CHAPTER 1. INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Lai Nullah has a catchment area of 234.8 km^2 and a length of about 30 km, stretching from the Margalla Hills at the northwestern edge until Soan River at the southeastern edge. The catchment area is administratively divided into Islamabad in the upper reaches of 144.4 km^2 and Rawalpindi in the lower reaches of 90.5 km^2. Rawalpindi has been almost fully urbanized with the extremely high population, while Islamabad is the relatively new city established in 1961 and still less populated as compared with Rawalpindi.

Lai Nullah Basin receives a heavy rainfall of about 500mm during the monsoon from July to September, which could lead to the large flood runoff discharge. The recent intensive urban development in the City of Islamabad also tends to increase the peak flood runoff discharge. At the same time, the flow capacity of downstream of the Lai Nullah in the City of Rawalpindi has been remarkably reduced due to the illegal encroachment of buildings into the river course and the pile of garbage indiscriminately dumped into the river.

Due to the metrological conditions and river channel conditions as described above, the floods frequently overtop the Lai Nullah inflicting sever flood damages particularly in Rawalpindi. The flood in July 2001 caused the worst damage in the basin including death of 74 people[1] and the complete or partial destruction of about 3,000 houses. Public facilities such as transportation and electric power supply had also been completely paralyzed.

To cope with the flood problems of Lai Nullah, the Study on Comprehensive Flood Mitigation and Environmental Improvement Plan of the Lai Nullah Basin (hereinafter referred to as "the Study") was undertaken through technical cooperation by the Japan International Cooperation Agency (JICA) during a period from May 2002 to September 2003.

1.2 OBJECTIVE OF THE STUDY

As stipulated in the Scope of Works, the objectives of the Study are:

(1) To formulate a master plan for comprehensive flood mitigation and environmental improvement in the Study area; and,

(2) To transfer skills and technology of comprehensive flood mitigation and environmental improvement to counterpart personnel of the Federal Flood Commission (FFC), and other government agencies concerned.

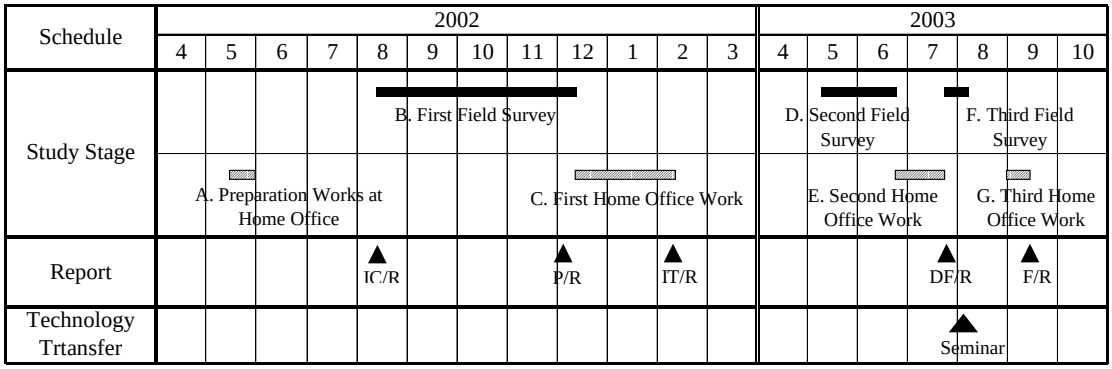
[1] The number of death was based on the information from Emergency Relief Cell of the Federal Government.

1.3 STUDY AREA

The Study Area covers the whole of the Lai Nullah basin of 234.8 km^2. A supplementary clarification is further made to the adjacent Kurang river basin, which is proposed as the outlet of the flood diversion channel.

1.4 OVERALL STUDY SCHEDULE

The Study is carried out through the phased field surveys in Pakistan and home office works in Japan within the entire study period of from May 2002 up to September 2003, as shown in Fig. R 1.4.1.



IC/R: Inception Report, P/R: Progress Report, IT/R: Interim Report, DF/R: Draft Final Report, F/R: Final Report

Fig. R 1.4.1 Tentative Study Schedule

CHAPTER 2. PHYSICAL CONDITIONS OF THE STUDY AREA

2.1 TOPOGRAPHY

The ground elevation of the Lai Nullah Basin ranges from EL. 420 m at the downstream end of the basin (i.e., the confluence with Soan River) to EL. 1,240 m at the upstream end (i.e., a mountaintop in the Margalla range) as shown in Fig. 2.1.1, and the Basin could be broadly divided to the following four (4) areas in view of topography; the Margalla range, the higher plain, the lower plain and the valley area in the north to south direction. The detailed topography of these four areas as described hereinafter:

2.1.1 Margalla Range

The Margalla range stands behind Islamabad City area as a wall, which forms the north boundary of the Lai Nullah Basin. The foot of the Margalla range is about EL. 620m, while the top of the mountain, which is only 3km away from the foot, is about EL. 1,200m. There are three (3) major tributaries of Lai Nullah namely Saidpur Kas, Tenawali Kas and Bedarawali Kas, which originate from the Margalla Range forming a very steep channel bed slope of about 1/10.

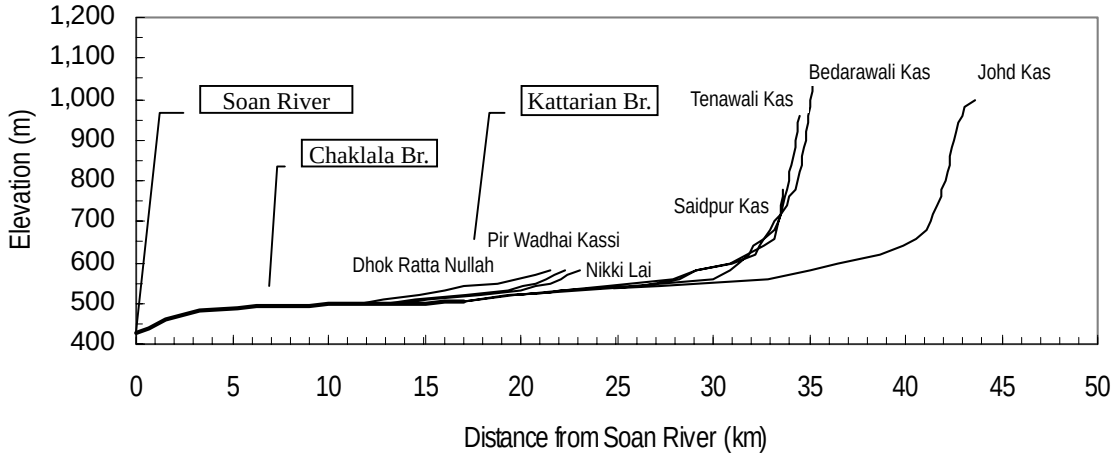


Fig. R 2.1.1 River Profiles

2.1.2 Higher Plain

The higher plain expands over the built-up area of Islamabad City with a gradual slope from North to South. Saidpur Kas, Tenawali Kas and Bedarawali Kas run southward in the plain with a slope of 1/100 to 1/500 weaving the build-up areas of Islamabad and finally flow into Lai Nullah just upstream of Kattarian Bridge.

2.1.3 Lower Plain

The lower plain extends over the upper part of the Rawalpindi area above Chaklala Bridge. This area is flatter than the upper Higher Plain and the lower Valley Area forming a

bowl-shaped topography as shown in Fig. 2.1.2. The lowest area along Lai Nullah from Gawal Mandi Bridge to Chaklala Bridge is the bottom of the bowl, towards which all floodwater gathers from tributaries as well as the main stream. This bottom area was deeply submerged in the floodwater in 2001.

2.1.4 Valley Area

Below Chaklala Bridge, the topography changes into a definite valley. The river turns steeper with several cascades, falling down to Soan River. The river channel is deeper than 10 m, and the average river slope between Chaklala Bridge and Soan River is about 1/70.

2.2 CLIMATE

The climate of the Study Area is classified as "Subtropical Triple Season Moderate Climate Zone", which is characterized by single rainfall season from July to September and its moderating influence on temperature.

The Study Area has hot summers and cold winters. In June the daily maximum temperature reaches 40˚C, while the daily minimum temperature falls near 0℃ in December and January. Between July and September, the temperature is slightly moderate due to humidity.

The Study Area receives rains in all seasons but the monsoon rain is pronounced and constitutes a definite rain season between July and September. The total rainfall during the rain season is about 600 mm, accounting for 60% of the annual rainfall of about 1,000 mm. These monsoons bring heavy downpours in the Lai Nullah Basin, resulting in flooding of Lai Nullah and the tributaries. In the monsoon season, the thunderstorm often occurs 12 or 13 days in a month in Rawalpindi.

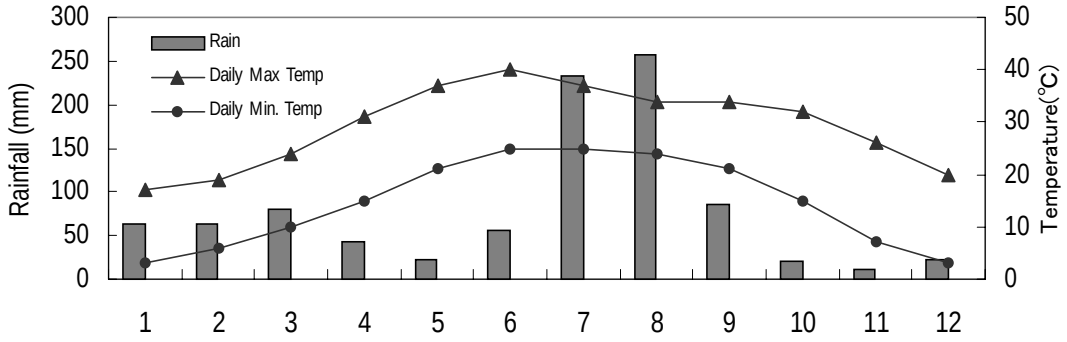


Fig. R 2.2.1 Rainfall and Temperature (Rawalpindi)

2.3 RIVER CONDITIONS

2.3.1 River System

In the jurisdiction area of Islamabad (i.e., the upper reaches of the Lai Nullah), the river system is composed of three (3) major tributaries (i) "Saidpur Kas", (ii) "Tenawali Kas" and (iii) "Bedarawali Kas" (refer to Fig. 2.3.1). These tributaries originate from Margalla hills and flow into the mainstream of Lai Nullah just upstream from Kattarian Bridge (RD17+210)[2], which was built on Khayaban-I-Sir Syed (or I-J Principal Road) forming the administrative boundary between Islamabad and Rawalpindi.

Below Kattarian Bridge (i.e., the jurisdiction area of Rawalpindi), the mainstream meets other three (3) major tributaries, namely (i) Nikki Lai, (ii) Pir Wadhai Kas and (iii) Dhok Ratta Nullah one after another, then flows down through the center of Rawalpindi City and finally pours into Soan River (refer to Fig. 2.3.1). In addition to these major tributaries, there are other six (6) tributaries or drainage/sewage channels, which joins the mainstream between the confluences of Dhok Ratta Nullah and Soan River. The name and the catchment area of the whole tributaries are as listed in Table R 2.3.1.

Table R 2.3.1 Tributaries of Lai Nullah

Location of Confluence with Main Stream	No. and Name of Tributary		Catchment Area (km^2)
	No.*1	Name*2	
Islamabad	-	Saidpur Kas	24.7
	-	Tenawali Kas (Including Kanitawali Kas as the secondary tributary)	39.7
	-	Bedarawali Kas (Including Johd Kas as the secondary tributary)	79.9
	Sub-total		144.3
Rawalpindi	R5	Nikki Lai Kas	20.9
	R4	Pir Wadhai Kassi	11.2
	R3	Dhok Ratta Nullah	10.8
	R2	Unknown	22.8
	R1	Saddar Tributary	
	L2	Arya Nullah	
	L1	Dhok Chiraghdin Tributary	
	L4	Workshop Tributary	6.8
	L3	Unknown	
	-	Residual Area	18.0
	Sub-total		90.5
Grand Total			234.8

*1: Identification numbers assumed by the Study Team (The numbers corresponds to those shown in Fig. 2.3.1).
*2: Refer to "Feasibility Report on Flood Control of Lai Nullah in Rawalpindi City" by NESPAK-NDC in 1987.

The tributaries as well as the mainstream of Lai Nullah are the natural stream but also used as the channels for drainage/sewage disposal from the built-up areas in Islamabad and Rawalpindi without any treatment. As the results, the tributaries and the mainstream are significantly polluted giving off a stench during a period of low flow discharge in particular.

[2] The figure with RD at the head hereinafter means the distance from New G.T. Road Bridge located 320m upstream from the confluence of Soan River. That is, RD17+210 is the point 17,210m upstream from G..T. Road Bridge.

2.3.2 River Features

The Lai Nullah shows the distinctly different river features among the following four (4) stretches; (i) the upstream from Kattarian Bridge (RD17+210), (ii) the middle stream from Kattarian Bridge to Chaklala Bridge (RD6+251) (iii) the middle stream from Chaklala Bridges to the waterfall below Murree Brewery (RD3+800), and (iv) the downstream from the waterfall to the confluence with Soan River (RD0-310). The principal river features of these stretches are as described below:

1) Upstream from Kattarian Bridge (RD17+210)

As described above, the river system of Lai Nullah is divided into three (3) major tributaries, namely Bedarawali Kas, Tenawali Kas and Saidpur Kas in the upper reaches from Kattarian Bridge. These tributaries have the rather spacious channel cross-sections with less meandering alignment. The channel bed-slopes of the lower stretches of Bedarawali Kas, Tenawali Kas and Saidpur Kas are more than 1/500, which is far steeper than that of 1/1,250 of the mainstream of Lai Nullah located downstream from Kattarian Bridge.

Due to the spacious and rather steep channels, the upper stretches of the tributaries, which are out of the extent of backwater effect of Lai Nullah, have the large channel flow capacity, and have never caused any extensive and serious river flood overflow since establishment of Islamabad in 1961, although minor flood inundation locally occurs due to inadequate drainage capacity and/or encroachment of houses into the habitual flood inundation area.

On the other hand, the lower stretches of the tributaries is under influence of the backwater effect by the water level of Lai Nullah, because all flood runoff discharge from the tributaries concentrates into the mainstream of Lai Nullah at Kattarian Bridge raising its water level of the mainstream. This backwater effect occasionally causes the serious flood overflow and the extensive flood inundation along the lower stretches of the tributaries. In the flood 2001, the water level of mainstream at Kattarian Bridge rose above EL. 508m, which is far higher than the bank level of the mainstream (i.e., EL. 500m). Due to such high water level, the extensive flood inundation occurred in the area along the lower reaches of the tributaries administratively called Block Nos. I-8 and I-9 of Islamabad.

2) Middle Stream between Kattarian Bridge and Chaklala Bridge (RD6+251)

Below Kattarian Bridge, Lai Nullah passes through the area of Rawalpindi. The area is on the flat alluvium plain, and the section of Lai Nullah in the area has the gentle riverbed slope of about 1/1,250 with several meandering portions.

The river channel improvement for this stretch is now in progress (the detailed clarification of the channel improvement is as described in the following subsection 2.3.3). Before the channel improvement, the stretch had a single cross-section with a narrow channel width; the width of several bottlenecks in the stretch is less than 20m. Moreover, there have been many encroachments of structure in the river channel. Due to these river conditions, the stretch has frequently caused the flood overflow.

According to the simulation by non-uniform calculation, the bank level of the stretch before the on-going channel improvement could confine the flood water level for only less than 300 m^3/s which corresponds to recurrence probability of less than 3-years (refer to Fig. 2.3.2). On the other hand, the channel flow capacity is expected to increase to more than 600 m^3/s upon completion of the on-going river channel improvement. Detailed clarification of this incremental channel flow capacity is as described in the following subsection 2.3.4.

3) Middle Stream from Chaklala Bridge to Waterfall below Murree Brewery (RD3+800)

Below Chaklala Bridge, the Lai Nullah passes through the residential area of the Cantonment Area. This stretch has the gentle channel bed-slope, which is almost same as that of the upper on going channel improvement section (i.e., 1/1,250) as shown in Fig. 2.3.3.

There were heavily meandering sections of about 1,150m in length around Murree Brewery Area from RD4+077 to RD5+227 (i.e., about 2.1km to 1.0km downstream from Chaklala Bridge). The meandering section had a limited channel width causing a rather frequent flood overflow. According to the interview survey with the residents, Askari Estate located at the left bank of meandering section had the flood inundation depth therein reached 1.5m above ground level in the flood in 2001. In order to offset the flood overflow, realignment (short-cut) together with widening of the river channel has been made by PMU, RDA as an extension of the aforesaid on-going channel improvement of Lai Nullah from Chaklala Bridge to Kattarian Bridge. Through this channel improvement, the short-cut section has a channel flow capacity of more than 1,800 m^3/s.

The section of about 1.0km in length sandwiched between the aforesaid realignment/widening of the meandering section and the on-going channel improvement above Chaklala Bridge is, however, left behind without any channel. The section contains the several bottlenecks, the cross-sections of which are far smaller than the design cross-section at Chaklala Bridge. As the results, the floodwater level tends to abruptly rise just upstream of the section due to the water head swelled at the bottlenecks of the section. The floodwater level thus abruptly raised causes the adverse backwater effect to the upper

on-going channel improvement sections. The backwater effect would extend to the upstream section near to Gunj Mandi Bridge, which is about 6km upstream from Chaklala Bridge. Should the existing bottleneck section remain as it is without any improvement, the actual channel flow capacity within the extent of the backwater effect would be decreased to be below the design flow capacity of the on-going channel improvement project (refer to section 2.3.4 in detail).

4) Downstream from Waterfall to Confluence with Soan River (RD0-310)

The Lai Nullah meets the first waterfall about 3,800 m upstream from New G.T. Road Bridge (RD0+000). Below the water fall, the Lai Nullah passes through less populated area, having the rather large channel width and channel depth with steep channel slope of about 1/70 as shown in Fig. 2.3.3. Due to these conditions, the flood damage along this stretch could be evaluated to be nil.

2.3.3 On-going River Improvement Works for Middle Stream from Kattarian Bridge to Chaklala Bridge

As described above, the channel improvement is currently in progress for the stretch from Chaklala Bridge to Kattarian Bridge. The heavily meandering section around Murree Brewery Area (RD4+077 to RD5+227) has also been realigned (short-cut) and widened as a part of the on-going channel improvement. This channel improvement started, on experiencing the disastrous flood damage in 2001, as a part of the project of the on going “Urban Water Supply and Sanitation Project Phase-1 for Rawalpindi City” under the financial assistance of ADB Loan {Loan No. 1260 Pak (SF)}.

The project is composed of (i) widening and realignment of the section of 10.96km from Chaklala Bridge (RD6+251) to Kattarian Bridge (RD17+210), (ii) reconstruction of the three (3) bridges, namely: Dhoke Chiragh Din Bridge (RD8+050), Gawal Mandi Bridge (RD12+976), and Pir Wadhai Bridge (RD13+760) and (iv) realignment/widening of meandering section around Murree Brewery Area from RD4+077 to RD5+227 (i.e., about 2.1 km to 1.0 km downstream from Chaklala Bridge).

The actual construction works had started upon award of contract in January 2002, but demolishing of the structures for securing of the right of way could not start until July 2002 in spite of efforts of the relevant government agencies. Due to difficulties in demolishing, the actual work progress was much delayed, and the target completion time was extended to September 2003 from January 2003. The salient features of the improvement works as well as the dimensions of the design cross-sections are as listed in the following Tables R 2.3.2 and R 2.3.3, respectively:

Table R 2.3.2 Salient Features of On-going Channel Improvement of Lai Nullah

Item	Description
Design scale	25-year return period at non-bridge sections, and 100-year return period for bridge sections
Design discharge	About 600 to 1,000m^3/s
Improvement section	(a) Section of 10,959m from Kattarian Bridge (RD17+210) to Chaklala Bridge (RD6+251) (b) Meandering Section of 1,150 m from around Murree Brewery Area from RD4+077 to RD5+227 (Short-cut to 775m)
Shape of cross-section	Single cross-section with the side slope of 1 to 1.5
Side protection	Stone pitching for the sections of 50m in length along twelve (12) bridges
Depth of cross-section	6.5m at the design high water level (HWL) and 7.5m at the top of the bank (i.e., height of free board is 1m)
Width of cross-section	Top width of 47.0 to 69.7 m within the Right of Way of 56 to 79m
Reconstruction of bridge	Three (3) bridges; namely, Dhoke Chiragh Din Bridge (RD8+050), Gawal Mandi Bridge (RD12+976), and Pir Wadhai Bridge (RD13+760)
Side drain	The concrete drain with its top width of 0.37m placed along the bank of the river channel as required.

Source: Design Report Vol.1, Urban Water Supply and Sanitation Project Phase 1 for Rawalpindi City, March 2002., and interview from PMU, RDA

Table R 2.3.3 Typical Cross-section Designed in the On-going River Channel Improvement

Section				Design Flow Capacity (m^3/s)	Channel Width (m)		Channel Depth (m)	Width of Right of Way (m)
Downstream		Upstream			Bottom	Top		
Description	RD	Description	RD					
Short-cut section	4+077	Short-cut section	5+277	N.A*	47.3	69.7	7.5	N.A*
Chaklala Bridge	6+215	Dhoke C. Din Bridge	8+060	1,009	44.4	66.9	7.5	79.0
Dhoke C. Din Bridge	8+060	Railway Road Bridge	8+325	968	42.4	64.9	7.5	77.0
Railway Road Bridge	8+325	Murree Road Bridge	8+628	962	42.2	64.7	7.5	76.0
Murree Road Bridge	8+628	Gawal Mandi Bridge	9+814	957	41.9	64.4	7.5	76.0
Gawal Mandi Bridge	9+814	City S. Road Bridge	10+790	942	41.2	63.7	7.5	75.0
City S. Road Bridge	10+790	Ratta A. Road Bridge	11+780	934	40.8	63.3	7.5	75.0
Ratta A. Road Bridge	11+780	Gunj Mandi Bridge	12+630	923	40.3	62.8	7.5	74.0
Gunj Mandi Bridge	12+630	Pir Wadhai Bridge	14+428	873	37.9	60.4	7.5	72.0
Pir Wadhai Bridge	14+428	Khayaban S.S. Bridge	14+100	819	35.4	57.9	7.5	69.0
Khayaban S.S. Bridge	14+100	Parrian Bridge	16+178	633	26.4	48.9	7.5	58.0
Parrian Bridge	16+178	Kattarian Bridge	17+210	594	24.5	47.0	7.5	56.0

Source : Design Report Vol.1, Urban Water Supply and Sanitation Project Phase 1 for Rawalpindi City, March 2002, and Variation Order No.05 Contract No. CW/LCB/DW-08A on Straightening of Chaklala Loop, PMU RDA.
Note* : Not specified

2.3.4 River Channel Flow Capacity

The river channel flow capacity of Lai Nullah and its major tributaries were estimated by non-uniform calculation method with using the channel cross-sections and the probable runoff discharges as the basic data. Among others, the probable runoff discharges are derived from the results of the hydrological analysis (refer to chapter 5), while the channel cross-sections are from the results of the river channel survey carried out in the Study and/or the construction drawing for the on-going river channel improvement. The extent and the Manning's Roughness Coefficient adapted to the estimation of channel flow capacity are as listed below.

Table R 2.3.4 Stretches for Estimation of Channel Flow Capacity

Name of River	Extent	Length (km)	Manning's Coefficient	Source of cross-sections
Bedarawali Kas	From Kattarian Bridge to 2.3km upstream	2.2	0.035	Results of river channel survey carried out in the Study
Tenawali Kas	From confluence with Saidpur Kas to 2.2km upstream*	2.2	0.035	- ditto -
Saidpur Kas	From confluence from Kattarian Bridge to 2.2km upstream	3.5	0.035	- ditto -
Lai Nullah	From Waterfall (RD3+800) to outlet of short-cut section (RD4+077)	0.3	0.035	Variation Order No.05 on Straightening of Chaklala Loop, PMU RDA.
	Short-cut section (RD4+077 to RD5+277)	0.8	0.030	Construction drawing for the on-going river channel improvement
	From inlet of short-cut sec. (RD5+277) to Chaklala Bridge (RD6+251)	1.0	0.035	Results of river channel survey carried out in the Study
	Chaklala Bridge (RD6+251) to Kattarian Bridge (RD17+210)	10.1	0.030	Construction drawing for the on-going river channel improvement

*: The confluence of Tenawali Kas and Saidpur Kas is located about 600m upstream from Kattarian Bridge

1) Tributaries in Islamabad

The probable water levels of Lai Nullah at Kattarian Bridge were first estimated by the non-uniform calculation from waterfall (RD 3+800) up to Kattarian Bridge based on the critical flow at the waterfall as the boundary condition at the downstream end. The results of the estimation are as listed in Table R 2.3.5.

Table R 2.3.5 Probable Water Level and Discharge at Kattarian Bridge

Return Period	Probable Discharge (m^3/s)*				Water Level of Lai Nullah at Kattarian Bridge (EL. m)
	From Tributaries			Lai Nullah at Kattarian Bridge	
	Bedarawali Kas	Tenawali Kas	Saidpur Kas		
5	180	95	55	330	498.0
10	340	175	105	620	499.8
25	640	315	195	1150	502.1
50	930	450	280	1660	503.7
100	1270	620	380	2270	505.3

* Estimated by the flood runoff simulation (refer to Chapter 5)

The profile of water level along the tributaries, Bedarawali Kas, Tenawali Kas and Saidpur Kas was further estimated applying the above probable water level of Lai Nullah at Kattarian Bridge as the initial water stage (i.e., the boundary condition) at the downstream end of the tributaries. The probable water level of the tributaries thus estimated were then compared with their existing bank levels, and the channel flow capacity of the tributaries were estimated through the comparison as listed below (refer to Fig. 2.3.4):

Table R 2.3.6 Channel Flow Capacities of Tributaries in Islamabad

Name of Tributaries	Length of Channel Surveyed	Flow Capacity	Flood Scale to be coped by Flow Capacity*
Bedarawali Kas	2.2 km	730 m^3/s	30-year return period
Tenawali Kas	2.2 km	320 m^3/s	25-year return period
Saidpur Kas	3.5 km	200 m^3/s	25-year return period

*: The values are estimated by interpolation of the flow capacity into the probable runoff discharges listed in Table R.2.3.5.

As listed above, the channel flow capacity of the lower stretch of Bedarawali Kas is about 730 m^3/s, which could cope with the probable flood discharge of 30-year return period. As for Tenawali Kas and Saidpur Kas, their channel flow capacities are estimated at 320 m^3/s and 200 m^3/s, respectively, which would correspond to the probable flood runoff discharges of 25-year return floods, respectively.

As described in the following item 2), the on-going channel improvement section of Lai Nullah has the channel flow capacity of 640 m^3/s at Kattarian Bridge, which corresponds to the probable runoff discharge of about 10-year return period[3]. Accordingly, it is evaluated that the tributaries of Bedarawali Kas, Tenawali Kas and Saidpur Kas have the larger channel flow capacity than the mainstream of Lai Nullah, even after completion of the on-going channel improvement of the mainstream.

2) Mainstream of Lai Nullah from Waterfall (RD3+800) to Kattarian Bridge (RD17+210)

The profile of the water levels for probable flood flow discharges along Lai Nullah from waterfall to Kattarian Bridge was estimated through the aforesaid non-uniform calculation based on the critical flow at the waterfall (RD 3+800) as the boundary condition at the downstream end of the stretch. As the results, the probable flood discharge, which has its corresponding water level below the bank level, was estimated as the channel flow capacity of Lai Nullah. The results of the estimation are as listed below (refer to Fig. 2.3.5):

Table R 2.3.7 Estimated Channel Flow Capacity of Lai Nullah
{In case of Non-Channel Improvement of the Section (RD5+277 to RD6+215)}

Section				Flow Capacity (m^3/s)
Downstream		Upstream		
Description	RD	Description	RD	
Short-cut section	4+077	Short-cut of mender	5+277	1,810
Non improvement section	5+277	Non improvement section	6+215	800
Chaklala Bridge	6+215	Dhoke C. Din Bridge	8+060	620
Dhoke C. Din Bridge	8+060	Railway Road Bridge	8+325	770
Railway Road Bridge	8+325	Murree Road Bridge	8+628	780
Murree Road Bridge	8+628	Gawal Mandi Bridge	9+814	800
Gawal Mandi Bridge	9+814	City S. Road Bridge	10+790	850
City S. Road Bridge	10+790	Ratta A. Road Bridge	11+780	880
Ratta A. Road Bridge	11+780	Gunj Mandi Bridge	12+630	890
Gunj Mandi Bridge	12+630	Pir Wadhai Bridge	14+428	890
Pir Wadhai Bridge	14+428	Khayaban S.S. Bridge	14+100	880
Khayaban S.S. Bridge	14+100	Parrian Bridge	16+178	690
Parrian Bridge	16+178	Kattarian Bridge	17+210	640

As described above there are bottlenecks along non-improvement section of 1.0 km in length below Chaklala Bridge (RD5+277 to RD6+215). The bottlenecks swells the water head and

[3] According to the design report of the on-going channel improvement, the design channel flow capacity was assumed to meet a probable flood runoff discharge of 25-year return period but it was reevaluated to be nearly equal to a probale discharge of only 10-year return period in this Study (refer to Table R 5.2.3).

brings about the abrupt rise of the flood water level just upstream of the bottlenecks and, its backwater effect extends about 6km upstream near to Gunj Mandi Bridge as shown in Fig. 2.3.5. The backwater effect causes the unfavorable conditions such that the channel flow capacity of the lower section reversibly drops below that of the upper section within an extent from Chaklala Bridge up to Gunj Mandi Bridge; the channel flow capacity of at Gunj Mandi is 890 m^3/s, while the flow capacity drops to 620 m^3/s at Chaklala Bridge as listed in Table R 2.3.7.

The reversal of the channel flow capacities from the upper to lower sections inflicts the risk of flood overflows and therefore, should be unconditionally dispelled. In order to offset the reversal of the channel flow capacities, it is indispensable to improve the bottlenecks. The necessary channel improvement could be made through enlargement of the cross-sections. Designed channel profile, typical cross-sections and alignment for the bottlenecks are as described in Item 3) of subsection 6.2.1

On the premises that the channel improvement of the bottlenecks, the channel flow capacity of the Lai Nullah could be recovered and almost compatible to the design discharge adapted to the on-going channel improvement project as listed in Table R 2.3.8 (refer to Fig. 2.3.6).

Table R 2.3.8 Estimated Flow Capacity of Lai Nullah and Design Discharge adopted to the On-going River Channel Improvement

{In case of Channel Improvement of the Section (RD5+277 to RD6+215)}

Section				(1) Estimated Flow Capacity*1	(2) Design Discharge*2
Downstream		Upstream			
Description	RD	Description	RD		
Short-cut section	4+077	Short-cut section	5+277	1,810	-
Proposed improvement section	5+277	Proposed improvement section	6+215	1,010	-
Chaklala Bridge	6+215	Dhoke C. Din Bridge	8+060	1,010	1,000
Dhoke C. Din Bridge	8+060	Railway Road Bridge	8+325	1,010	970
Railway Road Bridge	8+325	Murree Road Bridge	8+628	1,000	960
Murree Road Bridge	8+628	Gawal Mandi Bridge	9+814	970	960
Gawal Mandi Bridge	9+814	City S. Road Bridge	10+790	960	940
City S. Road Bridge	10+790	Ratta A. Road Bridge	11+780	950	930
Ratta A. Road Bridge	11+780	Gunj Mandi Bridge	12+630	940	920
Gunj Mandi Bridge	12+630	Pir Wadhai Bridge	14+428	910	870
Pir Wadhai Bridge	14+428	Khayaban S.S. Bridge	14+100	890	830
Khayaban S.S. Bridge	14+100	Parrian Bridge	16+178	690	630
Parrian Bridge	16+178	Kattarian Bridge	17+210	640	590

Note

*1: The flow capacity estimated by non-uniform calculation assuming widening of the sections below Chaklala Bridge (RD5+227 to RD6+215)

*2: The rounded values of design discharge adopted to the on-going channel improvement (Source: Design Report Vol.1, Urban Water Supply and Sanitation Project Phase 1 for Rawalpindi City, March 2002)

As listed above, the flow capacities adapted to the design of the on-going channel improvement (i.e., the values under the column of (2) in Table R 2.3.8) tend to be slightly lower than the values estimated in the Study (i.e., those under the column of (1) in Table R 2 3.8), which are subject to the widening of the existing channel section below Chaklala Bridge (RD5+227 to RD6+215).

The channel flow capacity adapted to the on-going channel improvement is estimated by the uniform calculation method, where considered is not given to the possible increment of the flow capacity due to the downward expansion of the designed typical cross-sections (refer to Fig. 2.3.7).

Taking the above conditions into consideration, the values estimated by non-uniform calculation in this Study (i.e., the values under column of (1) in Table R 2.3.8) are assumed as the design channel flow capacity of the on-going channel improvement section from Chaklala Bridge to Kattarian Bridge. As described above, however, the design flow capacity adapted in the Study is on conditions that the channel improvement of the existing non-channel improvement section below Chaklala Bridge (RD5+227 to RD6+215) is made in accordance with the proposed channel profile and cross-sections as specified in subsection 6.2.1.

2.4 GEOLOGY

2.4.1 General

The study area is located at the northwestern extension of the Himalayan mountain system developed in a series of stages 30 to 50 million years ago. The Himalayan range was created from powerful earth movement that occurred as the Indian plate pressed against the Eurasian continental plate (Plate Tectonics). This collision raised the deposits laid down in the ancient to form the Himalayan ranges from Pakistan eastward across northern India, and from Nepal and Bhutan to the Myanmar border.

Major tectonic activity has shaped the geologic structures observed in northern Pakistan. The main sutures among the Indian and Eurasian continents, and the others are clearly outlined. As shown in the following figure, the major contact, which over a vast area separates lower crustal or upper mantle rocks from the sialic crust of the Indian Plate, can be referred to as the Main Muntle Thrust (MMT), the Main Karakorum Thrust (MKT) and the Main Bundary Thrust (MBT).

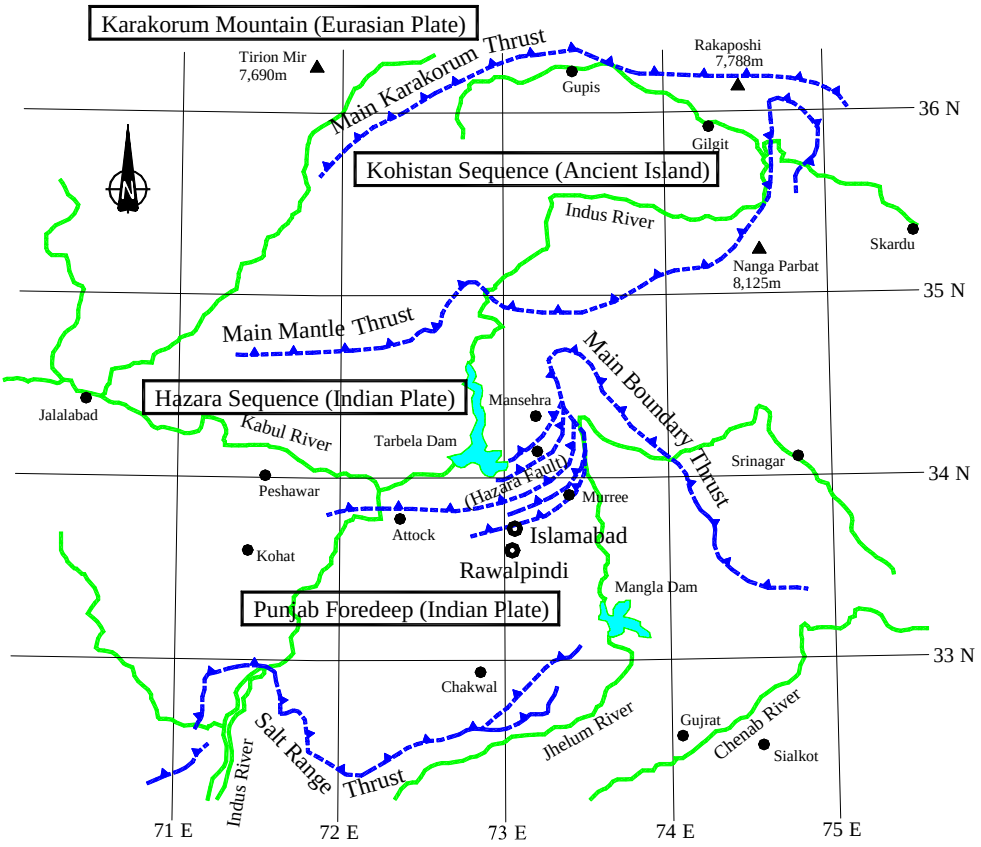


Fig. R 2.4.1 Tectonic Boundary observed in Northern Pakistan

2.4.2 Geology in the Study Area

The study area is located near the trace of the Hazara fault that corresponds to the Main Boundary Thrust (MBT). The area forming the northeastern Potwar Plateau and adjacent hills is in its geological condition largely Tertiary in age and with smaller areas of formations belonging to Cretaceous age. The following stratigraphical sequence is seen in the area.

Table R 2.4.1 Stratigraphical Sequence in Study Area

Formation	Constitution	Epoch	Period	Time Boundaries
Surficial Deposit	Loessic Silt (Loam), Older Alluvium,	Holocene	Quaternary	1.6 mil. years ago
	Gravelly Conglomerate	Pleistocene		
Siwalik Formation	Sandstone, Conglomerate	Miocene-Pliocene	Tertiary	65 mil. to 1.6 mil. years ago
Murree Formation	Sandstone, Shale	Miocene		
Kuldana Beds	Sea Deposits, Fluvial Deposits	Eocene		
Upper Nummulitics	Limestone, Shale			
Lower Nummulitics	Limestone, Shale			
Giumal Formation	Quartzitic Sandstone, Calcareous Shale, Limestone	-	Cretaceous	138 mil. to 65 mil. years ago

The details of geological constitution mentioned in the above table are explained hereinafter.

1) Giumal Formation

The oldest formation outcropping in the study area belongs to Cretaceous age and is represented by the Giumal Formation. It comprises dark colored quarzitic sandstone, calcareous shale and limestone. These rocks are thinly developed, but make a conspicuous appearance in the Margalla hill slopes bordering the north margin of the Potwar Plateau. The rocks are very much folded and squeezed. The sequence is greatly disturbed by reversed faulting.

2) Lower and Upper Nummulitics

The Lower Nummulitics comprises a massive gray or dark colored limestone of great thickness with intercalation of shale containing nummulite fossils. The Lower Nummulitics outcrops forming the Margalla hill range in the northwestern corner of the study area.

The Lower Nummulitics is succeeded by Upper Nummulitics variegated limestone and shale. Outcrops of this series are seen as thin zones with the Lower Nummulitics in the Margalla hill range and have some calcareous conglomerates and red shale toward its top.

3) Kuludana Beds

These passage beds denoting recession of sea deposits and beginning of fluvial deposits.

4) Murree Formation

A thick group of red and purple sandstone and shale sequence over lying the Kuldana Beds are designated the Murree Formation. The strata are red and purple shale veined by calcite, sandstone and concretionary clay pseudo conglomerates. Apart from the Margala hill range, the entire region is formed by the Murree Formation. Regular outcrops are, however, seen only in the small ridges at the base of the Margalla hill range, in the Murree hills and in lower reaches of Lai Nullah (downstream from RD 3+600). Rest of the area is covered by surficial deposits.

5) Siwalik Formation

The rock formations succeeding the Murree Formation in conformable sequence have been called the Siwalik Formation. It can be divided into three groups; namely, Lower Siwalik, Middle Siwalik and Upper Siwalik, which is the youngest and terminates the Tertiary formations.

The lowest beds of the Lower Siwalik indicate clear transitional passage into the upper Murree Formation. It is formed of hard, dark colored and massive sandstone. The Upper Siwalik overlies the previous formation in a transitional manner, but often with overlapping

margin, sometimes appearing as fault contact. The lower one of this formation is composed of red earthy clay with massive beds of coarse, loosely cemented and pebbly sandstones. The upper one is composed of pebbly beds, which gradually increase in size to form a regular siliceous conglomerate. The Siwalik Formation outcrops southeast and south of Rawal Pindi

6) Surficial Deposits

In upper reaches (upstream from RD 4+050), Lai Nullah cuts through the surficial deposits, which generally consists of Potwar loessic silt. It deposits forming a thick mantle overlying Lai Conglomerates as per stratigraphical sequence. However, in lower reaches of Lai Nullah (downstream from RD 3+600), the surficial deposits are found to be present directly over older formation, the Murree Formation, where the Lai Conglomerate has been removed by the degradation.

The loessic silt deposits are massive and comprises well-sorted silt with some clay and very fine sand. Below RD 4+50, these silts have been eroded in the river and older alluvium has been exposed.

The Lai Conglomerate, which is the oldest among Quaternary deposits in the study area, is exposed along the course of Lai Nullah between RD 3+600 and RD 4+50. The Lai Conglomerate is poorly graded, well cemented and quite hard. It is of varying composition, consisting of limestone, sedimentary rock, quartzite and igneous rock.

7) Folds and Faults

Due to the measure tectonic activity, the study area forms a part of the northern limb of a big geosyncline. The rock formations from the Murree to the Upper Siwalik have been folded and striking approximately in a northeast-southwest direction. The angle of inclination of the main fold axis varies considerably, but is about 20 degree.

According to the report, “Active Fault Systems in Pakistan”, some of the active faults were revealed in Pakistan by the study of aerial photographs and Landsat images. The Attock and Campbellpur Active Faults were observed in or near the Margalla hill region of the study area. There are two parallel E-W trending faults, which cut through recent alluvium and form fault terraces. It will be desirable to conduct further ground checks and detailed field studies.

2.5 FLOOD

Details of the past flood disasters are unfortunately not available, but scraps of descriptions about past floods could be collected from several study reports. According to them, the flood has occurred with the frequently of 19 years at least in 59 years from 1944 to 2002 as listed in Table R 2.5.1. In other words, flood damage broke out almost once in every three years.

Table R 2.5.1 Flood Years

Year	Date	Year	Date
1944	August 13	1985	No Data
1957	No Data	1988	No Data
1966	July 31	1890	No Data
1970	No Data	1994	July 3
1972	No Data	1995	July 24
1976	No Data	1996	July 29
1977	No Data	1997	August 27
1978	No Data	2001	July 23
1981	No Data	2002	August 13
1982	August 10	N/a	N/a

2.5.1 Habitual Flood Inundation Areas

Habitual inundation areas have been identified by the relevant administrations such as CDA, RDA and TMA. The low-lying areas along Lai Nullah and the tributaries in Rawalpindi suffer from even small floods. The serious flood tents to occur particularly along the mainstream between Gunj Mandi Bridge and Railway Bridge, and the tributaries of Arya Nullah, Dhok Ratta Nullah and Donk Charaghdin. According to TMA, flood overflow of Lai Nullah starts along these areas once the water level of Lai Nullah reaches 18 feet (491.5 m) at Gawal Mandi Bridge. In order to disseminate the risk of flood over flow, TMA blow sirens over the low-lying areas when the water revel reaches the alert water level at 16 feet (491.3 m).

Due to the geophysical features, Islamabad is safer against floods than Rawalpindi. Residential areas in Islamabad are generally placed on the relatively high ground level and surrounded by extensive green spaces, which might function as retention ponds or buffers from flood water. Nevertheless, the localized flood inundation still occurs in the low-lying areas along the tributaries of Lai Nullah such as Saidpur Kas and Tenawali Kas in I-Block areas in Islamabad. The community called “Kachi Abadi” in particular, who live in the right-of-way of the tributaries, is exposed to the frequent flood inundation.

2.5.2 Flood Discharges

The flood marks at Gawal Mandi Bridge have been recorded by TMA for these 13 years, although the records do not contain the dates of their occurrences. Table R 2.5.2 gives the maximum water levels and their corresponding discharges estimated from the water level-discharge relationship by the non-uniform flow calculation in Section 2.3. Among others, however, the discharge of the flood in 2001 (2,560 m^3/s) was estimated through the flood simulation model instead of the water level-discharge relationship due to the massive volume of flood inundation. This discharge thus estimated is subject to an assumption that all the floodwater had been confined in the river.

Table R 2.5.2 Observed Max. Water Levels and Estimated Discharges at Gawal Mandi Bridge

Year	Maximum Water Level		Discharge (m^3/s)
	(ft)	(m)	
1966	25	494.02	450
1970	30	495.54	700
1972	26	494.32	500
1976	25	494.02	450
1977	30	495.54	700
1978	25	494.02	450
1981	29	495.24	650
1982	32	496.15	850
1994	31	495.85	770
1995	26	494.32	500
1996	20	492.50	270
2001	41	498.90	2,560*
2002	22	493.10	320

Note: * by the flood simulation model confining flood water in the river (refer to Chapter 5).

2.5.3 2001 Flood

The flood in 2001 would be the largest among the recorded floods. On 23 July 2001, the rainfall depth was recorded at 620 mm in 10 hours from 0600 to 1600 hours (in Pakistan Standard Time) at the Islamabad Station. The water level of Lai Nullah and its tributaries remarkably rose and all houses and some road bridges along them were swept away.

Heavy rainfall in this South Asian region is generally associated with monsoon depressions formed over Bay of Bengal during summer. The rainfall experienced in the flood in 2001 is, however, exceptionally not associated with any depression. According to PMD, the rainfall was caused by a freak combination of disastrous weather events including: (a) intense heating on the surface, (b) presence of mid latitude westerly trough and (c) moisture feeding through monsoon flow along Himalayas.

A meso-scale rainfall was firstly developed a day before about 50 km north of Islamabad producing more than 200 mm around the origin during the night. It moved in south and southeast direction. In Islamabad, rain started at 0600 hours and attained peak intensity at 1200 hours lasting till 1600 hours. The intensity as well as amount of rainfall was more in Islamabad than in Rawalpindi. The swollen flow of Lai Nullah invaded Rawalpindi causing several times more damages than Islamabad. Loss of 74 human lives has been reported in this disaster.

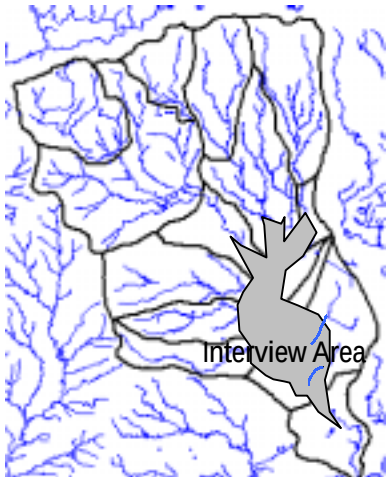


Fig. R 2.5.1 Interview Area

Interviews were conducted between September and October 2002 at 500 points in Rawalpindi and Islamabad, to clarify the conditions of the 2001 flood in particular that people still remember well.

The 500 interview points spread over the low-lying areas and their surroundings along Lai Nullah and the tributaries that were specified in advance through a preliminary study on topography, interviews to officials concerned and site-inspections. The results of interview survey results are summarized as below:

1) Inundation Depth, Duration and Causes

The results of interview on the 2001 flood are plotted on three maps in Fig. 2.5.1. The first map indicates the maximum inundation depths, the second the duration of the inundation, and the third the causes of the flood inundation that the interviewees believed. The maximum inundation depths are as deep as 4 m or over in the low-lying areas along Lai Nullah and the tributaries, where the inundation duration is also as long as 6 hours or over. As for the causes of the flood damage, the overflow of Lai Nullah was raised by more interviewees, followed by the overflow of the tributaries and the combination of the overflow of Lai Nullah and the local rainfall. In some low-lying spots, the local rainfall was also raised as one of the principal causes of the flood.

2) Evacuation Activities

Out of the 500 interviewees, 152 interviewees evacuated somewhere during the 2001. Most of the evacuation places were the rooftops of their houses followed by the neighbors' houses. It is noted that almost none of evacuees was given any advice on the evacuation by the administrations but they acted by themselves. In addition, about 130 interviewees answered that the flood was too fast to allow them to evacuate.

3) Request on Flood Mitigation and Environment Measures

Fig. R 2.5.2 shows requests from the interviewees for the future flood mitigation and environmental improvement. As shown in the figure., the garbage control and river improvement are more prefered by them. Flood Forecasting and Warning System is also desired by nealy half of the interviewees. Not a few interviewees mentioned flood diversion of Lai Nullah in the upper reaches as a conceivable flood mitigation measure that was not included in the questionnaire list.

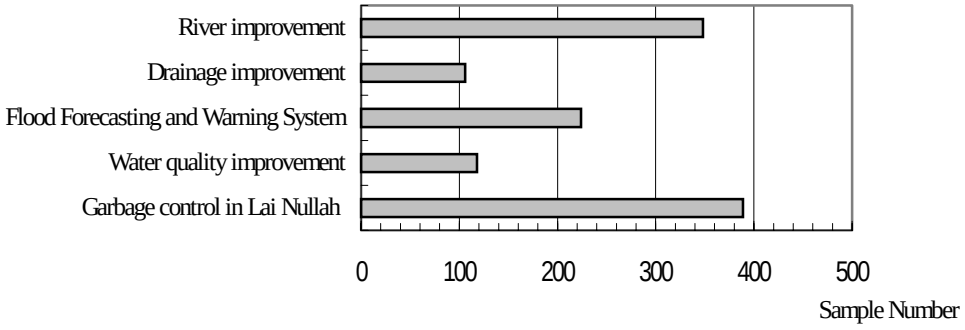


Fig. R 2.5.2 Requests from Interviewees

CHAPTER 3. SOCIO-ECONOMIC CONDITIONS OF THE STUDY AREA

3.1 SOCIAL CONDITIONS

3.1.1 Administrative Boundary of the Study Area

The Study Area extends over three (3) jurisdiction/administration units of Islamabad, Rawalpindi and Cantonment positioning on the northern most edge of the tract known as Potohar plateau in the range of about 22 km long and 19 km wide.

1) Islamabad

Islamabad is a new Capital City for Pakistan, which was finally decided in late 1950's and started the construction in 1961 based on the Master Plan of a Greek consultant, Konstantinos Doxiadis. CDA (Capital Development Authority) is the implementing agency for the new Capital administered under direct jurisdiction of the Federal Government. After two years of the construction start, Islamabad started its functions as the Capital in 1963. The construction itself is still on-going to develop mainly in the Western direction.

According to the Master Plan, the large area of Islamabad was divided into five zones, of which Zone 1 is urban area. Some part of Zone 2 will be urbanized in the future. Zone 3 basically consists of the forest in the North and a National Pak in the South, including some residential areas in the vicinity with Zone 1. Zone 4 and 5 are sparsely populated and basically rural areas (refer to Fig. 3.1.1). Accordingly, the urban area will be developed up to C-16, namely from I-8 and H-8 to 16, G-6, F-6 to 16, E-7 to 16, D-10 to 16 and C-13 to 16. Now the development has been almost completed around E-11, F-11, G-9 and H-10. But there are some spots left vacant without any buildings, meaning that there are no concrete plans to development. CDA is to implement the areas according the demand from public and private sectors. The area size of each Zone is given in the table below. The total area is 910.6 km^2, which is more than tree times of the Study Area.

Table R 3.1.1 Zones of Islamabad

Zone	Area (acre)	Area (km^2)
1	54,958.26	222.4
2	9,804.92	39.7
3	50,393.01	203.9
4	69,814.35	282.5
5	39,029.46	158.0
Total	225,000.00	910.6

Source: Master Plan of Islamabad

2) Rawalpindi

In Rawalpindi area a mixed land use is predominant in the central areas of the City. There is no segregation of compatible land uses, which have not been related to overall

transportation system, thereby creating congestion, chaotic traffic hazards environmental problems. The concentration of the commercial activity and its linear growth has created complex problems, such as inadequate parking places, poor accessibility due to encroachments on roads/foot paths and presence vendors/hawkers. The areas between the main streets, forming pockets, are filled with residential use.

Rawalpindi is defined, in a narrow sense, as the jurisdiction area of RDA, which is sandwiched by those of CDA and RCB. The whole jurisdiction area of RDA and RCB could be also called as Rawalpindi. Moreover, the jurisdiction area of TMA, which is far larger than those of RDA and RCB, is again called as Rawalpindi. The administrative boundaries of the areas of RDA, RCB and TMA are as shown in Fig.3.1.2. In this Study, the first definition is used in most cases, if otherwise defined.

3) Cantonment

Cantonment is a part of Rawalpindi and it is called as "Rawalpindi Cantonment", because there are many cantonments in Pakistan. Most of the administration for the area is ruled by the RCB (Rawalpindi Cantonment Board). The area is characterized not only by the general headquarter of the Pakistan Army and its relevant offices but also by many Government offices, residential and commercial area. The Cantonment area is in the southern side of Murree Road and main railway track, connecting the City with Lahore and Karachi. The other physical barrier between the Municipal and Cantonment areas is complex and intermixed at some locations. The industrial area of the City is situated in Western ridge and near Kohinoor Textile Mills along with Peshawar Road. The best residential area of the Cantonment is also located in this area. The largest owners of the lands are private with 63.2%, which is followed by Armed Forces with 16.8% as listed in Table R 3.1.2. The remaining owners have only small shares of less than 5%. The land values are widely different in a range of about five times, reflecting the localities, specialties or traditional values.

Table R 3.1.2 Land Ownership

Sr.Nr.	Ownership	Area (in Acre)	Area (km^2)	Percentage
1	Central Government	971	3.93	4.10
2	Provincial Government	1,056	4.27	4.46
3	Armed Forces	3,986	16.13	16.83
4	Cantonment Board	959	3.88	4.05.
5	Pakistan Railways	817	3.31	3.45
6	Airport	933	3.78	3.94
7	Private	14,965	60.56	63.17
	Total:	23,687	95.86	100.00

3.1.2 Land Use

The present and the future land use maps were prepared applying the following seven (7) categories of the land use.

(1) Agricultural area: to be used for agricultural purposes

(2) Residential area/densely populated: like the congested area in Rawalpindi

(3) Residential area/moderately populated: like the planned area in Islamabad

(4) Residential area/suburbs: like ones located in the suburbs, or village centers.

(5) Forest area

(6) Green area and bare land

(7) Water body

The present land use map as of 2001 was produced based on the Landsat image taken in 2001. The future land use maps in 2012 and 2030 are based on the Urban Master Plan 2030 by the relevant government agencies and the population projected in the Study (refer to the under-mentioned subsection 3.1.2). The land use maps thus prepared are as shown in Figs. 3.1.3 to 3.1.5, which are summarized as shown in Table R 3.1.3.

Table R 3.1.3 Summary of the Land Use

Land Use	Present (2001)		2012		2030	
	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)
Agricultural Area	33.4	14.2	29.1	12.4	11.4	4.9
Residential Area/ Densely Populated	31.2	13.3	35.2	15.0	38.8	16.5
Residential Area/ Moderately Populated	53.3	22.7	68.6	29.2	95.2	40.5
Residential Area in the Suburbs	6.1	2.6	5.6	2.4	2.3	1.0
Forest	34.9	14.8	32.3	13.8	32.0	13.6
Green and Bare Land	74.3	31.6	62.4	26.6	53.5	22.8
Water Body	1.6	0.7	1.6	0.7	1.6	0.7
Total	234.8	100.0	234.8	100.0	234.8	100.0

Source: JICA Study Team 2002

As listed above, it is clear that residential areas will increase in the future, while agricultural area and green/bare land decrease. The forest area will also slightly decrease to provide more residential areas, as the population increases.

As the development of the study area continues, the land use pattern will change to adjust it and accommodate the population increase. The moderately populated residential area of Islamabad will increase from 53.3 km^2 in 2001 to 68.6 km^2 in 2012 and reach 95.2 km^2 in 2030. The densely populated residential area, most of which is located in Rawalpindi, will also increase from 31.2 km^2 in 2001 to 35.2 km^2 in 2012 and 38.8 km^2 in 2030, respectively. These incremental rates are not lager than those of the moderately populated residential area, which could explain that the population density in Rawalpindi have reached the maximum level, and there will be almost no room to take in new residents.

In order to compensate the increase of the residential area, the green and bare land will decrease from 74.3 km^2 in 2001 to 62.4 km^2 in 2012and 53.5 km^2 in 2030, respectively. Likewise, the agricultural area will decrease from 33.4 km in 2001 to 29.1 km^2 in 2012and 11.4 km^2 in 2030, respectively.

3.1.3 Population

The population for the study area is clarified based on the census and other relevant data/information as described hereinafter:

1) Present Population in the Concerned Administrative Units

As shown in the present population in the concerned administrative listed on Table R 3.1.4, the present population density of Islamabad City is 2,383 persons per km^2, while those of Rawalpindi City and Cantonment Area are 27,436 and 8,636, respectively. If the population density of Islamabad is assumed at 1, that of Cantonment Area is 3.6 times more than that of Islamabad. Under the same assumption, the population density of Rawalpindi City is 11.5 times more than that of Islamabad City.

Table R 3.1.4 Population of the Concerned Governing Bodies as of 1998

Area	Population	Area (km^2)	Density (person/km^2)
1. Islamabad District[*4]	805,235	906	889
(1) Islamabad City	529,180	222[*1]	2,383
(2) Islamabad Rural	276,055	684	404
2. Rawalpindi District	3,364,000	5,286	636
(1) Tehsil Rawalpindi	1,409,768	686[*2]	2,055
(2) Rawalpindi City	781,927	28.5[*3]	27,436
(3) Cantonment Area	627,841	72.7[*3]	8,636

Source : Provincial Census Report of Punjab, 1998, District Census Report of Islamabad, 1998 and District Census Report of Rawalpindi, 1998

Note*1 : The land area for urban part of Islamabad is defined herein as Zone 1 of the Master Plan of Islamabad, while, the area for the rural corresponds to the rest of the area of Islamabad Capital District.

Note*2 : Initial enumeration by JICA study team

Note*3 : Measured by GIS software

Note*4 : The term 'Islamabad District' is identical to 'Islamabad Tehsil', under which the urban area is called as Islamabad City

2) Present Population within the Study Area

The Study Area is demarcated by natural settings of the Lai Nullah watershed; therefore, the boundary of the Area does not correspond to administrative division. The Table below shows the estimated present population within the Study Area.

Table R 3.1.5 Estimated Present Population within the Study Area

Area	Population	Households	Area (km^2)	Density (/km^2)		Average Household Size
				Population	Households	
Islamabad City	432,678	72,086	161.3	2,682	446.9	6.0
Zone 1 (urban)	432,678	72,086	74.0	5,847	974.1	6.0
Rawalpindi City	724,311*1	107,219*1	26.4	27,436	4,061	6.8
Cantonment Area	407,622*1	62,770*1	47.2*2	8,636	1,330	6.5
Total	1,564,611	242,075	234.9	6,661	1,031	6.5

Note *1 : The population of Islamabad in the following areas was excluded from the population of the Study Area:. C-16, D-15, D-16, E-14, E-16, F-5, G-6(ExG-6/2), I-15, I-16, Mochi Mphra, Noorpur Shahan, Ojhri Khud & Kalan, Poona Faqiran, Qauid-E-Azam Univ., Rawal Town

*2 : Approximate population in the Study Area is enumerated by proportional distribution to the land area.

*3 : The Cantonment Area includes a small strip of land, 2.1km^2 administered by TMA.

3) Population Growth and Projection

The national population growth until the year 2030 was firstly project by assessing the past patterns of growth and extrapolating the recent trends as: (a) 2.60% up to 2002, (b) 2.50% for 2003-2015 and (c) 2.40% for 2016-2030. Based on this projection, the population for the Study Area is projected under assumptions that national level growth rate corresponds to natural birthrate and, therefore, gaps between the growth rate at the national level and that of respective administrative division, Islamabad City, Rawalpindi City and Rawalpindi Cantonment Area, are proportional either to social inflow or outflow of population. Other major assumptions are presented below.

(a) Islamabad City : Population growth rate converges with the projected national growth rate in the year 2030.

(b) Rawalpindi City : Outflow of migrants begins from the year 2015.

(c) Rawalpindi Cantonment : Social inflow and outflow of population would balance until the year 2030 with a growth rate converging with that of the national average.

Historically the population density, which allows a human-like living standard, is said to be about 20,000 persons per km^2 at maximum. That of Rawalpindi City has reached the level (27,346 at present). Most likely the population pressure would work emigration from the area to Islamabad Cit and Cantonment. Therefore the table below, showing rather mathematical figures, presents the summary of the projection.

Table R 3.1.6 Summary of Population Projection within the Study Area

Jurisdiction Area	Population (persons)			Population Density (p/km^2)		Household Density (p/km^2)	
	1998	2012	2030	2012	2030	2012	2030
Islamabad City	432,678	715,151	1,020,697	4,434	6,328	739	1,055
Rawalpindi City	724,311	1,111,802	1,496,339	42,114	56,680	6,230	8,385
Cantonment Area	407,622	676,354	979,562	14,330	20,753	2,208	3,198
Total	1,564,611	2,503,307	3,496,598	10,657	14,885	1,650	2,304

3.2 SOCIO-ECONOMIC CONDITIONS

3.2.1 Twin City in Sub-regional Economy

The Twin City of Islamabad and Rawalpindi constitutes a vital nodal point of emerging east-west economic corridor of the country connecting Peshawar and Lahore and further extending to Kabul in Afganistan on the west and to New Dehli in Inida on the east through the Asian Highway. The corridor extends to the south forming a north-south economic corridor from Lahore, the landlocked Punjab capital, to the country's international port in Karachi. The nodal point of the Twin City is further connected toward the north with Xinjiang province in China running through northern areas by the new all-weather road of the Karakoram Highway. The city of Rawalpindi is, in addition, connected to Trans-Asian Railway in the southern corridor of Asia-Europe Routes, which is expected to contribute to development of the subregional economy through improving industrial and commercial efficiency and export competitiveness.

Although about 80% of Pakistan's economic activity and population currently live within 50 to 100 km of the 1,700 km north-south corridor linking Lahore to Karachi[4], the Twin City is becoming strategically important in terms of pivotal and catalytic role in promoting sub-regional economic development and reducing poverty in the sub-region through emerging trade opportunity with neighboring counties and increasing presence in the domestic business development.

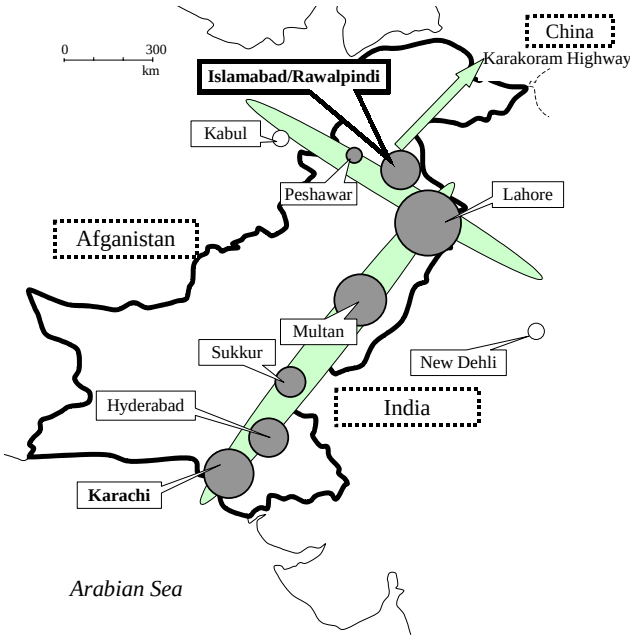


Fig. R 3.2.1 Strategic Position of the Study Area

Table R 3.2.1 compares population size, and hence size of potential market, of the major administrative bodies lying along the corridors. Social increment of population indicates polarized urbanization of Karachi, the south most metropolitan with an international port and the cities in emerging east-west corridor.

Among the cities, Islamabad has achieved the highest population growth rate in the last decade. With 2.5% annual growth rate, the population would be doubled within three decades. The population has slightly increased in other cities along the east-west corridor except Rawalpindi.

[4] Project Information Document: Pakistan-Pakistan Railways Privatization Project, World Bank

Although Karachi has undergone slight increase in the last decade, other cities along the north-south corridor such as Multan, Hyderabad and Sukkur have been subject to slightly declining population in contrast with cities along the east-west corridor.

The said bipolar urbanization may have been resulted from migration of population from rural area as well as other urban part of the country seeking for new economic opportunity created in the last decade.

Table R 3.2.1 Demographic Data of the Major Bodies lying along the Corridors

Corridor	Division	Households	Population in 1998	Social Increment per annum from 1981 to 1998
East-West Corridor	Islamabad	128,753	805,000	2.5%
	Rawalpindi	1,065,486	6,659,528	-0.4%
	Peshawar	474,634	3,915,855	0.5%
	Lahore	2,010,471	14,248,641	0.3%
North-South Corridor	Karachi	1,457,096	9,856,318	0.9%
	Multan	1,655,474	11,577,431	-0.1%
	Hyderabad	1,212,859	6,829,537	-0.4%
	Sukkur	936,756	5,584,613	-0.3%

Source: Economic Survey 2001-2002, Finance Division

Due to geographical advantage in proximity to the border with Afghanistan, the Twin City is expected to contribute to enhancing economic development of landlocked Afghanistan through border trade, though comprehensive statistical data on border trade is currently considerably limited.

3.2.2 Economic Structure of the Study Area

Islamabad is the core of the politics and public administration of the country with emerging private sector. Comprising five zones including the diplomatic enclave, the commercial district, the educational sector and the industrial area, the city of Islamabad has evolved into an urbanized modern city with development history of 40 years, which is spacious and carefully planned with tree-lined streets, large houses, elegant public buildings and well organized bazaars.

Rawalpindi, on the other hand, has rather versatile dimensions consisting of thriving commercial operation in the city and military base in the Cantonment. The city has undergone sprawling peripheral expansion with basic infrastructure facilities concentrated in and around a few big urban centers. Traffic system of the city was originally designed to accommodate animal drawn vehicles and pedestrians, which resulted in prevalent over-crowding and choking bottleneck of city roads.

1) Employment and Structure of the Economy

Reflecting region's structure of the economy, occupational structure differs between two cities. In Islamabad, high paying professionals predominate Islamabad's residents including professionals in science, education, technicians and associated professionals, those of which are mostly paid by public sector as presented below. It is noteworthy that there are poor people in Islamabad with subsistence level of income. They live in low-lying flood prone area of the Lai Nullah, generally referred to as Kachi Abadi, with poor infrastructure accessibility. This will be further described in the succeeding part of the report.

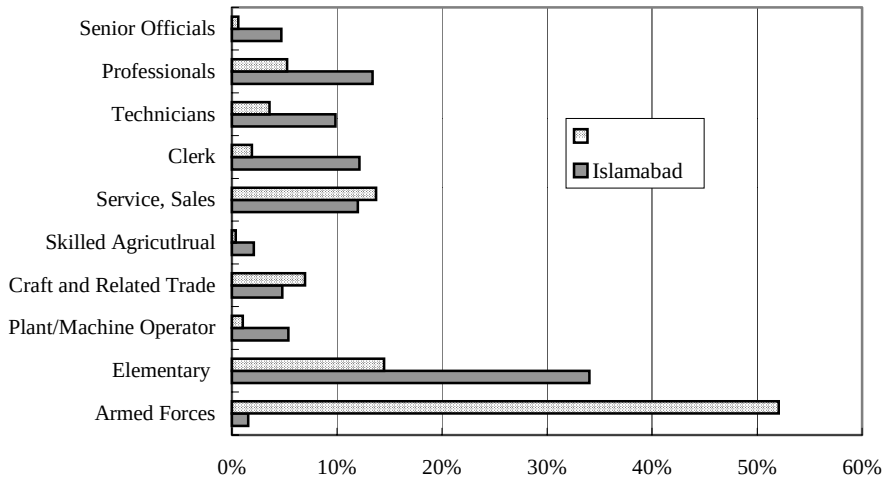


Fig. R 3.2.2 Comparison of Occupational Group
Source: District Census Report of Islamabad/Rawalpindi 1998

In Rawalpindi, more than 50 % of the employed rely on various occupations within the armed force of Cantonment. The rest of the occupation includes service workers and market sales agents and other elementary occupation.

In addition to the people holding Pakistnni's nationality, there are a large number of refugees living in a large camp locating in the western part of Islamabad. Detailed statistic on refugee is not available, though statistics of UNHCR indicated that total population in the country has risen from 1.2 million to 2 million in the year 2001.

a) Public Sector

Being the core of the politics and public administration of the country, more than a half of the employed population in Islamabad serves as governmental officers of the federal bodies as well as CDA. Contribution of public sector to employment opportunity in Rawalpindi is more accentuated in contrast with Islamabad due to presence of the armed force, which provides various positions to military officers as well as civilian bureaucrats contributing more than 50% of the total employment.

Table R 3.2.2 Total employed Population in Urban Area

District	Sector	Employed Population in the Urban Area	
Islamabad	Public Sector	61,656	54%
	Private Sector	52,326	46%
	Self Employed	20,799	18%
	Total	113,982	100%
Rawalpindi	Public Sector	250,594	64%
	Private Sector	141,441	36%
	Self Employed	90,089	23%
	Total	392,035	100%

Source: District Census Report Islamabad / Rawalpindi 1998
Note: Public sector includes government employee and autonomous body employee. Unpaid family helper was excluded from the statistics.

b) Private Sector

Endowed with geographical advantage in commercial and industrial activity, the economy of the Twin City is bolstered with a large number of small and medium size enterprises dealing with a wide range of products including household chores, utensils, foods and furniture.

In Islamabad, private sector has emerged providing employment opportunity to 52,326 people including employees at private establishments and those of self employment, while robust business entities operating in Rawalpindi provide 141,441 people.

The Cantonment of Rawalpindi is also dominated with small and medium enterprises accompanied by industries including petroleum refinery, an ordnance factory, an arsenal factory, engineering workshops, a steel-rolling mill, gasworks, and a brewery.

2) Small and Medium Enterprises (SME)

An enterprise with total assets of up to Rs. 20 million is defined as a small enterprise, while that exceeding Rs.20 million up to Rs.100 million is defined as a medium enterprise in the country. Most of the business entities operating within the Study Area are deemed categorized either small or medium size enterprise.

Number of enterprises operating within the Study Area was estimated assuming a homogeneous land use pattern within the Study Area. Total number of enterprises within the Study Area is estimated to be nearly 620,000.

Table R 3.2.3 Estimated Number of Enterprises within the Study Area

Enterprise	Number of enterprises
Commercial operation	600,000
Industrial Operation	20,000
Total	620,000

Source: JICA Study Team 2002

As presented in the table above, total number of employees in the private sector amounts to nearly 200,000, which therefore indicates merely three employees at one enterprise reflecting presence of a large proportion of small-scale enterprises.

Due to non-availability of concrete data on the SME sector such as financial statements and accounts, financial appraisals of SMEs become an arduous task for the formal lending organizations and banks and thus SMEs have always been termed as non-bankable and risky. The unavailability of the financial statement of SMEs constrains sector's further development and, in the flood in 2001, limited capability to cope with risks of the business, due to inaccessibility to formal financial market.

3) Dimensions of Poorer Segment

a) Wage Laborer in Urban Sector

Wages of urban construction workers in the cities along the East-West economic axis increase have grown in a similar pattern in contrast with those in other cities such as Karachi and Quetta. This may indicate possible migration of labors among the cities lying along the East-West axis and resultant equilibrium of wage labor market. Wages is highest in Lahore among the cities along the East-West Axis, which generally seems to decline towards the west to Islamabad, 82%, and Peshawar, 58% of Lahore.

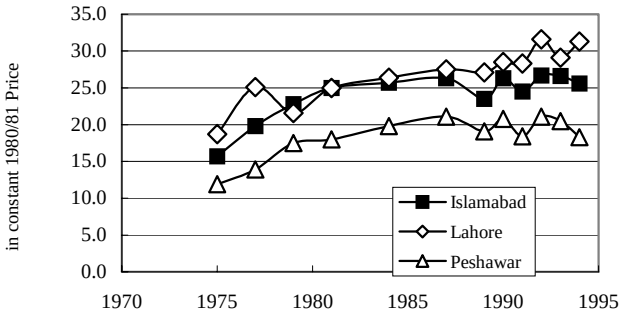


Fig. 3.2.3 Wages of unskilled Urban Construction Workers
Source: Federal Bureau of Statistics Monthly Bulletins, Economic Survey for construction workers wage data

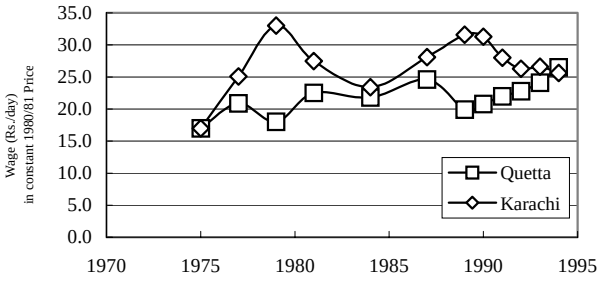


Fig. 3.2.4 Wages of unskilled Urban Construction Workers
Source: Federal Bureau of Statistics Monthly Bulletins, Economic Survey for construction workers wage data

b) Dimensions of Women

There is a significant gender gap in labor participation rate. Number of female employed in private sector is lower particularly in Rawalpindi where it is frequently referred as a city of conservative Muslim culture. Domestic works are the major form of employment for poor female in the area. In some cases, however, domestic work provides a substantial income, and pays better wages than professional work or casual work done by males. Women domestic workers in Dhok Naddi, Rawalpindi make Rs. 600 to 1,000 per month, while unskilled male casual workers make Rs. 700 to 1,000. But men are only guaranteed regular work at this rate during the peak summer season.

Table R 3.2.4 Gender Comparison of Labor Market

District	Sector	Male	Female	Female/Male (%)
Islamabad	Public Sector	54,438	7,218	13%
	Private Sector	48,485	3,841	8%
	Self Employed	19,895	904	5%
	Total	102,923	11,059	11%
Rawalpindi	Public Sector	241,496	9,098	4%
	Private Sector	138,835	2,606	2%
	Self Employed	89,758	331	0%
	Total	380,331	11,704	3%

Source: District Census Report Islamabad / Rawalpindi 1998
Note: Public sector includes government employee and autonomous body employee. Unpaid family helper was excluded from the statistics.

c) Kachi Abadi and Encroachment

In the city of Islamabad, several communities are extensively developed within the existing right-of-way of the river, which are seemingly poorer settlers than the rest of the communities. The term “encroachment” herein is defined as the settlements that are referred to as “Kachi Abadi” in Urudu with the meaning of non-brick housing units.

Reported population living in Kachi Abadi in Islamabad corresponds to nearly 3 % of the total population of the city. Kachi Abadis are dispersedly present in the certain sectors of Islamabad city including the sectors of E-9, F-6, F-7, G-7 and G-8. There are other Kachi Abadis that are not recorded in the statistics, which include, for instance, those in I-9 section of the city. The combined figure of the total population in Islamabad’s Kachi Abadi is roughly estimated to be 7 % of the total population. A structured interview survey conducted during the Fist Field Study Period covering 160 households in Islamabad and Rawalpindi indicated more than double dense population in Kachi Abadi with larger average family size in smaller residential plot.

Table R 3.2.5 Population and Number of Household residing in Kachi Abadi in Islamabad

Area	Population	Number of Houses	Average Household Size
Islamabad city total	529,180	86,575	6.1
Kachi Abadi Total in Islamabad city	17,263	2,689	6.4

Source: District Census Report of Islamabad, 1998

The statistical definition of Kachi Abadi of housing unit is non-brick structure, however, there are variations in housing structure among residents in Kachi Abadi including low quality brick structures as well as those with/without stone floor. Those of stone floored structure constitutes 55% of the total Kachi Abadi, while corresponding value for Islamabad city and rural Islamabad is 89% and 86% respectively. Structure without floor still remain about 32 % of the total Kachi Abadis. In terms of structure, the area of Kachi Abdi is less developed than the rural part of Islamabad. On the other hand, accessibility to potable water is higher than the rural part

of Islamabad due to availability of hand pumps or community tap water installed by CDA.

Table R 3.2.6 Structure and Housing Facility

Study Area	Floored structure	Structure with semi- earth floor	Structure with earth floor	Potable water	Electricity
Islamabad city	89%	5%	6%	75%	91%
Rural Islamabad	86%	7%	7%	21%	92%
Kachi Abadi Total in Islamabad city	55%	13%	32%	62%	84%

Source: District Census Report of Islamabad, 1998
Note: Floored structure, structure with semi-earth floor and structure with earth floor corresponds to PACCA, Semi-PACCA and KACHA respectively in Urudu.

The dweller of Kachi Abadi is predominantly non-Muslim people with lower literacy rate. They include Protestant as well as Catholic Christians, overwhelmingly minority groups in the Islamic society, while there are some Muslim communities of Kachi Abadi including those in I-9.

Table R 3.2.7 Literacy Rate and Religion

Study Area	Literacy Rate (%)	Religion	
		Muslim	Others
Islamabad city	77%	94%	6%
Rural Islamabad	63%	99%	1%
Kachi Abadi Total in Islamabad city	45%	8%	92%

Source: District Census Report of Islamabad, 1998

4) Development of Kachi Abadi in Islamabad and Present Livelihood

There are many reasons why the poor encroach upon the publicly owned right-of-way. The settlement in Islamabad began with the inception of development of Islamabad, which was initiated nearly 40 years back when the Government decided to move the Capital to Islamabad. During the early period of Islamabad development, a large number of construction workers were recruited from nearby cities and villages including Faisalabad and Lahore.

Although dynamic demographical data of Islamabad is unavailable, an informant of Kachi Abadi dweller in G-7/2, a former sharecropper in a small village of Faisalabad, revealed that he came to Islamabad as a construction worker nearly 35 years ago when the construction of the city was still under its initial stage. His nephew also settled in, thereafter, at the age of fifteen and started working as an officer in the lower echelons of the government. He found the position through his aunt who was working as a maid at a wealthy household of a high official. The sources of income in the area varies from sweepers of offices, hospitals, housekeepers of wealthy Islamabad residents to unskilled laboring on a daily wage basis, all of which are low paying job without secure terms of

employment. The family of the said informant subsists on or below the international poverty line with total estimated daily expenditure nearly equal to US$ 1.0/capita[5].

3.3 ORGANIZATION SETUP FOR MANAGEMENT OF LAI NULLAH

The management and/or administration of Lai Nullah is currently undertaken by the following six (6) organizations (1) Federal Flood Commission (FFC), (2) Capital Development Authority (CDA), (3) Small Dam Organization (SDA), (4) Rawalpindi Development Authority (RDA), (5) Tehsil Municipal Authority (TMA) in Rawalpindi and (6) Rawalpindi Cantonment Board (RCB). The functions and role of these organizations are as described hereinafter:

3.3.1 Federal Flood Commission (FFC)

Up to the end of 1976, Provincial Irrigation and Power Departments were responsible for the planning and execution of flood protection works. Upon occurrence of the disastrous flood in the country in the year 1973 and 1976, which caused heavy losses of life and infrastructures, it was recognized that the flood protection facilities were inadequate to provide effective measures for the country. This resulted in the creation of Federal Flood Commission in January 1977 (refer to Fig. 3.3.1). The major responsibilities and duties assigned to FFC are:

(1) Preparation of National Flood Protection Plan (NFPP);

(2) Approval of provincial flood mitigation schemes;

(3) Reviews of plans for restoration and reconstruction works;

(4) Measures for improvements in the flood forecasting and warning system;

(5) Evaluation and monitoring of the progress of implementation of National Flood Protection Plan, and;

(6) Preparation of research program for flood mitigation and other flood management measures.

Since its creation, FFC has coordinated implementation of flood works over Rs. 10 billion under a number of programs (i.e. Normal ADP, FPSP-I, 1988 FDRP, FPSP-II, etc.) financed by Government of Pakistan and various donor agencies.

Regarding Lai Nullah development projects, ECNEC in its meeting held on 30th May, 1984 decided to set up a Technical Committee under the Chairmanship of the Secretary Water and Power, Chairman WAPDA, Chairman CDA, representative of Punjab Irrigation and Power

[5] The family with eight members monthly spends Rp.10,000, which is equivalent to daily expenditure of US$ 0.73/capita. The ownership of the residence that resides in CDA rents the unit at free charge, therefore, it can be regarded as income transfer from the public sector to the poor household with estimated market value of US$ 0.29 /capita/day. The family subsists on or below the international poverty line with total estimated daily expenditure nearly equal to US$ 1.0/capita.

Department and Chief Water, Planning Commission to go into the technical issues raised and come up with an agreed plan on the flood mitigation measures of Lain Nullah. Later on, the Technical Committee held several meetings regarding the issues. In the Technical Committee meeting held on August 20, 1985, a sub committee chaired by CEA/CFFC had been appointed to supervise the feasibility study for the Pacca Canalization of Lai Nullah and furthermore, National Economic Council decides that Federal Flood Commission may act as lead agency for the project.

Keeping in view the above recommendations and the flood passed in July 2001, FFC feels very seriously necessity of strengthening of coordination among the responsible agencies like CDA, RDA, and RCB regarding Lai Nullah management. As a part of institutional strengthening Chairman FFC has decided to constitute a steering committee to supervise the future development and management works of Lai Nullah. After getting the approval from Ministry of Water and Power, Steering Committee has been constituted for the stakeholders of Lai Nullah vide office No. FC-I(5)34-2001-XIX dated October 10, 2001 with the following setup.

Table R 3.3.1 Members of Steering Committee for Development and Management of Lai Nullah

Agencies Concerned/Person in Charge	Role of Steering Committee
CEA/CFFC	Chairman
Chief Engineer (DSC) / Floods	Member / Secretary
Member of Eng. Directorate, GHQ, Rawalpindi	Member
Representative of 10 Corps	Member
Representative from CDA, RDA, TMA & PID	Member

3.3.2 Capital Development Authority (CDA)

Capital Development Authority (CDA) was constituted on 14th June 1960 under CDA act, as a corporate body for the purpose of planning development and construction of the Federal Capital of Pakistan. The Authority shall prepare a master plan and the phased master program for the development of the Capital sites and may prepare a similar plan and program for the rest of the specified areas and all such plans and programs shall be submitted to the Central Government for approval. The authority may, pursuant to the master plan and master program, call upon any local body or agency operating in the specified areas to prepare, in consultation with the Authority, a scheme or schemes in respect of matters ordinarily dealt with by such local body or agency and there upon the local body or agency shall be responsible for the preparation of the scheme or schemes with a reasonable time. Such Schemes may relate to, land use, zoning and land reservation, public buildings, industry, transportation, communications, highways, roads, streets, railways, aerodromes and tele-communications. The organization chart showing the major staffing setup is shown in Fig. 3.3.2.

During July, 2001 exceptionally high rain took place and due to very heavy storm Lai Nullah channel overflowed and inundated in I – 9 Sector of Islamabad along the I.J principle road. After the severe damages took place during July 2001, CDA was forced to realize the importance of operational plan to fight against the expected rainwater storm in future. For this purpose a meeting was held on July 1st, 2002 under the chairmanship of Chairman CDA and operational plan was discussed in detail how to face the expected flood in future. After the meeting a notification was issued for this purpose, vide No. CDA/DS-2(2)/2002/38 Dated July 9, 2002. According to the operational plan Chairman informed in the meeting that un-precedent rain in the last year and above average rain predicted for the coming monsoon in 2002 necessitates the preemptive measures to ensure against damage to life and infrastructures. The meeting also discussed the last year's experience and the actions that could be taken to avoid repetition of the situation. Chairman also designated the Director Sanitation as the focal person / co-coordinator on behalf of CDA for the arrangements to pass the storm water safely from Capital city. It is true that CDA has realized the importance of storm water but according to the office of Director Sanitation that no budget was allocated additionally for this purpose. Director Sanitation has made all the arrangements by his existing staff and from his normal budget.

3.3.3 Small Dam Organization (SDO)

SDO is the subordinate office of the PID, presently responsible for the operation and maintenance of Rawal Dam. After the dissolution of West Pakistan Agricultural Development Corporation in January 1972, SDO was established by the Central Government but finally it was decided to entrust its functions to respective provinces from February 1st, 1973. This office has the vast experience for flood mitigation projects for the rivers and hill torrents and construction of small dams throughout the Punjab Province and especially in Potohar Platuo around Islamabad. About 31 small dams have already been constructed by the organization in Pothohar area during last thirty years and operation and maintenance for all of those constructed dams is also being done by SDO office very successfully. The existing organization setup is as shown in Fig. 3.3.3.

After the exceptionally high flood passed from Lai Nullah during July 2001, Secretary of the PID has been asked by the Army Head Quarter Rawalpindi to give the technical opinion for the management of Lai Nullah to avoid future damages. The secretary has given a briefing at the core commander office at Rawalpindi on 2nd of August 2001. The secretary has explained that PID through its subordinate office located at Islamabad (SDO), has conducted so many studies regarding flood management of Lai Nullah time to time since 1973.

3.3.4 Rawalpindi Development Authority (RDA)

Rawalpindi Development Authority (RDA) was established in 1989 (total area of jurisdiction is 311 km^2), under the Punjab Development of Cities ACT-1976. Its existing organization setup is shown at Fig. 3.3.4. The major responsibilities of RDA are, to plan, guide, control and implement major and long-term development works for the followings,

(1) To control construction of structures in its controlled areas.

(2) To launch housing schemes and other similar projects and to control private housing schemes.

(3) To execute land development and estate management.

(4) To preserve the environment.

(5) To evolve policies and plans including their implementation.

(6) To undertake provision and maintenance of water supply & sewerage services in the city.

(7) To undertake improvement, beautification, operation and maintenance of parks.

(8) To construct major roads and advertisement boards etc.

As a part of institutional strengthening, Water and Sanitation Agency (WASA) was established in 1992 as an agency of RDA to deal with the water supply and sewerage services for the areas under the control of RDA. It became partially operational after taking over the Rawal Lake Filtration Plant from Public Health Engineering Department in 1996 and further became fully operational in 1998 after taking over the charge of water supply and sewerage services from Rawalpindi Municipal Corporation (RMC).

According to the responsibilities mentioned above, it seems that RDA plays a role to deal with surface drainage or flood mitigation projects relates to Lai Nullah in the context of water supply, sewerage, land development and management within the city. A network of sewers covers the central city area bounded by Lai Nullah, Kassi Nullah and Asghar Mall road. Most of the system discharges untreated sewage to Kassi Nullah, which ultimately flows into Lai Nullah. In addition to the above, Lai Nullah is prone to occasional short period of flooding during the summer/rainy season every year and due to the tight sections, Channel overflowed and causes severe inundation during these flood events and damages to peoples living close to the banks of Lai Nullah, particularly those in Kachi Abadies.

3.3.5 TEHSIL Municipal Administration (TMA) in Rawalpindi

Keeping in view the present institutional strengthening, Punjab Government has issued new Act during the year 2001 to devolve the political power and decentralize administrative and

financial authority in a manner of setup of District Tehsil and Union Administration (refer to Fig. 3.3.5). As a result of the above, Gazette Notification issued by the Government of Punjab, Rawalpindi Tehsil Municipal Administration (TMA) was also established. According to the notification it is a corporate body and consist of a Tehsil Nazim, Tehsil Municipal officer, Tehsil officer, Chief officer and other officials of the local council services, as shown in Fig.3.3.6. The Major duties assigned to TMA Rawalpindi under the new act are,

(1) To prepare spatial plans for the Tehsil in collaboration with the union councils, including plans for land use and zoning.

(2) To seek approval of the Tehsil Council to the spatial plans prepared by it after due process of dissemination and public enquiry, incorporating modifications on the basis of such enquiry.

(3) To execute and manage development plans.

(4) To exercise control over land-use, land-subdivision, land development and zoning by public and private sectors for any purpose including agriculture, industry, comers market, shopping and other employment centers, residential, recreation, park entertainment, passenger and other transport freight and transit stations.

(5) To enforce all municipal laws, rules and byelaws governing the function.

(6) To prevent encroachment.

(7) To regulate affixing of signboards and advertisements.

(8) To provide, manage, operate, maintain and improve the municipal infrastructure and services.

(9) To compile information provided by the union and village councils of prioritized projects in the Tehsils.

(10) To prepare budget, long term and annual municipal development programs in Collaboration with the union councils under the direction of Tehsil Nazim.

(11) To maintain with the assistance of District Governments, Union and village Councils, a comprehensive data base and information system for Tehsil Municipal Administration and provide public assess to it on nominal charges.

(12) To propose and notify taxes, user fee, rates, rents, tolls, charges, levies, fines, and penalties after approval of Tehsil Council.

(13) To collect approved taxes, user fee, rates rents, tolls, charges, fines and penalties.

(14) To organize sports cultural and recreational events, fair and shows.

(15) To coordinate and support municipal functions amongst unions and villages.

3.3.6 Rawalpindi Cantonment Board (RCB)

Rawalpindi city had the population about 1.4 million in 1998 of which approximately 45% reside in the Cantonment areas under the Jurisdiction of Military Engineering Services (MES) and Rawalpindi Cantonment Board (RCB), while the remaining 55% live in the jurisdiction of RDA. Organization set up shown in Fig. 3.3.7. The major charter of duties for Cantonment Board is explained as,

(1) Municipal Administration

(2) Provision of Civic Amenities i.e., water supply, sanitation, roads/streets/lanes, street lights and surface drainage

(3) Fire Fighting

(4) Taxation

(5) Building Control

(6) Land Management

(7) Horticulture

(8) Primary Education

(9) Acquiring and maintaining Cantonment Property

(10) Registration of Births and Deaths

(11) Maintaining Public Markets / Slaughter Houses/Public toilets

(12) Regulating trade and professions

(13) Enforcing pure food act

(14) Enforcing Muslim Family Laws

By the discussion and interview with the cantonment board staff, it has been observed that cantonment board does not have any kind of precautionary measures arrangement against the floodwater flowing through Lai Nullah in the jurisdiction of Rawalpindi Cantonment Board. In addition to that it has also been pointed out that there is no proposed project available at the moment and never any kind of funds have been allocated and spent for the purpose of flood mitigation measures in Lai Nullah, because the Lai Nullah channel passing within the jurisdiction of cantonment board is almost safe and there were very few complaints about the inundation of the areas and no serious damages have been recorded during flood season. After 2001 exceptionally high flood Board has been forced to think about the flood mitigation measures in future.