

**Appendix H**  
**Environmental Assessment**

**FEASIBILITY STUDY  
ON  
THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT  
IN  
ISLAMIC REPUBLIC OF PAKISTAN**

**FINAL REPORT  
VOLUME III  
SUPPORTING REPORT**

**Appendix H : Environmental Assessment**

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## APPENDIX H ENVIRONMENTAL ASSESSMENT

### H1 Introduction

#### H1.1 Purpose of Report

This report comprises part of the "Feasibility Study on the Development of Munda Dam Multipurpose Project". This report has been prepared at the end of the feasibility study stage and presents the results of the environmental assessment of the Project.

#### H1.2 The Feasibility Study

The Munda Dam Multipurpose Project is situated in the NWFP, and covers the area 5 km right above the existing Munda Headworks. It includes the surrounding area of the Swat River basin where the dam will be constructed as is shown in the Location Map of the Project Area. The main objective of the Study is to formulate an optimum development program of the Munda Dam Project in considering the comprehensive effective water usage including hydropower, flood control, and irrigation. The Feasibility Study is prepared also for the consideration of the international lending agencies in implementing the Project. Only a brief description is given here. For a more detailed account see the Main Report.

#### H1.3 Initial Environmental Examination (IEE)

##### H1.3.1 Introduction

Based on the Pakistan Environmental Assessment procedures, dams and reservoirs with a maximum storage volume greater than 50 million m<sup>3</sup> or a surface area greater than 8 km<sup>2</sup> require an EIA. An IEE was carried out based on JICA Environmental Guidelines for Dam Construction Projects, JICA Environmental Guidelines for Infrastructure Projects (Water Supply), and the World Bank's New Policy on the Environmental Aspects of Dam and Reservoir Projects. The preparation of an IEE is generally an iterative assessment process that begins at the outset of the project.

Based upon JICA Environmental Guidelines for Dam Construction, evaluation of soil, water, air, and ecosystem (wildlife), in particular the following survey items were examined in the field, for the actual field condition in the Project Area.

Present status and impacts on riverine fisheries in the Swat River basin, (the aquatic environmental changes and fishing rights) were studied.

Present status of irrigation area and land use condition and status of allocation of water between landholders.

Distribution status of historical and cultural assets in and around the dam site and reservoir were thoroughly studied.

Present status of precious ecosystem or endangered species in and around the dam site and reservoir (impacts on ecosystem of wild-lands, species or plant communities of special ecological significance) were examined.

Impact on local communities upstream and downstream of the dam and reservoir area caused by the dam project (impact on construction traffic, workers, stockyards and waste disposal and water discharge from the dam) was analyzed.

In addition to these field surveys, population and property survey has been carried out at and around the dam and reservoir areas for EIA.

### H1.3.2 Description of the Project

See Main Report

### H1.3.3 Description of the Environmental Issues

Previously an Environmental Study was carried out during the pre-feasibility and an IBE had been carried out by JICA Experts during the visit of scope-of-work mission in 1996 for the Munda Dam Multipurpose Project. Both of these had found the project to be environmentally viable. After reviewing these, and the field survey, the following have been identified as the area for serious consideration:

- i) The impact on the fishery will be investigated in detail, the JICA IBE recommends the study of fishery for the entire reservoir area from Amandara Headwork to the Munda Headwork on the Swat River and downstream until it joins the Kabul River downstream. This aspect has been analyzed fully as part of the Environment Survey. The analysis will go beyond the issues related to the fish taxonomy and will study the prevailing inter-dependent relationship between aquatic biodiversity and the fish caught for economic reasons. The migratory routes of fish have been in the scope of this study.
- ii) The change in the flow regime of the river has been an important issue to study. The JICA IBE has recommended a study of the water discharge pattern, as another component of the Environment Survey.
- iii) During the first field survey, in the dam area many historical graves of pre-Islamic, and Islamic period appeared to be within the proposed construction area of the dam site. A professional appraisal of these has been undertaken as part of the Survey. Most likely salvage excavations would be carried out after mapping all the sites on both the banks of the river.

It was observed and reported that due to the traffic to and from the dam and reservoir site because of the team activity, the tribal people around the area have

started demarcating land plots as a preemptive activity to get prepared for the upcoming issue of compensation to those settled in the area. This has been carried out by WAPDA, and an analysis is being carried out.

#### H1.3.4 Screening of Potential Environmental Impacts and Mitigation Measures

Using JICA guidelines, and the checklist of parameters for dams and reservoirs a screening out of the Munda Dam Multipurpose project is presented below.

Checklist of Environmental Parameters

Environmental Impacts of Munda Dam Project	Damages Likely to Environment	Abatements Recommended	Initial Environmental Examination (IEE)
<b>A. Project Location</b>			
1. Resettlement	1. Serious inequities	1. Resettlement program (WAPDA performed Compensation Survey)	1. Very small effect, no settled population
2. Precious Ecology	2. Ecological loss	2. Careful planning & offsetting measures	2. No significant effect
3. Historical / Cultural	3. Loss of cultural heritage	3. Salvage excavation & relocation of shrine	3. Major effect
4. Erosion / Silt	4. Shortened reservoir life	4. Upper Swat river watershed management	4. Small effect
5. Navigation	5. Economic loss	5. Careful planning	5. No effect
6. Groundwater levels	6. Economic loss	6. Careful mitigation	6. Small effect
7. Fish Migration	7. Decrease in catch	7. Furnish fish traps.	7. Major effect
8. Mineral Resources	8. Loss of value	8. Mine before inundation of reservoir	8. No significant effect
9. Inundation Losses	9. Some recent bridges	9. Careful dismantling	9. Small effect
<b>B. Design Problems</b>			
1. Road Erosion	1. Impaired water quality	1. Careful planning	1. No significant effect
2. Reservoir Site Preparation	2. Nutrients & water quality affects fishery	2. Prepare site to suit optimal uses	2. No significant effect
3. Water rights Conflicts	3. Serious social conflicts	3. Careful management of water rights allocated	3. No significant effect
4. Fish Screens	4. Loss of fish stock	4. Study fish migration	4. Major effect
<b>C. Construction Stage</b>			
1. Soil Erosion	1. Impaired water quality	1. Proper construction planning & monitoring	1. No significant effect
2. Safety of Workers	2. Hazards to safety	2. - do -	2. No significant effect
3. Sanitation	3. Hazard to health	3. - do -	3. No significant effect
4. Dust/ Noise / Odors	4. Hazard to workers	4. - do -	4. Small effect
5. Quarrying Hazards	5. Blasting & hauling from long distance	5. - do -	5. No significant effect at the site.
6. Environmental Aesthetics	6. Loss of scenic value temporarily	6. - do -	6. Small effect
7. Construction Monitoring	7. Without it contractor not likely to observe constraints	7. Appropriate construction monitoring	7. No significant effect



Environmental Impacts of Munda Dam Project	Damages Likely to Environment	Abatements Recommended	Initial Environmental Examination (IEE)
<b>D. Project Operations</b> 1. Downstream Flow Variations 2. Depreciation of Downstream Fisheries 3. Downstream Erosion 4. Lack of Reservoir Management 5. Eutrophication (aquatic weeds) 6. Downstream Water Quality 7. Insect vector disease hazard 8. Fisheries impacts in Kabul river 9. Reservoir Bank Stability 10. Operation Monitoring	1. Disturbance to fisheries downstream 2. Loss of fisheries 3. Erosion of banks & river bottom 4. Social conflicts around reservoir 5. Heavy evaporation, fishing loss & power generation 6. Lower water quality due to flow restrictions 7. Community health hazard 8. Loss in fisheries 9. Impairment of uses & water quality 10. Without it, no compliance.	1. Minimum adverse effects 2. Offset by promotion of aquaculture 3. Careful design to control & monitoring 4. Appropriate reservoir management 5. Temporary phenomenon 6. Careful operation planning 7. Control measures & monitoring 8. Operations to offset & minimize 9. Careful planning / design 10. Appropriate monitoring	1. Major effect 2. Major effect 3. Small effect 4. No significant effect 5. Small effect 6. No significant effect 7. No significant effect 8. Moderate effect 9. No significant effect 10. No significant effect
<b>E. Environmental Enhancement Actions</b> 1. Reservoir Fishery 2. Drawdown Agriculture 3. Downstream Water Supply 4. Downstream Aquaculture 5. Forestry /Wildlife 6. Recreation	1. Huge fishery potential 2. Command area extra agriculture benefits 3. Improvement of living standards 4. - do - 5. Conservation of forests / wildlife 6. Quality of life	1. Appropriate plan 2. Management plan 3. Planning for optimal use of stored water 4. -do- 5. Use of project for reserves to offset losses 6. Uses of reservoir	1. Major benefit 2. Minor benefit 3. Major benefit 4. Small benefit 5. Small benefit 6. Major benefit
<b>F. Other Consideration</b> 1. Multipurpose Management Need 2. Rural Electrification 3. Transmission Lines i) Encroachment on area ecology ii) Impairment of wildlife passage iii) Environmental aesthetics	1. Optimize overall project benefits 2. Benefits to poor 3. 220 kV lines to Charsadda 500/220 kV i) Peshawar (Shahibagh)-Mardan ii) Loss of resources, wildlife & scenic beauty	1. Multipurpose reservoir management. 2. Plan to accommodate 3. Careful planning / design / monitoring to minimize and offset problem.	1. Moderate benefit 2. Small benefit 3. Moderate effect
<b>G. Critical Review</b> 1. Permanent Loss of Natural Resources 2. Endangering of Species		1&2. Planning should be consistent with NWFP & national environmental conservation strategy	

### H1.3.5 Conclusions

The following are the key conclusions for the IEE.

Summary of Conclusions of the IEE

Impact Areas / Problems	Further Study
<b>Serious</b> 1. Impact on the fish migration and fishery 2. Change in flow regime 3. Relocation of cultural heritage sites	1. Study on the fishery migration between Amandara and Munda Headworks. 2. Study the water discharge pattern 3. Prepare a plan of salvage excavation
<b>Mild</b> 1. Change in the population distribution 2. Change in life-style 3. Impact on agriculture and forestry 4. Additional use of agri-chemicals 5. Increased garbage and effluents 6. Deterioration during construction 7. Draining area accretion  8. Impact on downstream flow variations 9. Detrimental changes in water temp. 10. Water quality deterioration 11. Change in sediment composition 12. Water rights, fishing rights, and rights relating to common use of trees	1. Study the irrigation plans in the area. 2. Study socioeconomic conditions. 3. Study cropping patterns and plans 4. Study command area farming plans. 5. Study overall development in the area. 6. Study sanitation conditions in the area. 7. Study influence of bed-load transport earth-flow into Panjkora river. 8. Prediction of discharge pattern  9. Impact prediction 10. Study transport earth-flow in Panjkora. 11. Same as above. 12. Study the vested rights and customs

### H1.4 Pakistan Environmental Protection Legislations

According to the GOP guidelines, a comprehensive EIA is required for all dams, reservoirs, and hydroelectric power projects with a maximum storage volume greater than 50 million m<sup>3</sup> or surface area greater than 8 km<sup>2</sup>, and hydro projects above 50 MW of installed capacity. This EIA has been planned and carried out following the detailed 1997 GOP, 'Guidelines for the Preparation and Review of Environmental Reports' and 'Policy and Procedures for Filing Review and Approval of Environmental Assessments'. In addition, donor agency guidelines, e.g. World Bank, ADB, and OECF (JBIC) have also been followed to supplement the GOP requirements.

The EIA has to comply with the, "Pakistan Environmental Protection Act, 1997" requirements, where the EIA has to be submitted by the executing agency to the Provincial Environmental Protection Agency in NWFP. For resettlement and compensation issues, most hydro projects, since Ghazi Barotha Hydropower Project, have followed the ADB and World Bank requirements rigorously.

**Major Pakistan Environmental Legislation Relevant to the Project**

<b>Sector</b>	<b>Legislation</b>
Environmental protection	The Pakistan Penal Code (1860) Pakistan Environmental Protection Act, No. XXVII of 1997
Land use	The Land Improvement Loans Act (1883) The West Pakistan Agricultural Pests Ordinance (1959) and Rules (1960) The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s) (1979/80) The NWFP Salinity Control and Reclamation Act (1988)
Water quality and resources	The Pakistan Penal Code (1860) The Canal and Drainage Act (1873) The Factories Act (1934) West Pakistan (?) Act (1958) The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s) (1979/80) On-Farm Water Management and Water Users' Associations Ordinance (1981) Indus River Water Apportionment Accord (1991) Statutory Notification S.R.R. 742 (1993)
Air quality	The Pakistan Penal Code (1860) The Factories Act (1934) The Motor Vehicles Ordinance (1965) and Rules (1969) The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s) (1979/80) Statutory Notification S.R.R. 742 (1993) Statutory Notification S.R.R. 1023 (1995)
Noise	The West Pakistan Regulation and Control of Loudspeakers and Sound Amplifiers Ordinance (1965) The Motor Vehicle Ordinance (1965) and Rules (1969)
Toxic or Hazardous Substances	The Pakistan Penal Code (1860) The Explosives Act (1884) The Factories Act (1934) The Agricultural Pesticides Ordinance (1971) and Rules (1973)
Solid wastes and effluents	The Factories Act (1934) The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s) (1979/80) Pakistan Environmental Protection Act, No. XXVII of 1997
Marine and fisheries	The West Pakistan Fisheries Ordinance (1961) The NWFP Fisheries Rules (1976)
Forest conservation	The Forests Act (1927) The NWFP Hazara Forest Act (1936) The West Pakistan Firewood and Charcoal (Restrictions) Act 1964 The Cutting of Trees (Prohibition) Act (1975) The NWFP Management of Protected Forests Rules (1975) The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s) (1979/80) The NWFP (Conservation and Exploitation of Certain Forests in Hazara Division) Ordinance (1980) The NWFP Forest Development Corporation Ordinance (1980)
Parks and wildlife conservation protection	The West Pakistan Ordinance (1959) The Kohat Marzri Control Act (1954) The NWFP Wildlife (Protection Preservation Conservation and Management) Act (1975) and Rules (1976) The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s) (1979/80) Export and Control Order (1982)
Cultural environment	The Antiquities Act (1975)

Sector	Legislation
Livestock	West Pakistan Goats (Restriction) Ordinance (1959) The Grazing of Cattle in the Protected Forests (Range Lands) Rules (1978) Pakistan Animal Quarantine (Import and Export of Animals and Animal Products) Ordinance (1979/80) The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s) (1979/80)
Public health and safety	The Pakistan Penal Code (1860) The Boilers Act (1923) The Public Health (Emergency Provisions) Ordinance (1944) The West Pakistan Factories Canteen Rules (1959) The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s) (1979/80) The West Pakistan Epidemic diseases Act (1979/80)

Principal source: Table 5.8, The Pakistan National Conservation Strategy

## H2 Project Description

### H2.1 Project Location

The Munda Dam Multipurpose Project is located on the Swat River at a distance of about 5 km upstream of the existing Munda Headworks. The reservoir area of the Munda Dam extends upstream at the border of Malakand and Bajaur agencies. The length of the reservoir is approximately 56 km in an extended 'boomerang' shape, in the Swat River's rocky gorge. The dam, and reservoir are located in Mohmand Agency, Federally Administered Tribal Area (FATA), NWFP.

The command area and downstream riparian area is located in Malakand and Mohmand Agencies and Tangi Tehsil, Charsadda District. The left bank irrigation canal will pass through rocky areas beyond Abazai town in Mohmand Agency (FATA) and Malakand Agency, Provincially Administered Tribal Area (PATA), and Tangi Tehsil, Charsadda District area which has been vacated in portions by the Afghan refugees near the towns of Shabqadar and Yakaghund. The right bank canal will pass entirely through Mohmand Agency.

The Project is located in Pakistani province of NWFP, which was created as an administrative entity of colonial India in 1901. In terms of size, NWFP is the smallest province among the four provinces of Pakistan. It is comprised of administrative units starting from divisions (7 in number), districts (22 in number), and the Provincially Administered Tribal Areas (PATA). The area of NWFP is approximately 100,200 km<sup>2</sup>, of which 74,500 km<sup>2</sup> is under the provincial government administration. The remaining land area consists of FATA and Frontier Region, under the political control of the Federal Government.

The province is diverse, comprising high mountains, including some more than 5,000 m high peaks in the north, (the highest peak is 7,170 m Trich Mir) and the lower elevation plains in the south. It covers richly diverse ecological systems including snowy forest covered mountains, arid range-lands, the barren hills of the tribal areas including Mohmand and Bajaur agencies and the fertile Peshawar

valley. Brief descriptions of the Swat River, Mohmand and Bajaur agencies and the Malakand protected area is provided below.

### H2.1.1 The Swat River

The Swat River originates at an elevation of 4,850 m rising high amidst the western Karakorum and Himalaya mountains, it moves to the west of the Indus River near Kalam. It is joined in the northern Swat by the Usho, and the Gabral rivers, then flowing southwards it passes through an elevation of 4,000 - 5,500 m to the west. At this location, the condition of water in the river is clean, and cold. The Swat River near its source is pristine with no pollution. In the upper Swat River where the water is colder, brown trout is found. The rainbow trout has also been introduced which can be purchased in Madyan, Bahrain, and Kalam.

There are 16 types of fishes, found in the Swat River in the study area. The Mahseer, Swati fish (schizothorax), and Sher mahee are locally famous for their taste and are flagship species in this portion of the Swat River. The vegetation in the dam and reservoir area can be briefly described as dry subtropical broad-based forests, comprised mainly of kau (*Olea cuspidata*), phulai (*Acacia modesta*) and the scrub. Detailed description of the biodiversity is given in proceeding sections.

There is only sparse and sometimes seasonal settlement of population, approximately 350 people, in the entire reservoir area. During April to November there is intensive grazing in the reservoir area of cows (1,185) and goats (4,855), belonging to the area's farmers / shepherds.

Almost a century ago, in 1905, "The Imperial Gazetteer of India, Provincial Series, on North West Frontier Province" had the following information on the Swat River, "it is formed by the junction at Kalam in Swat Kohistan of the Gabral and the Ushu. The former rises on the East of the Badugai pass, and the latter comes down from the higher hills of Bashkar to the north. From Kalam the Swat River flows almost due south for about 68 miles (109 km), but at Manglaur turns abruptly to the South-West and West for 24 miles (39 km) until it is joined by the Panjkora. The united waters then sweep in a great curve south-westwards to Abazai in Peshawar District, where they emerge to the north of the Mohmand hills into the Peshawar valley. Here the river spreads south-east in several streams over the plain, joining the Kabul River at Nisatta after a total course of about 400 miles (640 km)." And the following information has been provided for the perennial Swat River Canal, "taking off from the Right Bank of the Swat River at Abazai and irrigating 155,000 acres (62,728 ha). The main canal was opened in 1885, and the trans-Kalpani distributary in 1899."

Its extensive irrigation system provides water for agriculture in Mardan and Peshawar Districts. Downstream of Munda Headworks, the Swat River gets divided into Abazai and Khiali Rivers, these branches join into Kabul River near the town of Charsadda.

## H2.1.2 Mohmand and Bajaur Agency and Malakand Protected Area

The proposed location of the Munda Dam is in the Mohmand Agency, which takes its name from the Mohmand tribe that inhabits this area. The Agency was established in 1951 and is bounded by Bajaur and Kurram Agencies on the north and northeast; by Khyber Agency on the south and southwest; by Peshawar District on the southeast; and by Afghanistan on the west and northwest. The total area is 2,296 km<sup>2</sup> and is largely an area of rugged mountains with barren slopes. The general slope of the area is northwest to southeast, with an average elevation of 1,450 m. The main objectives of the project are power generation, flood control, and the provision of irrigation water to the command areas.

All of the 24 km<sup>2</sup> inundated area of reservoir falls in the Mohmand Agency. The Left Bank Command Area falls in Mohmand Agency and Malakand Protected Area, and Tangi Tehsil in Charsadda District. The Right Bank command area falls entirely in Mohmand Agency. The command areas will benefit directly from the canals that will be constructed as part of the project.

Mohmand Agency comprises of mostly rugged hills and river basins. Two rivers, the Kabul and the Swat and some of their tributaries flow through Mohmand Agency. The annual rainfall in the area averages 400 mm. The climate is hot and dry in summer and cold and dry in winter.

The Mohmand Agency, where the Munda dam and reservoir, and left and right bank command areas are located, has its headquarter in Ghallanay. It also includes the towns Halimzai, Pindiali, Safi, Upper Mohmand, Utman Khel, and Yakaghund. The Swat River passes through the eastern part of Mohmand Agency and flows from north to south. The main tributaries of the Swat River in Mohmand Agency are the Karzine Khawar and Ambahar rivers. The Mohmand Agency's population in 1998 was 270,000. The table below provides Mohmand Agency land utilization and tenure information for 1994 and 95.

**Mohmand Agency Land Utilization & Tenure in, 1994-95**

<b>Type of Land</b>	<b>Area in Hectares</b>
Cultivated Area Total	229,620
Net Area Sown	139,39
Current Fallow Area	9,729
Cropped Area Total	4,210
Area Sown Reported Area Total	16,308
More than Once	6,579
Un-cultivated Area	215,681
Culturable Waste	15,433
Forest Area	3,015
Not Available for Cultivation	197,233
<hr/>	
<b>Private Farms</b>	<b>Farms in Hectares</b>
Owner Farms	8,587
Owner-Cum-Tenant	1,500
Tenant	603
<b>Total</b>	<b>10,690</b>

The left bank of the reservoir is located in the Bajaur Agency, and its headquarter is Khar, and includes the towns of (Tehsils) Barang, Charmung, Mohmand, Salarzai, Utmanzai, Nawa Gai. The population of the Bajaur Agency in 1998 was 476,339.

The present Malakand Agency has an area of 692 km<sup>2</sup> and boundaries with Dir and Swat districts in the North, Bajaur Agency in the West. In the south it has boundaries Mohmand Agency, Charsadda, and Mardan District and in the East Malakand has a mountainous terrain interspersed with narrow valleys. The Swat River flows through Malakand Agency and its waters have been diverted at Amandara weir into a canal system, at the Upper Swat Canal (USC) through Benton Tunnel under the Malakand Pass, commanding Peshawar District villages. Furthermore, the water diverted is utilized for power generation at Jabban and Dargai. Malakand is approximately 825 m above sea level, and Dargai, Sakhakot, Batkhela, and Thana are important towns.

Administratively it is part of Provincially Administered Tribal Agency (PATA). Malakand has a unique position it is not a full-fledged District or an Agency. There are anomalies, which consider Malakand a settled district as it has representatives in the National and Provincial Assemblies and it has a full functioning District Council.

The land use data of Malakand Protected Agency for the left command area is given in the table below.

**Malakand Agency Land Utilization, 1994-95**

<b>Land Use</b>	<b>Area in Hectares</b>
Reported Area	21,114
Total Cultivated Area	18,502
Net Sown	14,695
Fallow	3,776
Cropped Area	23,704
Area Sown Twice /Year	8,978
Uncultivated Area	2,612
Culturable Waste	420
Forests	1,875
Not Available Data	317

**H2.2 Description of the Structural Components of the Dam**

**Planned Constructions in the Project Area**

<b>Structure /Activity</b>	<b>Area / Volume</b>
Dam	Height: 213 m
Reservoir	Inundated surface area 24 km <sup>2</sup>
Powerhouse	7,000 m <sup>2</sup>
Switchyard	9,800 m <sup>2</sup>
Re-regulation Weir	3.5 km d/s of the dam
Excavated Earth/Dirt	1 km <sup>2</sup> x 10 m high

Only brief data of area/volume of structural components is given here. For a more detailed account see Main Report.

**H2.3 Description of the Structural Components of the Irrigation System**

The main components of the irrigation system comprise the feeder systems and the main canals.

The main canals will be branched off to distribution points at the required locations.

Irrigation will be a big benefit of this Project as the rainfall in the Project Area is undependable and erratic. The irrigation system will have distribution canals aggregating a total length of 48 km approximately, which will be concrete lined. A total of 25 off-takes, 126 aqueducts, 70 super passages and 62 culverts under the canals will form part of the proposed irrigation system. The agricultural benefits accrued have been estimated to include the following after the implementation of the Project.



### Agricultural Products

Agricultural Produce	Metric Tons	% of Total
Tobacco	2,000	6
Wheat	13,000	35
Sugar-beet	30,000	-
Sugarcane	239,000	35
Corn/Maize	10,000	29
Fruits	9,000	5
Vegetables	-	4

Only brief information is given here. For a more detailed account see the Main Report.

### H3 Assessment of Baseline Conditions

The baseline environment has three components, the physical, biological, and human environments. While the environment is categorized, it is subject to interactions and relationships that exist between them. For example, climate is determined by a range of physical factors, it in turn, will influence the biological and human environments.

The Project area is mainly scrub hills which apart from Pindiali, Yakkaghund etc., has fragmented the population to numerous small scattered villages which are described in WAPDA's Compensation Survey and Resettlement Action Plan. The majority of the population is engaged in cattle grazing and agriculture, and the overall socioeconomic status of the population is very low with high rates of illiteracy and underemployment.

#### H3.1 Physical Environment

##### H3.1.1 Topography

The topography of the Mohmand Agency area is situated between latitudes 33°30' and 30°40' north, and longitudes 70°30' east. It covers an area of 2,206 km<sup>2</sup> and is bordered by Bajaur Agency on the north, by Peshawar division and Malakand Protected Areas on the east, by Khyber Agency on the South and Afghanistan on the West.

The Project area is in the Swat River gorge surrounded by rugged hills. In general, very little vegetation grows in the area, except coarse grass scrubwood and dwarf palm. Physiographically the area can be divided into hills, and the Swat River basin. The hills are situated in the transitional zone between the Hindukush mountains and the lowland basins. The area hills include the Sappar Ranges, the Illazai Hills, and the Malakand Hills.

The Sappar Ranges are the extension of the Dir-Bajaur Ranges which stretch to the north of the Project area. The Illazai hills branch off the Sappar to the

southwest of the area. The Malakand hills occupy the eastern side of the area. And have a thin cover of wild olive and oak trees.

**The Swat River Basin:** The Swat River originates at an elevation of 4,850 m rising high amidst the western Karakorum and Himalaya mountains, it moves to the west of the Indus River near Kalam. It is joined in the northern Swat by the Usho, and the Gabral rivers, then flowing southwards it passes through an elevation of 4,000 - 5,500 m to the west. The Swat River enters the Mohmand Agency from the northeast. It first flows southwards and then turn eastwards, and finally breaks into the plains to the west of the Charsadda Tehsil. The Swat River on its way is joined by the Danish Kol River and its tributary the Ambahar River, and the Pindiali River. The Swat River flows in a deep gorge here, and not much cultivable land is found along its banks. At various places along the river banks are pierced by deep ravines, and at the confluence of some of these, there are patches of alluvial fans which are sometimes cultivated by the local people.

Downstream of the proposed dam, its extensive irrigation system provides water for agriculture in Mardan and Peshawar Districts. Downstream of Munda Headworks, the Swat River gets divided into Abazai and Khiali Rivers, these branches join into Kabul River near the town of Charsadda. The Swat River in the south has become mostly degraded, due to agriculture run off and animal grazing activities. The ecological conditions of the surrounding area are also degraded due to excessive grazing and timber cutting.

### **H3.1.2 Climate**

The climate of the Project area is hot and dry in the summer and cold and dry in the winter. The summer starts in April and continues until October. June, July and August are the hottest months. The mean maximum and minimum temperatures for the summer are 34°C and 23°C, respectively. The winter season lasts from November to March with December, January and February being the coldest months. The mean maximum and minimum temperatures for the winter are 13°C and 2°C, respectively. The rainfall is small and mostly occurs during the winter months.

Detail data on temperatures and rainfall are given in the Main Report. Additional information on land forms and soils, regional geology, seismicity, drainage system, hydrology, erosion and sedimentation are also provided in detail in the Main Report.

## **H3.2 Biological Environment**

### **H3.2.1 Terrestrial Flora and Fauna**

The Project area is located in the southern part of the Swat valley, where the Swat River passes through a narrow gorge. The Project area has 150 species of scrub vegetation. The scrub vegetation suited for grazing cows and goats, which due to

overgrazing has now become severely degraded. In the reservoir area, more than 6,000 goats, and 4,000 cows are present which are owned by the local people for grazing in the rocky and craggy scrub vegetation terrain. The ecological conditions are being deteriorated due to overgrazing, deforestation, and hunting.

Information on the Project area's vegetation was collected through random sampling in 110 m<sup>2</sup> quadrant's laid out in the dam, reservoir, and the command area of the proposed canals and along the reaches of the Swat River downstream of the dam. A total of 15 vegetation communities by habitat types were found in the Project area. The floristic composition of all the habitat types were investigated at the Munda Dam site, reservoir area and command area. The dam and reservoir area mainly possesses scrub vegetation type with some trees and wild palms. Most plant species found were common to areas impacted by heavy grazing and tree-felling.

In the flora of the project area, there are 24 species of *Pteridaceae*, 21 species in *Liliaceae*, 22 species of *Cyperaceae* family, 52 species of *Graminae* family, 19 species of *Papilionatae* family, 12 species of *Labiatae* family, while *Compositae* family has 36 species. *Graminae* family has the maximum species, which is followed by *Compositae* family. Only four threatened species were noted in the Project area.

Natural plant communities include *Acacia nilotica*, *Dodonaea viscosa*, *Rhazya stricta*, *Zizyphus nummularia*, *Adhatoda vasica*, *Chrysopogon*, *Aerua pseudotomentosa*, and *Themeda anathera* as important plant communities. The project area has no endangered species as far as flora is concerned.

The Project area's fauna includes 17 reptiles, 2 amphibians, 36 mammals, and 119 birds. Avian family Accipitridae had 13 species followed by Turdidae with 11 species. Amongst the Mammalia, family Muridae has 9 species. Detailed information is provided in the Attachment 3.

During the wildlife survey interviews, it was found out that some species like Urial and Kabuli Markhor were present in the Project area in the past but now they are locally extinct. No rare or threatened animals were seen during field surveys. According to the locals, very few animal species are found in the area, since over the years, they have suffered from habitat degradation and uncontrolled hunting.

### H3.2.2 Fishery & Aquatic Biodiversity

There are sixteen species of fish in the Project area. The Mahseer (*Tor putitora*), Swati (*Schizothrax plagiostomus*), and Sher Mahi (*Clupisoma naziri*) are the area's most important fish. Eleven different macro-invertebrate species are found in the Study area. At present, there appears to be a healthy ecological balance between fish populations, and their predators and parasites.

The following fish were caught during the environment survey from the Study area, detailed information on fish and macro invertebrates is provided in the Attachment 1.

**Fish Collected for the Field Survey of Swat River at Munda Dam & Reservoir**

Classification	Scientific Name	Local Name	English Name
Family: Cyprinidae Sub Family: Rasborinae	1. <i>Baralius vagra</i> 2. <i>Baralius bendelisis</i>	Chilwa Patha Chilwa	Carp Carp
Sub Family: Barbinae	3. <i>Labeo dero.</i> 4. <i>Labeo dyocheilus pakistanicus</i> 5. <i>Tor putitora</i> 6. <i>Puntius ticto</i> 7. <i>Puntius Sophore</i>	Pehari Rohu Torki Mahseer Ticto popra Sophore popra	Carp Carp Carp Carp Carp
Sub Family: Garrinae	8. <i>Gara gotyla</i>	Pather chat	Carp
Sub Family: Schizothoracinae	9. <i>Schizothorax plagiostomus</i> 10. <i>Ptychobarbus conirostris</i> 11. <i>Racomia labiata</i> 12. <i>Schizopyge esocinus</i>	Swati Ladakhi snow carp Chun mahi Asala mahi	Snow trout Ladakhi snow carp Snow trout Snow trout
Sub Family: Cyprininae	13. <i>Carassius auratus</i>	Goldfish	Goldfish
Family: Sisoridae	14. <i>Glyptothorax cavia</i>	Sulemani, Kan Kapr (Pushto)	Cat fish
Family: Schilbeidae	15. <i>Clupisoma naziri</i>	Sher mahi	Cat fish
Family: Chandidae	16. <i>Channa punctata</i>	Daula	Snake-headed fish

### H3.3 Socioeconomic Environment

#### H3.3.1 Reservoir Area

The Dam area has small villages and hamlets on both side of the Swat River. The dam, power house, and re-regulation weir will be constructed here. The reservoir is more than 56 km long extending south to north in the steep gorge of Swat River. The table below provides the information on population and property collected by the WAPDA Compensation Survey Team.

**Population & Property in the Munda Dam Axis & Reservoir as of June 1999**  
(Village Survey Conducted by WAPDA)

Name of the Village	Approximate Location	Number of Houses/Hutments	Number of Families/Persons	Total Population	Land Area Possessed in 'Marla'
Bara Adeera		3	3	3	23
Chak Mundi		6	8	8	9
Todobo Banda	3 km. U/S from Dam Axis, R/B of the river	8	21	21	68
Jorogh Banda	5 km. U/S from Dam Axis, R/B of the river	12	12	12	15
Munda Dam Axis	Huts on the dam site L/B of the river	11	11	11	38
Changal (Sandak Patti)		3	5	5	5
Palosai Banda	5 km. U/S from Dam Axis, R/B of the river	29	29	29	35
Bara Palosai Banda	5 km. U/S from Dam Axis, R/B of the river	6	6	6	8
Bara Gurkai Banda		9	6	6	10
Ziari Godar	4.5km. U/S from Dam Axis, R/B of the river	1	1	1	3
Gurkai Banda	7 km. U/S from Dam Axis, R/B of the river	6	9	9	12
Shamat Khan Banda	12km. U/S from Dam Axis, R/B of the river	2	2	2	6
Narai Banda	11km. U/S from Dam Axis, R/B of the river	2	1	1	4
Durood Banda	15km. U/S from Dam Axis, R/B of the river	1	1	1	4
Khajurai Khula	L/B of the river	3	3	3	5
<b>Grand Total</b>		<b>102</b>	<b>118</b>	<b>118</b>	<b>245</b>

Note: 1 Marla = 25 Yards<sup>2</sup>

And, the tables below provide information about the land area requirements during the construction of the Munda Dam.

**Required Land Area for Construction of Permanent Facilities**

Facilities	Area (m <sup>2</sup> )	Remarks
Access Road		
Right Bank; Length: 6 km, Width: 10 m	60,000	Permanent
Left Bank; Length: 5 km, Width: 10 m	60,000	Permanent
WAPDA Staff Colony	150,000	Permanent
<b>Total</b>	<b>270,000</b>	<b>Permanent</b>

**Required Land Area for Construction of Temporary Facilities**

Facilities	Area (m <sup>2</sup> )	Remarks
Contractor – Civil Works	120,000	Temporary
Contractor – Metal Works	20,000	Temporary
Contractor – Hydro-mechanical Works	15,000	Temporary
Contractor – Hydro-electrical Works	15,000	Temporary
<b>Total</b>	<b>170,000</b>	<b>Temporary</b>

**H3.3.2 Command Area**

**(1) General Socioeconomic Data**

The population by Tehsil in 1981 Census was reported as follows:

**Population by Tehsil (1981 Census)**

Halimzai	26,783
Pandiali	23,671
Safi	35,708
Upper Mohmand	48,757
Pranghar	16,613
Yakaghund	12,401
Ambar	N.A.

**Working Members in a Typical Family in the Command Area**

	Men %	Women %	Total
Full Time	88	12	100
Part Time	75	25	100
<b>Total</b>	<b>83</b>	<b>17</b>	<b>100</b>

Source: Field Survey

**Work Done by Women on Family Farm in the Command Area**

Full Time	44
Part Time	55

Source: Field Survey

**(a) Agricultural Credit**

In the Command area, the Agricultural Development Bank of Pakistan (ADBP) maintains a branch office at Ghalanai, Mohmand Agency for providing credit to farmers. The branch was set up in 1989. All farmers in Mohmand Agency can borrow from the ADBP, but at present this facility is available only to farmers in Yakaghund and Prangghar tehsils because there are administrative problems in other parts of the agency. Generally, credit is given, other things being equal, on the recommendation of the Political agent.

From July, 1991 to December 1992 Rs. 3, 761,000 in credit was given.  
(Socio-Economic Profile of Mohmand Agency, USAID 1993)

(b) Local Development Projects

FATA- DC PE & D Department & MNA/Senator- wise ADP allocations for 1973 to 1993 have been in Millions of Rs as shown below:

ADP Allocations for 1973 to 1993 (Million Rs)

Agriculture	25.154
Power	99.960
Communication	199.745
Health	50.240
Education	127.338
Potable Water & Housing	109.672
Industry	9.846
Rural Development	15.036
PE&D	9.329
Irrigation	59.43
Forest	10.690
Mineral	1.438
Total	717.878

Source: PE&D Department (FATA Section), FATA -DC (Irrigation, Mineral & Industries)

(c) Local Professions

The professions in the command area are in agriculture (mostly unskilled), migrant workers, local workers, animal husbandry, government jobs, small businesses, mining, and small cottage industry. Setting up small industries that are energy intensive is financially very beneficial because of the subsidy involved. As the educational level of the people in the area is very low people working on government jobs are not highly paid. In the command area, a few families are highly educated and socially well placed, and some of their members have held or are holding important positions in various government departments. Most such people are posted outside the study area.

(d) Transport and Communications

Most settlements in the dam and reservoir area cannot be accessed without walking for at least a few kilometers from the nearest road. Most settlement in the command area are accessible by roads. Only less than 50% (33 of 70) have metalled roads, while little more than 50% (36 of 70) have dirt roads. The primary means of transportation for people and small goods in the area is Nissan and Toyota pick-ups, which has proved suitable for the rugged and rough terrain.

There are only two post offices located in the command area. One at 'Kharki', Malakand Agency, and one at 'Bahi Koroona', Mohmand Agency. Most people have to travel long distances to use these post offices, with average distance of the nearest post office from the settlements of 4.5 km. The command area has a total of 12 public call offices (PCOs), mainly located in the larger settlements. Again there is a lack of PCOs, as the average distance of the nearest PCO from the settlements is 4.6 km.

From a total of 19,454 households, 9,844 (50.6%) own television sets. Given the backwardness of the area, this is a high proportion and is indicative of the inroads of modernization through the electronic medium. Though the sociological impacts of exposure to information through TV could be interesting, only 8 of the 70 settlements receive newspapers.

#### (e) Education

Primary School: Girls total enrollment for 1992-93 was 1,733, boys total enrollment for 1992-93 was 12,446.

Middle School: Girls middle school enrollment for 1992-93 was 280, boys middle school enrollment was 3,859.

Secondary School: Girls secondary enrollment in 1992-93 was 41, and boys secondary school enrollment was 930. There was one higher secondary school for boys at Ghalani with 9 pupil in 11th class and 10 in 12th class in 1990.

All the teachers are trained locally, but no figure is available yet. There are also alternate education facilities including 6 mohallah schools and 3 industrial home schools for girls. There are vocational training institutes at Ghalani and Yakaghund and one government inter college at Yakaghund.

#### (f) Health

The command area has the following health facilities:

Civil Hospital            2

(No. of beds 56 and staff 5 medical doctors, 2 women doctors, compounders 6, radiographer 2, assistants 2)

Rural Health Center    1

Basic Health Unit       23

Civil Dispensaries      3



### (g) Market and Retail Shops

There are three main bazaars in the command area. Gandab bazaar in Mohmand Agency has 200 shops, Ghalnai bazaar has 60 shops and Yakaghund bazaar has 70 shops. Most of these shops have items of daily consumption. There are a few ammunition shops but no timber markets.

Three settlements in the Malakand Agency have 'melas' (open market) where cattle is bought and sold. The 'mela' is a traditional trade institution of the rural Pakhtoon areas. The 'mela' is a hub of economic activity and takes place at regular intervals.

Markets for wholesale items are located in the three Tehsil headquarters, Dargai, Yakaghund, and Tangi. These markets sell non-perishable items like sugar, cooking oils, etc. For more industrial goods people have to travel to Mardan or Peshawar.

### (h) Mining Based Industry

There are eleven marble and stone cutting, and chip and chip powder production units in the command area. The machinery required is of low quality. There are three units that produce asbestos heater plates and one unit that produces brake linings for vehicles. Locally mined asbestos is used in the production of these goods.

It is expected that on the completion of the Munda Dam project, greater availability of electricity is likely to give a boost to the mining and cottage industries, commerce, and help in modernizing agricultural and household activities. The greatest impact is likely to be in agriculture through availability of irrigation water. An increase in the demands for livestock, dairy products, and poultry could also be anticipated. These will all contribute to converting a semi-wilderness to a thriving area of economic activity.

## (2) Land Ownership Systems and Agriculture Practice

In the tribal territory of the Mohmand Agency, the land belongs to the tribes who form the community. Legend has it that the chief of the Mohmand tribes, Mohammad Baba, allocated lands in the present Mohmand Agency to different tribes based upon certain criterion, presumably in proportion to each tribe's population. Then, each tribe allocated land among its different households, again, presumably by criterion of household size. After this initial distribution, the household's land passed to the males of the next generation in equal proportion. There are no land records or cadastral maps but each household is aware of the ownership of all land in the area. Land is not sold to men outside the tribe or even outside the clan. If it is sold, then it is to men from one's own clan.

In the settled parts lying in the command area, i.e., Tangi and Malakand, the land is generally individually owned. Cadastral maps and ownership records, maintained by the revenue department, are available.

(a) Sample Farms

The total production in the area is projected to increase manifold due to the increase in crop area and the rise in yield per unit of land. The projected benefits in terms of total output of different crops are given in table below:

Present and Proposed Output in the Study Area

Season's Total Output (Tons)	Now	After the Canals	Increase (times)
Rabi	450	1,482	3.29
Kharif	42	7,387	176.0
Total	492	8,869	18.0

This analysis applies to the sample farms surveyed for this study. On the basis of these estimates, aggregate estimates for the Project area as a whole are worked out.

The major agricultural practices followed in the area are as follows:

- 1) More than 95% of farmers use tractors, and less than 5% of farmers use animal plow exclusively.
- 2) The use of chemical fertilizers is fairly extensive. Approximately 80% of the farmers use nitrogenous fertilizers, and 60% use phosphate fertilizer.
- 3) The study has found that all the farmers have shown an interest in improved seed, but due to limited supply the incidence of use is not reflective of their interest. Only 56% of the farmers use improved wheat seed, while corresponding figures for maize, onion, and tomato are 12%, 8%, and 44% respectively.
- 4) The use of insecticides, pesticides, and herbicides is low among farmers. Contributing factors may include high prices, low cropping intensity, and the farmers' inadequate knowledge.
- 5) Agricultural threshers are used by 36% of the study's sample farmers.
- 6) Around 23% of the farmers use hired labor on a permanent basis, and another 13% reported using casual labor on their farms. On the average, full-time hired labor was used for 23 days per farm. The corresponding figure for the farms where casual labor was hired is 25 days. This is an unexpected finding, explained by the high representation of high value, skill intensive vegetable farming in the sample farms' cropping pattern.
- 7) The introduction of commercial scale cultivation of vegetables has been instrumental in spreading information about modern farming practices in the project area. The farmers are constantly improving upon their current

practices, and it is expected that the process will accelerate with the coming of the proposed canal.

(b) Livestock

All but 4% of the sample farmers in the study own livestock. Similarly, around 70% of the farmers keep poultry.

Goats and cows are considered to be the most important livestock and account for 87% of total livestock owned by the sample farmers. The average holding is 17 heads per livestock owners and 12 heads per sample farmer in general. The composition of livestock is as follows:

Composition of Livestock

No.	Livestock	Number owned:		
		Total	Average per household of:	
			Owners	Sample farmers in general
1.	Buffalo	13	0.14	0.13
2.	Cows	403	4.20	4.03
3.	Goats	738	7.70	7.38
4.	Sheep	87	0.90	0.87
5.	Draft Animals	70	0.73	0.70
	Total All Kinds	1,311	13.67	13.11
	Poultry	1,188	17.00	12.00

Sheep and goats are almost entirely dependent on grazing in the study area. Following the operation of the proposed canals, the bulk of the current grazing land will be tilled for 2 crops a year, thereby reducing the land available for grazing. Hence, most farmers think that the sheep and goat population will either decrease or stay constant after the commissioning of the canals.

In the case of buffaloes, cows, draft animals, and poultry the farmers' perception has been that the population will increase. Among the main contributing factors to this perception is an expected increase in fodder availability.

Given the aridity of the CA, goats and sheep are easy to raise and graze. Most of the grazing is in the communal areas surrounding the V/Ss and young boys and girls take the cattle for grazing during the day. There is no overnight movement to grazing lands. Their meat and milk is consumed at home as well as being sold in the larger settlements and/or neighbouring towns and cities. There were roughly about 48,032 goats and 21,540 sheep in the CA at the time of the survey.

There were about 37,129 cows and oxen, and 4,201 water buffaloes in the CA at the time of the survey. The grazing patterns are similar to those of goats and sheep. Again, as in the case of goats and sheep, this cattle is both a source of food and some income through the sale of milk and beef.

There also are beasts of burden like donkeys, mules and horses. These animals are used in farming, transportation of goods and people, as well as construction activities. At the time of the survey the donkeys and mules numbered 3,902 and there were 406 horses. Cattle dung is used as fuel as well as fertilizer.

There are a total of 29 poultry farms in the CA. The chickens raised in these poultry farms are largely being sold in the nearby markets in towns and cities.

There are three veterinary facilities and one (veterinary) dispensary in the CA. The veterinary facilities are located in villages Palai (Nusrat Zai), Tehsil Tangi, District Charsadda; Palai Barozai (Paloojor), Tehsil Prangghaar, Mohmand Agency; and Gharib Abad, Tehsil Dargai, Malakand Agency. The dispensary is in Usmani Khel Garhi, Tehsil Dargai, Malakand Agency. The last named village is also the most populated in the CA.

#### **H4 Identification & Evaluation of Environmental Impacts**

##### **H4.1 Introduction**

NWFP has a rich biological diversity at the ecosystem, species, and genetic level. In the study area these resources have been declining because of the growing human population and increased population pressure on natural habitats. NWFP is also characterized by an uneven distribution of land, and land use. The three principal land uses in the study area are agriculture, grazing and forestry. The physical environment issues including, the topography, climate, hydrology and others have been described in the previous chapter. The Main Report deals with all of the physical environment issues in detail.

The Project will change the area's surface and groundwater hydrology, but is not expected to result in water logging or salinity. Reservoir and downstream water quality is expected to deteriorate during construction and operations, and measures may have to be taken to prevent this from becoming a public health or ecological hazard. The environmental impacts are identified and evaluated for the five main categories below.

##### **H4.2 Fishery & Aquatic Biodiversity**

The sections below provide the potential impacts on the approximately sixteen species of fishes identified, macro-invertebrates, and how the people of the area are affected by it.