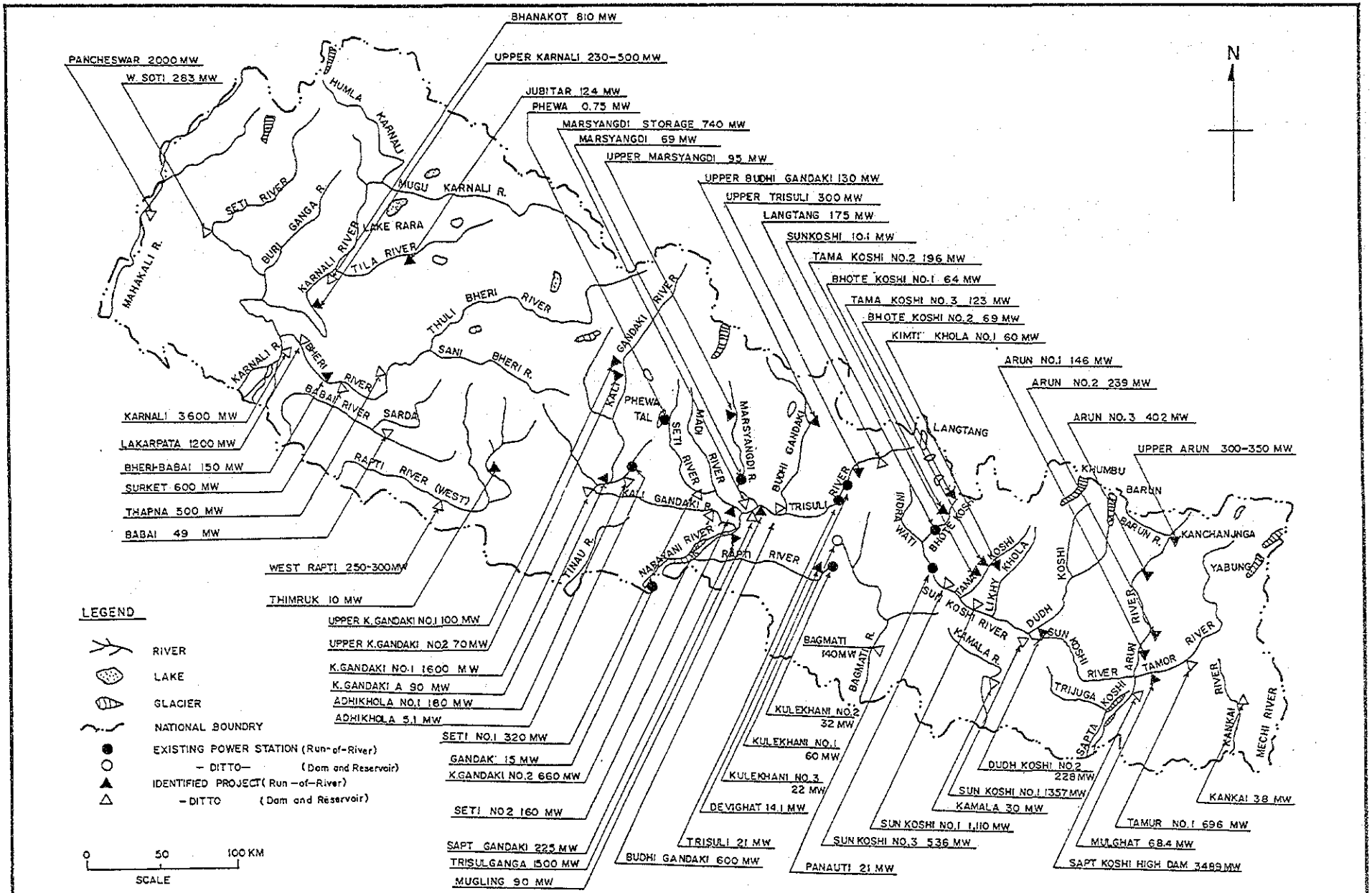
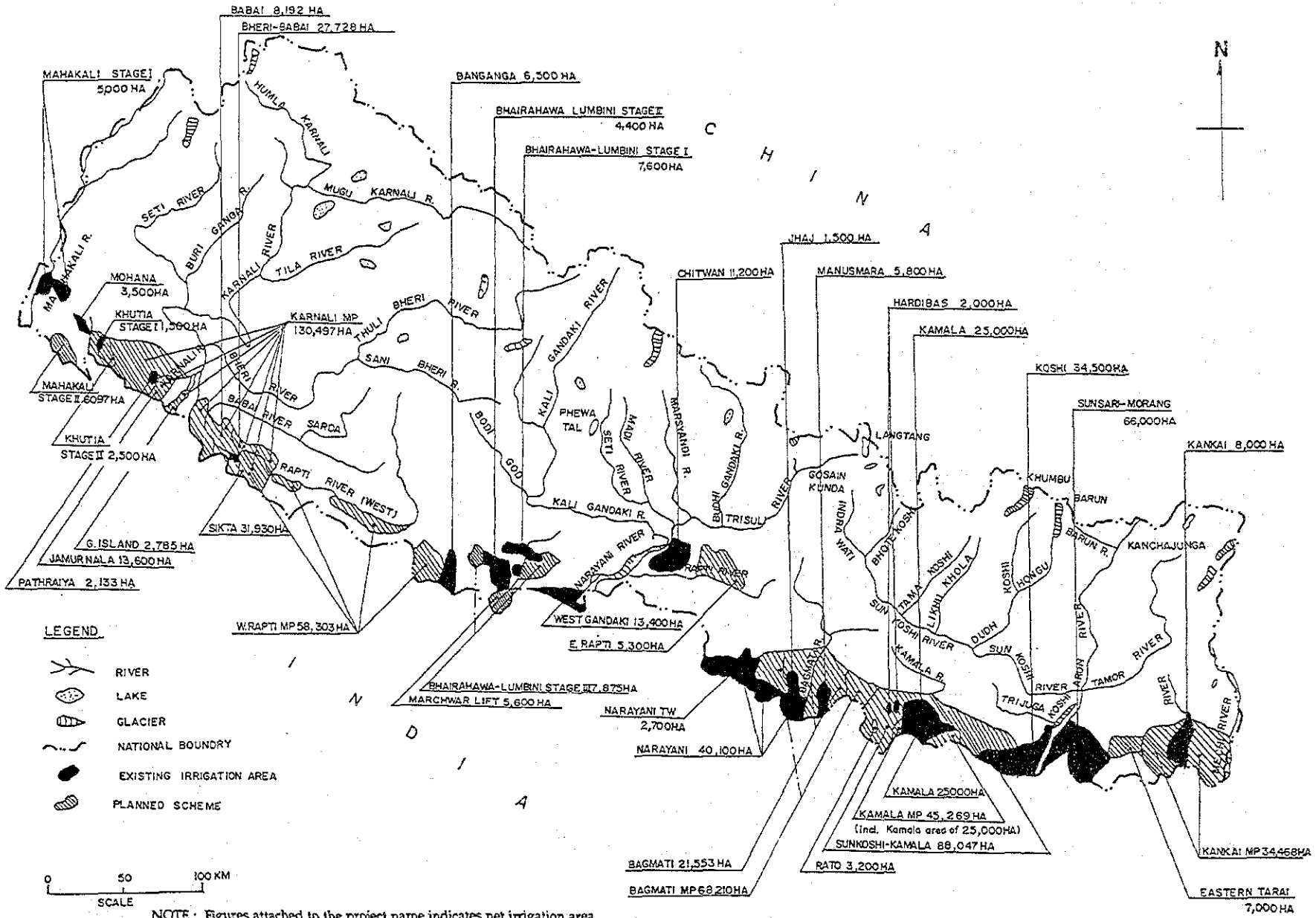


Fig. 4.1 LOCATION MAP OF HYDROPOWER DEVELOPMENT PROJECTS



NOTE : Figures attached to the project name indicates net irrigation area for the existing irrigation area and planed project.
irrigation schemes with a net irrigation area more than 1,000 ha area indicated in the figure.

Fig. 4.2 LOCATION MAP OF IRRIGATION DEVELOPMENT PROJECTS

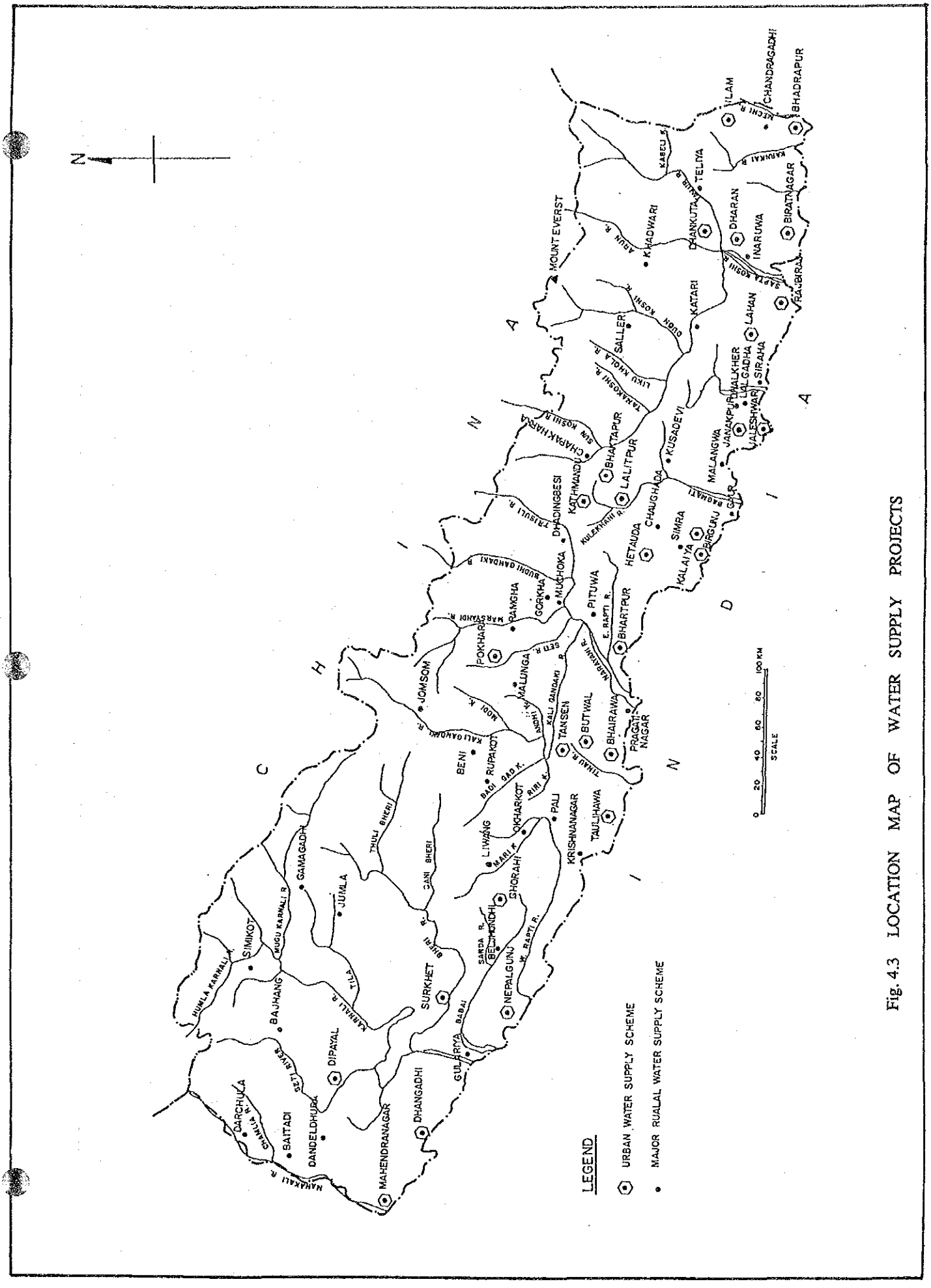


Fig. 4.3 LOCATION MAP OF WATER SUPPLY PROJECTS

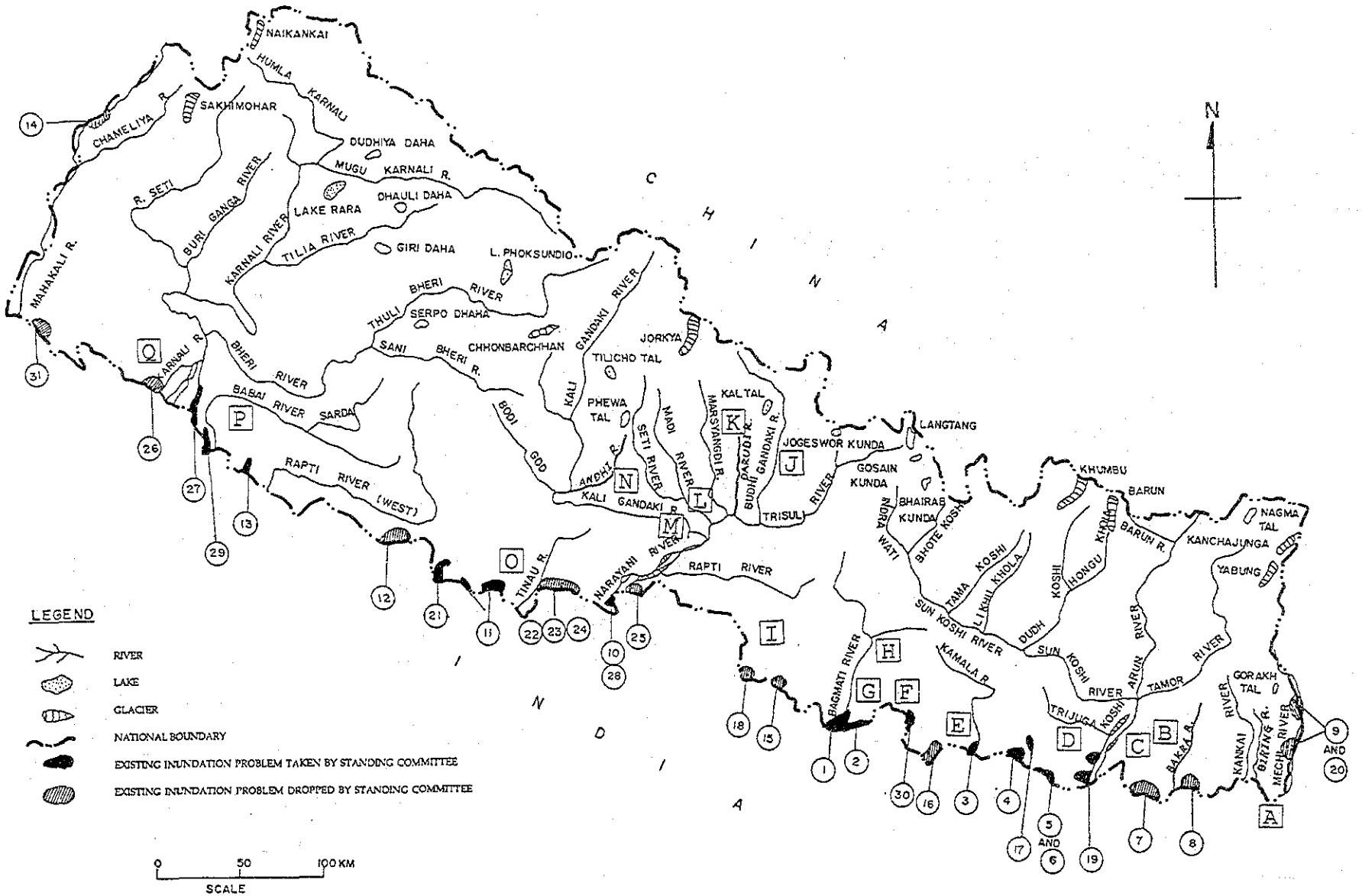
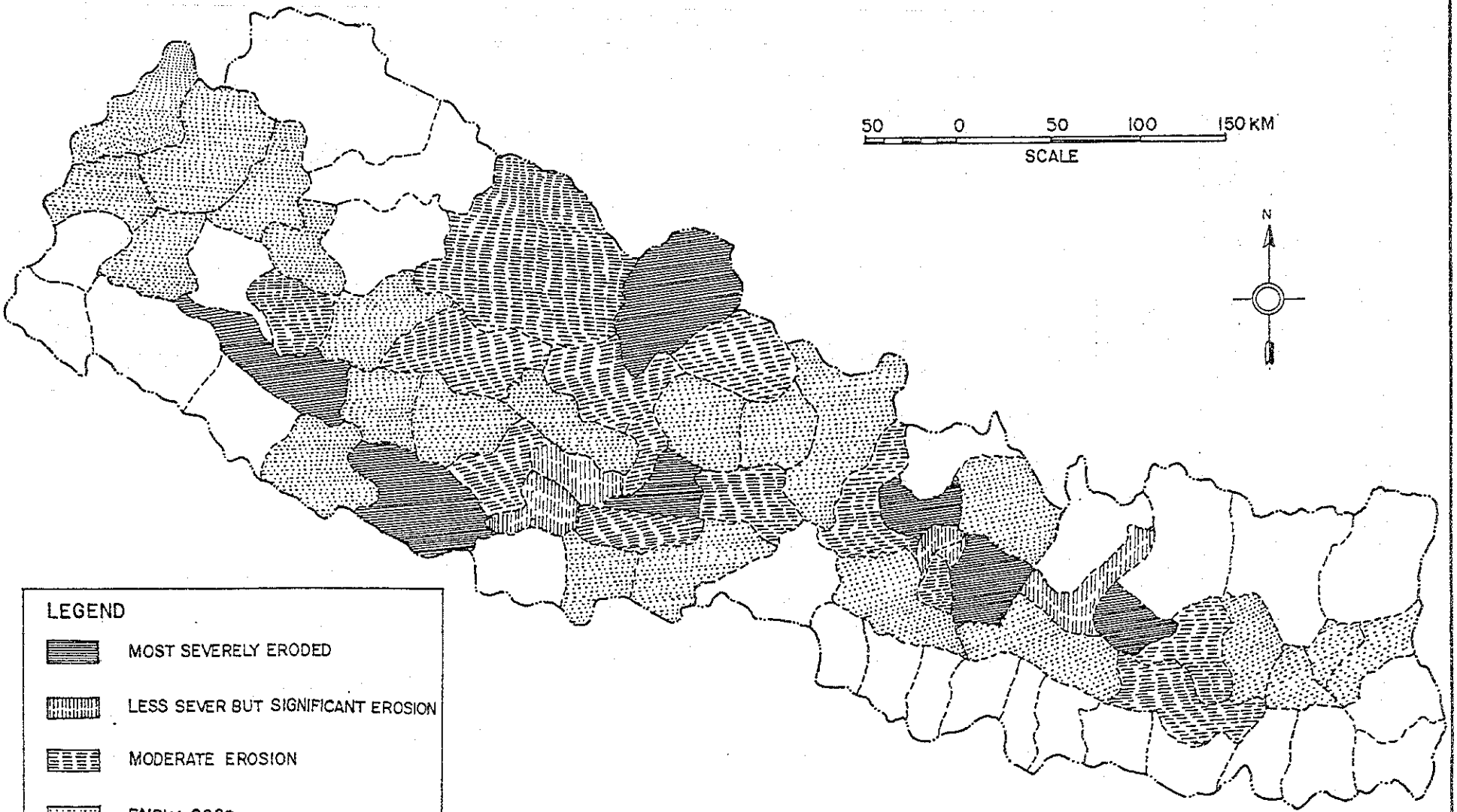


Fig. 4.4 PRESENT INUNDATION SITUATION

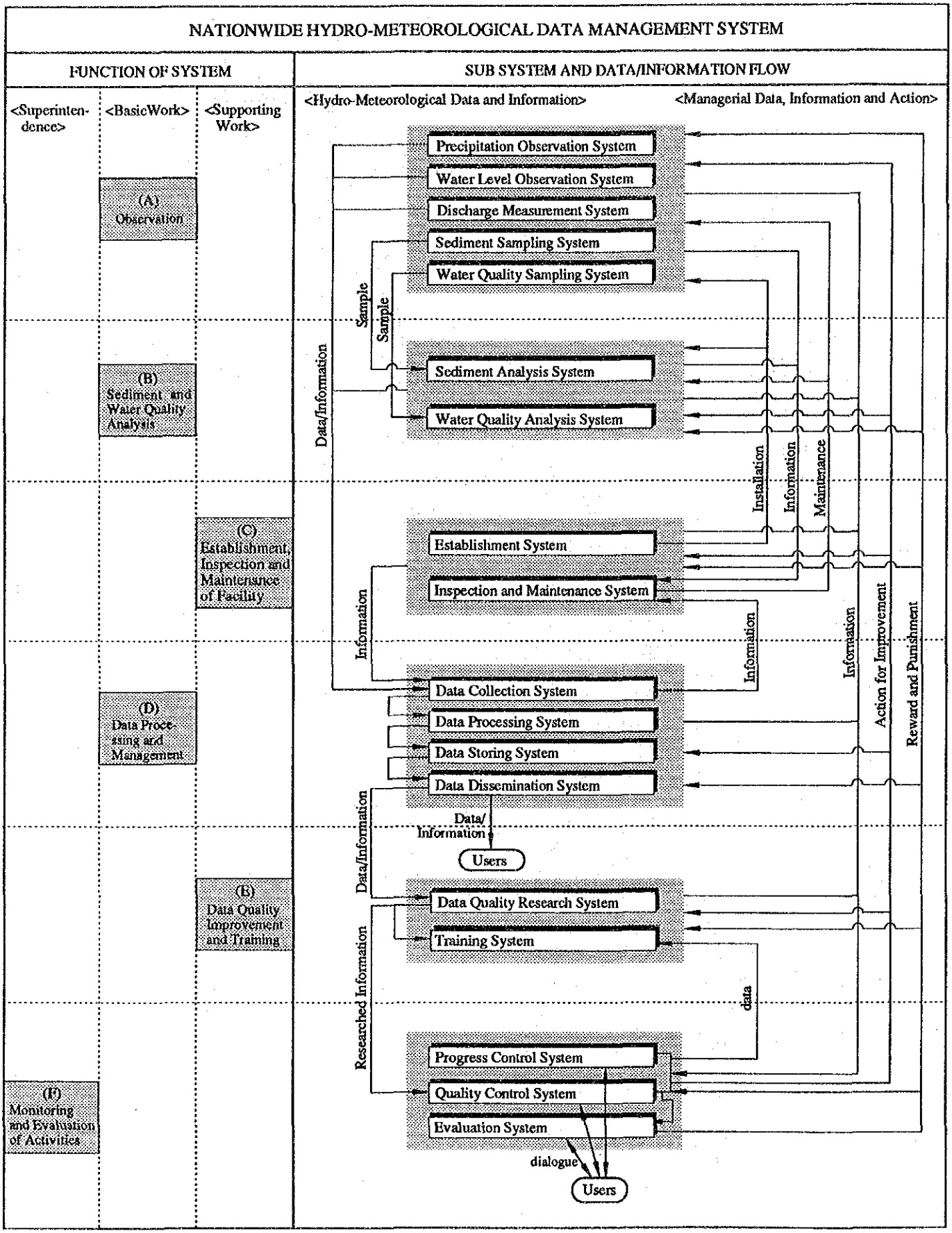
NOTE : List of the Problem Area is Shown in Table 2.6 in Annex D.



Source : Field Document No.9 (NEP/08/029)

Fig. 4.5 WATERSHED CONDITION IN NEPAL

Fig. 4.6 NATIONWIDE HYDRO-METEOROLOGICAL DATA MANAGEMENT SYSTEM IN THE IMPROVEMENT PROGRAMME



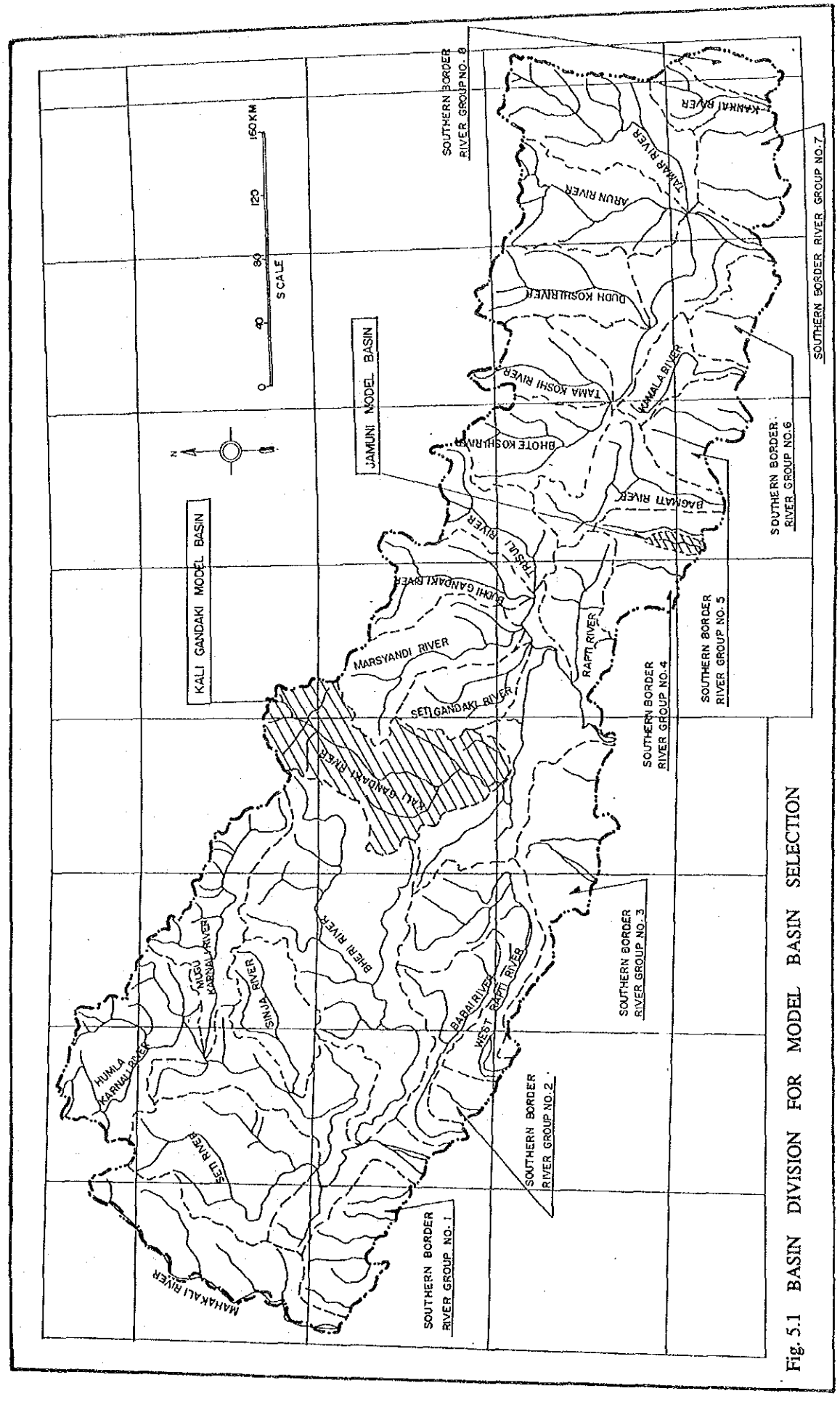


Fig. 5.1 BASIN DIVISION FOR MODEL BASIN SELECTION

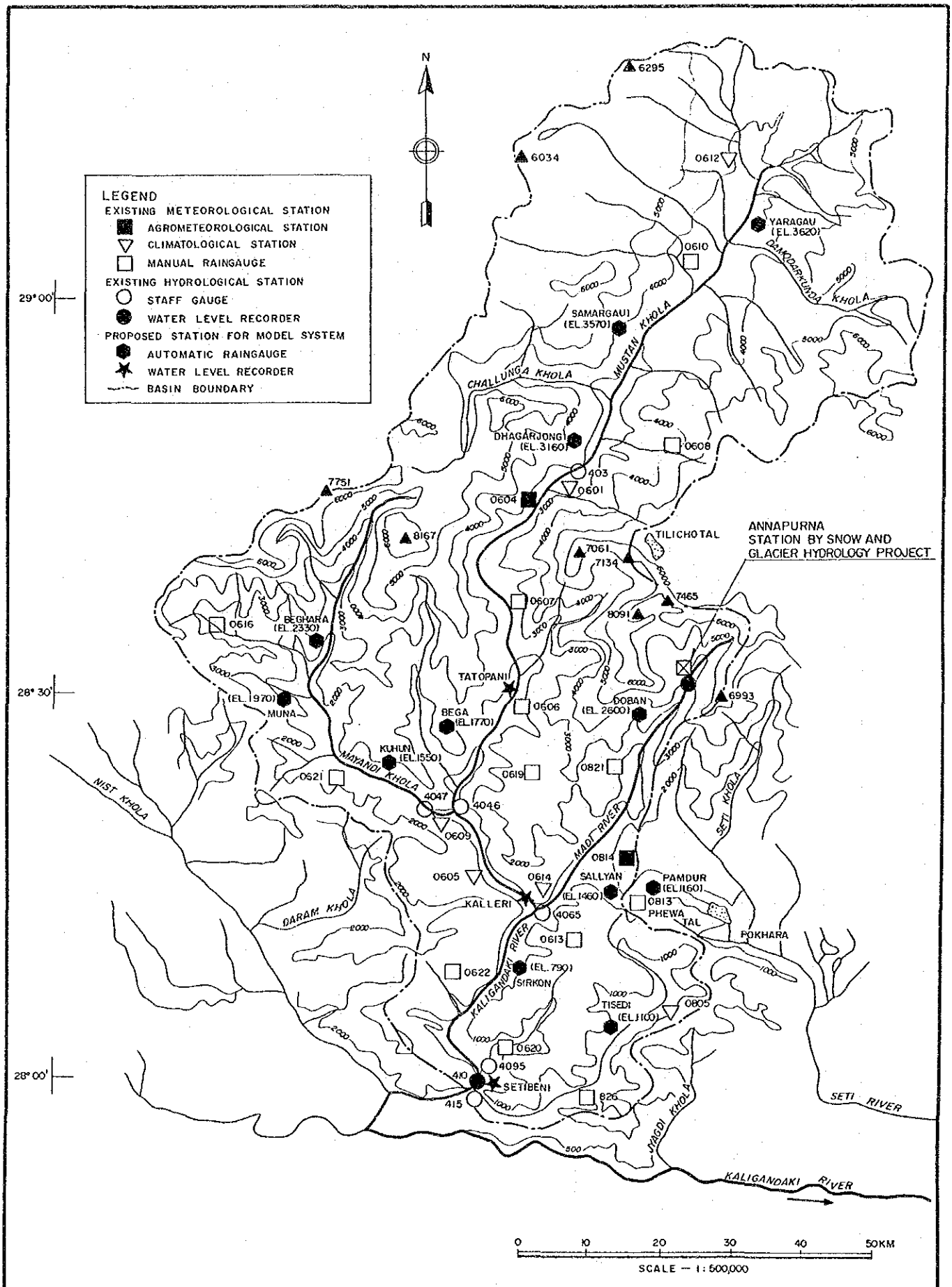


Fig. 5.2 KALI GANDAKI RIVER BASIN (MODEL BASIN)

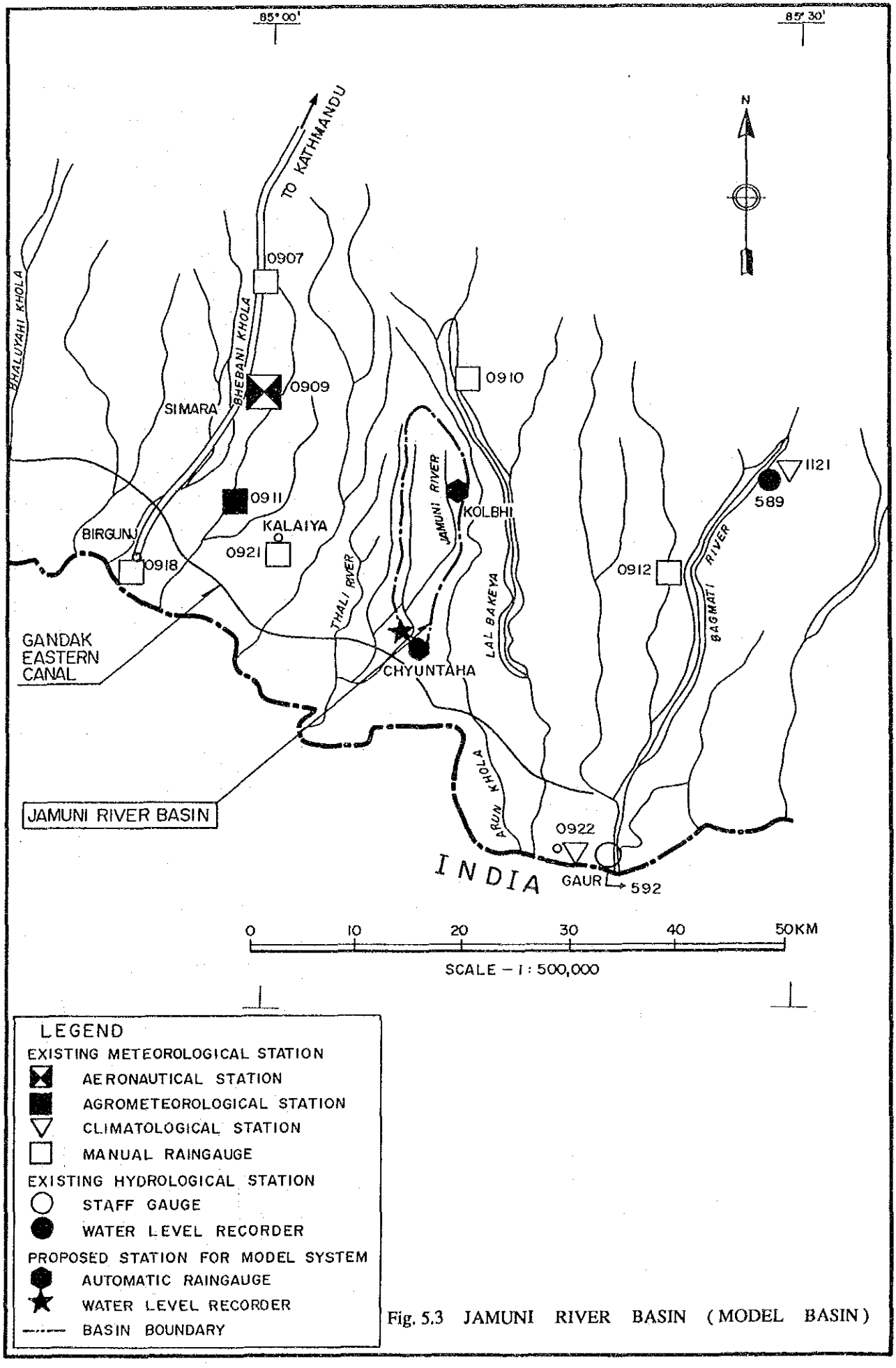


Fig. 5.3 JAMUNI RIVER BASIN (MODEL BASIN)

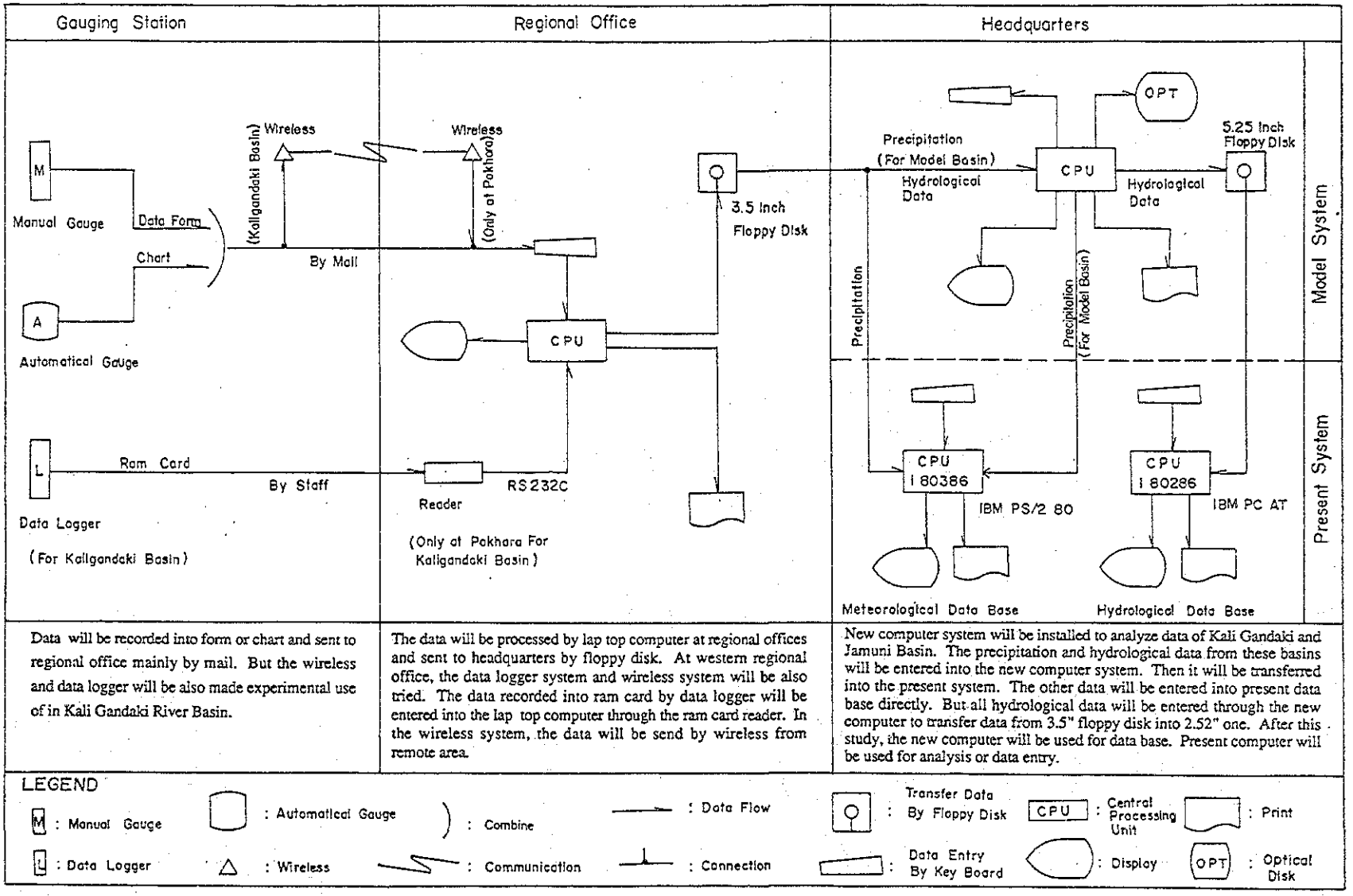


Fig. 5.4 SYSTEM COMPONENT OF MODEL SYSTEM

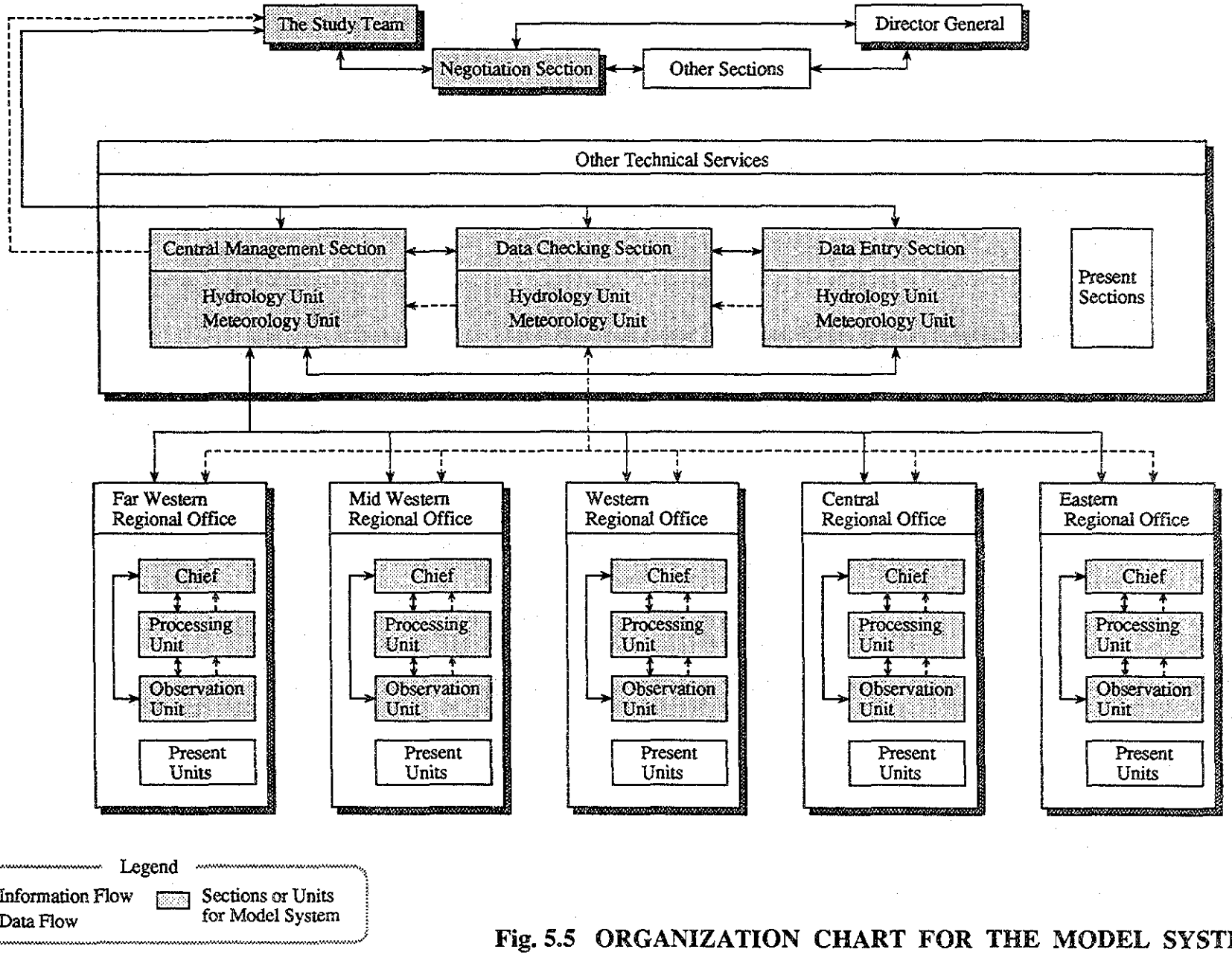


Fig. 5.5 ORGANIZATION CHART FOR THE MODEL SYSTEM

(Revised in June 1993)
(As of December 1992)

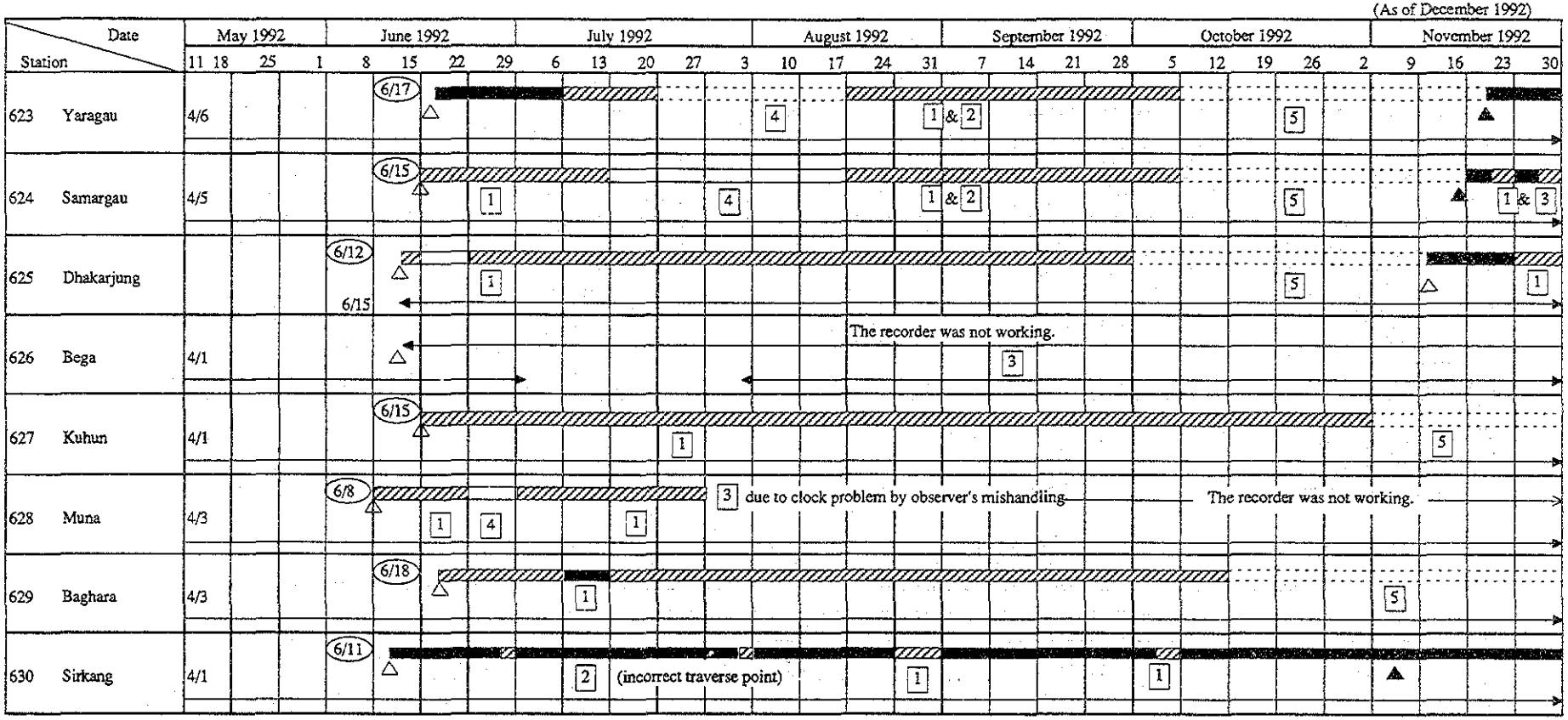
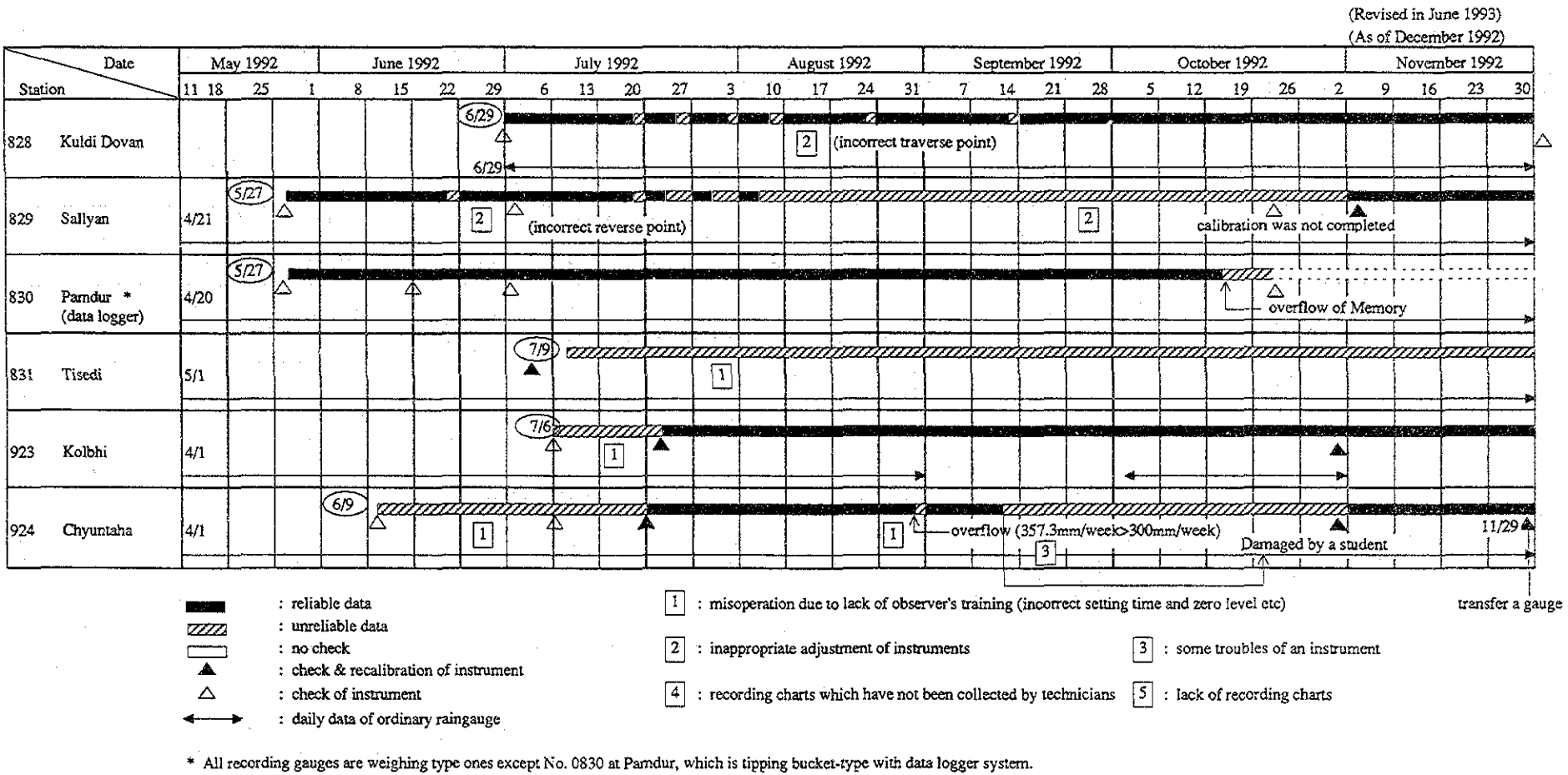


Fig. 5.6 STATUS OF RAINGAUGE RECORD (1/4)



* All recording gauges are weighing type ones except No. 0830 at Pamdur, which is tipping bucket-type with data logger system.

Fig. 5.6 STATUS OF RAINGAUGE RECORD (2/4)

(Revised in June 1993)
(As of December 1992)

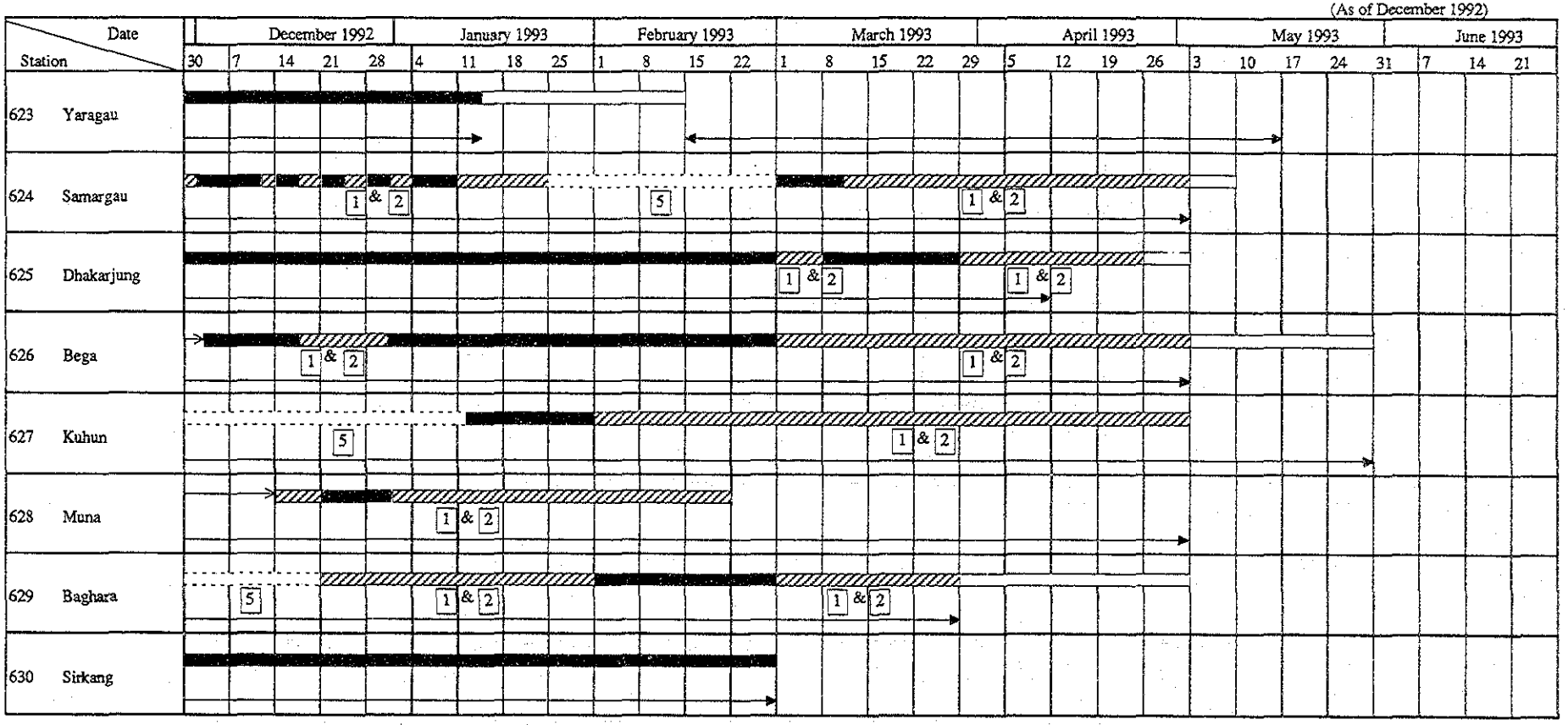


Fig. 5.6 STATUS OF RAINGAUGE RECORD (3/4)

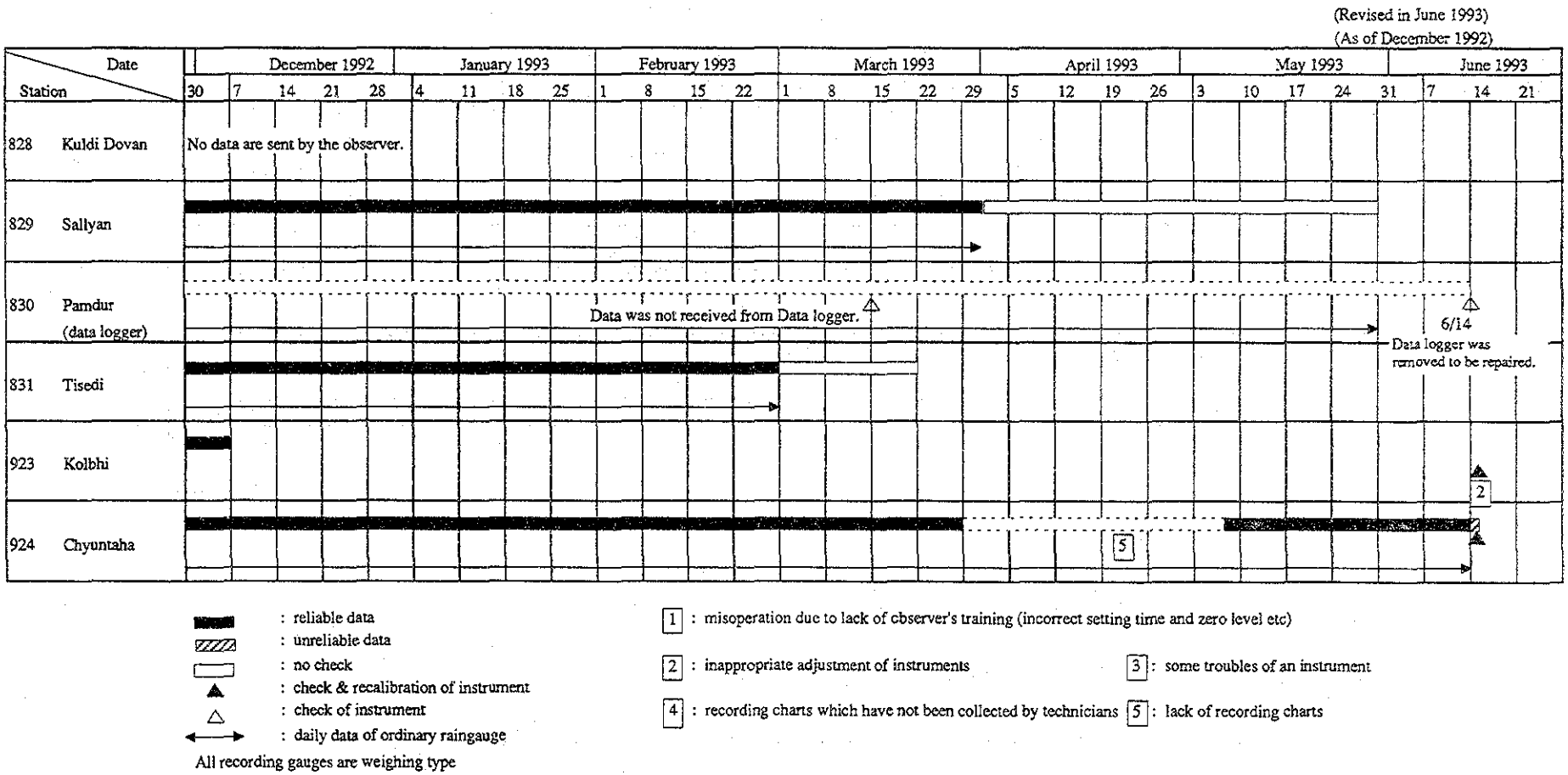
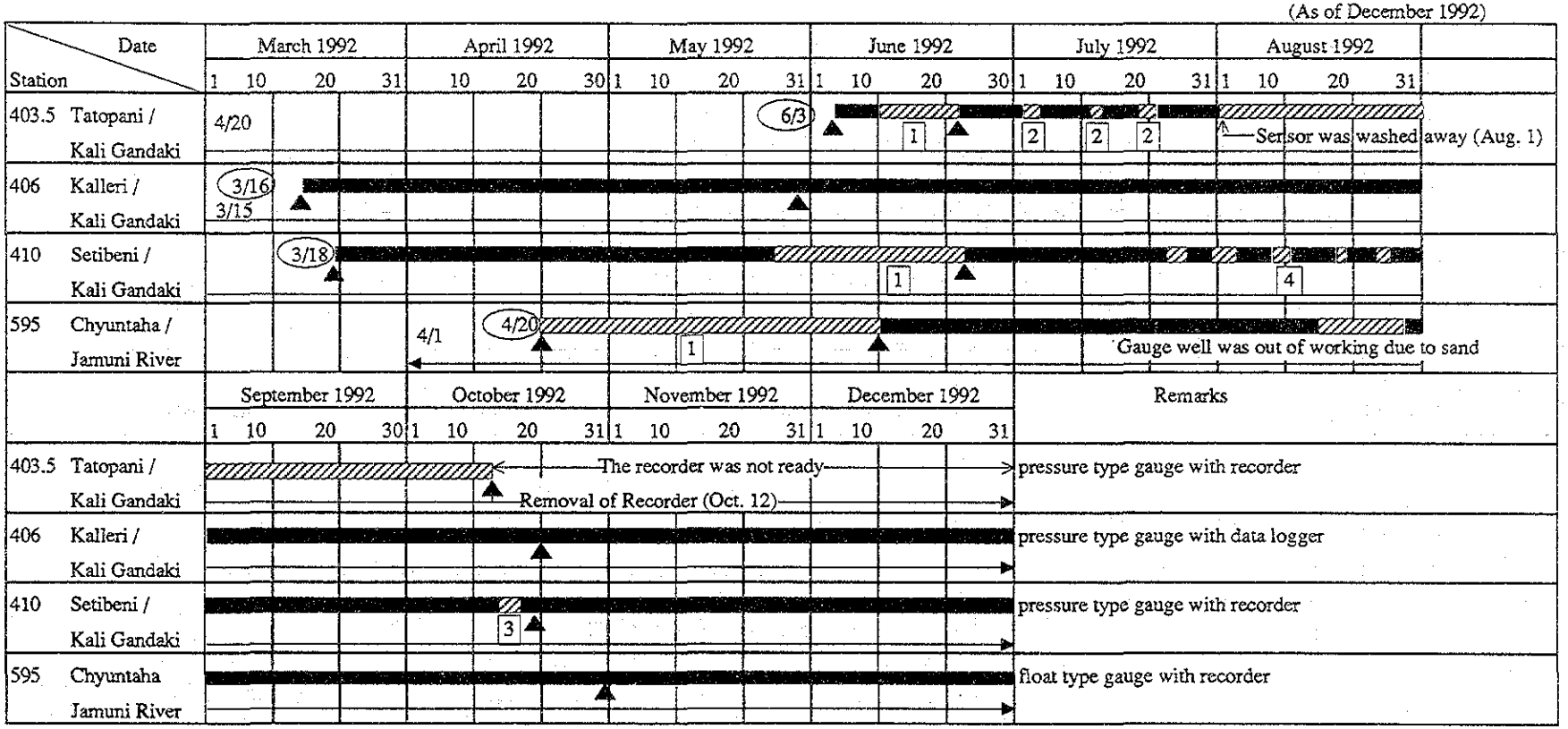


Fig. 5.6 STATUS OF RAINGAUGE RECORD (4/4)

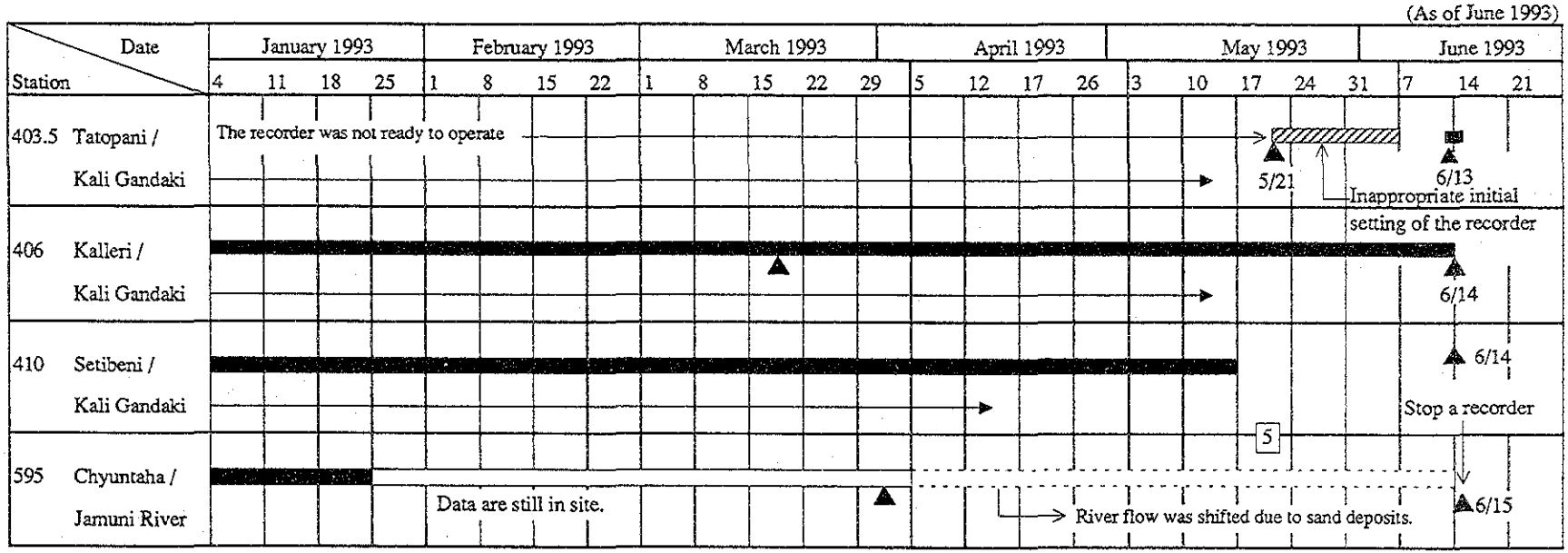
(Revised in June 1993)
(As of December 1992)



Note :
- reliable data
- unreliable data
- not yet checked
- inspection of station (DHM & JICA)
- staff gauge reading

1 : misoperation due to lack of observer's training (incorrect setting time and water level, misadjustment etc)
2 : stop clock (for spring watch)
3 : Low battery (for pressure sensor)
4 : High water level was cut due to some machine trouble
5 : Lack of recording chart

Fig. 5.7 STATUS OF WATER LEVEL GAUGE RECORD (1/2)



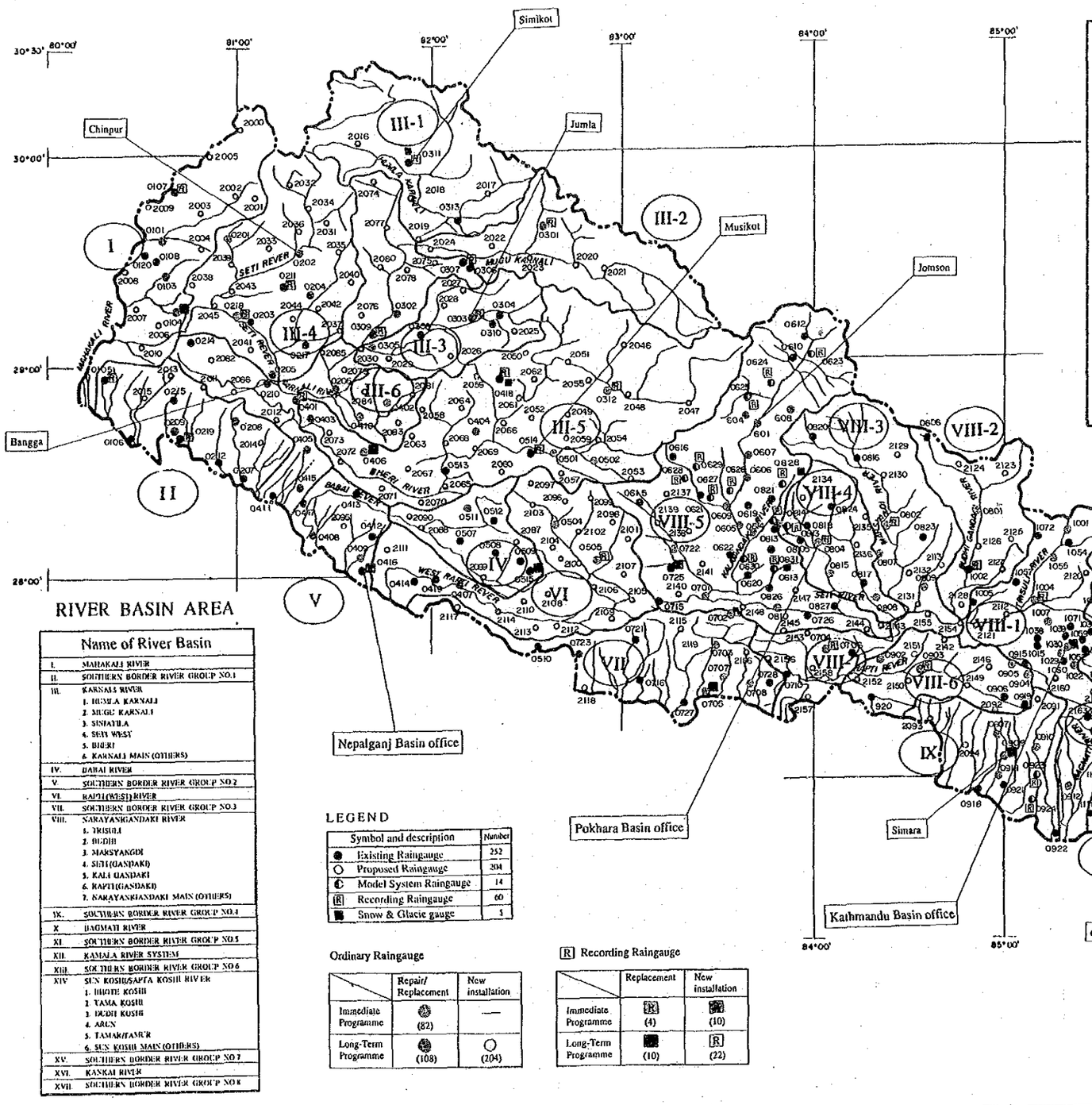
Note :

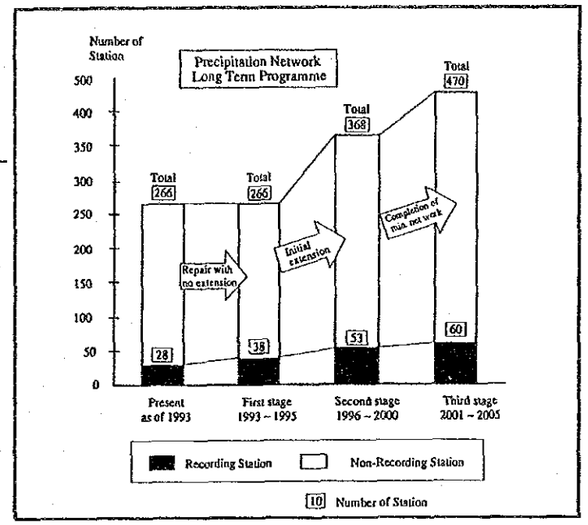
- : reliable data
- : unreliable data
- : not yet checked
- ▲ : inspection of station (DHM & JICA)
- ←→ : staff gauge reading

1 : misoperation due to lack of observer's training (incorrect setting time and water level, misadjustment etc)
2 : stop clock (for spring watch)
3 : Low battery (for pressure sensor)
4 : High water level was cut due to some machine trouble
5 : Lack of recording chart

Fig. 5.7 STATUS OF WATER LEVEL GAUGE RECORD (2/2)

Fig. 6.1 PRECIPITATION NETWORK IN THE LONG TERM PROGRAMME





RIVER BASIN AREA

Name of River Basin	
I.	MAHAKALI RIVER
II.	SOUTHERN BORDER RIVER GROUP NO.1
III.	KARNALI RIVER
	1. HUMLA KARNALI
	2. MUGU KARNALI
	3. SINJAFILA
	4. SETI WEST
	5. BHERI
	6. KARNALI MAIN (OTHERS)
IV.	BABAI RIVER
V.	SOUTHERN BORDER RIVER GROUP NO.2
VI.	RAPTI(WEST) RIVER
VII.	SOUTHERN BORDER RIVER GROUP NO.3
VIII.	NARAYANIGANDAKI RIVER
	1. TRISULI
	2. BUDHI
	3. MARSYANGDI
	4. SIKTI(GANDAKI)
	5. KALI GANDAKI
	6. RAPTI(GANDAKI)
	7. NARAYANIGANDAKI MAIN (OTHERS)
IX.	SOUTHERN BORDER RIVER GROUP NO.4
X	DAGMATI RIVER
XI.	SOUTHERN BORDER RIVER GROUP NO.5
XII.	KAMALA RIVER SYSTEM
XIII.	SOUTHERN BORDER RIVER GROUP NO.6
XIV.	SUN KOSHI&SAPTA KOSHI RIVER
	1. BHOTE KOSHI
	2. TAMA KOSHI
	3. DUDH KOSHI
	4. ARUN
	5. TAMAR/TAMUR
	6. SUN KOSHI MAIN (OTHERS)
XV.	SOUTHERN BORDER RIVER GROUP NO.7
XVI.	KANKAI RIVER
XVII.	SOUTHERN BORDER RIVER GROUP NO.8

LEGEND

Symbol and description	Number
● Existing Raingauge	252
○ Proposed Raingauge	204
◐ Model System Raingauge	14
[R] Recording Raingauge	60
■ Snow & Glacie gauge	3

Ordinary Raingauge

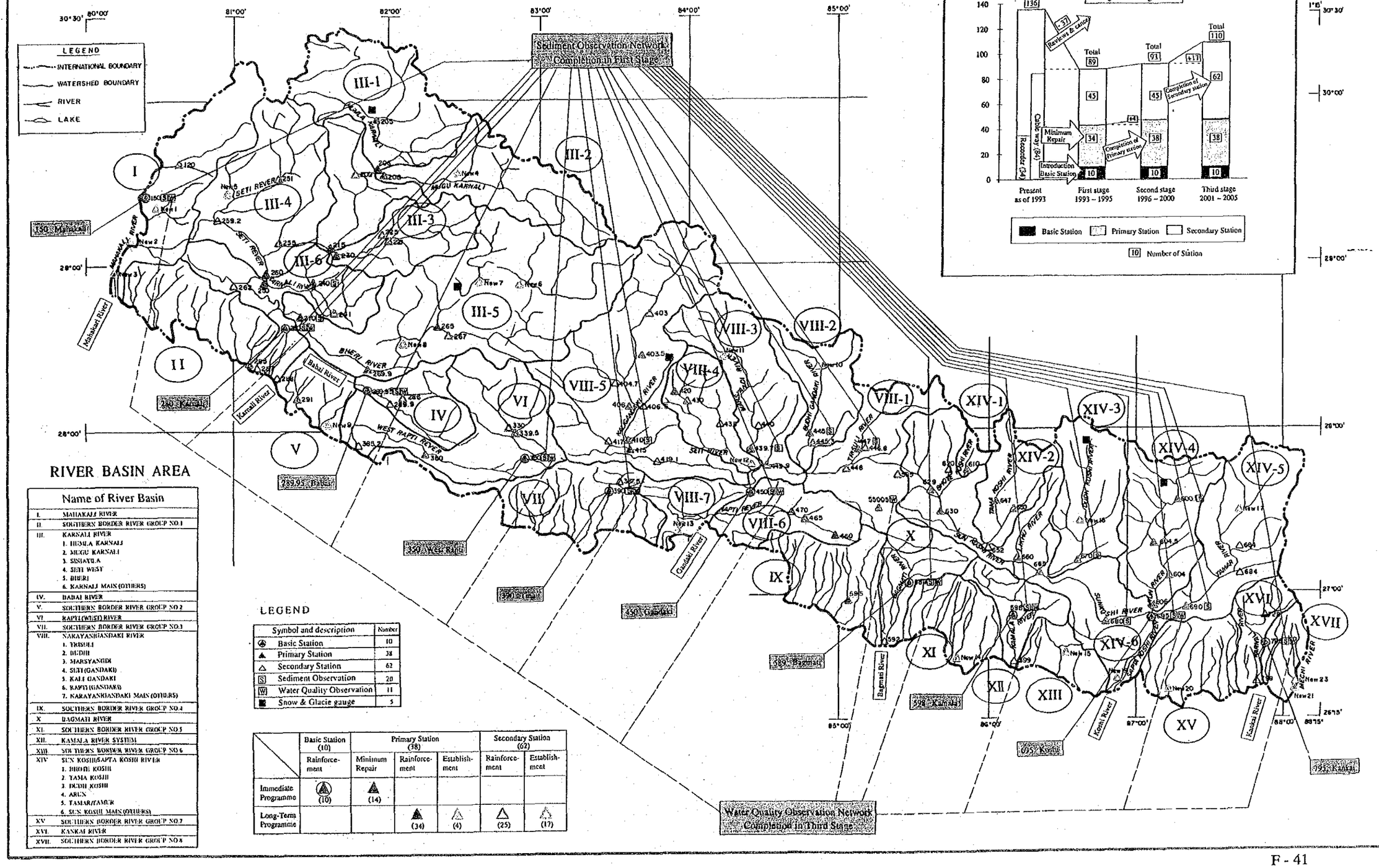
	Repair/ Replacement	New installation
Immediate Programme	◉ (82)	—
Long-Term Programme	◉ (108)	○ (204)

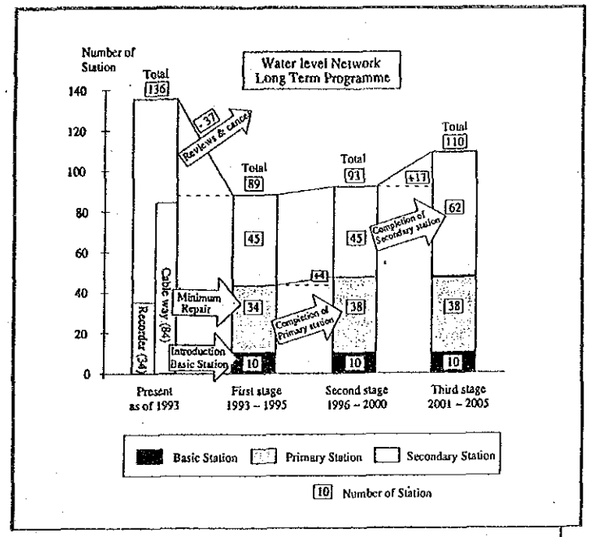
[R] Recording Raingauge

	Replacement	New installation
Immediate Programme	[R] (4)	[R] (10)
Long-Term Programme	■ (10)	[R] (22)

LEGEND
- INTERNATIONAL BOUNDARY
- WATERSHED BOUNDARY
- RIVER
- LAKE

Fig. 6.2 HYDROMETRIC NETWORK IN THE LONG TERM PROGRAMME





RIVER BASIN AREA

	Name of River Basin
I.	MAHAKALI RIVER
II.	SOUTHERN BORDER RIVER GROUP NO.1
III.	KARNALI RIVER 1. HUMLA KARNALI 2. MUGU KARNALI 3. SISIAPANI 4. SETI WEST 5. BHERI 6. KARNALI MAIN (OTHERS)
IV.	BABAI RIVER
V.	SOUTHERN BORDER RIVER GROUP NO.2
VI.	RAPTI (WEST) RIVER
VII.	SOUTHERN BORDER RIVER GROUP NO.3
VIII.	NARAYANI/GANDAKI RIVER 1. TRISULI 2. DUDHI 3. MARSYANGDI 4. SETI (GANDAKI) 5. KALI GANDAKI 6. RAPTI (GANDAKI) 7. NARAYANI/GANDAKI MAIN (OTHERS)
IX.	SOUTHERN BORDER RIVER GROUP NO.4
X	BAGMATI RIVER
XI.	SOUTHERN BORDER RIVER GROUP NO.5
XII.	KAMALA RIVER SYSTEM
XIII	SOUTHERN BORDER RIVER GROUP NO.6
XIV	SUN KOSHI/SAPTA KOSHI RIVER 1. BHOTE KOSHI 2. TAMA KOSHI 3. DUDHI KOSHI 4. ARUN 5. TAMAR/TAMUR 6. SUN KOSHI MAIN (OTHERS)
XV	SOUTHERN BORDER RIVER GROUP NO.7
XVI.	KANKAI RIVER
XVII.	SOUTHERN BORDER RIVER GROUP NO.8

LEGEND

Symbol and description	Number
Basic Station	10
Primary Station	38
Secondary Station	62
Sediment Observation	20
Water Quality Observation	11
Snow & Glacie gauge	5

	Basic Station (10)	Primary Station (38)			Secondary Station (62)	
	Rainforcement	Minimum Repair	Rainforcement	Establishment	Rainforcement	Establishment
Immediate Programme	(10)	(14)				
Long-Term Programme			(34)	(4)	(25)	(17)

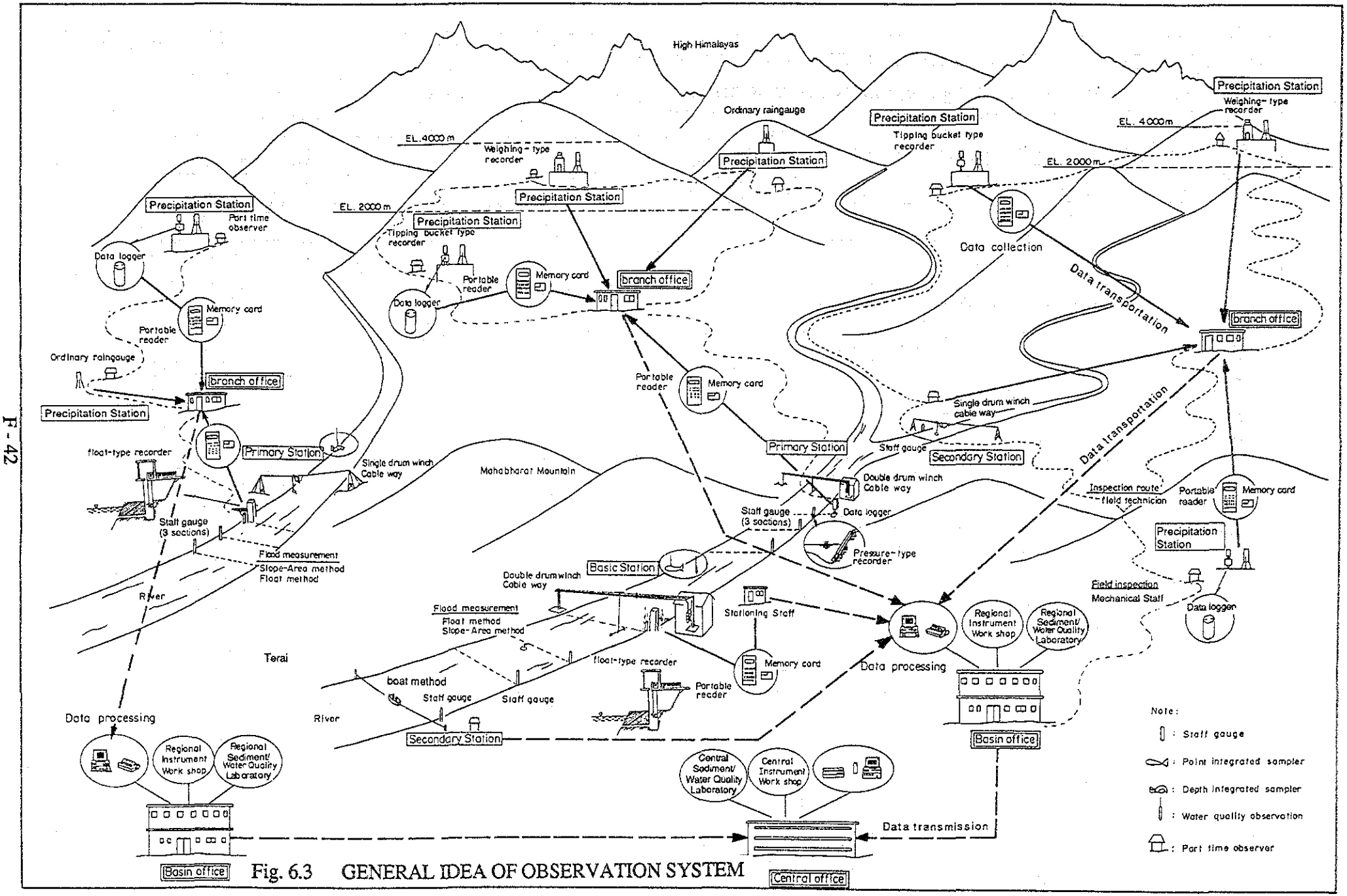


Fig. 6.3 GENERAL IDEA OF OBSERVATION SYSTEM

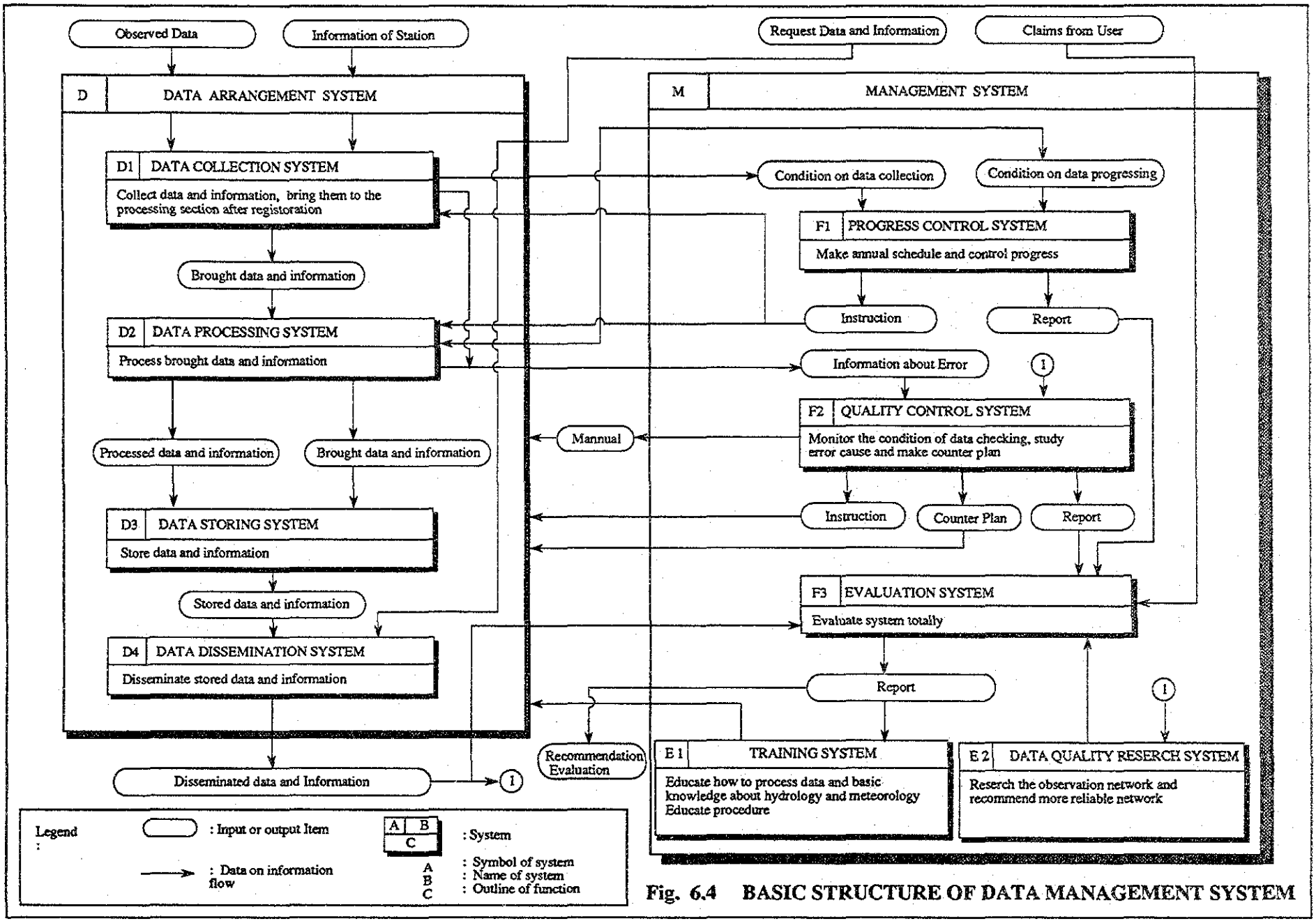


Fig. 6.4 BASIC STRUCTURE OF DATA MANAGEMENT SYSTEM

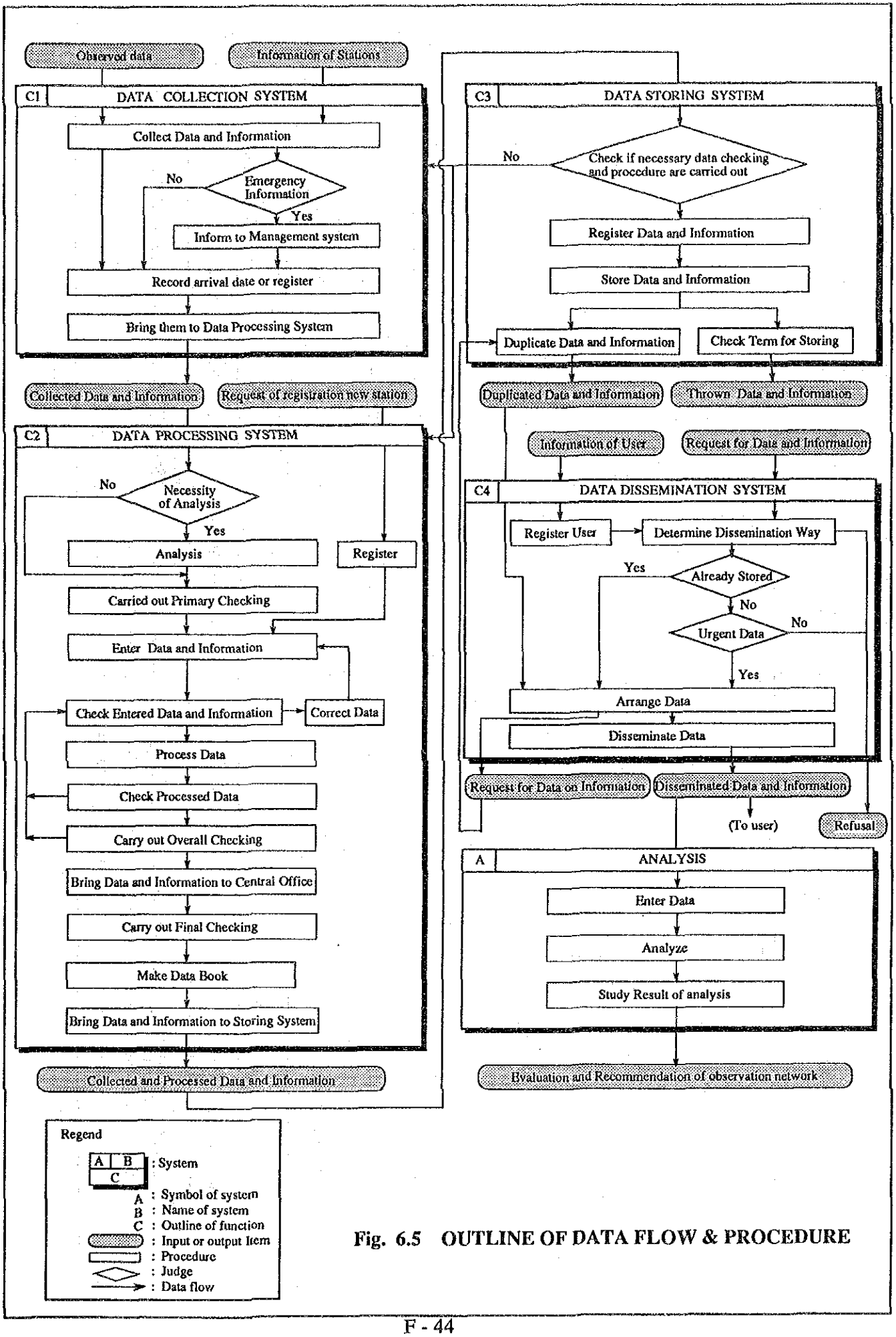


Fig. 6.5 OUTLINE OF DATA FLOW & PROCEDURE

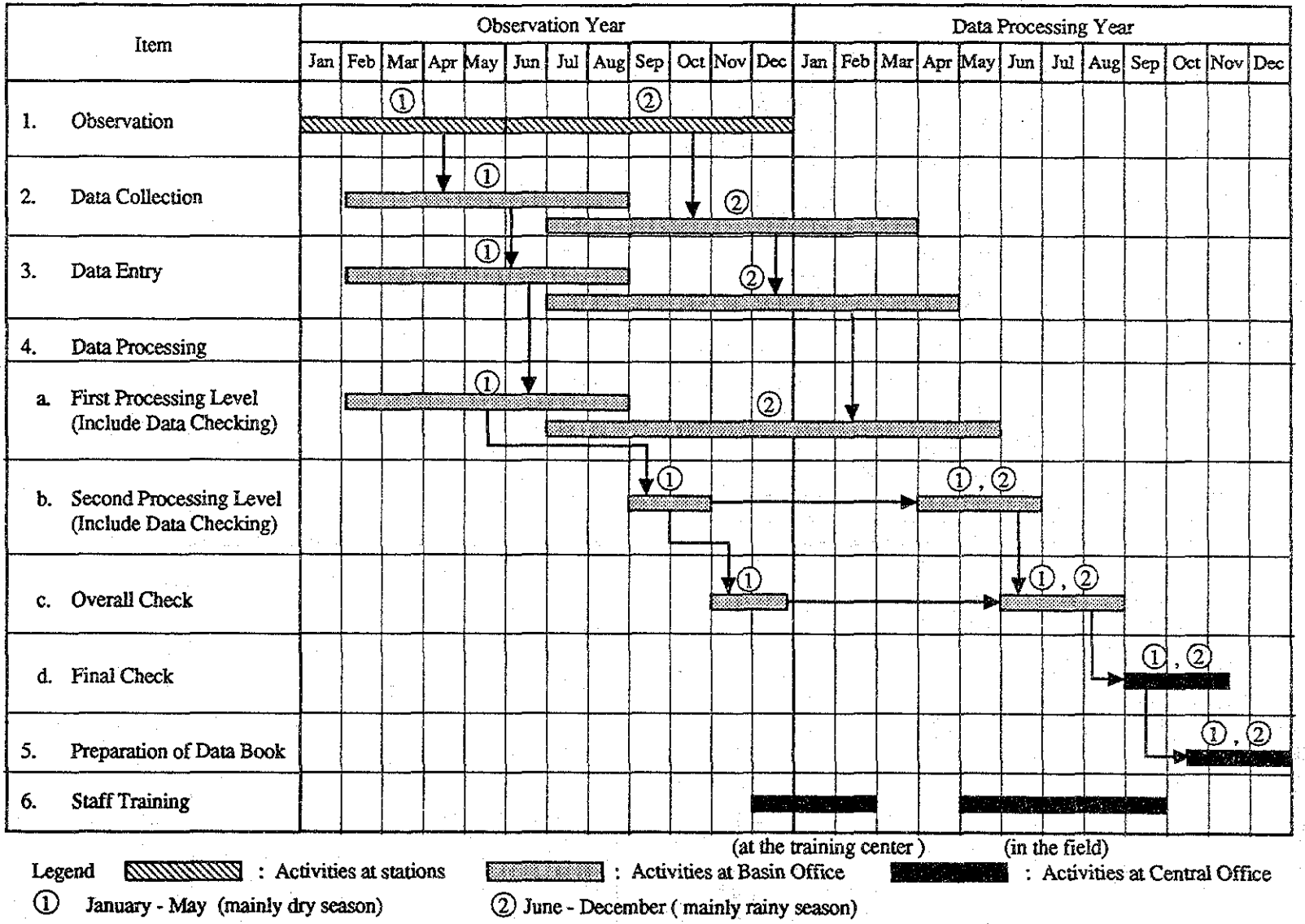


Fig. 6.6 OVERALL ANNUAL SCHEDULE IN DHM

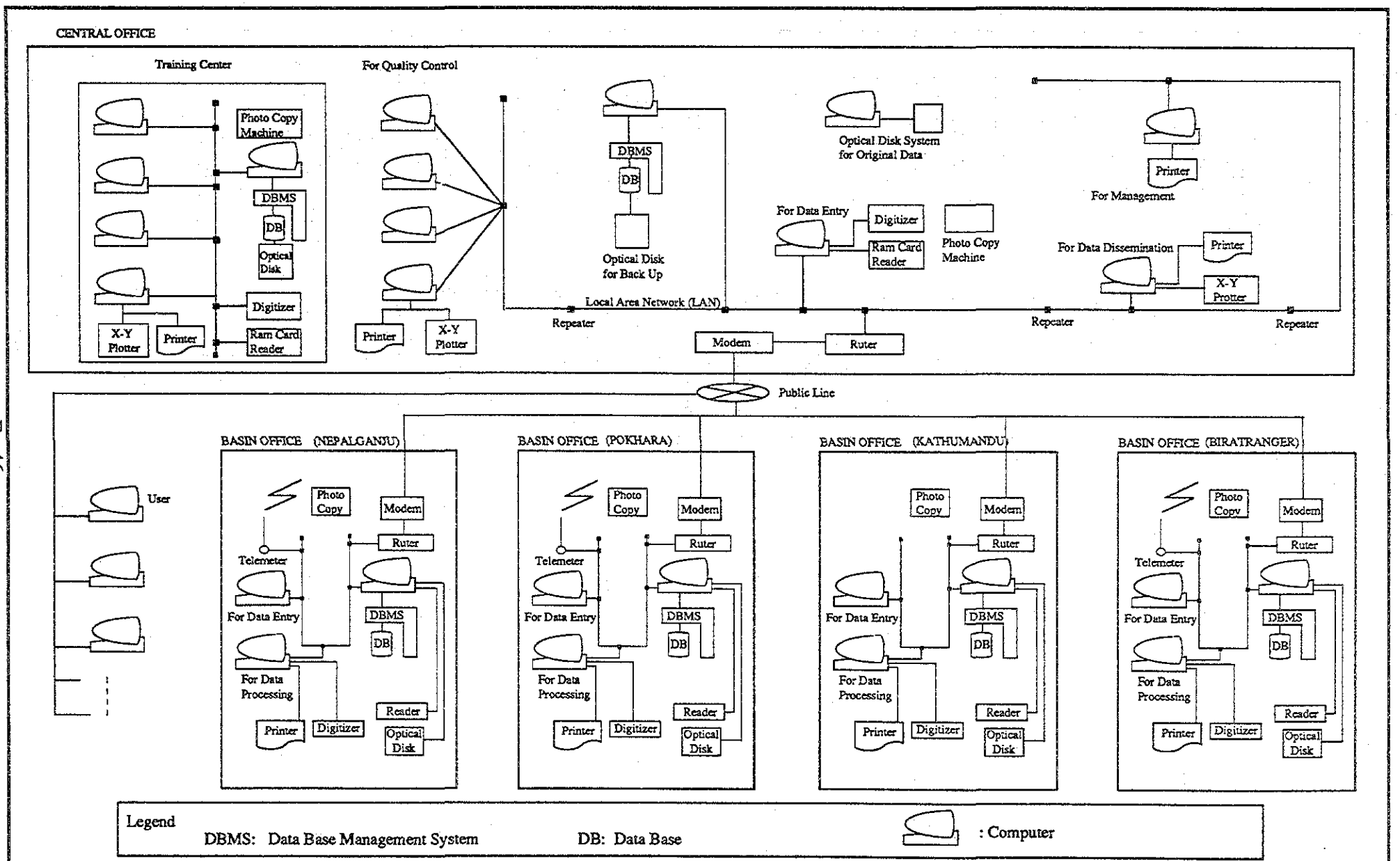


Fig. 6.7 GENERAL IDEA OF COMPUTER SYSTEM FOR THE LONG TERM PROGRAMME

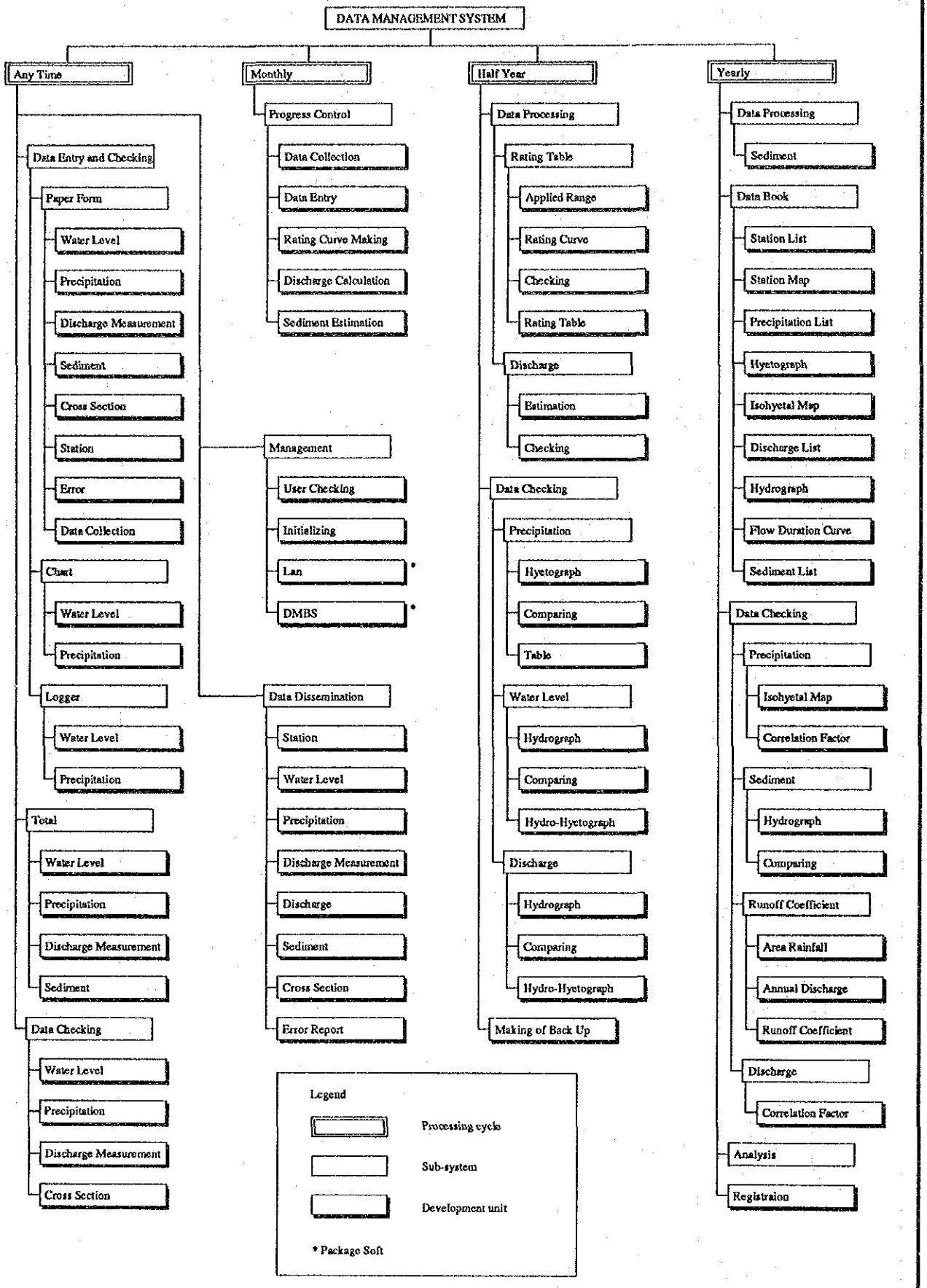


Fig. 6.8 STRUCTURE OF SOFTWARE

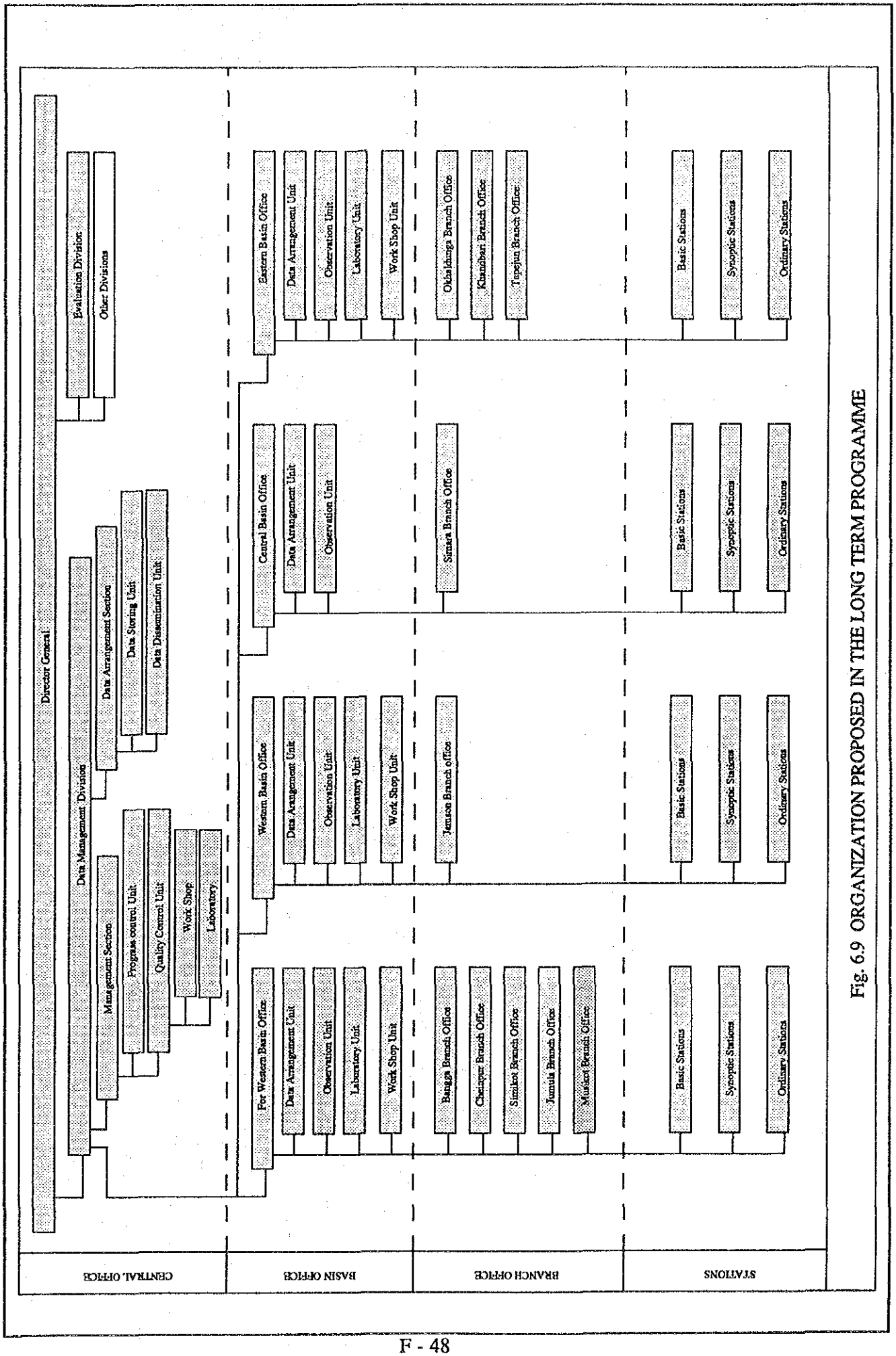


Fig. 6.9 ORGANIZATION PROPOSED IN THE LONG TERM PROGRAMME

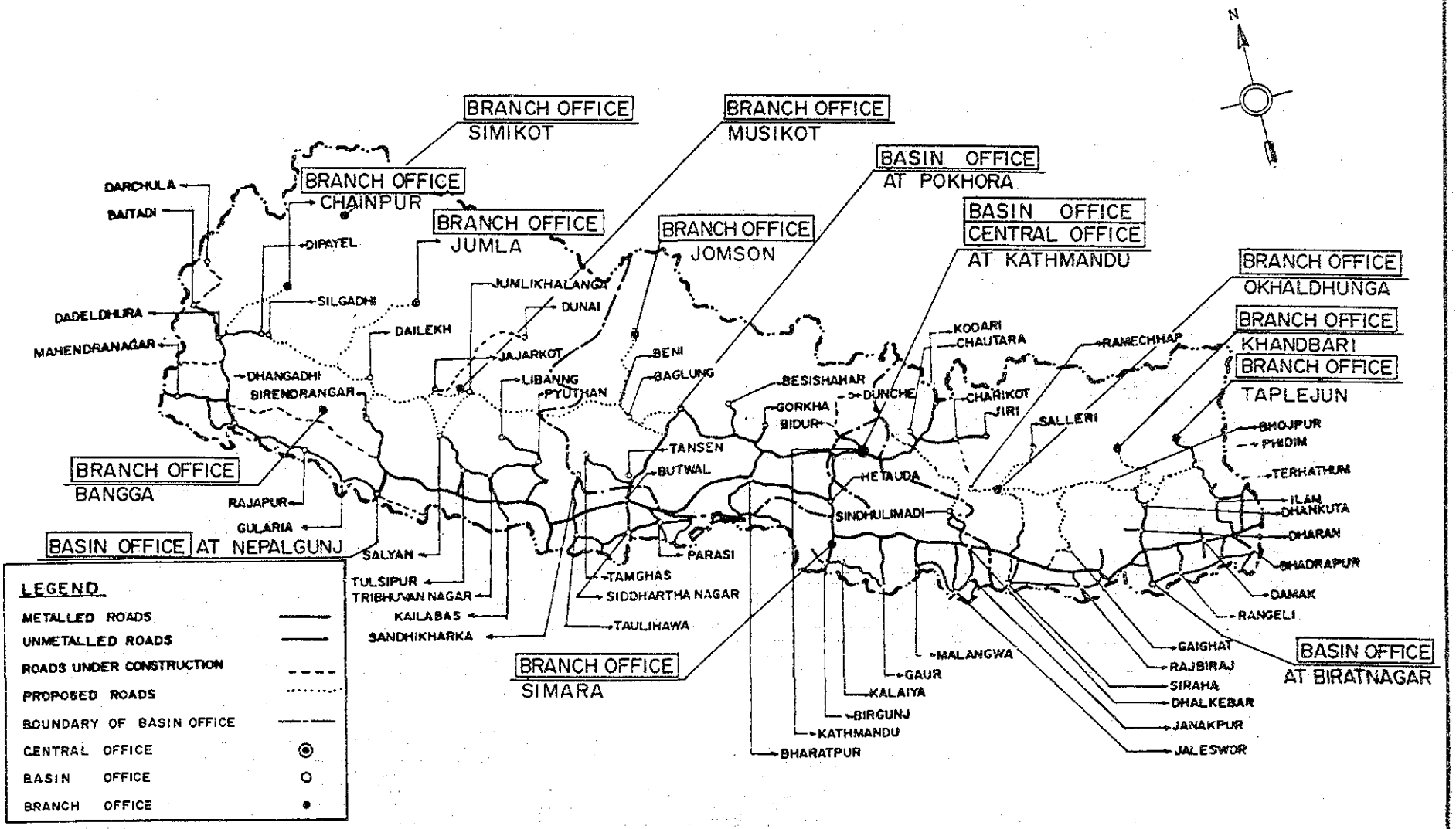


Fig. 6.10 SITE OF OFFICE

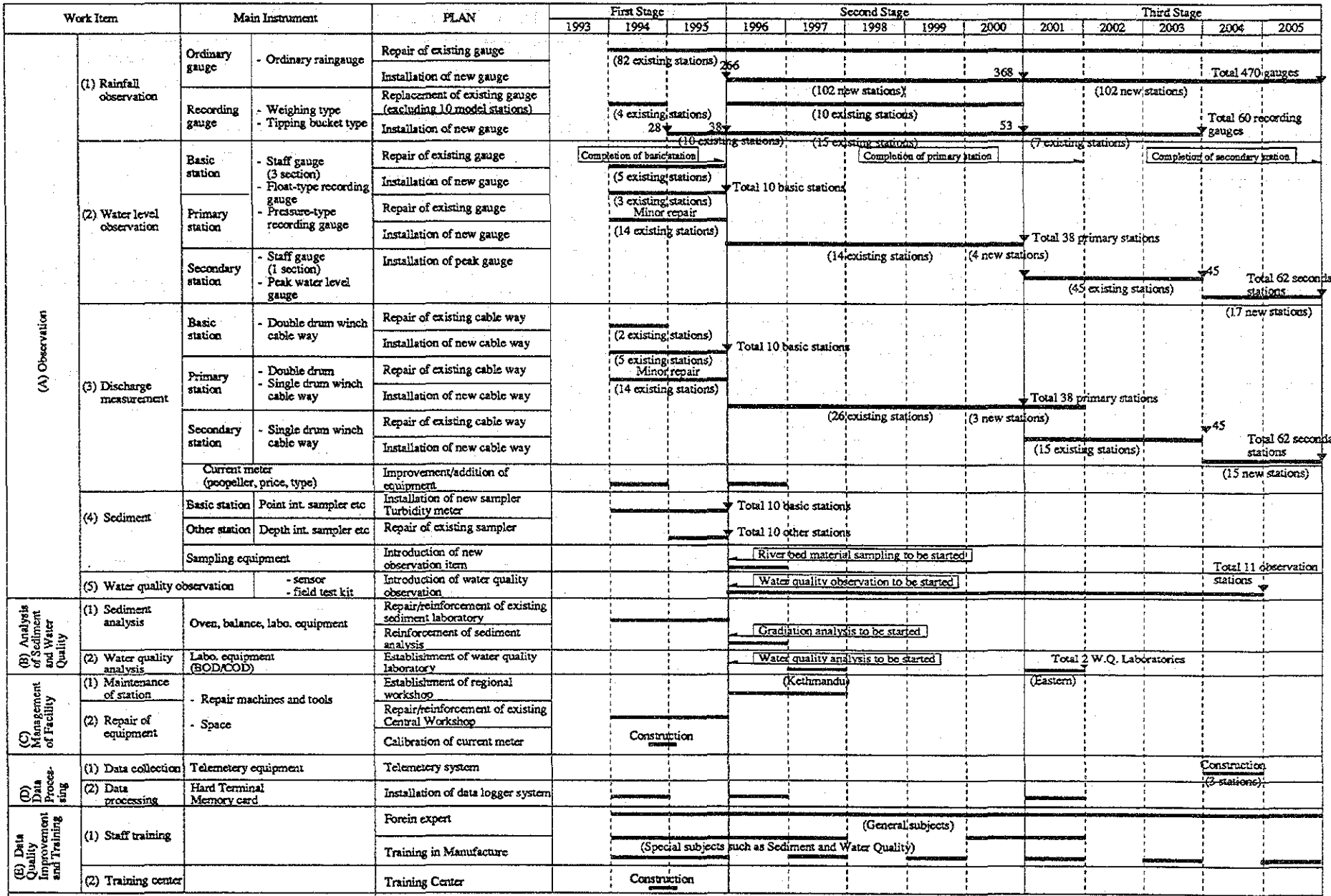


Fig. 6.11 IMPLEMENTATION SCHEDULE FOR OBSERVATION SYSTEM

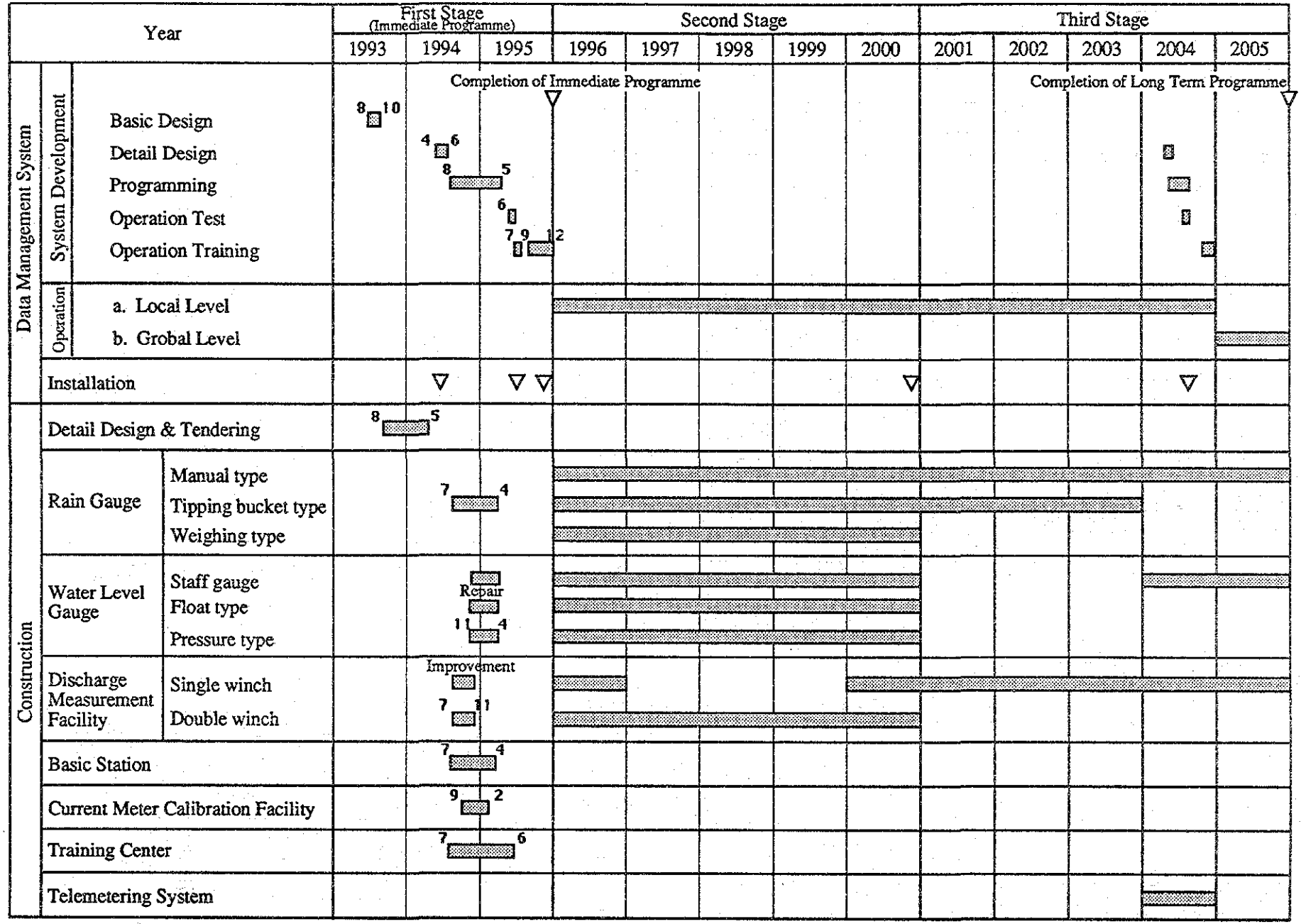


Fig. 6.12 IMPLEMENTATION SCHEDULE FOR DATA MANAGEMENT SYSTEM AND CIVIL CONSTRUCTION

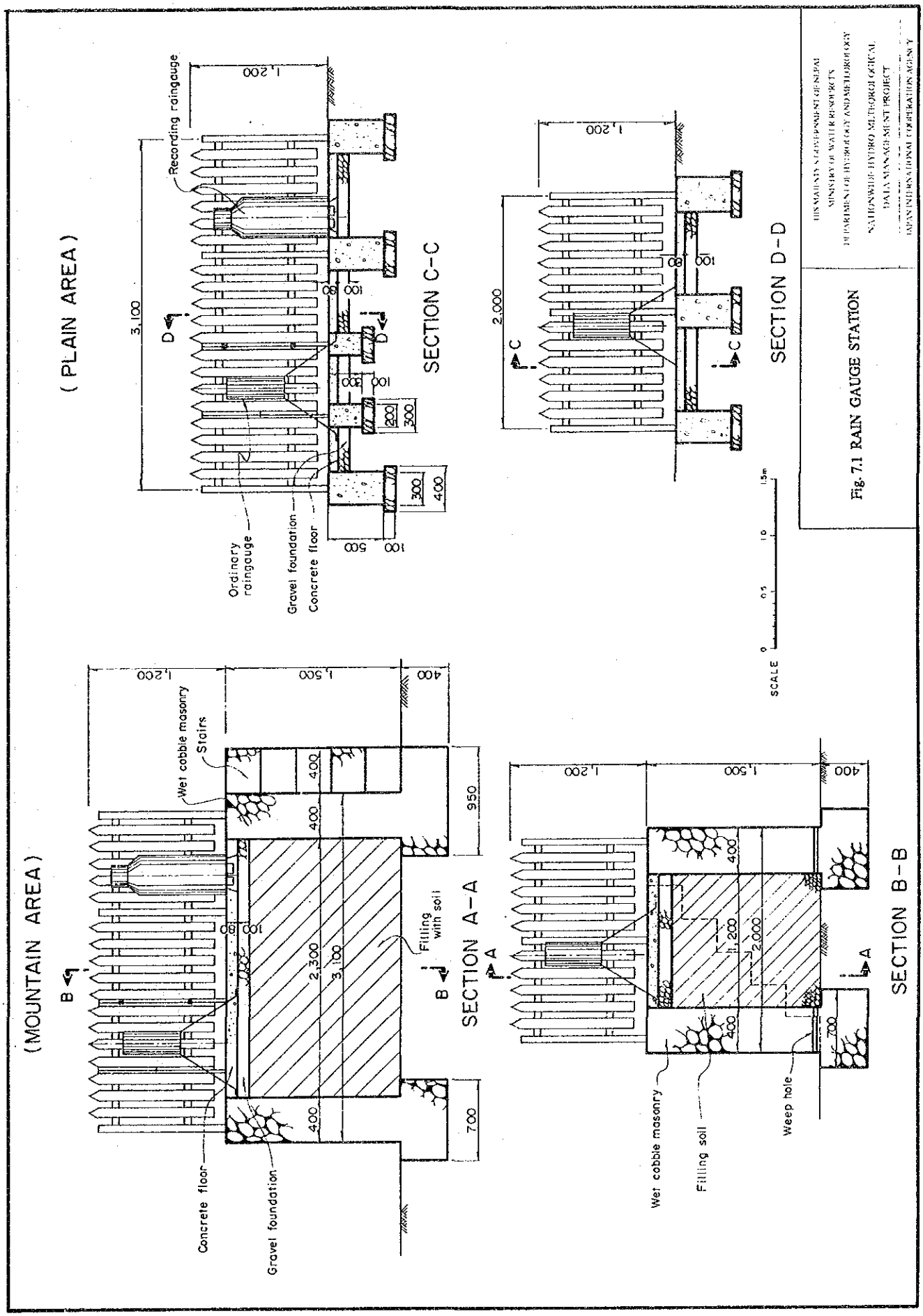
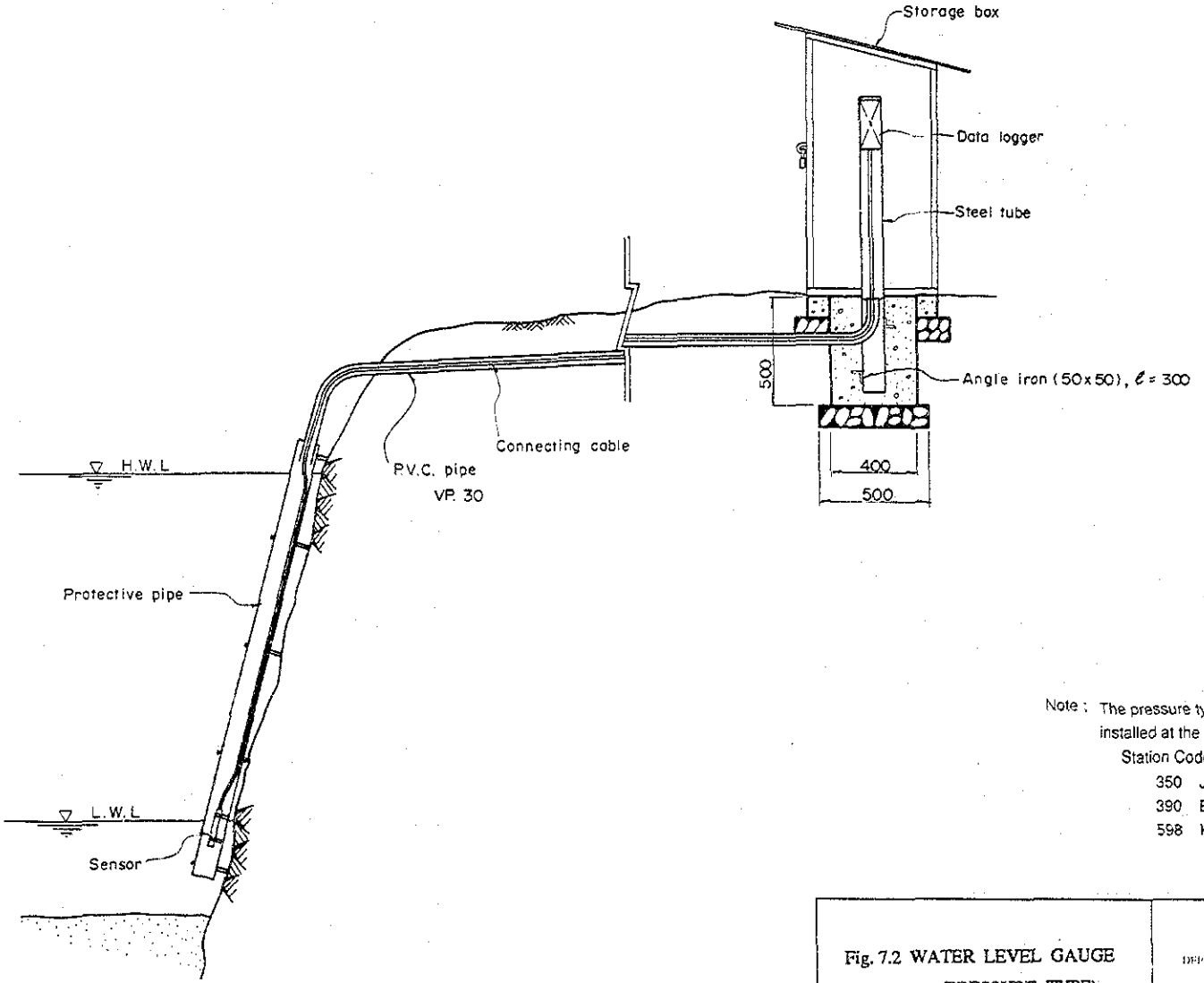


Fig. 7.1 RAIN GAUGE STATION



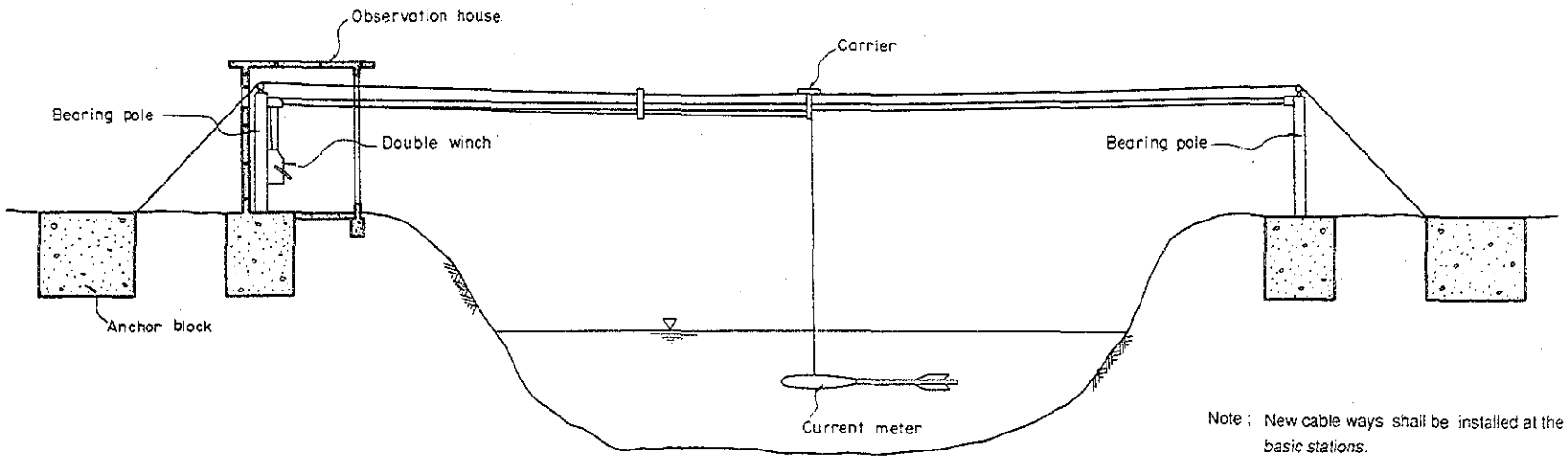
Note : The pressure type-water level gauge shall be installed at the following basic stations.

Station Code No.

350 Jalkundi (West Rapti River)
390 Butwal (Tinau River)
598 Kamala (Chisapani River)

Fig. 7.2 WATER LEVEL GAUGE (PRESSURE TYPE)

HIS MAJESTY'S GOVERNMENT OF NEPAL
MINISTRY OF WATER RESOURCES
DEPARTMENT OF HYDROLOGY AND METEOROLOGY
NATIONWIDE HYDRO METEOROLOGICAL DATA MANAGEMENT PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY



PROFILE

Note : New cable ways shall be installed at the following *basic stations*.

Code No.

※ 350 Jalkundi (West Rapti River)
390 Butwal (Tinau River)
589 Pandhera dovan (Bagmati River)
※ 695 Chatara kotsu (Sapta Koshi River)
795 Mainachuli (Kan Kai River)

At the station marked with [※], the existing tower on the opposite bank shall be used for the new cable way instead of the new bearing pole.

Fig. 7.3 CABLE WAY (DOUBLE WINCH)

HIS MAJESTY'S GOVERNMENT OF NEPAL
MINISTRY OF WATER RESOURCES
DEPARTMENT OF HYDROLOGY AND METEOROLOGY
NATIONWIDE HYDRO METEOROLOGICAL DATA MANAGEMENT PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

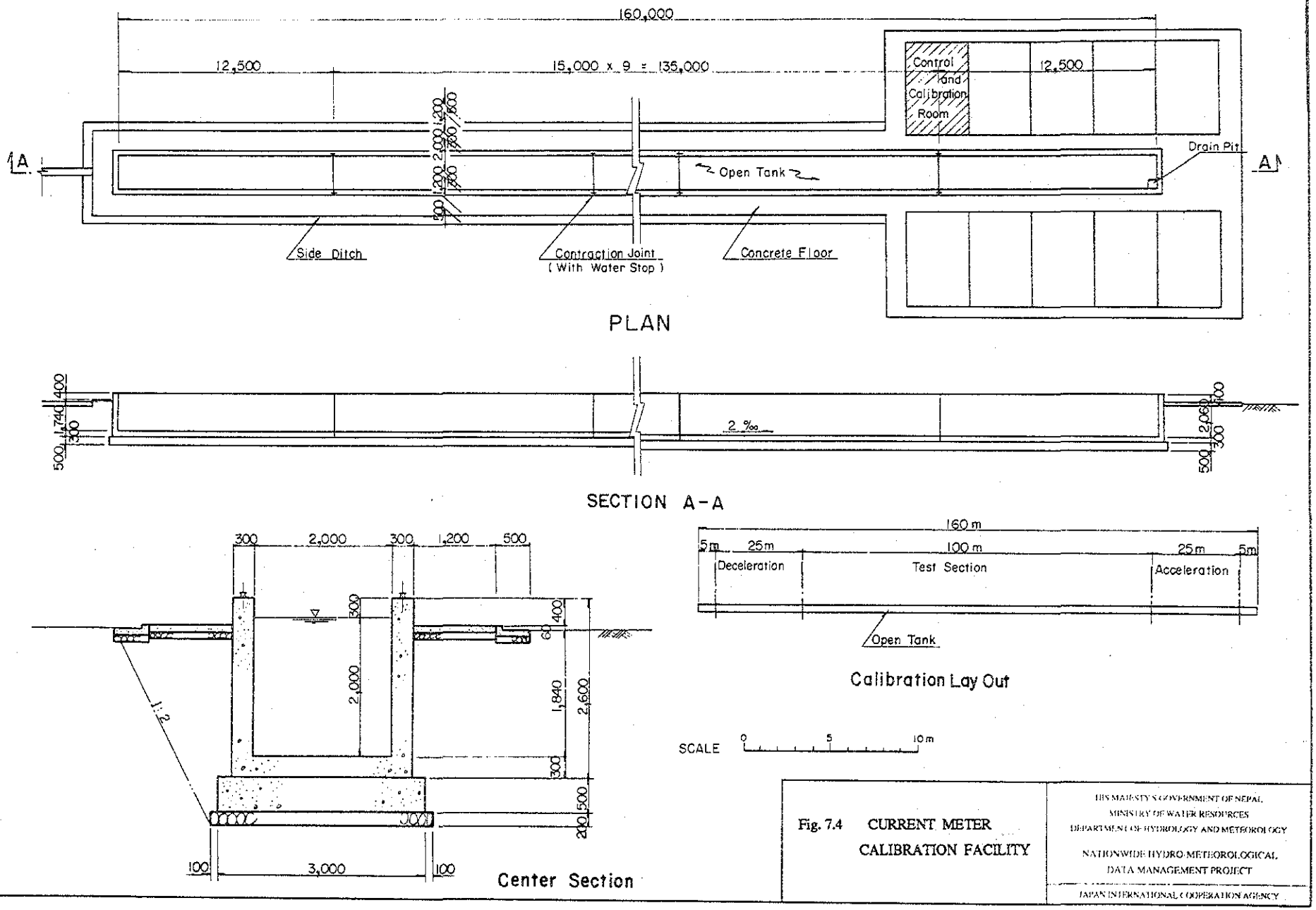


Fig. 7.4 CURRENT METER CALIBRATION FACILITY

HIS MAJESTY'S GOVERNMENT OF NEPAL
MINISTRY OF WATER RESOURCES
DEPARTMENT OF HYDROLOGY AND METEOROLOGY
NATIONWIDE HYDRO-METEOROLOGICAL DATA MANAGEMENT PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

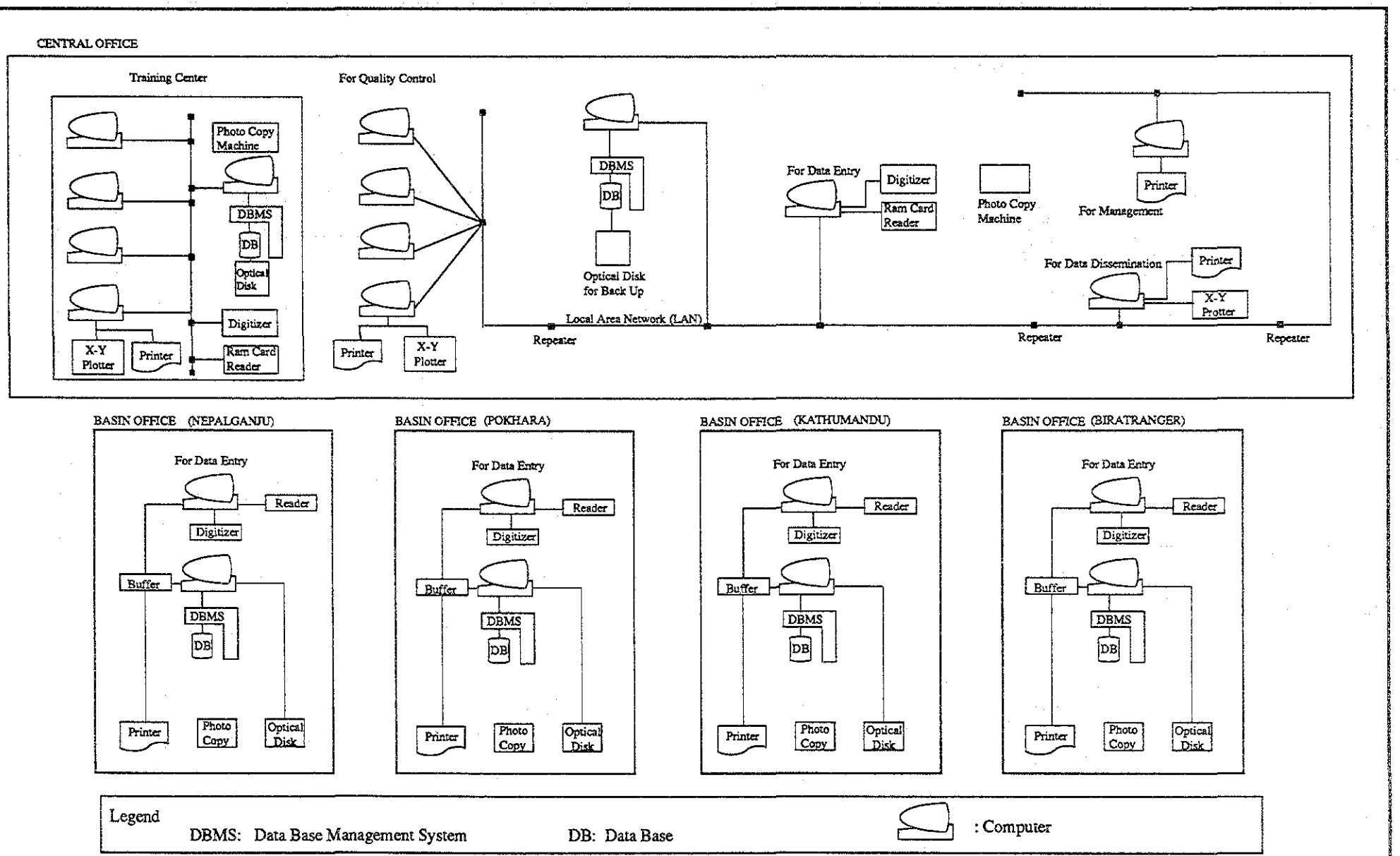


Fig. 7.5 GENERAL IDEA FOR COMPUTER SYSTEM IN THE IMMEDIATE PROGRAMME