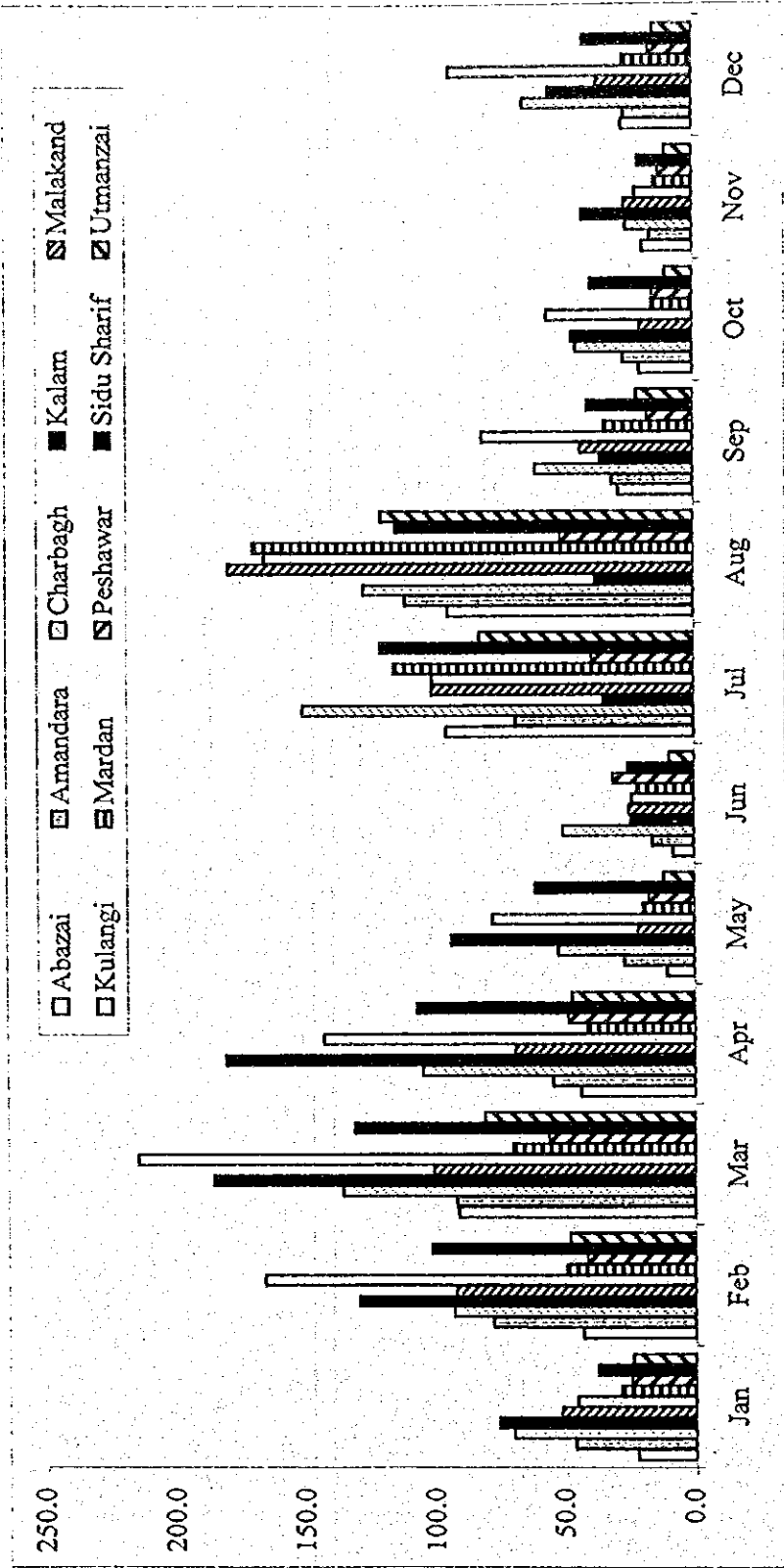


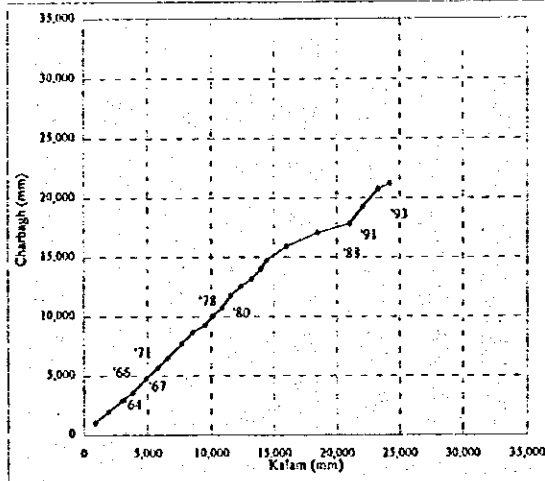
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**Figure 3.3.4**  
 Monthly Average Discharge at Kalam, Chakdara,  
 Warsak and Nowshera Stations

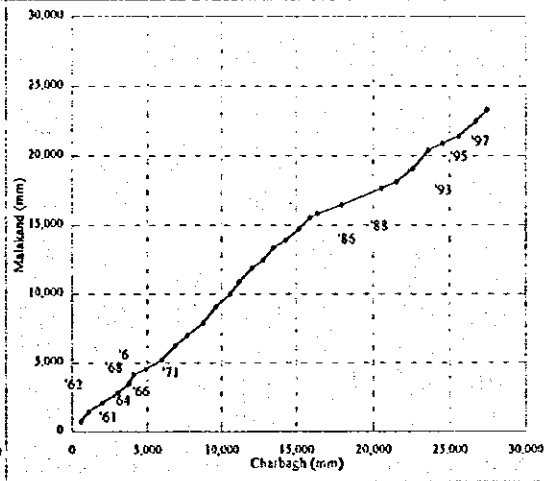


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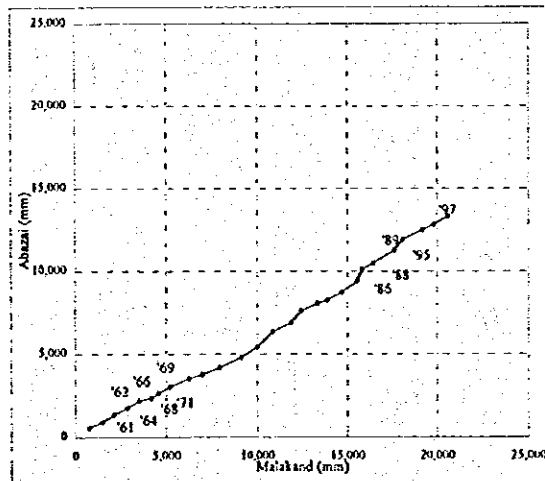
Figure 3.3.5  
 Average Monthly Rainfall for the Period 1961 - 1997



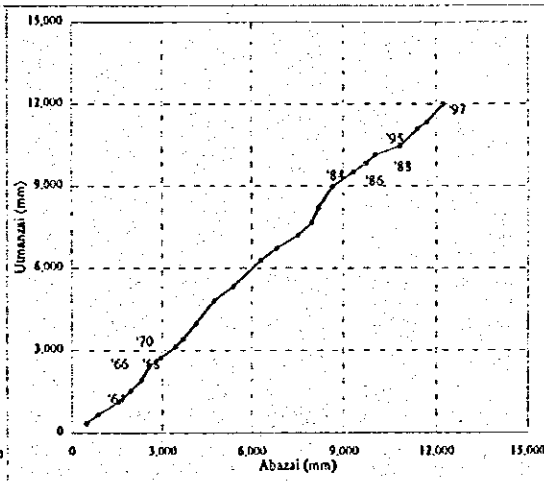
(a) Kalam and Charbagh



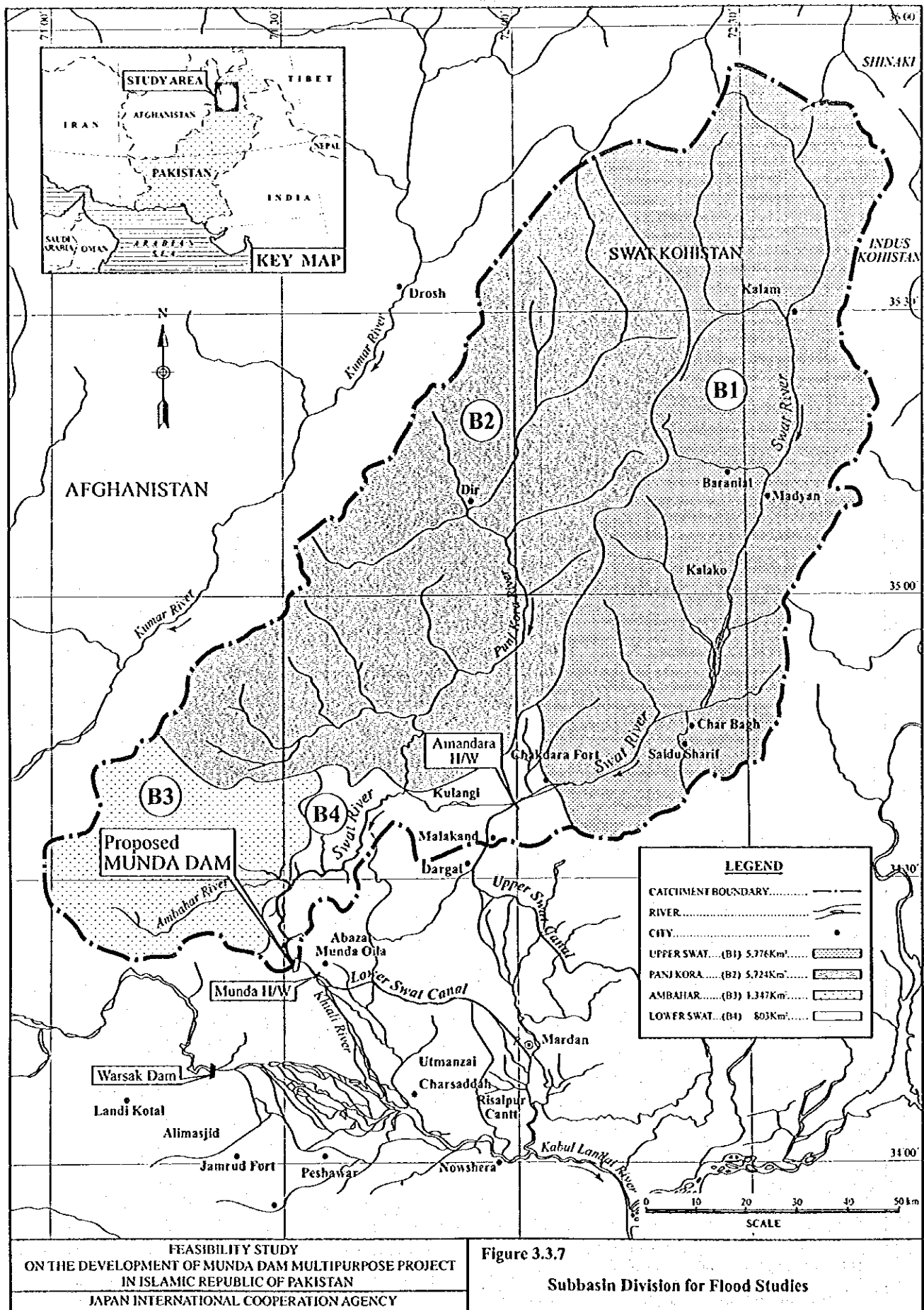
(b) Charbagh and Malakand

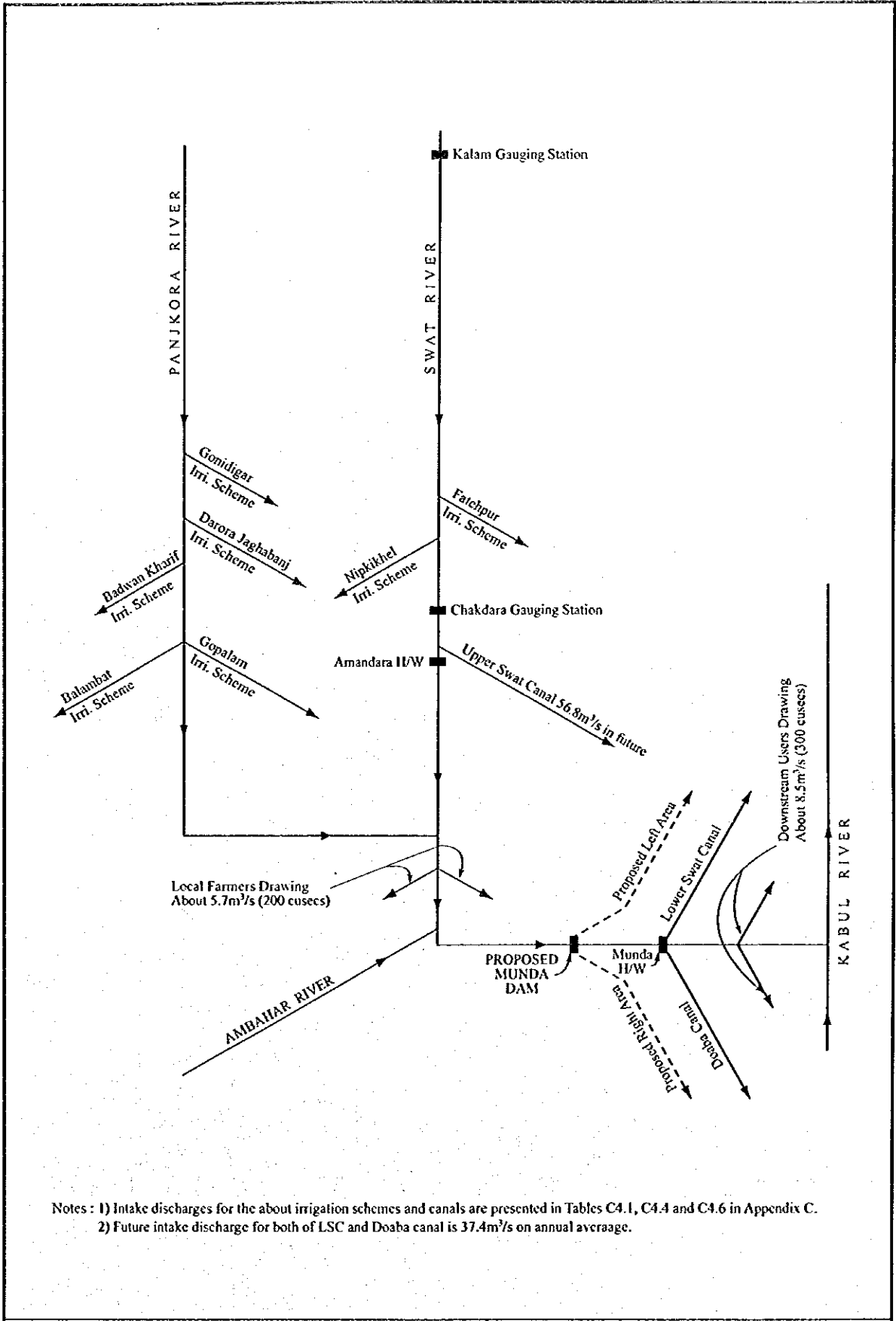


(c) Malakand and Abazai

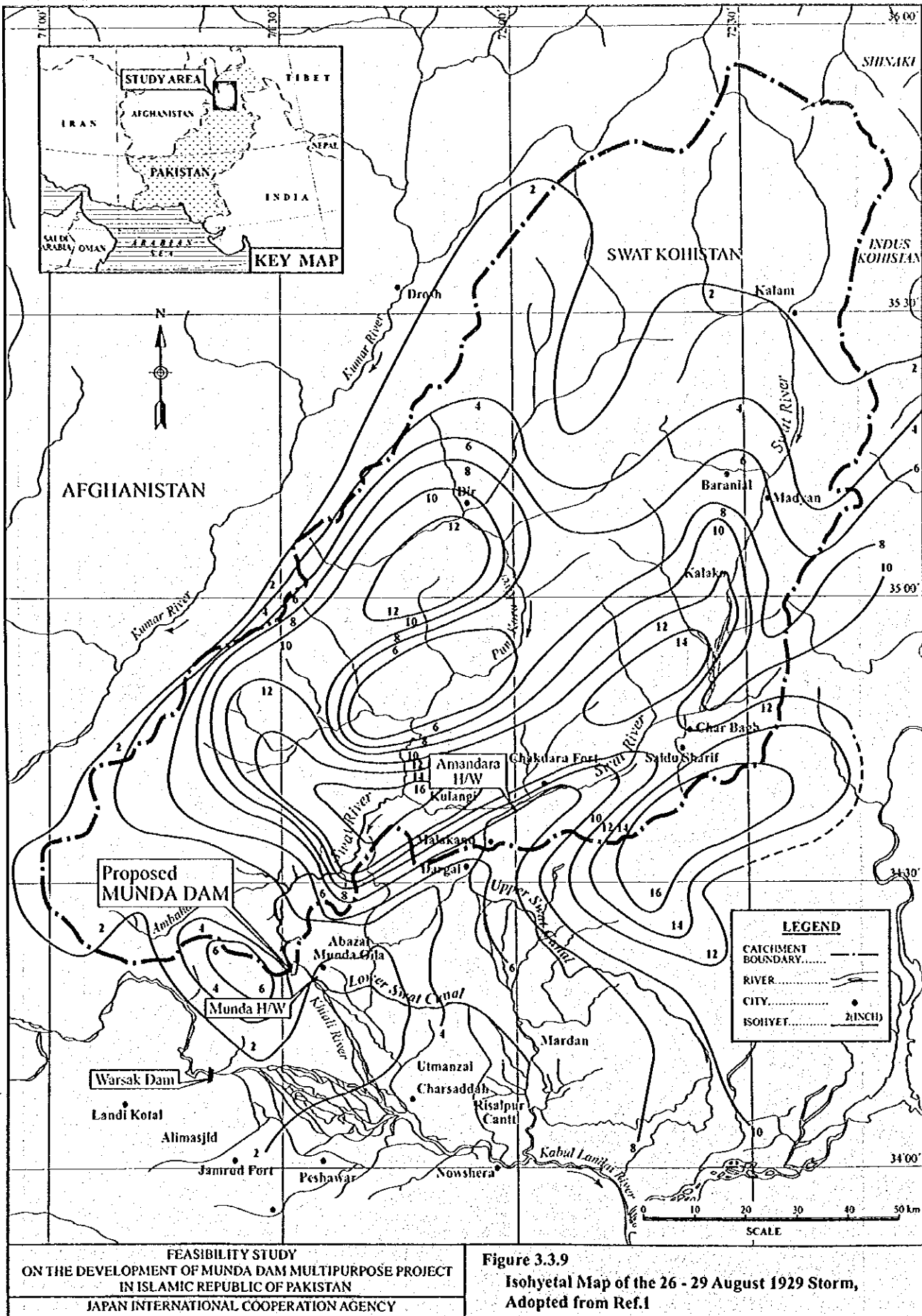


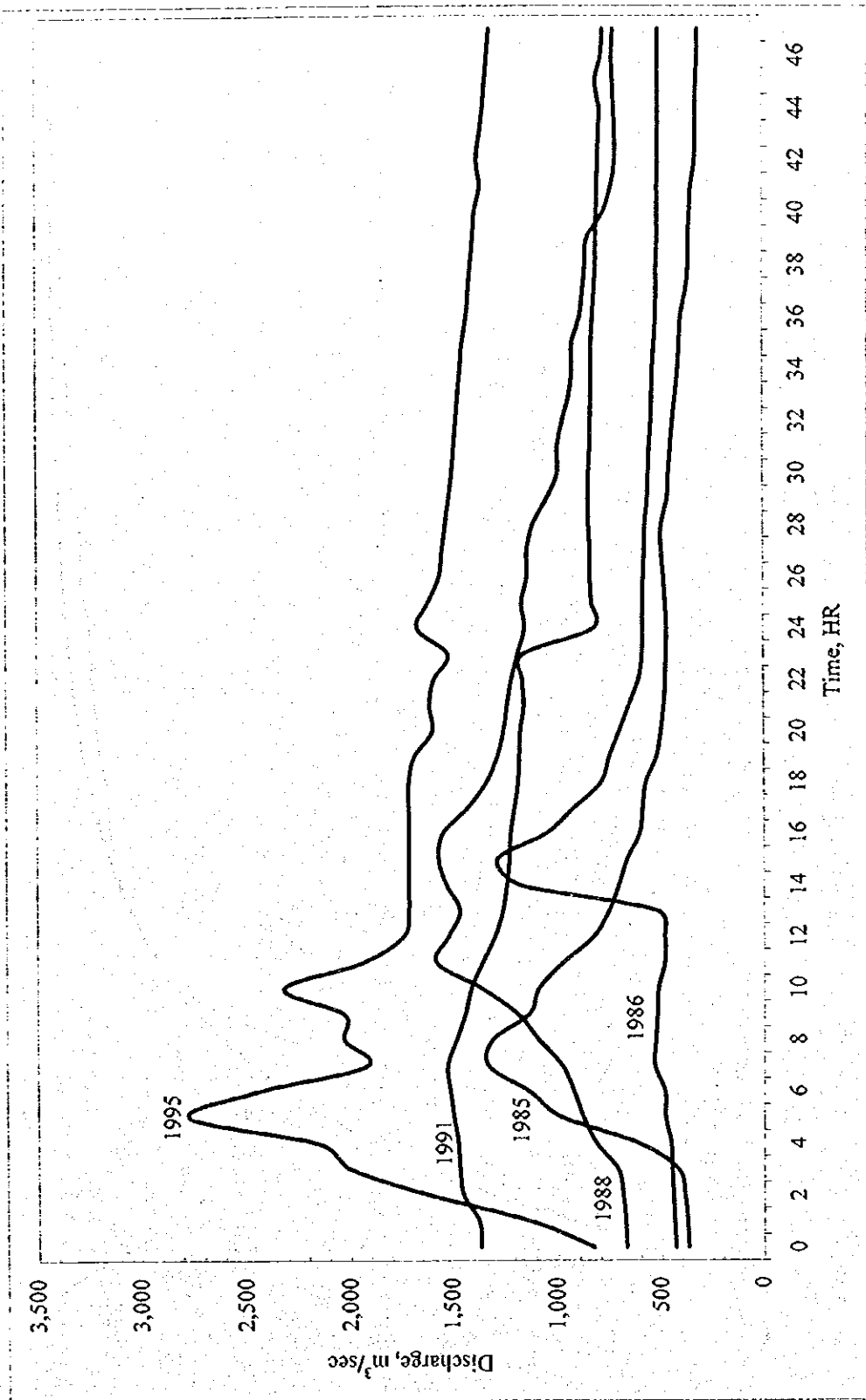
(d) Abazai and Utmanzai





Notes : 1) Intake discharges for the about irrigation schemes and canals are presented in Tables C4.1, C4.4 and C4.6 in Appendix C.  
 2) Future intake discharge for both of LSC and Doaba canal is 37.4m<sup>3</sup>/s on annual average.





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Figure 3.3.10

48 hours Flood Hydrographs at Chakdara

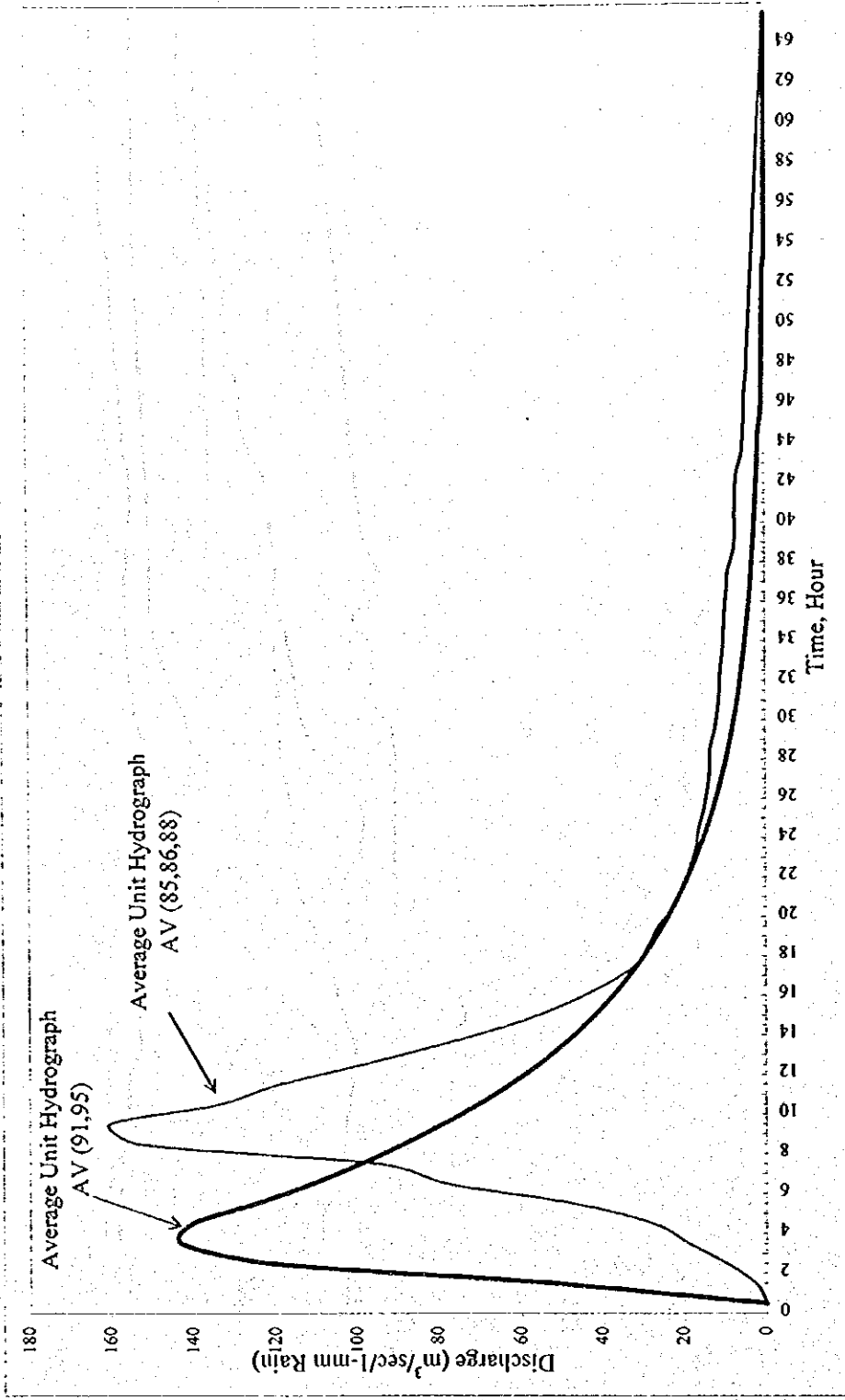
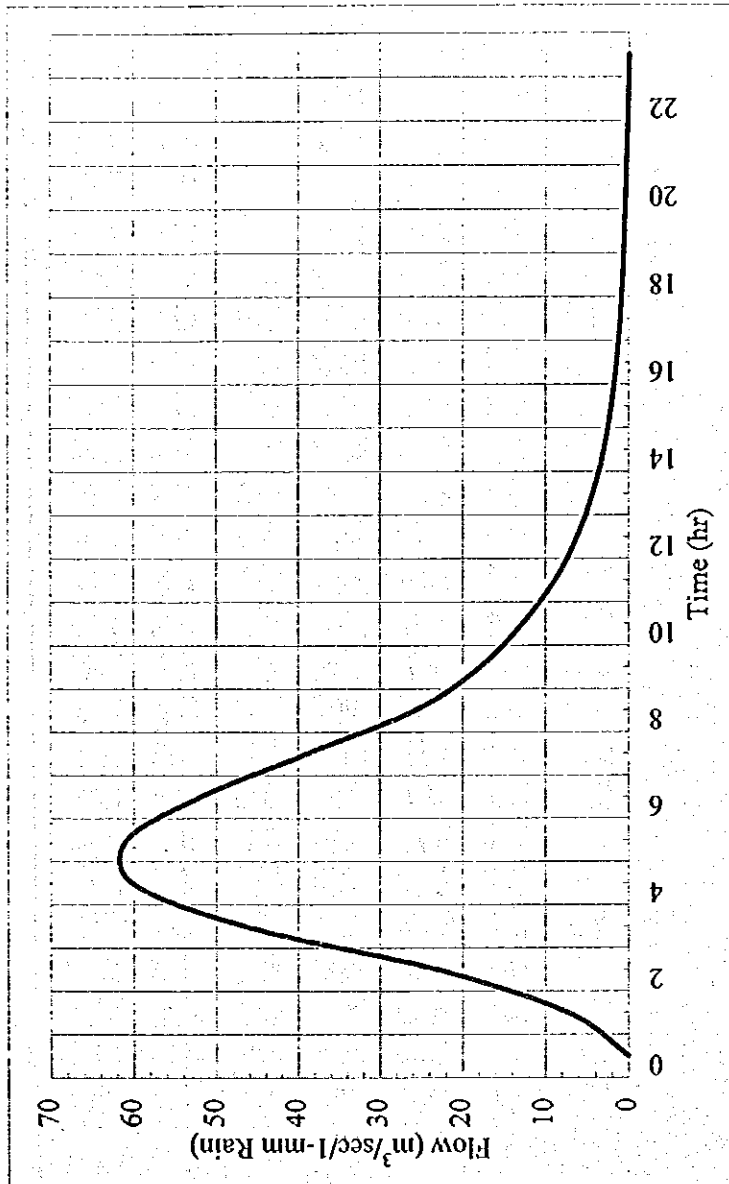


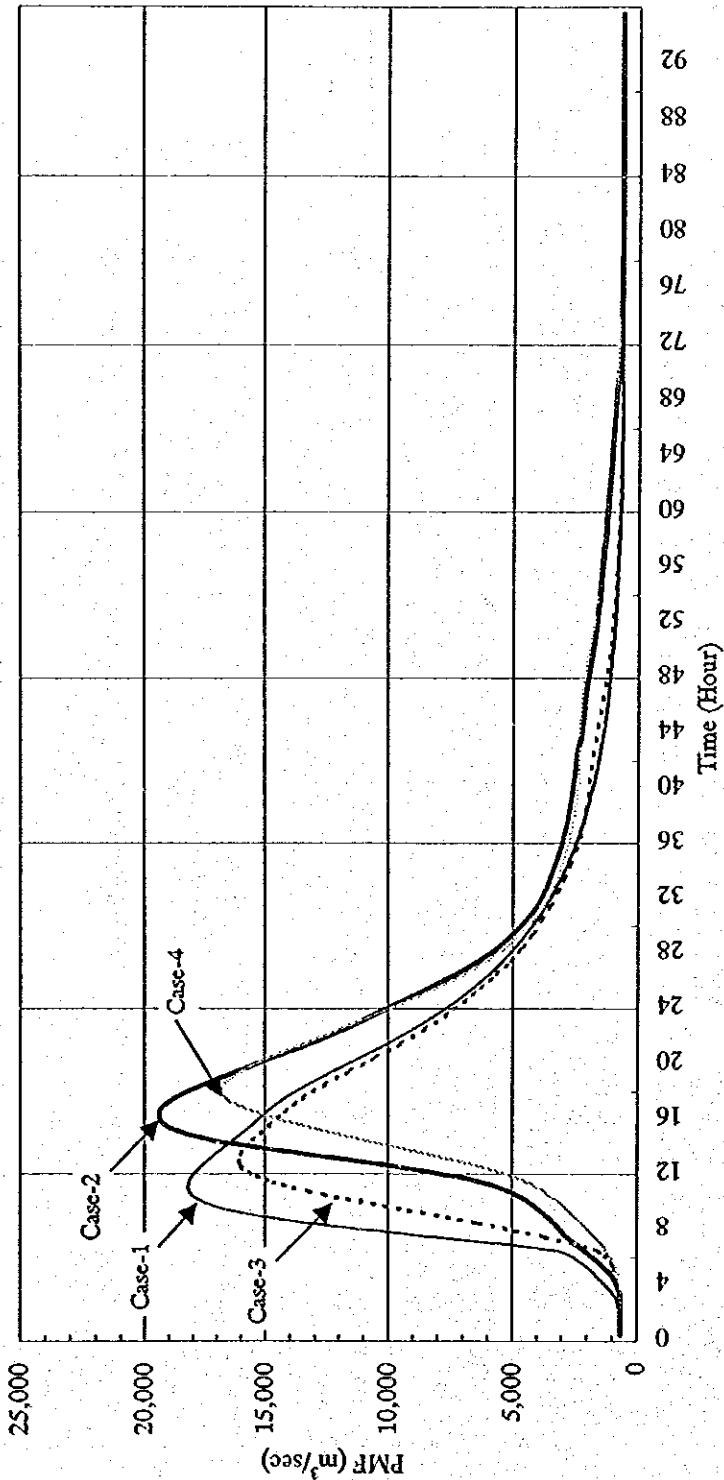
Figure 3.3.11  
 Adopted Unit Hydrographs for the Study





Time to Concentration      4.05 hour  
 Time to Peak                 4.55 hour  
 Peak flow                      61.67 m<sup>3</sup>/sec/l-mm Rain

TIME	UHamb
0.00	0
1.00	7.24
2.00	22.95
3.00	46.42
4.00	60.11
5.00	60.88
6.00	51.96
7.00	38.98
8.00	25.78
9.00	17.89
10.00	12.78
11.00	8.82
12.00	6.24
13.00	4.35
14.00	3.03
15.00	2.13
16.00	1.50
17.00	1.04
18.00	0.73
19.00	0.55
20.00	0.38
21.00	0.24
22.00	0.10
23.00	0.00

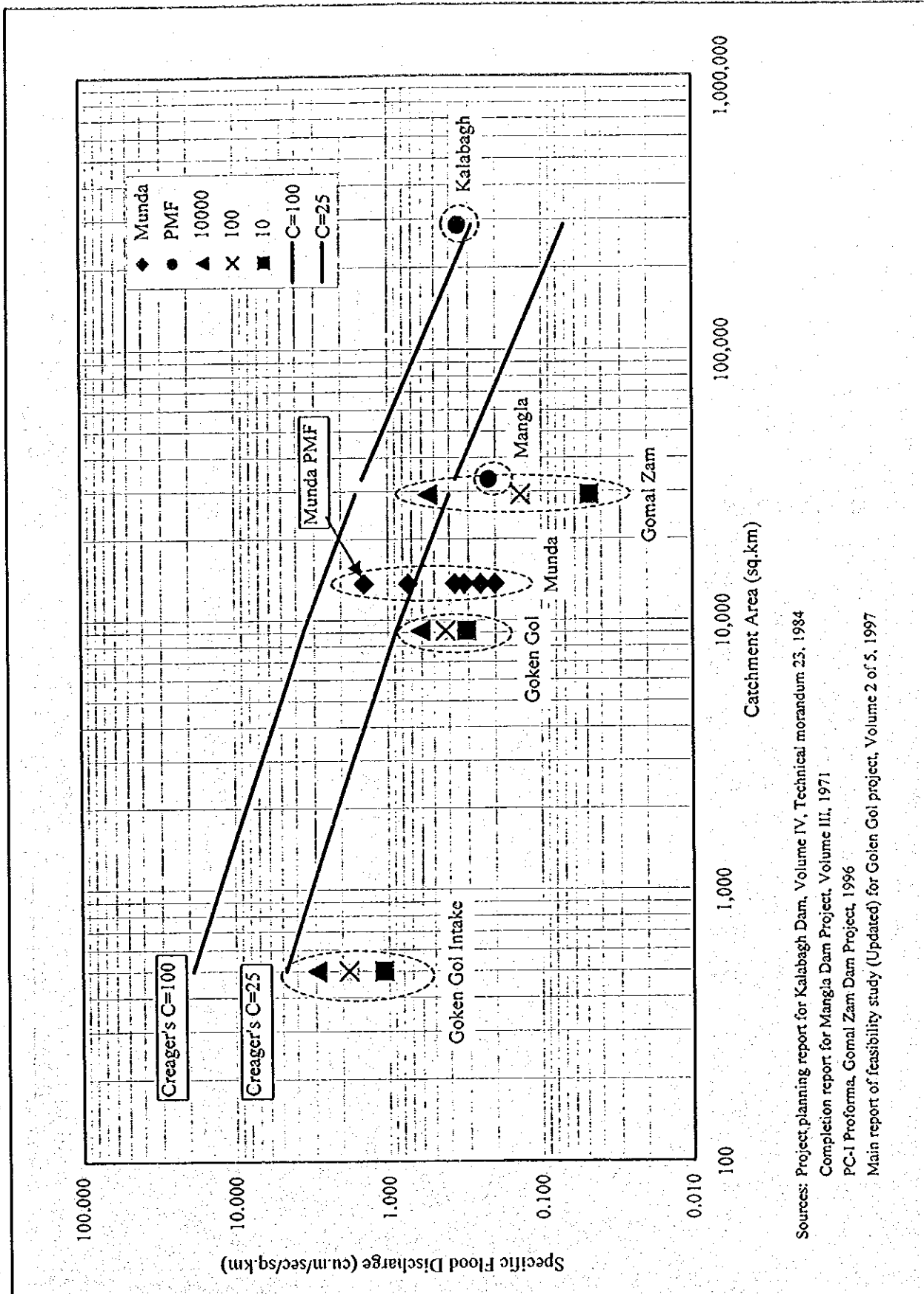


Qp	Tp	Case	Unit Hydrograph Condition	PMP
18,169	11	1	Average Unit Hydrograph 1991 and 1995	24-PMP
19,393	16	2	Average Unit Hydrograph 1985, 1986 and 1988	24-PMP
15,988	13	3	Average Unit Hydrograph 1991 and 1995	72-PMP
16,706	18	4	Average Unit Hydrograph 1985, 1986 and 1988	72-PMP

Qp Peak Flow, m<sup>3</sup>/sec  
 Tp Time to Peak, hours

Figure 3.3.13

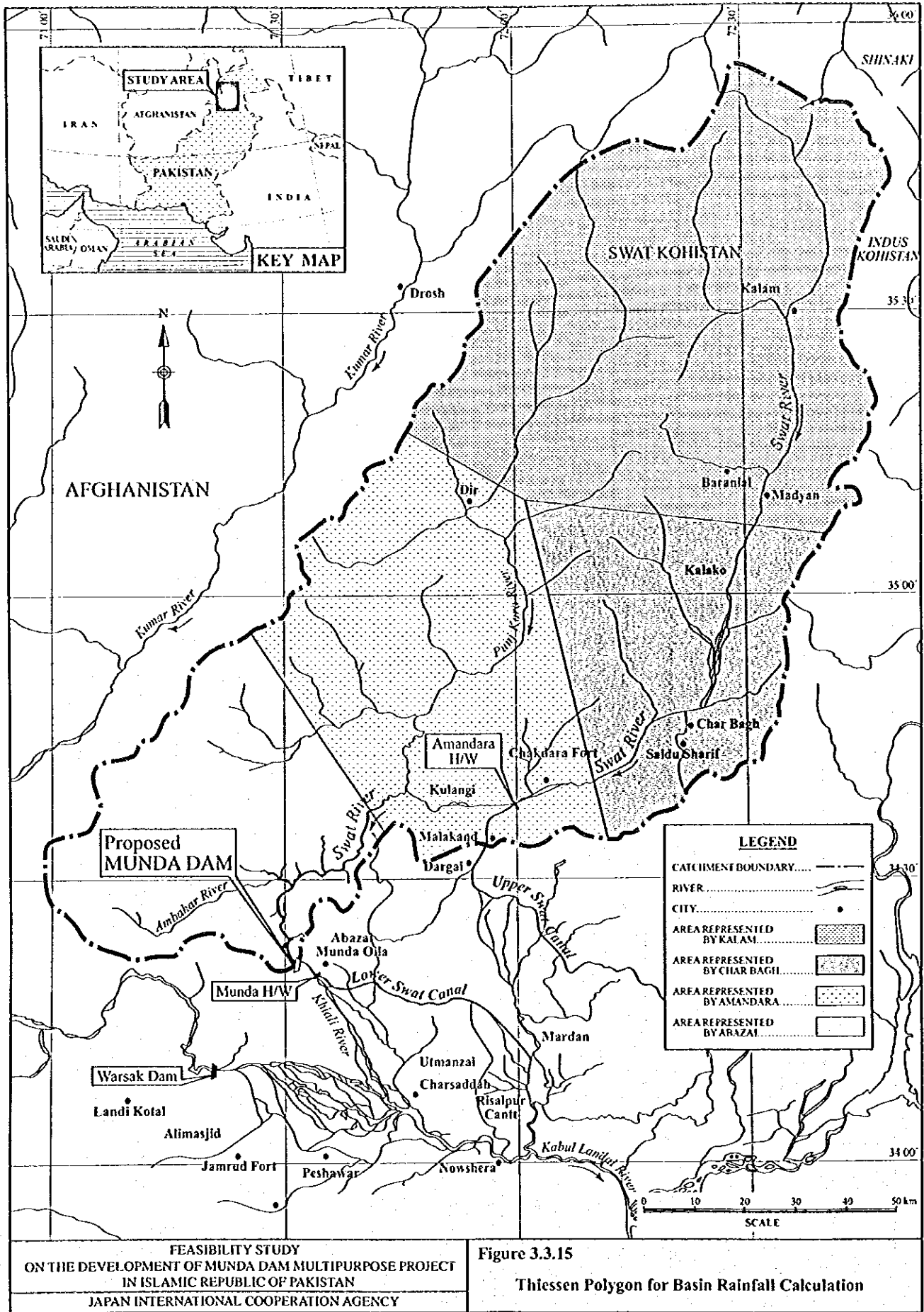
Estimated Composite PMF at Munda Dam Site



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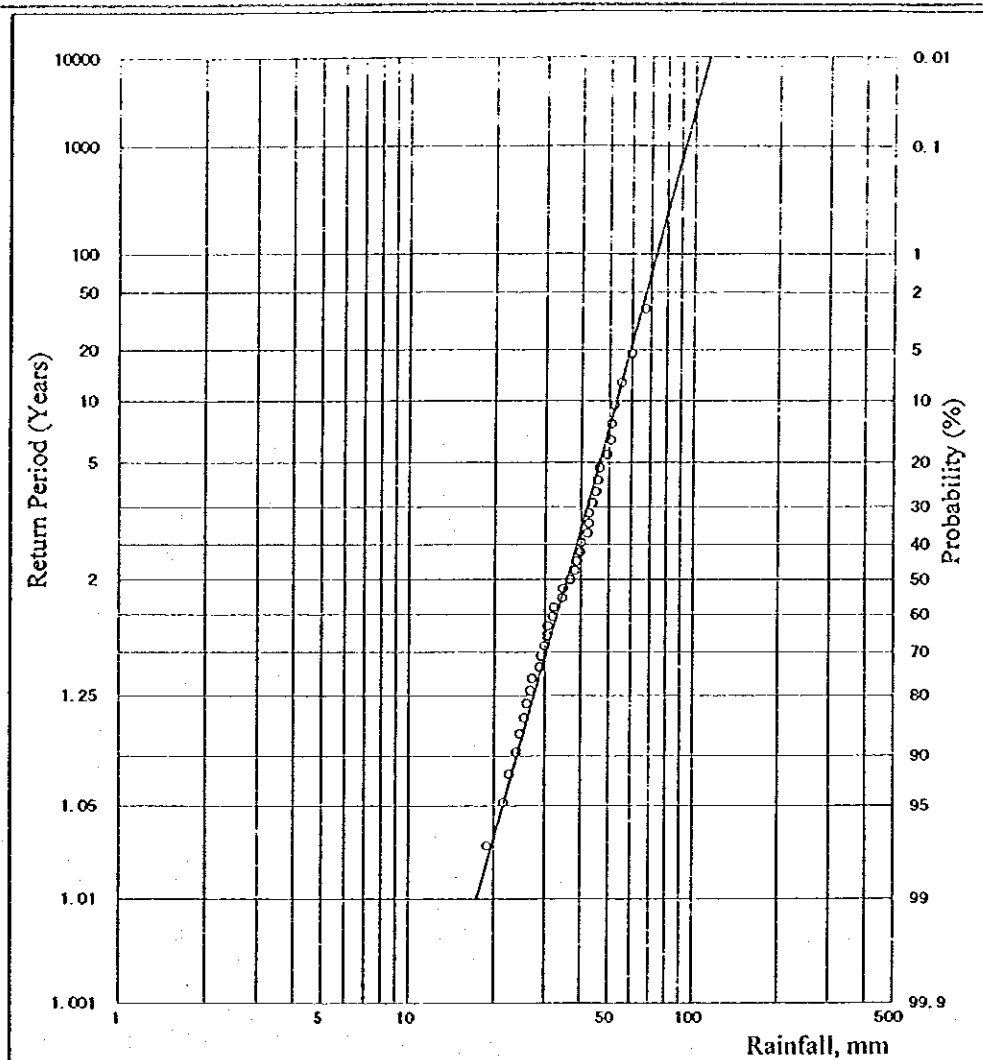
Figure 3.3.14  
Specific Design Floods for Various Projects

Sources: Project planning report for Kalabagh Dam, Volume IV, Technical memorandum 23, 1984  
Completion report for Mangla Dam Project, Volume III, 1971  
PC-1 Proforma, Gomal Zam Dam Project, 1996  
Main report of feasibility study (Updated) for Goken Gol project, Volume 2 of 5, 1997



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Figure 3.3.15  
 Thiessen Polygon for Basin Rainfall Calculation



Return Period (Year)	Probability	Probable Rainfall (mm)
2	0.5000	35.74
5	0.2000	46.34
10	0.1000	53.07
20	0.0500	59.37
25	0.0333	61.15
50	0.0200	67.35
100	0.0100	73.26
200	0.0050	79.12
300	0.0033	82.54
500	0.0020	86.85
1000	0.0010	92.73
2000	0.0005	98.64
5000	0.0002	106.53
10000	0.0001	112.58

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Figure 3.3.16  
Frequency Curve for Basin Annual Maximum  
24 hours Rainfall (Pearson Type III)

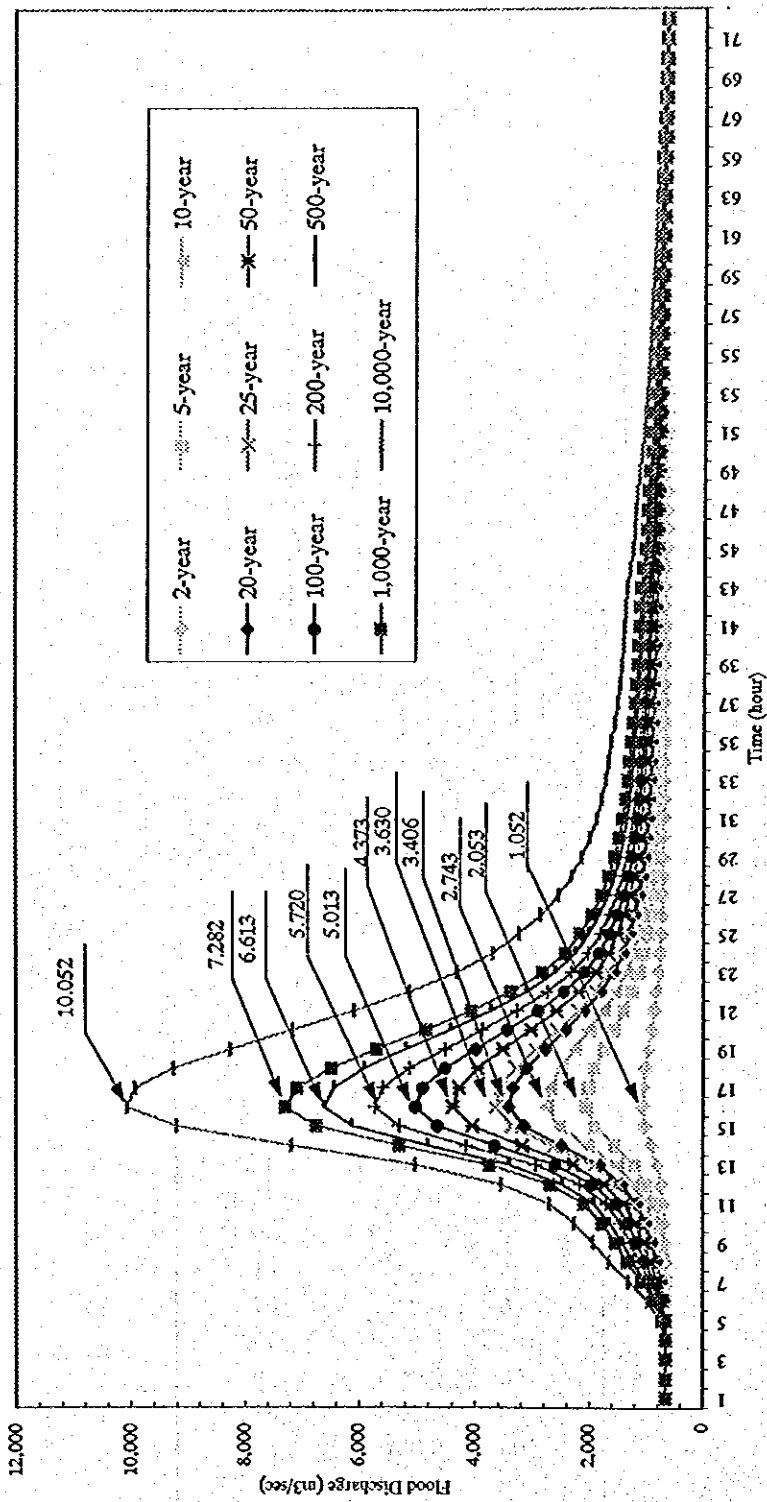


Figure 3.3.17

Flood Frequency for Different Return Periods  
at Munda Dam Site

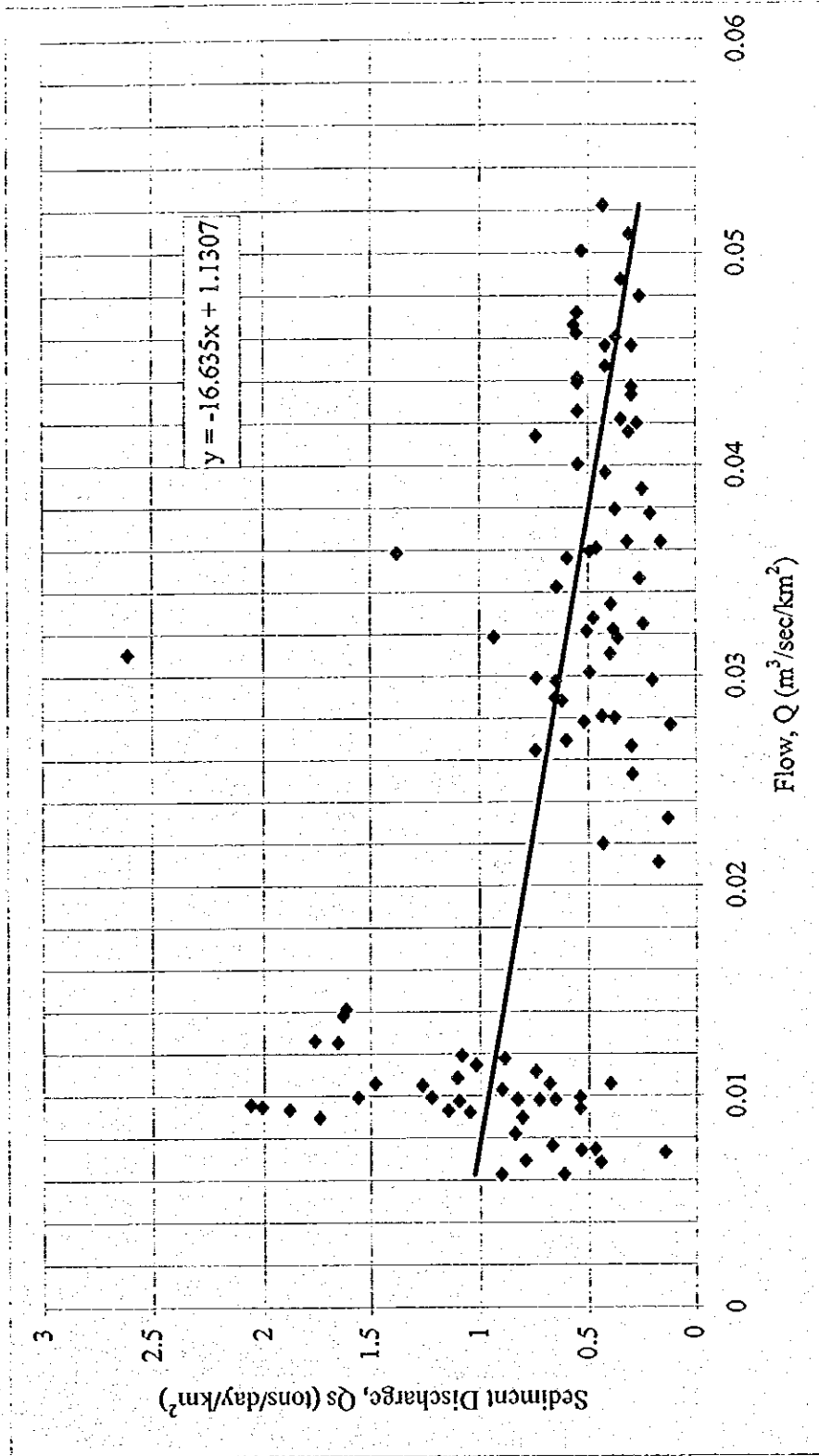
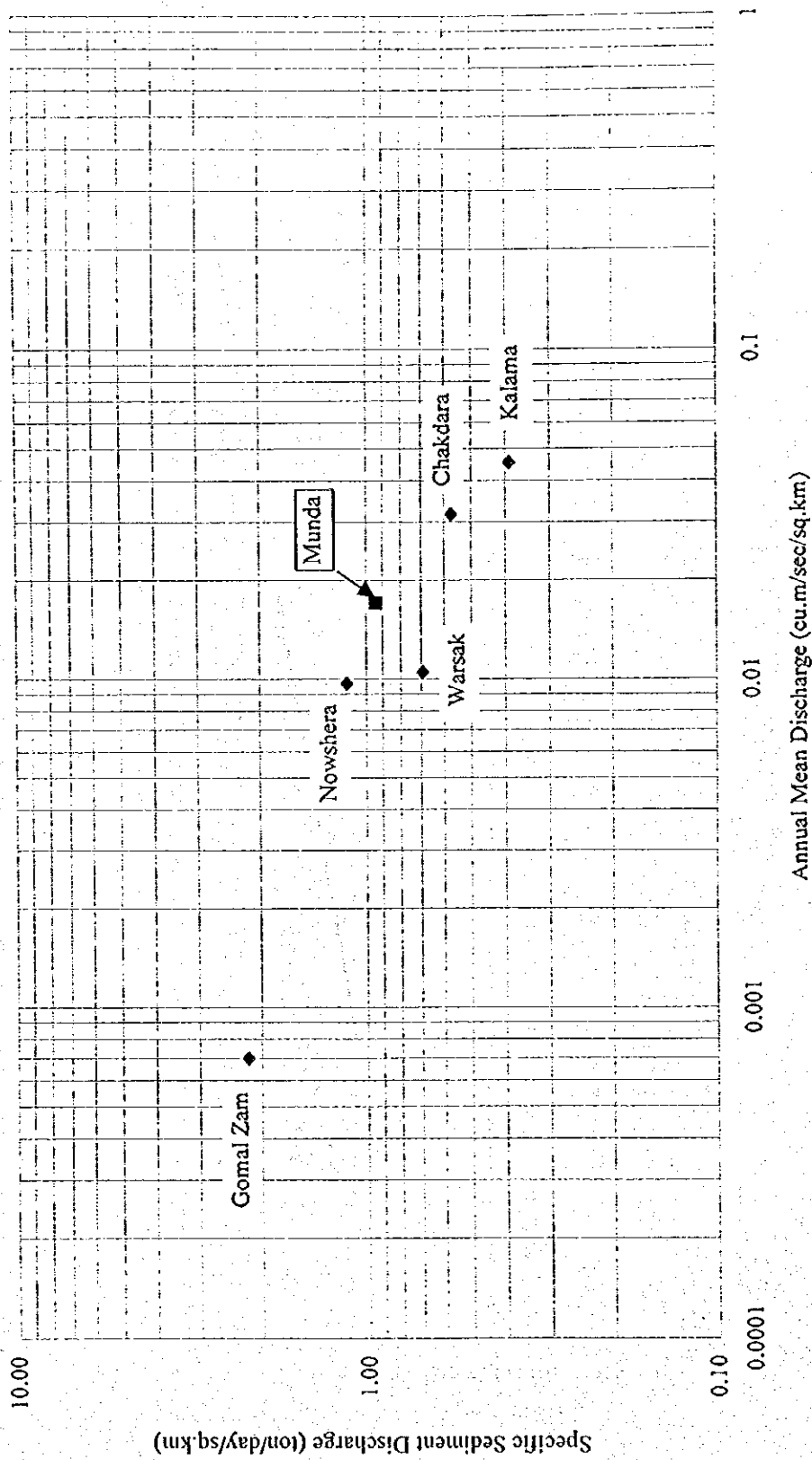


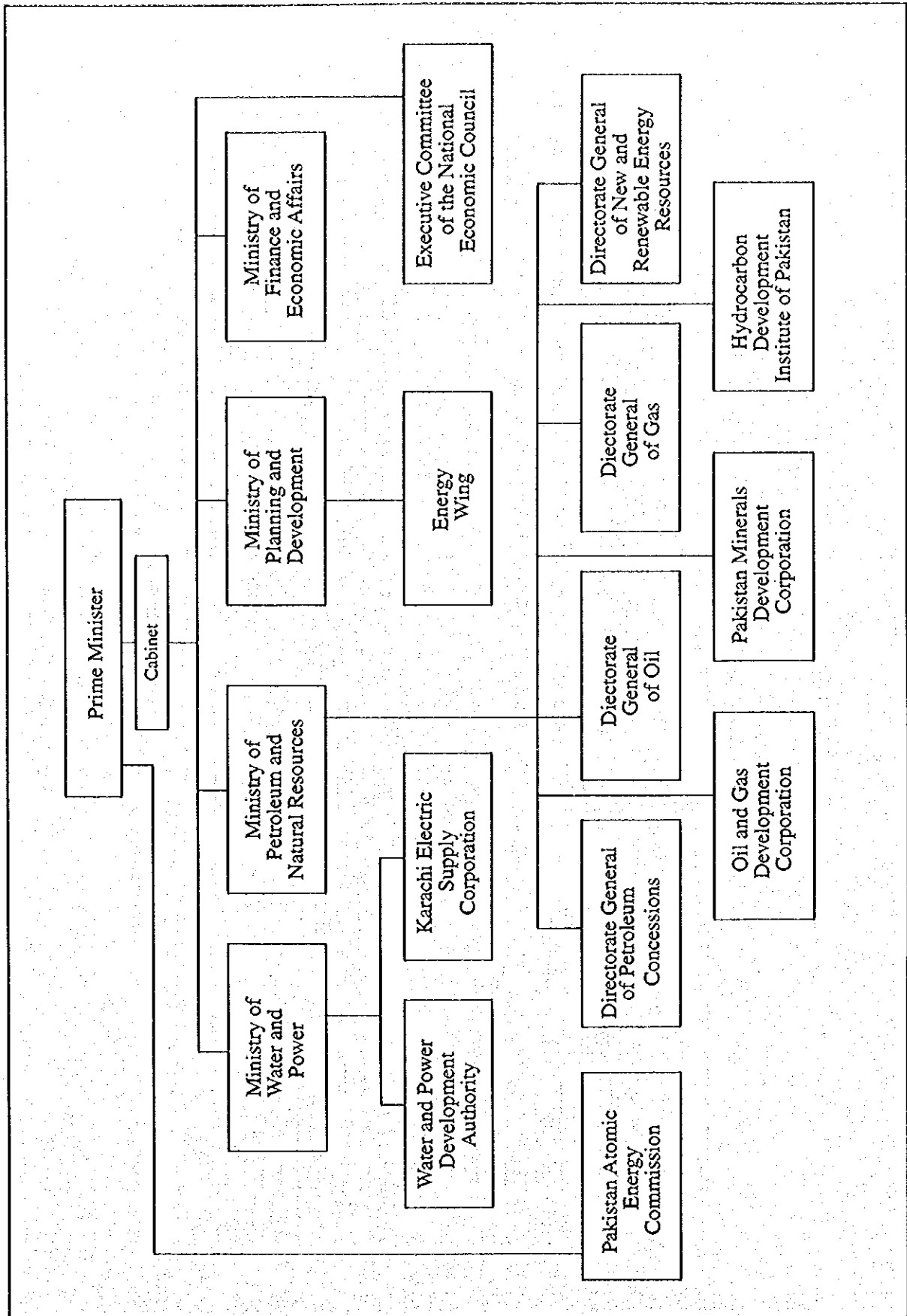
Figure 3.3.18

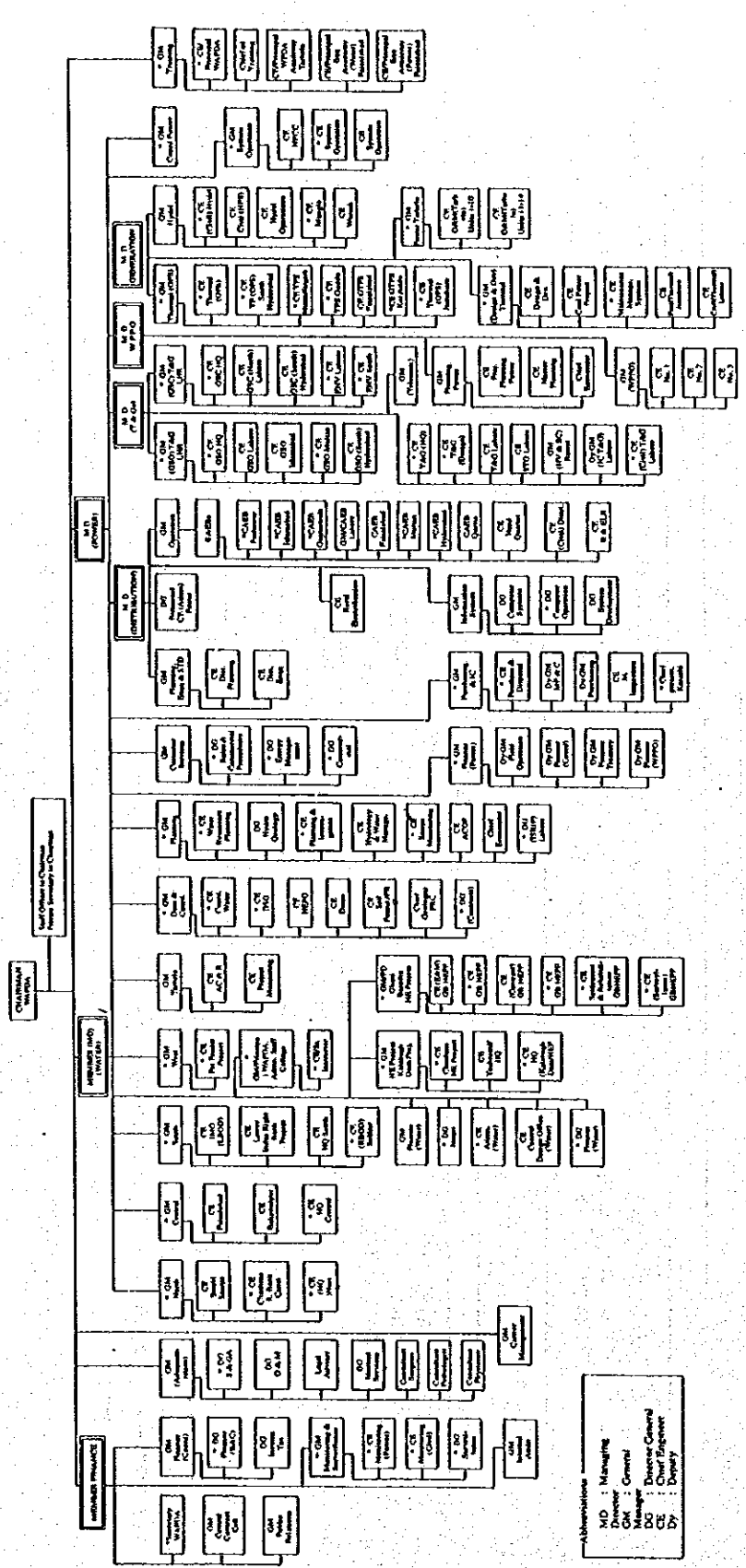
Sediment Yield vs. Water Yield



Sources: Suspended sediment data of at Kalam and Chakdara  
 Annual sediment loading records for Kalam, Chakdara and Nowshera stations (1961-1990)  
 Annual sediment loading records for Warsak station (1961-1970)  
 PC-I Proforma, Gomal Zam Dam Project, 1996



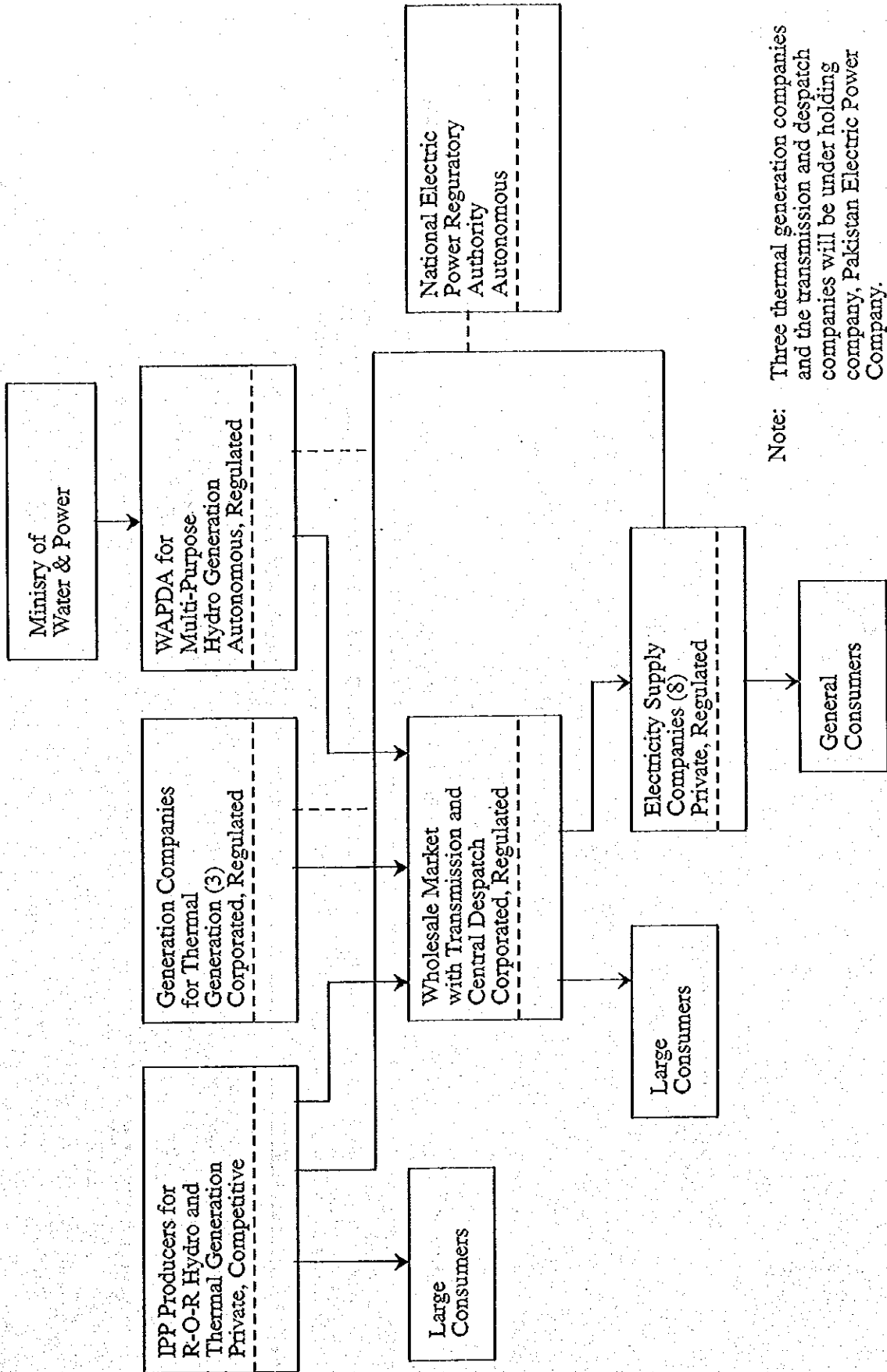




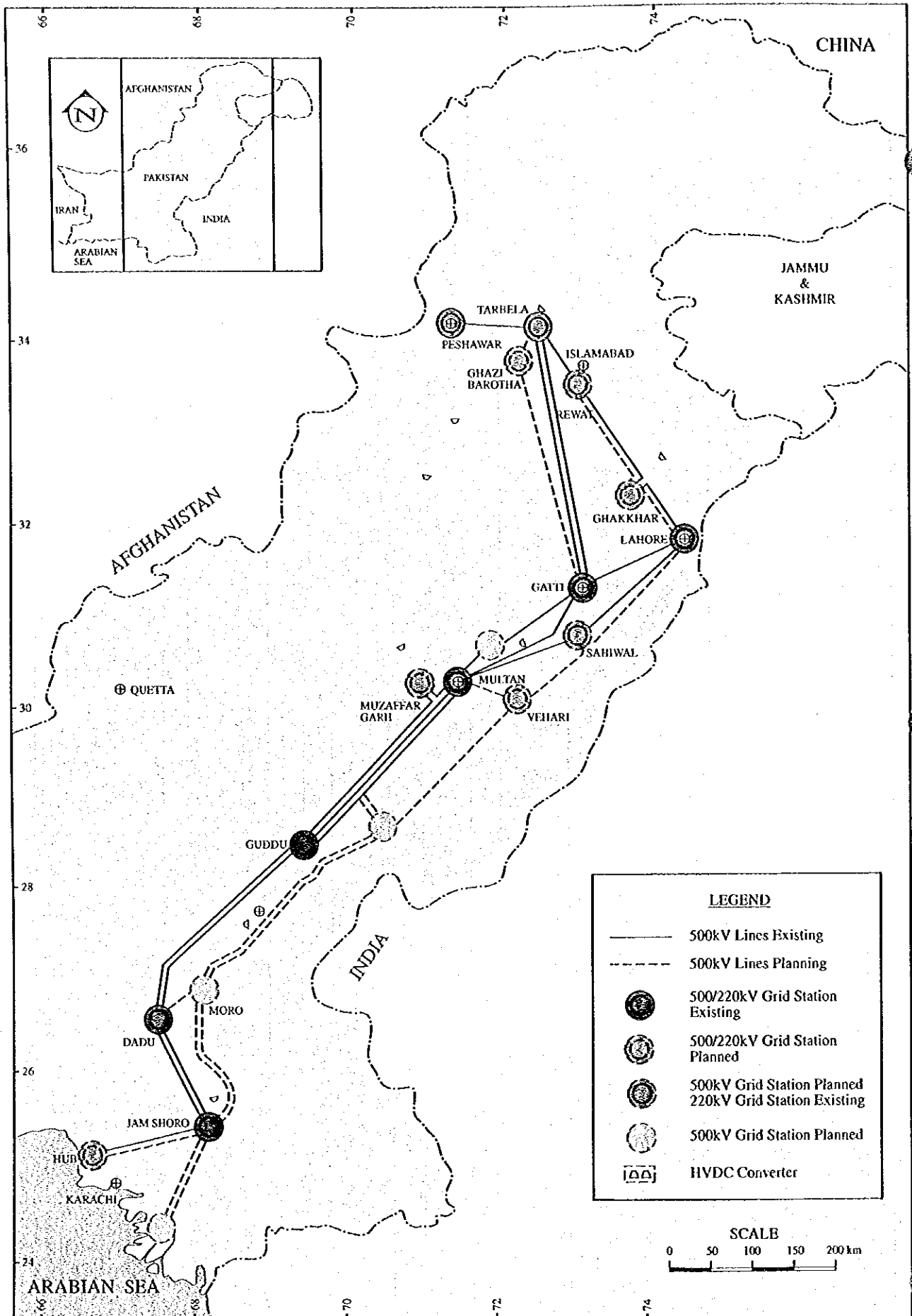
Abbreviations  
 MD : Managing Director  
 GM : General Manager  
 CM : Chief Manager  
 DM : Deputy Manager  
 DG : Deputy General Manager  
 CE : Chief Engineer  
 DE : Deputy Engineer

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Figure 4.1.2  
 Organization of WAPDA



Note: Three thermal generation companies and the transmission and despatch companies will be under holding company, Pakistan Electric Power Company.

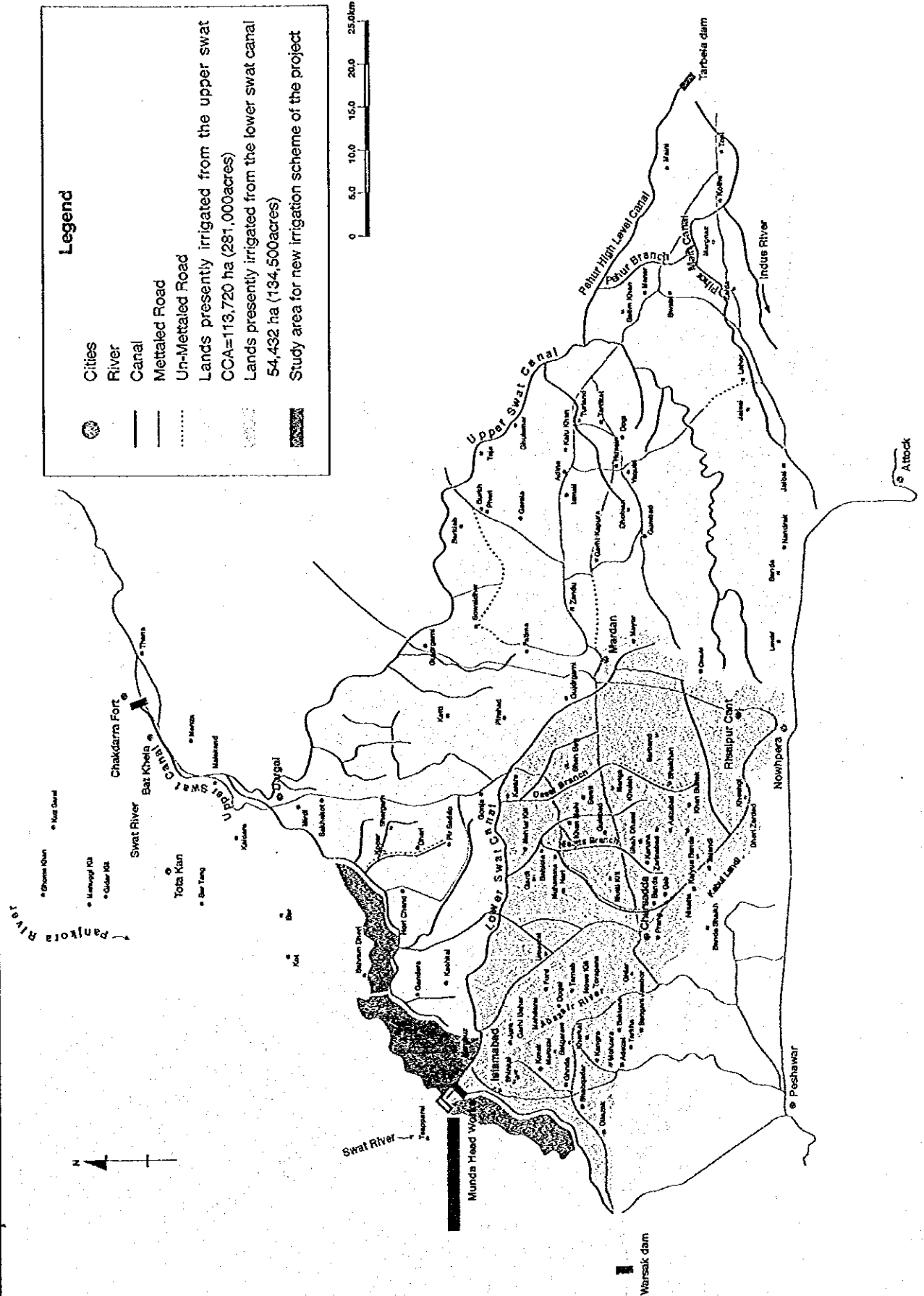
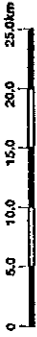


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Figure 4.4.1  
500kV Transmission Line Grid

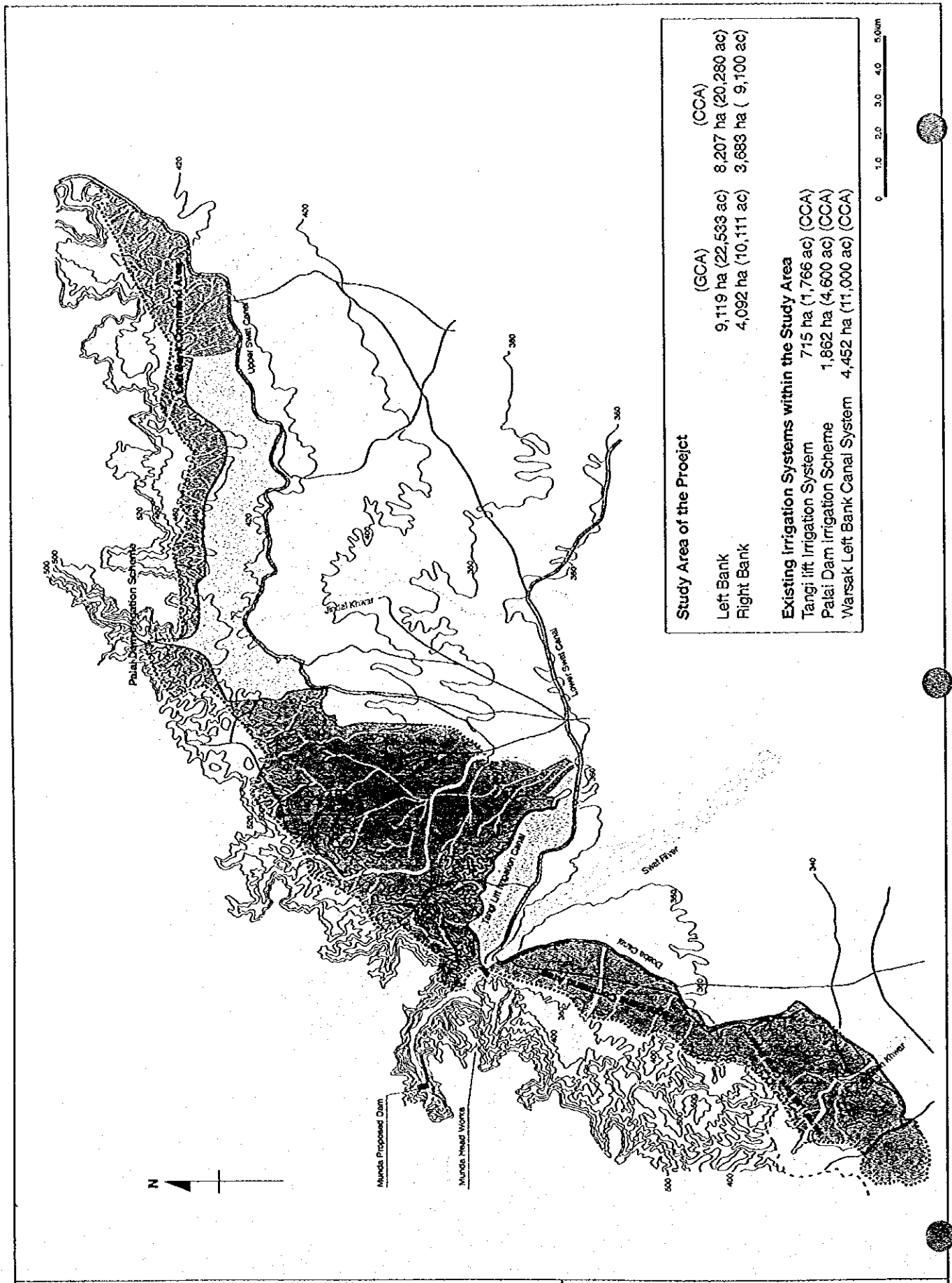
**Legend**

- Cities
- River
- Canal
- Mettalled Road
- Un-Mettalled Road
- Lands presently irrigated from the upper swat CCA=113,720 ha (281,000acres)
- Lands presently irrigated from the lower swat canal 54,432 ha (134,500acres)
- Study area for new irrigation scheme of the project



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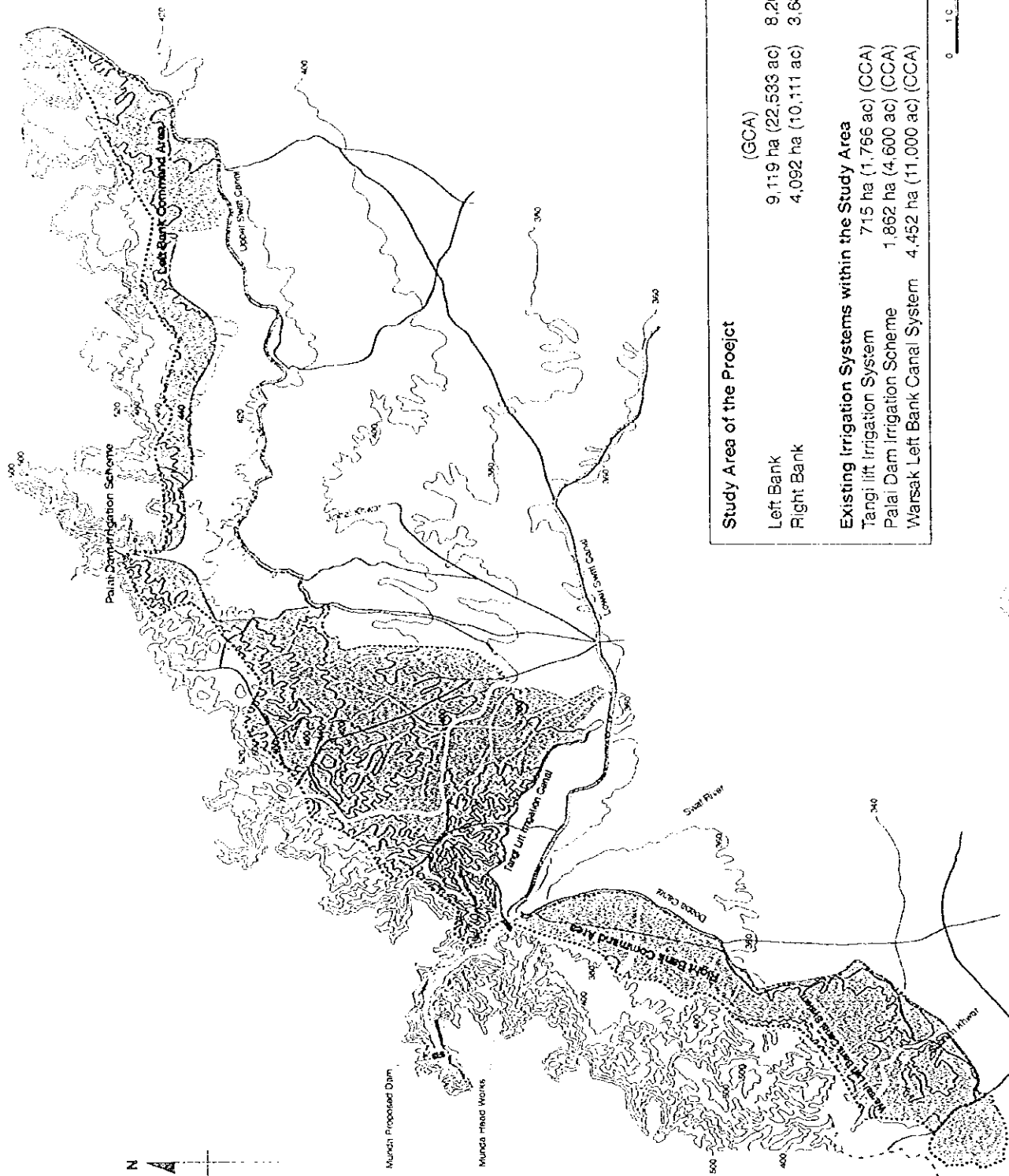
Figure 5.2.1  
 Study Area for Irrigation Planning of the Project



Study Area of the Project	(GCA)	(CCA)
Left Bank	9,119 ha (22,533 ac)	8,207 ha (20,280 ac)
Right Bank	4,092 ha (10,111 ac)	3,683 ha (9,100 ac)
<b>Existing Irrigation Systems within the Study Area</b>		
Tangi lift Irrigation System	715 ha (1,766 ac)	(CCA)
Palai Dam Irrigation Scheme	1,862 ha (4,600 ac)	(CCA)
Warsak Left Bank Canal System	4,452 ha (11,000 ac)	(CCA)

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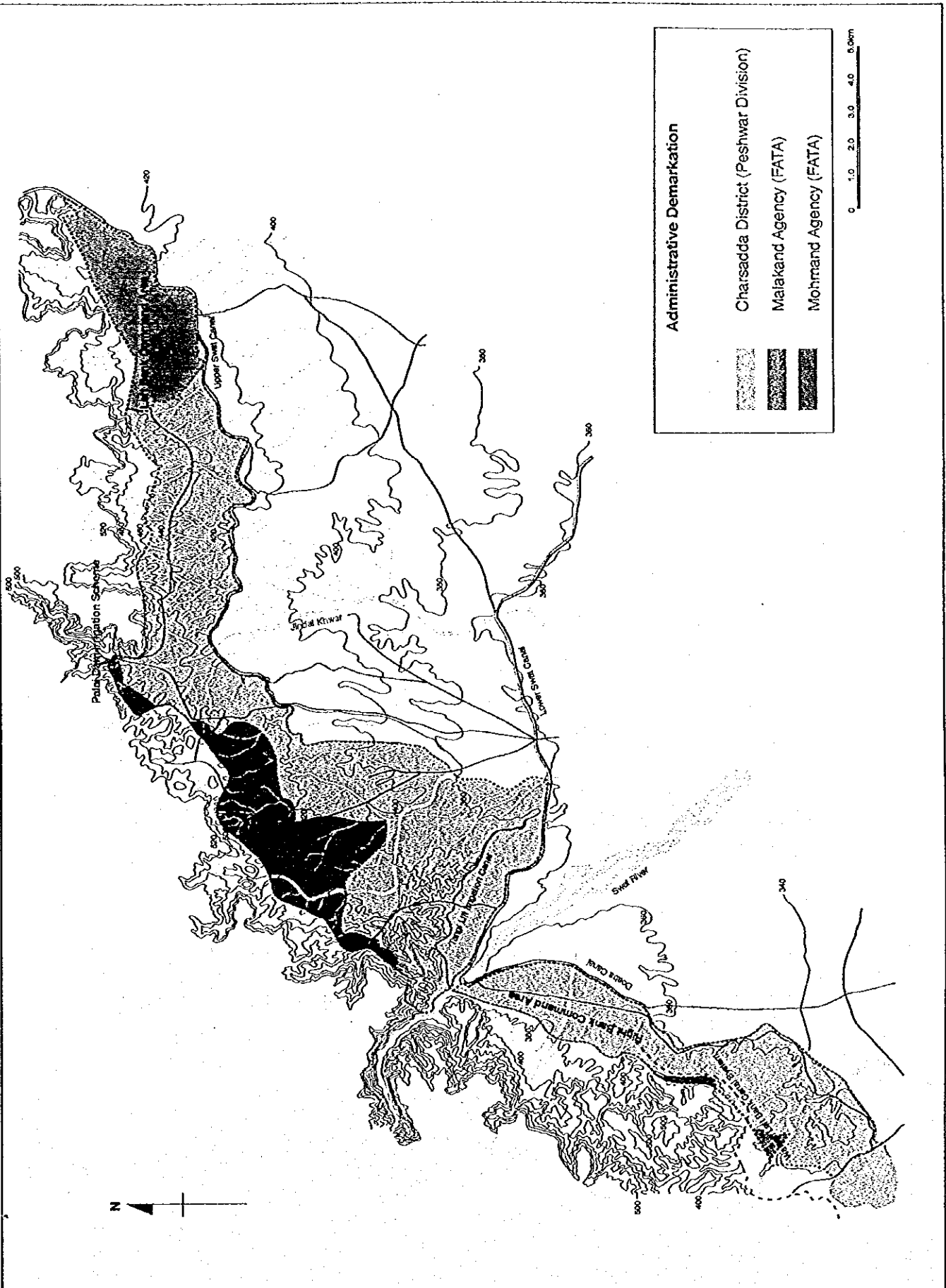
Figure 5.2.2  
 Study Area for Irrigation Planning Scheme



Study Area of the Project	(GCA)	(CCA)
Left Bank	9,119 ha (22,533 ac)	8,207 ha (20,280 ac)
Right Bank	4,092 ha (10,111 ac)	3,683 ha ( 9,100 ac)
<b>Existing Irrigation Systems within the Study Area</b>		
Tangi lift Irrigation System	715 ha (1,766 ac)	(CCA)
Palah Dam Irrigation Scheme	1,862 ha (4,600 ac)	(CCA)
Warsak Left Bank Canal System	4,452 ha (11,000 ac)	(CCA)



Figure 5.2.2  
 Study Area for Irrigation Planning Scheme

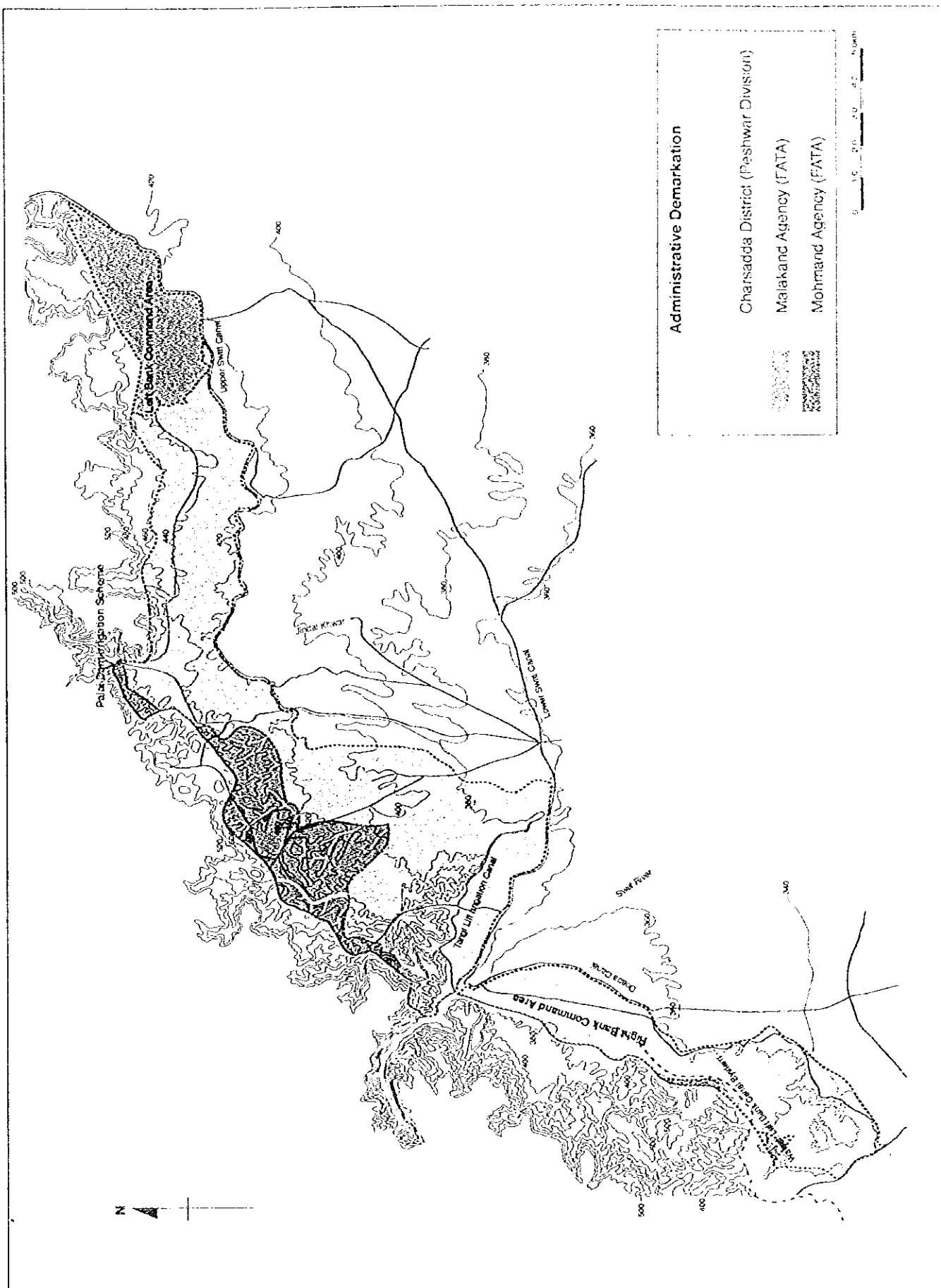


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Figure 5.2.3

Administrative Status of the Study Area

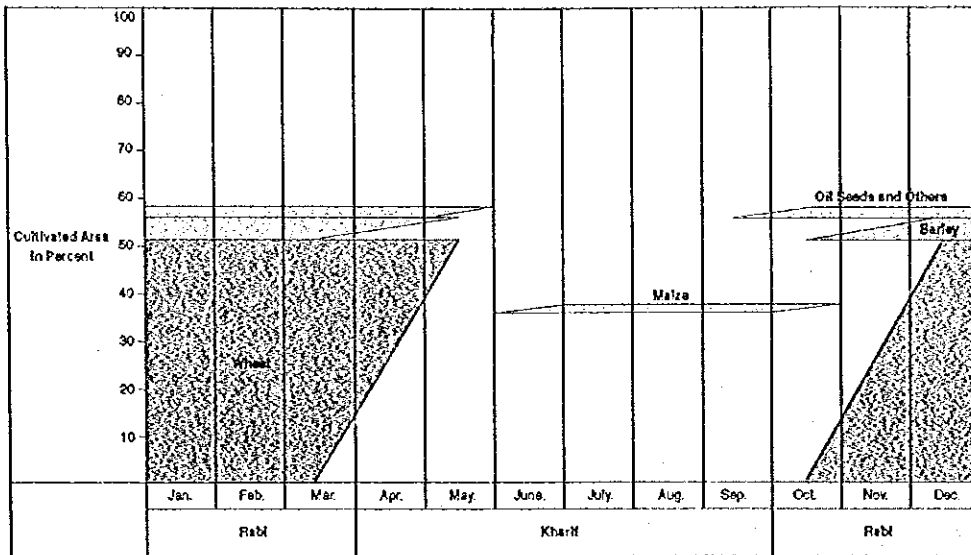




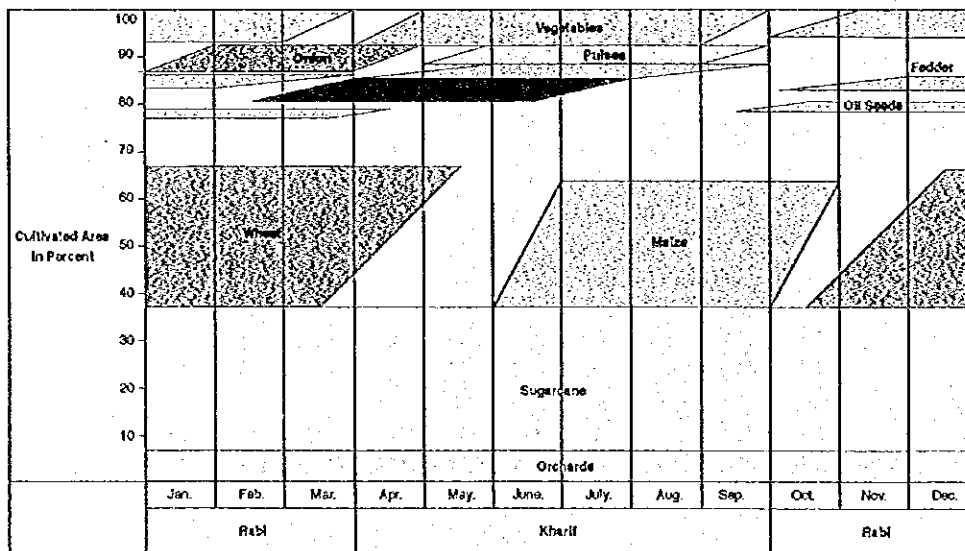
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Figure 5.2.3

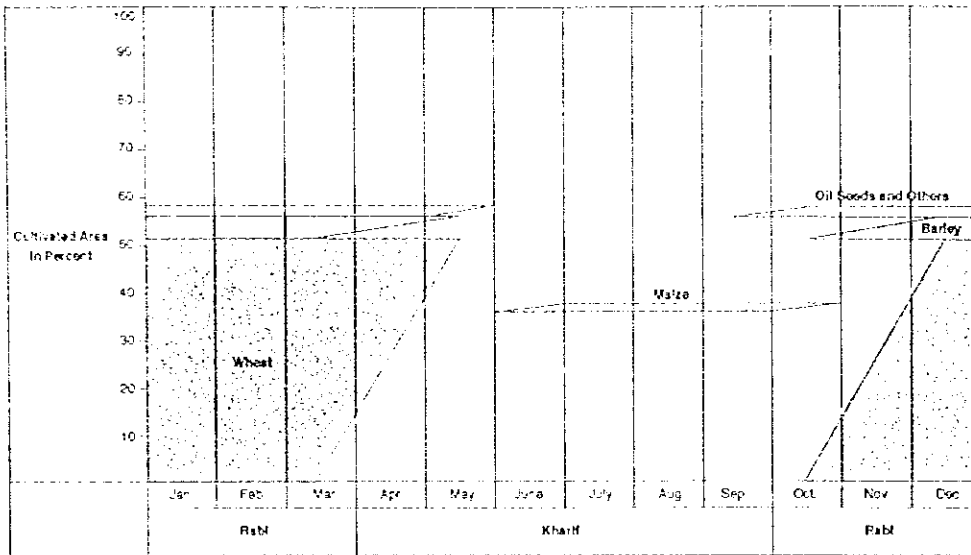
Administrative Status of the Study Area



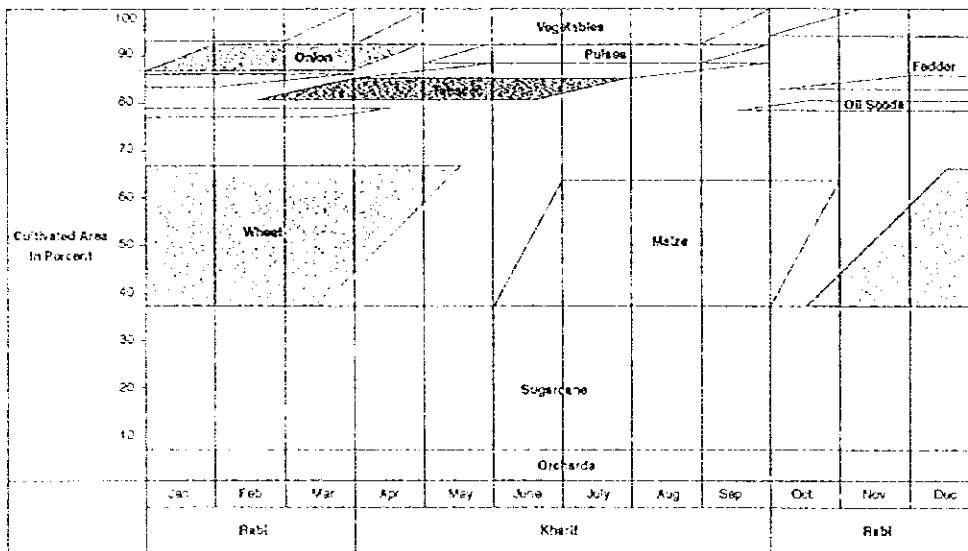
Present Cropping Pattern



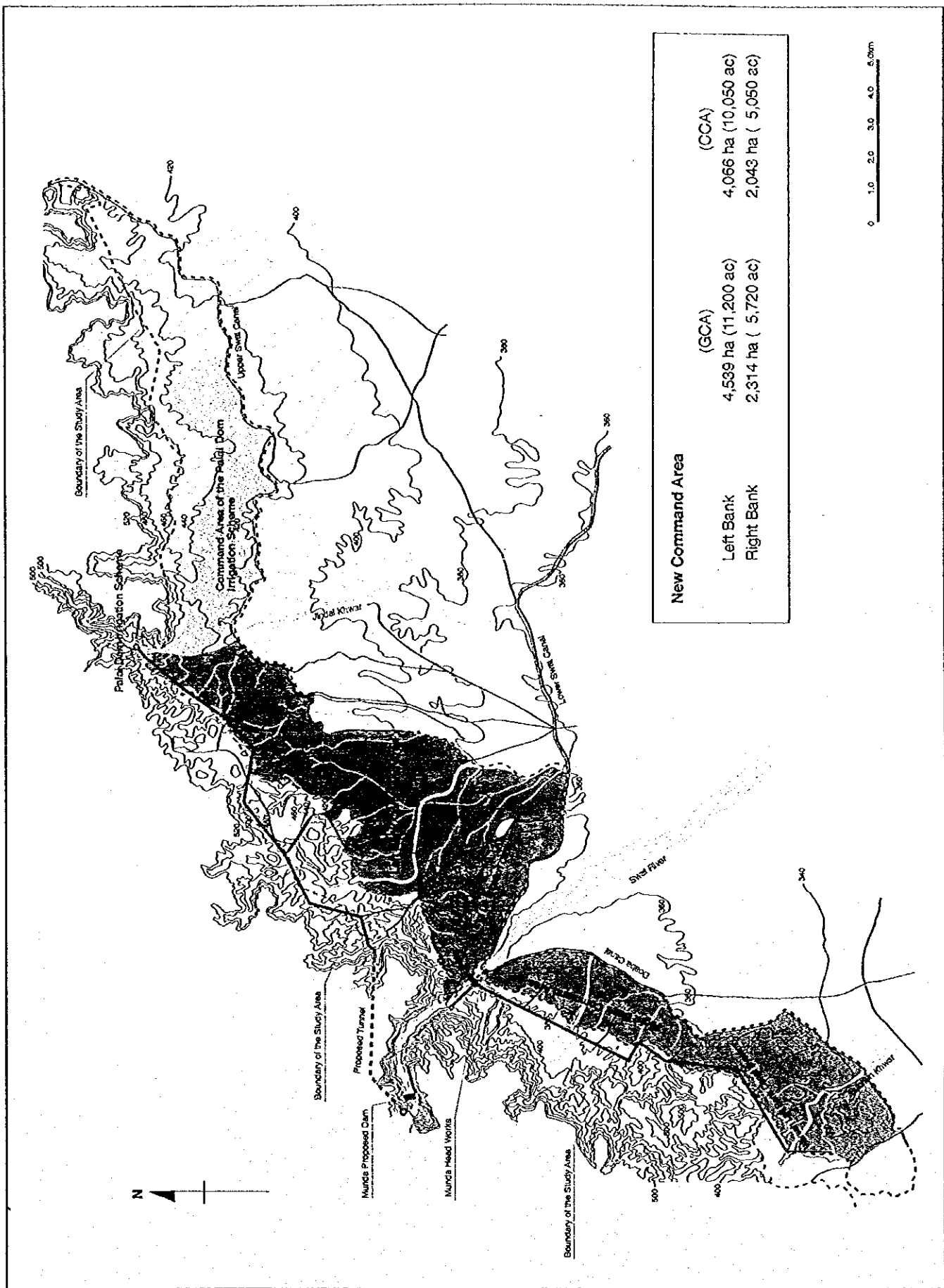
Proposed Cropping Pattern



Present Cropping Pattern

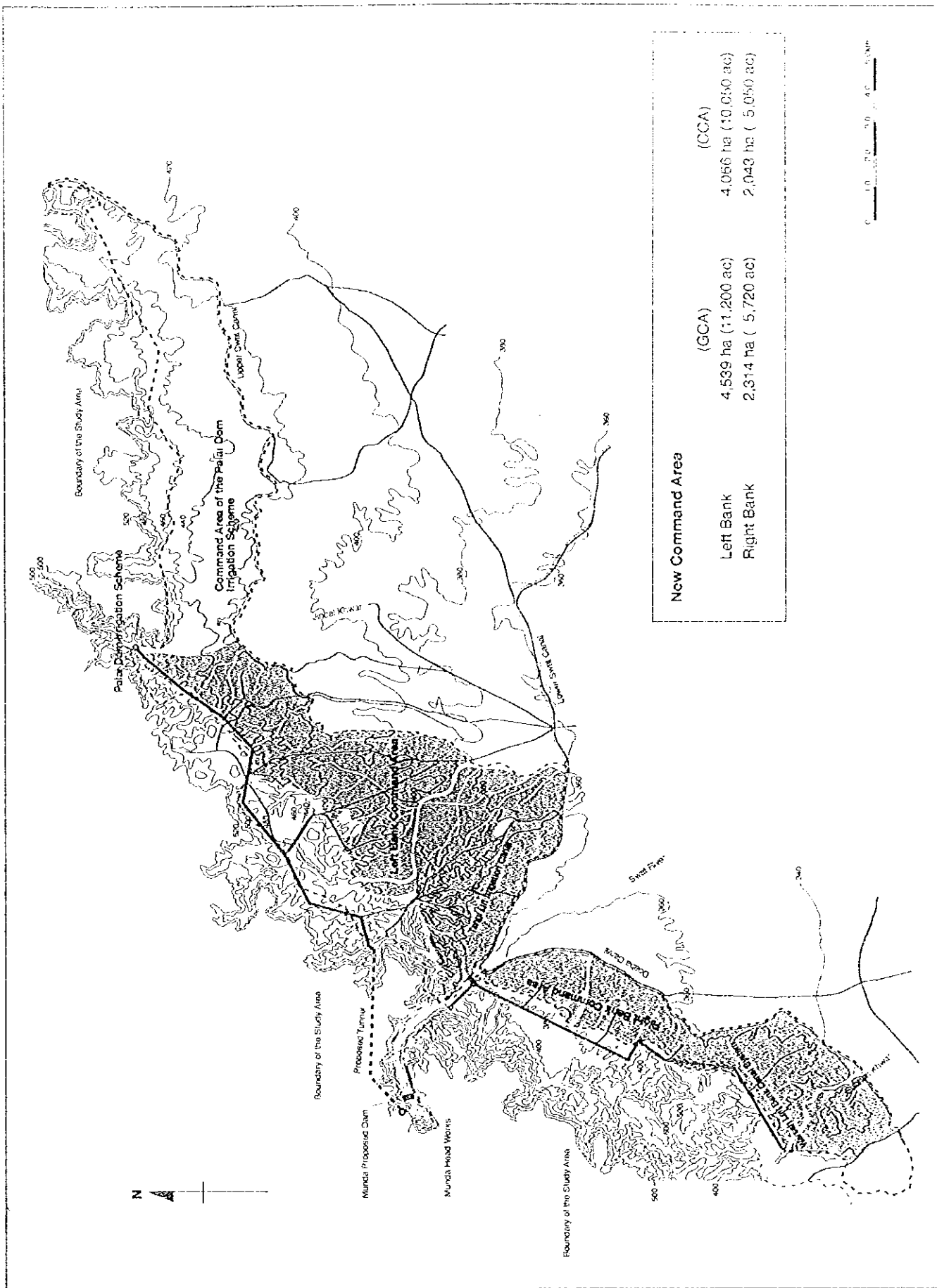


Proposed Cropping Pattern



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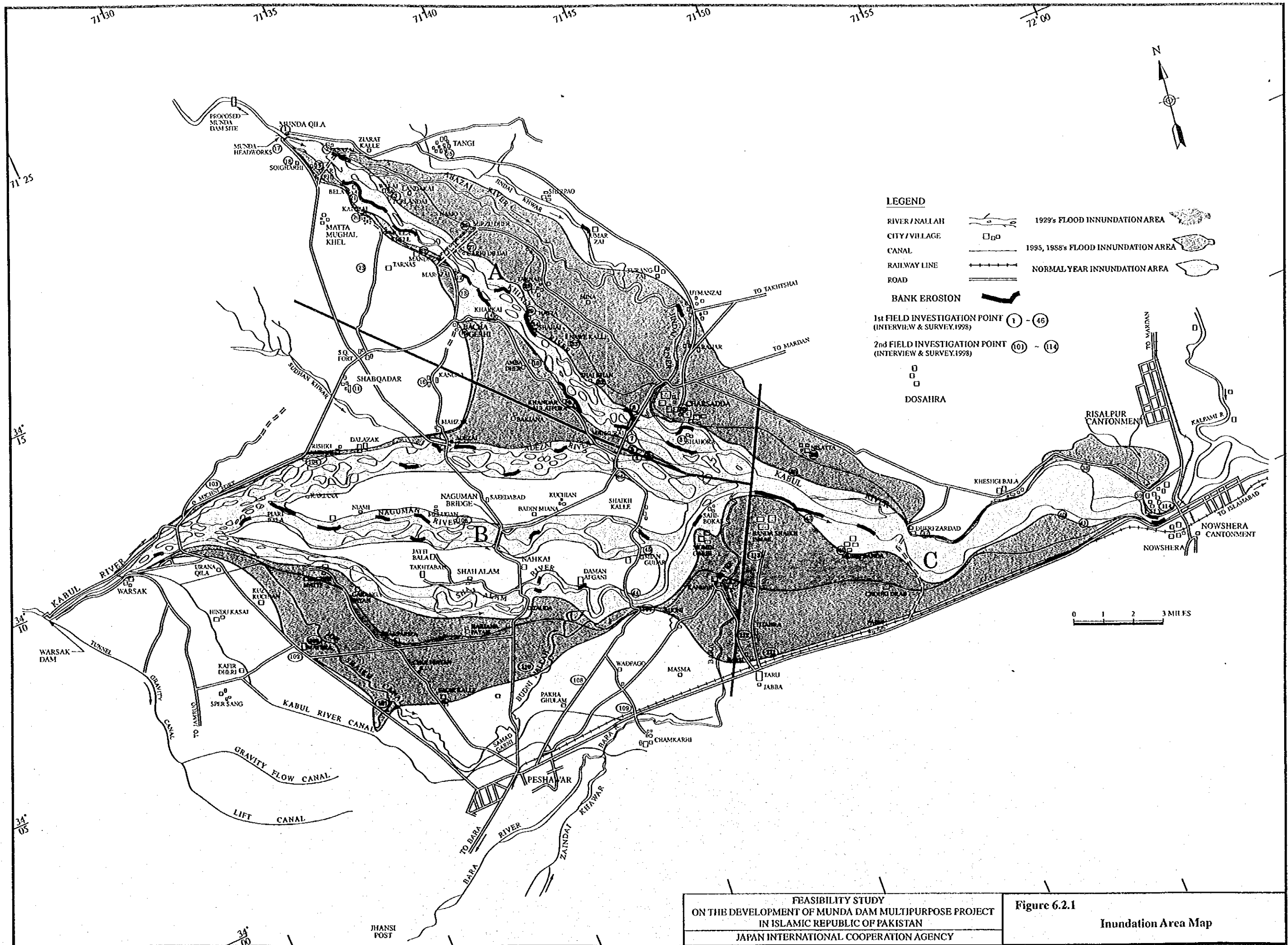
Figure 5.2.5  
 New Command Area of the Munda Multi-Purpose  
 Dam Project



New Command Area	(CCA)	
	(GCA)	(CCA)
Left Bank	4,539 ha (11,200 ac)	4,066 ha (10,060 ac)
Right Bank	2,314 ha ( 5,720 ac)	2,043 ha ( 5,050 ac)

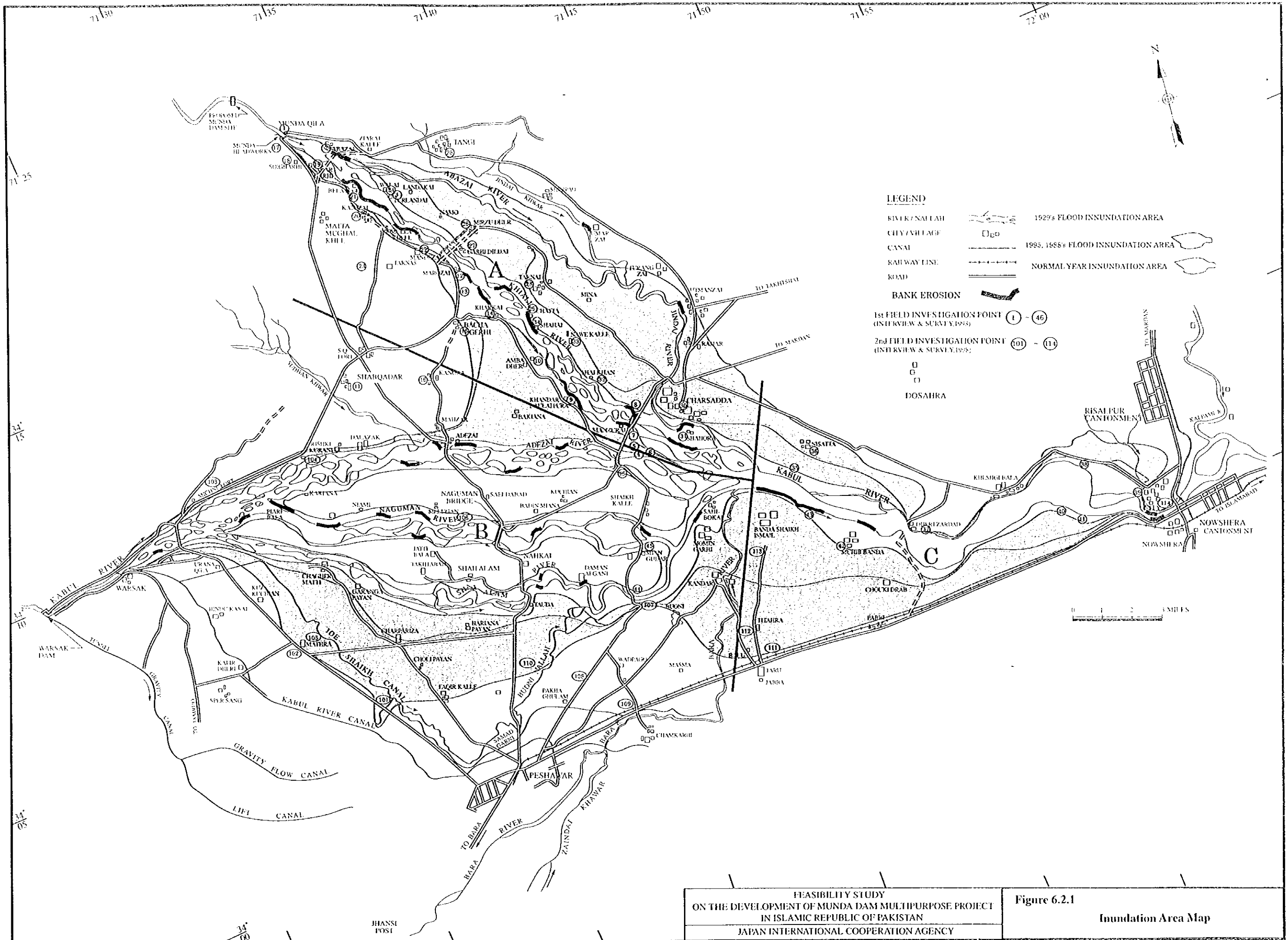
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Figure 5.2.5  
 New Command Area of the Munda Multi-Purpose  
 Dam Project



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Figure 6.2.1  
 Inundation Area Map



**DISCHARGE - INUNDATION AREA OF SWAT RIVER AND KABUL RIVER  
(DOWNSTREAM OF MUNDA HEADWORKS AND WARSAK UPTO NOWSHERA)**

		(km <sup>2</sup> )			
River	Stretch	Historical (Maximum) class Flood 1929/8/28	Midium class Flood (ex.1995/7/25)	Low (Nomal year) class Floods (ex.1989/7/31)	
A	Swat	From MUNDA H/W to Swat-Kabul confluence	188.75	95.75	57.50
B-1	Kabul	Kabul River from Warsak Dam to Influence line of Swat River backwater	227.25	149.50	72.00
B-2	Kabul	Kabul River from Influence line of Swat River backwater to confluence	112.50	97.25	50.75
C	Kabul	From Swat-Kabul confluence to Nowshera	169.25	105.75	64.00
		Total inundation area	697.75	448.25	244.25

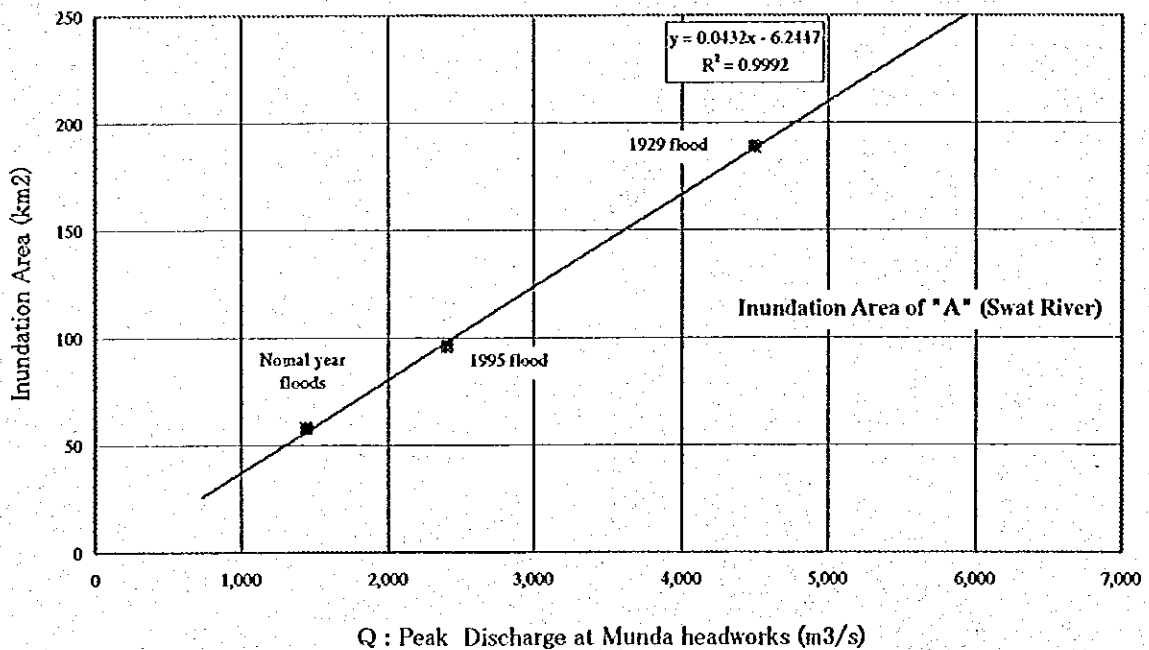
		Station	Peak discharge (m <sup>3</sup> /s)		
A	Swat	at Munda H/W (Swat River)	<sup>(1)</sup> 4,500	<sup>(1)</sup> 2,413	<sup>(1)</sup> 1,441
B	Kabul	at Warsak (Kabul River)	<sup>(1)</sup> 3,471	<sup>(1)</sup> 1,861	<sup>(1)</sup> 1,183
C	Kabul	at Nowshera (Kabul River)	<sup>(1)</sup> 7,531	<sup>(5)</sup> 4,039	<sup>(1)</sup> 2,478

\*1) Source : Irrigation Dept. NWFP., Q from observed water level at Munda Headworks.

\*2)&3) Source : WAPDA.

\*4) : estimated by using 19995 Flood Discharge at MundaHW and Warsak (=1861\*4500/2413)

\*5) : estimated by using 19995 Flood Discharge at MundaHW and Nowshera (=4039\*4500/2413)



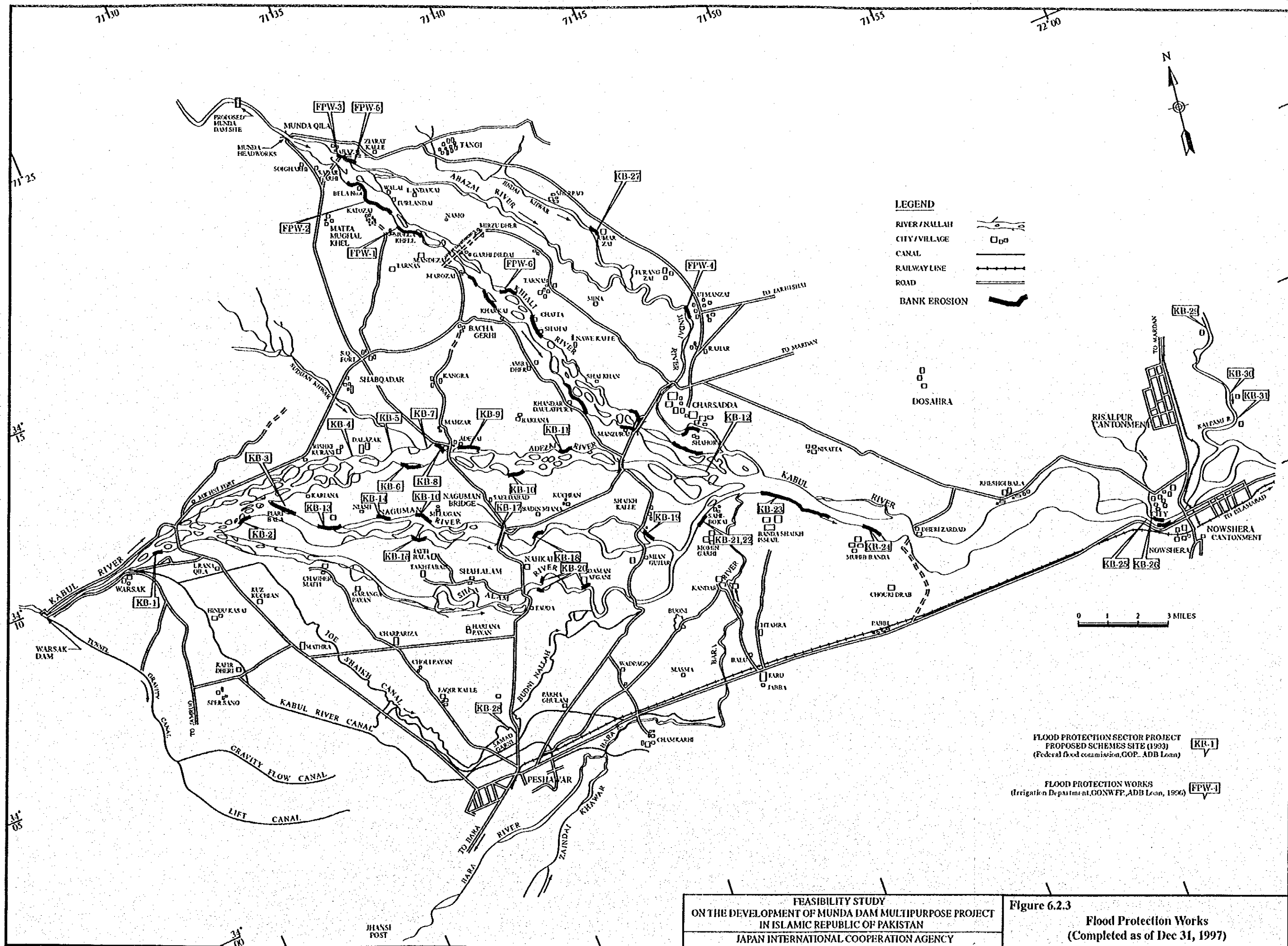
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**Figure 6.2.2**

**Discharge - Inundation Curve**  
(from Munda H/W to Swat/Kabul Confluence)

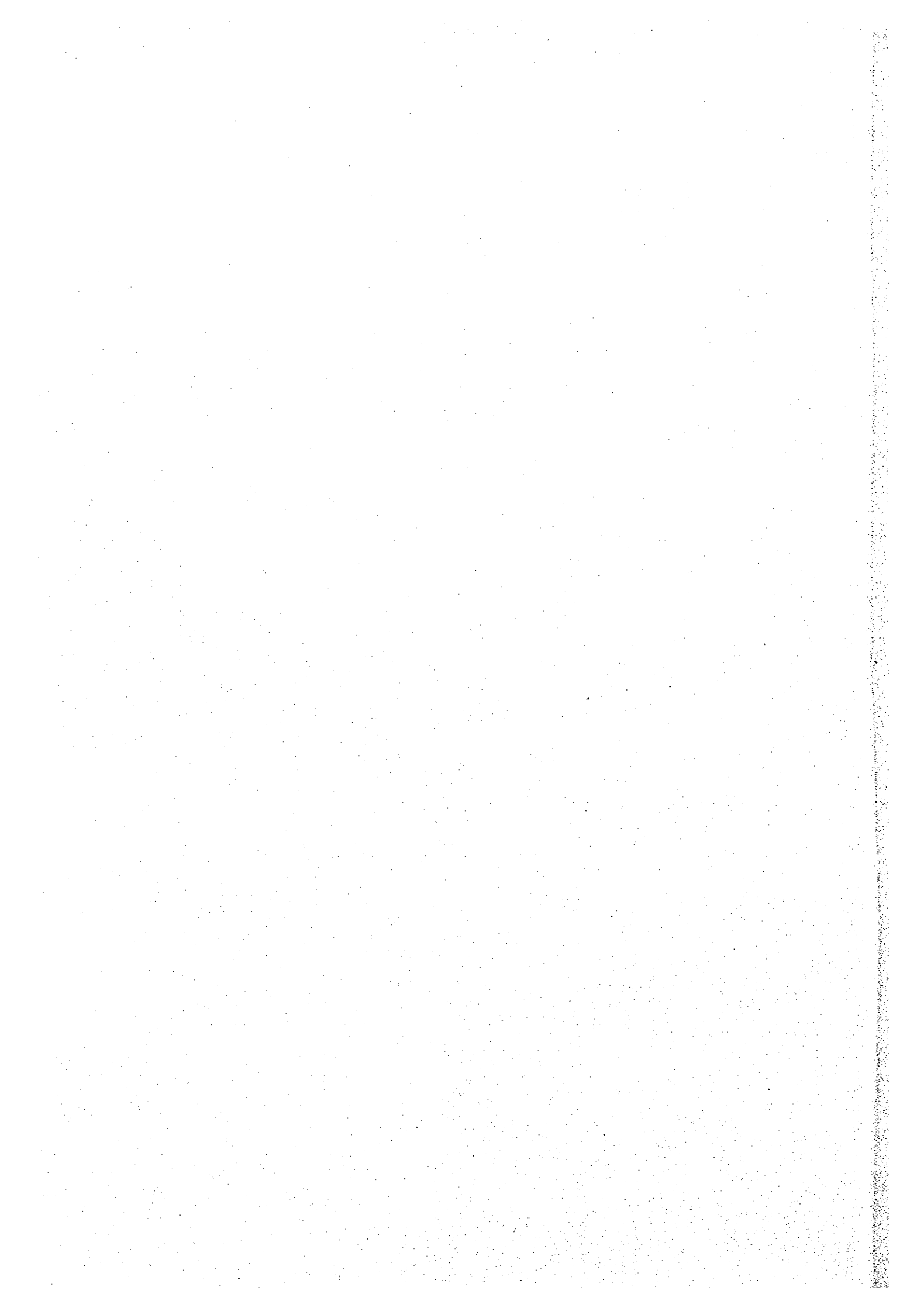






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Figure 6.2.3  
Flood Protection Works  
(Completed as of Dec 31, 1997)



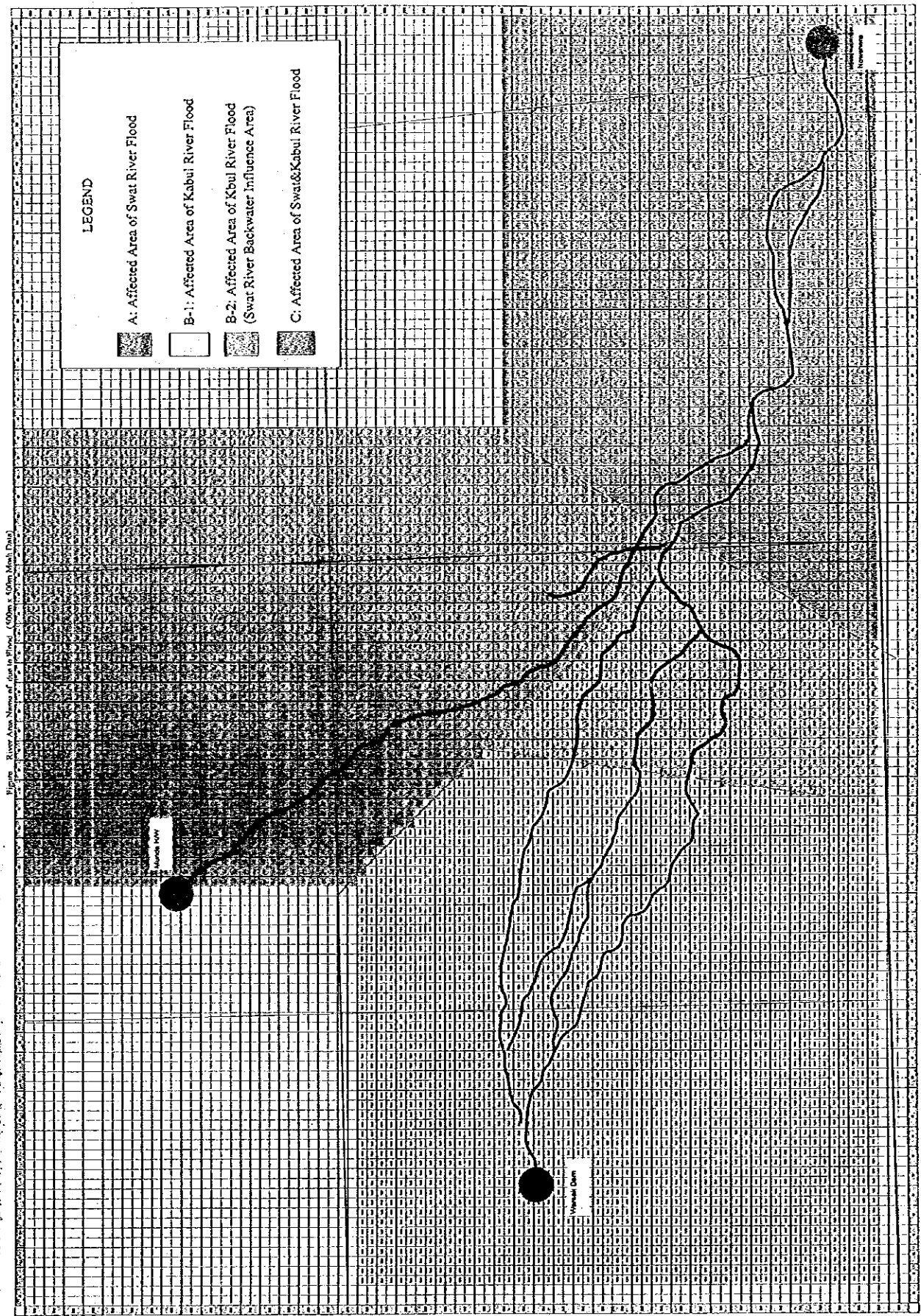
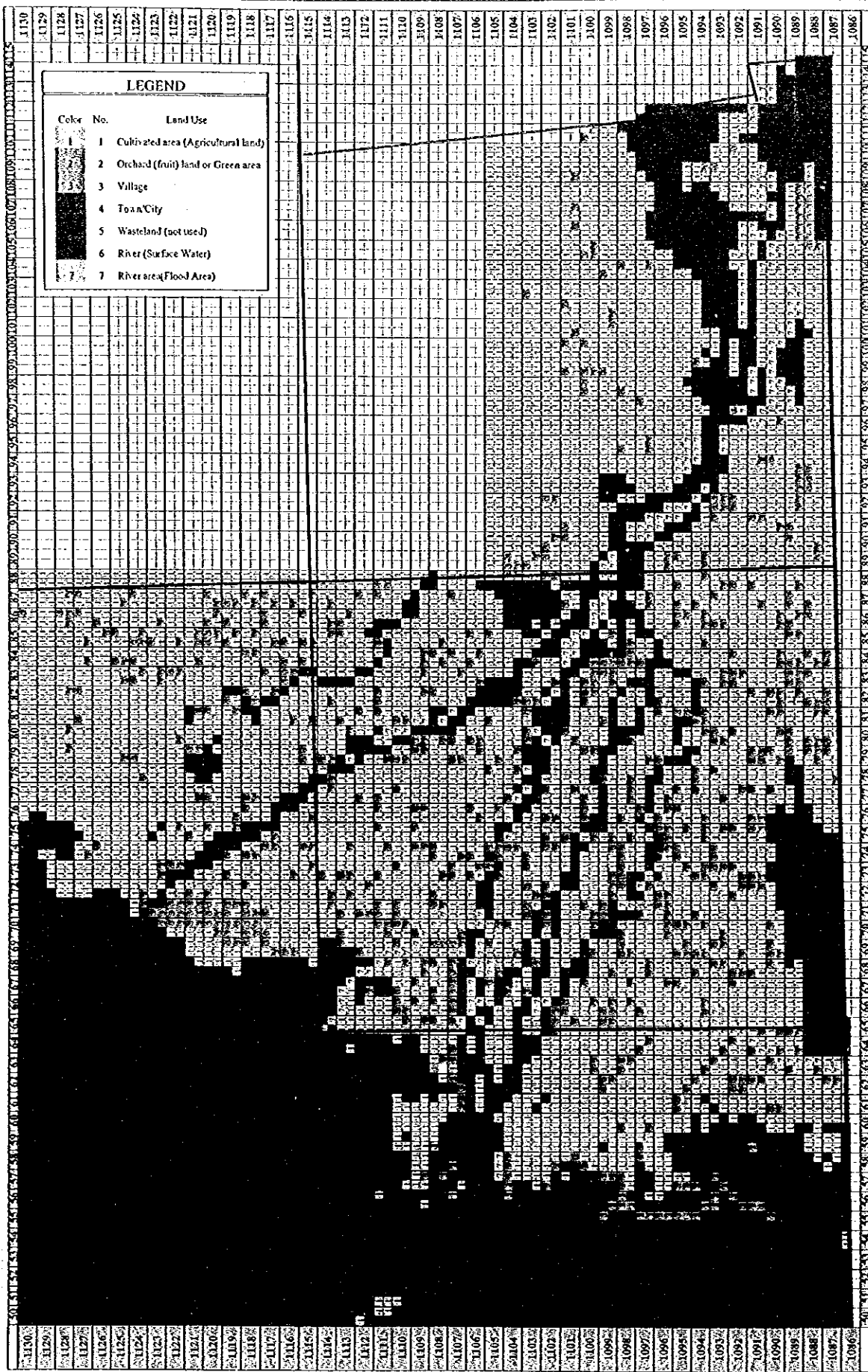


Figure 6.4.1  
 Flood Affected Area of Swat/Kabul River Flood  
 (500x500 m mesh)



Color	No.	Land Use
[Pattern 1]	1	Cultivated area (Agricultural land)
[Pattern 2]	2	Orchard (fruit) land or Green area
[Pattern 3]	3	Village
[Pattern 4]	4	Town/City
[Pattern 5]	5	Wasteland (not used)
[Pattern 6]	6	River (Surface Water)
[Pattern 7]	7	River area (Flood Area)

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Figure 6.6.1

Land Use Mesh Map  
 (500 x 500 m mesh)