



Pakistan Poverty Alleviation Fund

Environmental and Social Management Framework (ESMF)

Fourth Edition



Volume Two

REFERENCE MATERIAL AND USER GUIDELINES

April 2009



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FRAMEWORK (ESMF)
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User Guidelines**

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INTRODUCTION

Reference Material and User Guidelines document has been prepared as a background document for the PPAF Environmental and Social Management Framework (ESMF) to provide relevant background information to PPAF and POs on Pakistan's environmental issues, national and international legislations, and environmental impacts of PPAF interventions. It is envisaged that this document will help in increasing the insight and knowledge of PPAF and POs on environmental issues. It is anticipated that the document will help in promoting the environmental conservation in general and managing environmental impacts of the PPAF interventions more effectively in focus.

The document has been prepared predominantly on the basis of secondary information available from the literature. 33 major references (listed as References at the end of the document) were used to prepare the document. This is more a compiled document rather than an authored document. Mostly literature available in the references was summarized and focussed on the PPAF interventions. Empirical information is mostly abstracted and in some cases text has been copied as it is. The document has been prepared as a general reader or a digest. To maintain the reading flow, standard referencing method could not be applied.

The document consists of five chapters. Chapter-1 gives brief overview of the document. Chapter-2 summarises the most relevant sections of the national and provincial conservation strategies with respect to PPAF interventions. The Pakistan National Conservation Strategy (PNCS) is considered as the national environmental policy framework for the environmental programs, projects and interventions while the Balochistan and Sarhad Conservation Strategies serve as official provincial environmental policies of the concerned provinces. These are very comprehensive and large documents, only relevant sections for the PPAF interventions are selected and summarised.

Relevant national legislative requirements and guidelines of international agencies such as the World Bank and the USAID are summarised in Chapter-3. At a minimum, environmental review of all activities supported by the PPAF is required under these guidelines and procedures. Some of the projects may require more detailed studies such as IEE or EIA/SIA.

Chapter-4 compiles information on major environmental issues associated with the PPAF interventions in detail from diversified sources. Causes of the potential impacts along with the mitigation measures are also discussed. To prepare this chapter, many guidelines and handbooks, such as the World Bank, USAID, CIDA, JBIC, etc. have been referred. In this chapter, most of the text is presented as a summary of the original text and some of the text has been copied as it is.

For some large PPAF interventions, detailed environmental impact studies such as IEE or EIA will be required. Chapter-5 provides the framework for IEE and EIA/SIA under the Pakistan Environmental Protection Act 1997, and the Pakistan Environmental Assessment Procedures 1997. This chapter will help PPAF and POs in conducting the detailed environmental studies as per the national legalisation and the World Bank's requirements. In this chapter, most of the text has been picked and summarized as it is from the original documents.

In the end, a comprehensive list of references for all the materials consulted for the preparation of this reference material and user guidelines. Readers can obtain these documents from the relevant organizations and internet for further detailed reading.

PAKISTAN CONSERVATION STRATEGIES FRAMEWORK**2.1 General**

Pakistan National Conservation Strategy, Sarhad Provincial Conservation Strategy, Balochistan Conservation Strategy, and Sindh State of the Environment and Development are very comprehensive documents. It is recommended that the Partner Organization should keep a copy of these documents in their library for reference purposes. In this chapter, text of selective sections of these documents, which is directly relevant to the PPAF interventions, has been summarised.

2.2 Pakistan National Conservation Strategy (PNCS)

The PNCS provides environmental policy framework for the environmental programs, projects and intervention in Pakistan. Pakistan's NCS was approved by cabinet in March, 1992, and has been regarded as one of the largest and most comprehensive documents of its kind in the world. It has three macro objectives:

- Conservation of natural resources;
- Sustainable development; and
- Improved efficiency in the use and management of resources.

To achieve these objectives, PNCS recommended several specific programs for implementation in 14 priority areas. Some of the relevant policies for specific sectors, which are relevant to PPAF projects, are presented in Table 2-1.

Table 2-1 Summary of the PNCS's Relevant Policies and Measures

Sector	Proposed Policies	Proposed Measures
Agriculture	<ul style="list-style-type: none"> ⌚ Halt over-use of prime soil/land resources (in rain-fed areas). ⌚ Use cultivable waste area, based on land capability data and availability of water. ⌚ Minimize use of synthetic pesticides and insecticides. ⌚ Encourage recycling of organic matter. 	<ul style="list-style-type: none"> ⌚ Encourage adoption of effective soil and water conservation practices. ⌚ Adopt ecologically compatible cropping systems. ⌚ Grow salt-tolerant grasses, shrubs, trees in saline groundwater areas. ⌚ Adopt use of integrated pest management /control methods. ⌚ No use of banned pesticides /insecticides. ⌚ Encourage incorporation of crop residues into soil. ⌚ Adopt integrated crop/livestock production systems.
Rangeland rehabilitation	<ul style="list-style-type: none"> ⌚ Develop systems for effective periodic closure of rangelands, to rehabilitate them. 	<ul style="list-style-type: none"> ⌚ Time any financial support to herding systems (e.g., loans for improvement of breeding stock) with range reopening.
Livestock management	<ul style="list-style-type: none"> ⌚ Recycle agricultural products associated with livestock production. 	<ul style="list-style-type: none"> ⌚ Make better use of agricultural by-products and increase the recycling of nutrients.
Water management	<ul style="list-style-type: none"> ⌚ Give priority to increase irrigation efficiencies. ⌚ Invest funds for rehabilitation of water courses systems where needed. ⌚ Give increased attention to protecting watersheds. 	<ul style="list-style-type: none"> ⌚ Demonstrate and provide incentives for technical improvements leading to water conservation on farms. ⌚ Address problems of water-table drawdown by holistic approaches, encompassing both demand management and methods to increase water recharge.
Energy	<ul style="list-style-type: none"> ⌚ Take early account and full care of the impacts of hydel generation. ⌚ Develop alternative sources to meet additional energy requirements. ⌚ Use energy more efficiently ⌚ Use 'waste' resources for energy. 	<ul style="list-style-type: none"> ⌚ Subject site process selection for hydel projects to environmental objectives, and assess and mitigate the residual adverse impacts with the same rigour as engineering design. ⌚ Arrange carefully planned, country-wide demonstrations of the conveniences, adequacy, and increase reliability of locally generated energy to meet village needs. ⌚ Promote biogas plants with built-in local maintenance provisions and community support. ⌚ Disseminate fuel-efficient cookers to reduce wood consumption in critical districts.
Wastewater	<ul style="list-style-type: none"> ⌚ Adopt domestic wastewater treatment technologies that provide for recovery and reuse of water, nutrients and organic matter in ways that is safe and profitable to the operator. 	<ul style="list-style-type: none"> ⌚ Develop system for safe sewage irrigation. ⌚ Use sludge as fertilizer and soil amendment.
Solid waste	<ul style="list-style-type: none"> ⌚ Promote reuse and recycling 	<ul style="list-style-type: none"> ⌚ Promote energy from waste and composting plants ⌚ Ensure proper sanitary landfill practices

2.3 Balochistan Conservation Strategy

Balochistan Conservation Strategy (BCS), which was published in 2000, identified many environmental concerns of the province. The following section gives the summary of the PPAF interventions relevant to environmental issues of the province.

A- Agriculture

There are many issues of concern in the agricultural sector. The most pressing, however, relate to the heavy and inefficient use of water and the extensive, often indiscriminate use of agrochemicals. There are more than 21,000 tube wells in operation, contributing to the rapid decline in groundwater reserves. Due to the uncontrolled increase in their numbers, groundwater levels are steadily declining. The lowering of the water-table by over-pumping has resulted in the drying up of many karezes.

There is a very heavy use of pesticides and other agrochemicals, particularly in orchards. Little attention has been paid to integrated pest management approaches. In Pakistan, annual pesticide use has increased from 6,000 tonnes in 1982 to 45,000 tonnes in 1997. Where integrated pest management initiatives have been tried, the need for pesticide use has been substantially reduced.

B- Livestock

Range-based livestock production systems are one of the major sources of livelihood of people in rural areas. However over-grazing is one of the major problems of rangelands, which constitutes 79% of the total area of the province. There may be more than 20 million sheep and goats – six times the estimated carrying capacity in the province. As a result animals are low in productivity and prone to a variety of diseases.

C -Water resources

The major issues that must be tackled are groundwater mining and the inefficient use of the resource. As discussed above, the agriculture sector places the heaviest demand on the resource.

D- Biodiversity

There are two national parks, 14 wildlife sanctuaries and thirteen game reserves as designated protected areas along with one community conservation area to protect the rich biodiversity of the province. But with few exceptions, the protected areas contain few, if any, of the animals that they were set up to protect. Competition with other land use such as agriculture, and livestock grazing, indiscriminate and uncontrolled hunting and removal of natural vegetation for fuel are some of the contributing factors.

E- Energy

Balochistan has large reserves of natural gas and coal and accounts for 40% of the primary energy production of Pakistan. Ironically, 80% of the energy needs of the province are met through the use of biomass energy i.e. firewood and dung cakes. There have been major experiments with other forms of energy e.g. solar, wind, geothermal, biogas but these have not amounted to anything so far.

The BCS proposes 14 core programs for environmental improvements. Major recommended programs and measures, which are relevant to the PPAF interventions, are stated in the following table.

Table 2-2: Summary of the BCS's Relevant Core Programs and Measures

Sector	Proposed Core Program	Proposed Measures
Poverty	⌚ Alleviating poverty	⌚ Conserving and sustainably using natural resources, especially water and rangelands, because of the great dependence of poor on such resources.
Water	⌚ Arresting depletion and pollution of groundwater and increasing irrigation efficiency	<ul style="list-style-type: none"> ⌚ Improving the irrigation efficiency of groundwater and canal water. ⌚ Improving the recharge of groundwater and discouraging its excessive use. ⌚ Encouraging rainwater harvesting for 'sailaba' cultivation. ⌚ Controlling the pollution of surface and groundwater.
Agriculture	⌚ Making agriculture sustainable	<ul style="list-style-type: none"> ⌚ Improving irrigation efficiency. ⌚ Controlling groundwater mining (discharge not to exceed recharge) and encouraging the harvesting of rainwater and floodwater. ⌚ Promoting integrated pest management and making proper use of agrochemicals.
Livestock	⌚ Managing rangelands and enhancing productivity of livestock	⌚ Improving grazing capacity and managing the sustainable use of rangelands.

2.4 Sarhad Provincial Conservation Strategy (SPCS) 1995 -1998

The NWFP is geographically and climatically different from much of the rest of Pakistan. The province includes a great deal of country's forest reserves, clean water sources and biodiversity. The SPCS, which is the principal plan for implementing the NCS in the NWFP, identifies the following environmental issues of the province:

A- Forests

Depletion of natural forest has considerably increased since late 1970s, despite launching of many massive programmes of afforestation in the moist mountain tracts during the past two decades. Poverty and vested political and business interests are identified as the main reasons for the depletion. The rehabilitation of the natural vegetation of the southern parts of the NWFP, which is being over-used to meet local needs for domestic fuel and grazing, also has received little attention. The depleted grazing lands provide less feed and of lower quality than what they could under better management. An adequate cover of natural vegetation is also essential for the maintenance of biodiversity, the protection of watersheds, and the prevention of soil erosion.

B- Water and irrigation

Surface and groundwater are abundant in the northern part of the NWFP, while in the south, groundwater is brackish and in short supply. A serious problem of groundwater use in certain areas of the NWFP is abstraction in excess of recharge, as occurs in Karak, Kohat, Bannu and D. I. Khan. The groundwater balance in these areas is negative and sinking more tube-wells will lower the water-table. In Karak, due to the over abstraction of groundwater, the sweet water zone has already been contaminated by saline groundwater.

Rainfall in the NWFP is insufficient and poorly distributed through the year. Irrigation is therefore essential but only about 46% of the cultivated area of the NWFP is irrigated and there is a limit to which this can be increased.

C- Soil conservation

About 15% of the NWFP's cultivated land suffers from moderate water erosion and about 4% from slight erosion. Worse, soil erosion in the mountains not only decreases agricultural, forest, and rangelands productivity, it also exacerbates local flood hazards due to a reduction in the water storage capacity of mountain soils.

D- Conserving biodiversity

Given the large altitudinal and climatic diversity within the NWFP, there is a wide variation in the province's agricultural capability, vegetation zonation, forest cover types, soil and other features. Biological resources are, however, being lost due to population growth and land conversion. The principal threats to wildlife are over hunting, over fishing, pollution and habitat destruction due to deforestation, land conversion to agriculture, soil erosion and over-grazing. Deforestation, land

conversion to agriculture, soil erosion and over-grazing also pose threat to plants diversity.

The SPCS proposes several programs for environmental improvements. Major recommended programs and measures, which are relevant to the PPAF interventions, are stated in the following Table.

Table 2-3: Summary of SPCS's Relevant Commitments

Sector	Commitments in the SPCS (1995-1998)
Forestry	<ul style="list-style-type: none"> ① Prepare and process participatory integrated renewable resource development projects, to cover all the moist mountain watersheds for improving the ecology as well as the social and economic conditions of the local people.
Water & Irrigation	<ul style="list-style-type: none"> ① Excavating tube wells to depress water-tables in water logged areas.
Livestock	<ul style="list-style-type: none"> ① Introduce controlled grazing of rangelands, disease prevention, and cost-effective improved livestock-housing. ① Develop and apply flexible systems of controlled grazing appropriate to each site to improve the density and vigour of ground vegetation, with the cooperation of land and livestock owners.

2.5 Sindh State of the Environment and Development

This report, published by the IUCN in 2004, provides information on the status of environment and development in the Province. It is hoped that this report would provide a basis for future sustainable development strategy for Sindh. The report identifies the following environmental concerns of the province:

A- Water Resources

Indus water is crucial to Sindh's survival as 95 percent of its farmland acquires water from the Indus Basin Irrigation System and 97 percent of all water is used for agriculture. The groundwater available in Sindh accounts to only three to five MAF and is potable only in 28 percent of Sindh's geographical area.

Sindh has entered a phase of water insecurity due to non-implementation of Water Accord 1991 and persistent droughts. The per capita water availability in Sindh falls below the national average of about 1200 cubic meters per annum. The most severely affected area in the province is the Indus Delta which has shrunk to ten percent of its original size due to the construction of dams and barrages on the Indus.

The water problem is further aggravated by defective irrigation practices like flood irrigation, lack of drainage facilities and the absence of properly organized management and distribution of this resource. The absence of lining in canals and water channels result in leakages that cause water-logging and seepage in the urban water transmission and distribution system. Meanwhile, sea intrusion in the delta has made most of the subsoil in the aquifer saline.

Water sources are increasingly polluted due to untreated industrial and domestic wastes being disposed into the rivers and irrigation systems. Water pollution in the Sindh occurs through:

- ⌚ Municipal discharges: as most of the cities and towns in Sindh discharge their municipal waste into the Indus River without any treatment. In extreme cases when the assimilative capacity of river or canals is exceeded, anaerobic (septic) conditions arise especially during months of low dilution or when there are water shortages in the Indus. These conditions also cause groundwater pollution.
- ⌚ Industrial water discharges: Untreated industrial effluent contains various pollutant in high concentration such as ions of sodium, potassium, calcium, magnesium, carbonates and bicarbonates and other inorganic variables like fluoride, silica and cyanide and metals such as cadmium, chromium, copper, mercury, lead, zinc and nickel.
- ⌚ Return agricultural flows through drainage structures: particularly through the LBOD and the RBOD adversely affect Sindh's water resources.

Due to scarcity of freshwater, the riverine forest, irrigated plantations, mangrove forests and wildlife have been adversely impacted. There has been a loss of biodiversity and some species of flora and fauna have disappeared or are at the verge of extinction. This calls for taking all possible measures to manage and conserve water resources. This is imperative for ensuring the continuity of life and economic development in the province.

B- Land Degradation

Sindh is a major producer of grain, fruit and vegetables. However, crop yields are low and have been almost stagnant for the last decade. This is due to salinity caused by leakages from canals and from sea intrusion in the delta and coastal districts. Over-irrigation and badly managed water distribution also contribute to poor crop yield. An increase in the use of fertilisers and pesticides has been witnessed, which has led to land degradation and depletion of organic matter in the soil. The application of pesticides and broad spectrum chemicals has led to many pest outbreaks, damaging human health and the environment by killing non-target bio-control agents, environmental friendly organisms, and birds.

A major issue related to land degradation is the depletion of soil fertility and organic matter. To arrest the decline in soil organic matter, the use of organic sources of plant and animal origin need to be popularised. Whenever possible, crop residue must be recycled and organic manures included as a necessary input on a periodic basis. The inclusion of legumes and green manure crops should also be given a place in crop rotation.

C- Flora and Fauna

Eight percent of Sindh's geographical area consists of forests. These forests are of three kinds: riverine forests, mangrove forests and irrigated plantations. The riverine forests have been degraded due to the building of dams and barrages on the Indus and the irrigation system. Recent droughts have further thinned them out. The mangrove forests in the Indus Delta are the sixth largest in the world. Due to the lack of freshwater from the Indus flushing the delta and the resulting sea intrusion, the forest area has decreased to about 50 % in last 25 years. Irrigated plantations, initiated with the assistance of the Asian Development Bank, have been increasing, but at a very slow pace. In any case, they constitute a very small percentage (7.25 percent) of the forest area of Sindh.

Sindh is also experiencing a depletion of its floral resources at an increasingly high rate because of a rise in both human and animal population which results in over-exploitation. The absence of affordable energy options is a major factor along with the decreasing freshwater to the Indus Delta. Fifty-two percent of energy utilised in the household sector in Sindh is firewood. The figure speaks for itself and the result of this practice is deforestation. There is an urgent need to diversify energy sources and such diversification can take place through the use of wind and solar energy options.

The dwindling wildlife resources in Sindh are increasingly exposed to natural calamities and hazards inflicted by humans. Some causes of the decline in wildlife population is due to: the loss of water in the Indus river; poor seasonal flooding and inundation of Kacho areas; low to below average rainfall after 1992; shrinking of inland waters; drying-up of wetlands, conversion of wetlands into agricultural lands and unhygienic quality of water in wetland.

D- Livestock and Rangelands

The majority of the arid zone (Thar, Nara and Kohistan areas) population is engaged in herding and relies on the rangelands which provide more than 70 percent of the forage for the animals. However, due to various factors, now the rangelands are being over-exploited and there are increasing numbers of cases, of their desertification.

RELEVANT LEGISLATIVE AND ADMINISTRATIVE ARRANGEMENTS

This chapter summarizes the main requirements of: Pakistan Environmental Protection Act 1997, Pakistan Environmental Assessment Procedures 1997, and guidelines of international agencies such as the World Bank and the USAID.

3.1 Pakistan Environmental Protection Act 1997

To provide protection, conservation, rehabilitation and improvement of the environment for the prevention of pollution, and promotion of sustainable development Government of Pakistan enacted Pakistan Environmental Protection Act in 1997.

Most of the provisions of the Act are relevant to the large and medium sized projects. The Act's requirements are less relevant for individual CPI and CED projects; however, these are directly relevant to the accumulative impacts of the CPI and CED. Following are the most relevant provisions of the Act:

- Under the Act, the Pakistan Environmental Protection Council has been established as the highest body in the country to formulate policy and ensure its implementation within the frame work of the NCS.
- Under the Act, it is mandatory for the proponent of a project to submit an Environmental Impact Assessment (EIA) report to the concerned EPA when the project is likely to cause an adverse environmental effect. As stated in the Clause 12 of the Act:

“No proponent of a project shall commence construction or operation unless he has filed with the Government Agency designated by the Federal Environmental Protection Agency or Provincial Environmental Protection Agencies, as the case may be, or, where the project is likely to cause an adverse environmental effect, an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof”.

- It prohibits discharges or emission exceeding National Environmental Quality Standards (NEQS), as stated in section 11(1) of the Act.

“Subject to the provisions of this Act and the rules and regulations made there under no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the NEQS.”

- Under the Act, license is required for all activities which generate, collect, transport, treat, dispose of, store, or handle any hazardous substance.
- The Act describes penalties for the violators of the NEQS. The penalties can be a fine of up to one million rupees, and/or up to two years imprisonment, etc. depending upon the violation.

Complete copy of PEPA 1997 is attached as Annexure-1.

3.2 Pakistan Environmental Assessment Procedures

Pakistan Environmental Protection Agency issued environmental assessment procedures in October 1997. Though the procedures are predominantly relevant to very large, large and medium sized projects, these provide good reference material and guidelines for the CPI and CED projects and for the PPAF and POs. Major guidelines listed in the procedure are as follows:

- 🕒 **Policy and procedures for the filing, review and approval of environmental assessments:** These procedures contain the key policy statements on the purpose of environmental assessment and sets out the procedural requirements for conducting an initial environmental examination (IEE) or environmental impact assessment (EIA). Integration of an EIA with feasibility studies is emphasized. It also provides schedule of projects that require either an EIA or an IEE.

Procedure classifies projects into three categories; projects requiring an EIA are listed in a category-A, projects requiring an IEE are listed in category-B, while projects which neither require an EIA or IEE are classified in category-C.

Category-A: The projects in category-A are either major projects with a potential to affect a large number of people or located in environmentally sensitive areas. Some examples of the large projects are: Hydroelectric power generation over 50 MW, large scale industrial plants, major mining and mineral processing activities, dam and reservoirs with a storage greater than 50 million cubic meters, irrigation and drainage serving more than 15,000 hectares, major urban water supply infrastructure, waste disposal facilities handling more than 10,000 cubic meter of waste annually.

Category-B: These projects include those where the range of environmental issues from the project is comparatively narrow. These projects are generally not located in environmentally sensitive area or smaller proposal in sensitive areas. Some examples of the project in category B are: Large poultry farms and beef cattle lots, hydroelectric power generation less than 50 MW, major waste to energy generation projects, medium sized industrial facilities, dam and reservoirs with a storage less than 50 million cubic meters, irrigation and drainage serving less than 15,000 hectares,, small scale irrigation systems, small water supply and treatment systems, waste disposal facilities handling less than 10,000 cubic meter of waste annually, public facilities (such as hospitals) with significant off-site impacts (i.e. hospital wastes).

Category-C: All projects which are not listed in category A or B are classified as category-C projects. The procedure does not contain details of projects but gives few examples of project of category-C type, such as lining of existing canals and water courses, on-farm dams, rehabilitation of roads, construction of small buildings, small poultry farms, petrol pumps, etc. However, it is required that these projects should follow project/sector specific environmental guidelines.

Most of the CPI and CED interventions generally fall under category-C; hence, do not need an IEE or EIA. However, the PPAF integrated projects and other large interventions may qualify for an IEE or EIA depending upon the category, they belong.

- ⌚ **Guidelines for the preparation and review of environmental reports:** These guidelines detail the steps for preparation of environmental reports, which comprise of assessing impacts, suggesting mitigation measures and writing environmental impact assessment reports. (Please refer Chapter-5 for more details)
- ⌚ **Guidelines for public consultations:** These cover: objectives of consultation, involvement and participation, provide guidance on techniques for public consultations, effective public consultation, consensus building and dispute resolution and facilitating involvement. Public involvement is a feature of environmental assessment and can lead to better outcome. It provides an opportunity for those otherwise unrepresented to present their views on the proposed project, therefore allowing more sensitive consideration of mitigation measures and trade-offs. Specific tools for public consultation include: focused group meeting, participant observations, village meetings, workshop etc. Ideally the public involvement program should commence at the screening stage of a proposal and then continue throughout the whole EIA process. It should be noted that no public involvement program will be effective unless the proponent genuinely wishes to engage in a two-way dialogue with the community. The spirit of openness needs to embrace a willingness to listen to the information, values and concerns of the community, to amend the proposal so as to minimise community concerns, and to acknowledge the value of community input. Full participation is desirable for following type of projects: projects affecting indigenous people, projects requiring involuntary resettlement, projects for specific beneficiary groups and projects with community based development.
- ⌚ **Guidelines for sensitive and critical areas:** These cover: protected ecosystems and archaeological and cultural heritage sites which have been notified in Pakistan (see Annexure-2 for details) and the procedure for determining the requirements for the environmental assessment in such areas. It requires that the environmental assessment reports for projects in sensitive and critical areas should not be finalized until the comments and recommendations of provincial wildlife departments are taken into consideration as part of the mitigation and control measures.

The official classification of notified protected ecosystem in Pakistan consists of the following categories: Wildlife Sanctuaries, National Parks and Game Reserves. In addition, there are protected forests, reserved forests, and range lands.

The government rules pertaining to top wildlife sanctuaries require either prohibition or control of the following variables: (a) entry or residence, (b) cultivate any land, (c) damage or destroy any vegetation, (d) hunt, kill or capture any wild animal within three miles of the boundaries (e) introduce any domestic species of animal or plant (f) introduce any domestic animal or allow to stray, (g) cause any fire or pollute water.

The following acts are prohibited in a national park:

- a) hunting, shooting, trapping, killing or capturing of any wild animal in a national park or within three miles radius of its boundary;

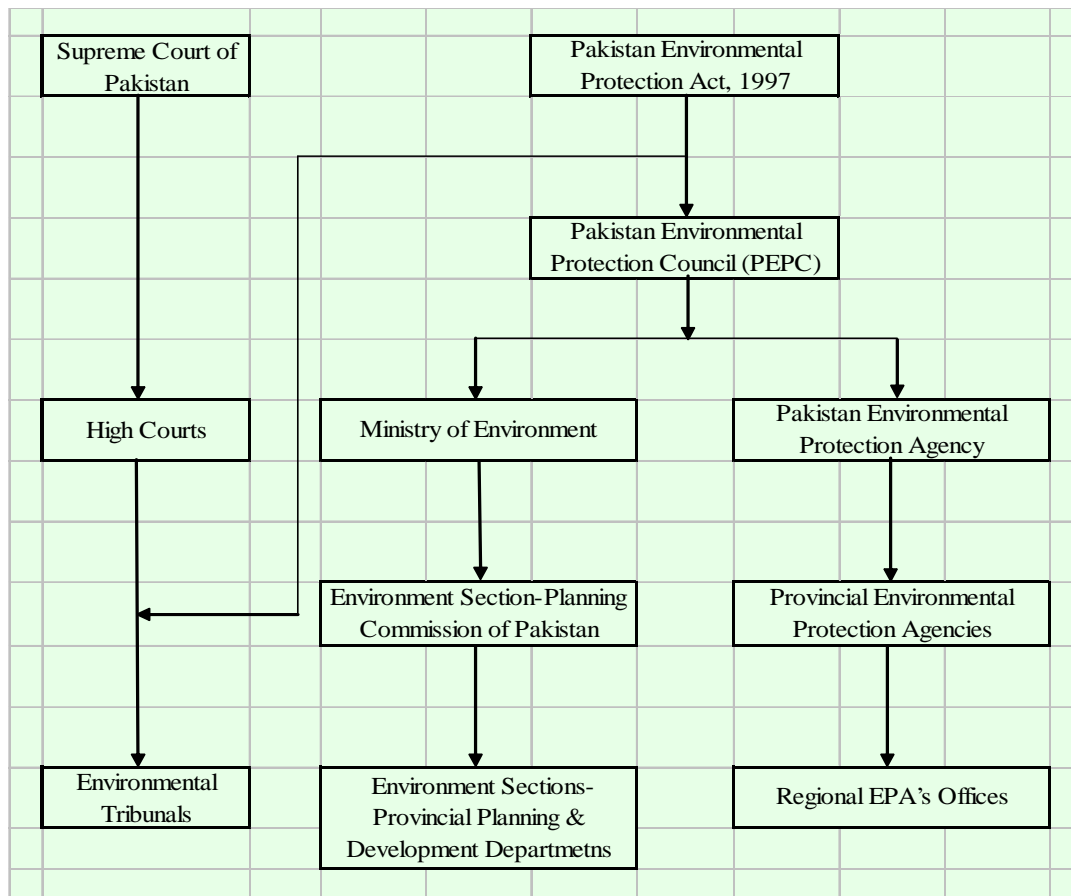
- b) firing any gun or doing any act which disturb any animal or bird or doing any act which interferes with the breeding places;
- c) felling, tapping, burning or in any way damaging or destroying, taking, collecting or removing any plant or tree there-from;
- d) clearing or breaking up any land for cultivation, mining or for any other purposes;
- e) polluting water flowing in and through the national park.

🕒 **Sectoral guidelines:** Sector specific guidelines contain guidelines for identification of environmental impacts and suggest mitigation measures for the following type of projects: major roads, water supply projects, major sewerage schemes, major thermal power stations, major chemical and manufacturing plants, housing estate and new town development, oil and gas exploration and industrial estates. The guidelines for major roads, water supply projects and major sewerage schemes provide good reference material and guidelines for the CPI and CED interventions in these sectors even though the procedures are predominantly relevant to very large, large and medium sized projects.

3.3 Institutional Arrangement for the Implementation of Environmental Laws in Pakistan

The Pakistan Environmental Protection Council (PEPC) is the apex institute for environment in Pakistan. The main function of the PEPC is to develop policies and strategies for the enhancement of environment. The PEPC is supported by the Ministry of Environment and Pakistan Environmental Protection Agency. The Planning Commission of Pakistan and provincial planning and development departments have also established environmental sections. These sections are responsible of environmental policy development, identification and development of environmental projects for the five-year plans and annual plans at the federal and provincial levels. To implement Pakistan protection Act 1997 and other regulations, all provincial governments have established Environmental Protection Agencies (EPAs).

Under the framework of the PEPA 1997 and the instruction of Supreme Court of Pakistan, High Courts of major cities have established Environmental Tribunals. Any person in the individual capacity can approach environmental tribunal to register the case against polluters. Figure 3.1 shows the organisation structure of environmental institutes in Pakistan.

Figure 3-1: Environmental Institutions' Organisation Chart

3.4 International Environmental Procedural Requirements

3.4.1 World Bank Operational Policies for Environmental Assessment

The World Bank (WB) operational policies for environmental assessment (EA) are very comprehensive and cover wide areas of subjects. In this section, only the topics of operational policies for EA, which were found relevant, are briefly stated for CPI and CED interventions.

The overall objective of operation policies for environmental assessment is to ensure that World Bank financed projects are environmentally sound and sustainable and improve the decision-making process.

The WB guidelines for environmental screening classify projects into the following categories:

- Category A-projects with significant adverse environmental impacts
- Category B-projects with potential adverse environmental impacts, but are less adverse than those of Category-A projects
- Category C-projects with minimal or no adverse environmental impacts

- Category-FI-projects in which financial intermediary is involved for financing sub-projects. Financial intermediary should ensure that sub-borrowers carry out appropriate EA for each sub-project.

Operational policies for environmental assessment instruct to follow general guidelines stated below while executing the World Bank (WB) financed projects:

- Assess project's potential environmental risks and impacts in its area of influence;
- Examine project alternatives for compensating environmental impacts and enhancing positive impacts;
- EA should cover natural environment (air, water, and land); human health and safety; social aspects; trans-boundary and global environmental aspects in line with the national environmental strategy, action plans, legislation, obligatory environmental treaties and agreements of the country;
- Project with high environmental risks or contentious or that involve serious and multidimensional environmental concerns are Category-A projects. EA of such projects should be conducted by independent EA experts and reviewed by independent advisory panel. The WB maintains the right to review the EA, and ask for additional EA work and call for public consultation.

When the borrower has inadequate legal or technical capacity to carry out key EA-related functions for a proposed project, the project includes components to strengthen the capacity.

For all category A and B projects, stakeholder consultations on the basis of factual disclosure of information are essential. The borrower and sub-borrower should ensure that during, implementation the recommendation and mitigation measures of EA are implemented.

Following are the most relevant operational policies for EA with respect to CPI intervention areas:

- Operational policies for natural habitats, June 2001 OP 4.04: these cover protection, maintenance and rehabilitation of natural habitats.
- Operational policies for pest management, December 1998 OP 4.09: promote the use of biological or environmental control methods and reduce reliance on synthetic chemical pesticides.
- Operational policies for cultural property, August 1999 OP 4.11: these cover sites having archaeological, pale ontological, historical, religious and unique natural values.
- Operational policies for forests, November 2002 OP 4.36: to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests.
- Operational policies for safety of dams, October 2001 OP 4.37: these require that the borrower adopts and implements certain dam safety measures for the design, bid tendering, construction, operation, and maintenance of the dam and associated works.

Relevant World Bank operational policies are attached as Annexure-3.

3.4.2 USAID Environmental Procedures

These procedures are developed to ensure that environmental factors and values are integrated into the A.I.D decision-making process. These procedures apply to all new projects, programs or activities authorised or approved by A.I.D. and also substantiate amendments or extensions of ongoing projects, programs or activities.

Procedure excludes many actions and activities for which IEE, EA, and EIS are generally not required. Out of these categorical exclusions, the following are relevant for CPI and CED:

- An action that does not have an effect on the natural or physical environment.
- Research activities that may have an affect on the physical and natural environment but will not have a significant effect as a result of limited scope, carefully controlled nature and effective monitoring.
- Support for intermediate credit institutions when the objective is to assist in the capitalization of the institution or part thereof and when such support does not involve reservation of the right to review and approve individual loans made by the institution.
- Matching, general support and institutional support grants provided to Private Voluntary Organizations (PVOs) to assist in financing programs where A.I.Ds objective in providing such financing does not require knowledge of or control over the details of the specific activities conducted by PVO.

Following are the major classes of actions mentioned in the procedures relevant to the CPI that normally have significant effect on the environment:

- (i) Irrigation or water management projects, including dams and impoundments
- (ii) Agricultural land levelling
- (iii) Drainage projects
- (iv) Penetration road building or road improvement projects
- (v) Potable water and sewerage projects other than the small scale projects

An IEE normally will not be necessary for these activities if the originator of the project provides explanation and justification that the project will not have a significant effect on the environment. Minimum requirement of US A.I.D. for CPI type of interventions is to include a table on 'Environmental Monitoring Plan-Mitigation Measures'.

The ESMF facilitates compliance to the national laws, the World Bank operational policies and AID procedural requirements through provisions in project design, avoiding adverse social / environmental effects of temporary or permanent nature during construction, and ensuring socially acceptable and environment friendly O&M practices, (Table – 3.1).

Table 3.1 Legal and Policy Compliance Framework

National Legislation and Regulations		
	Pakistan Environmental Protection Act	<p>Under the Pakistan Environmental Protection Act, 1997, no development project can be undertaken unless an initial environmental examination (IEE) or an environmental impact assessment (EIA) is conducted, and approval is received from the federal or relevant provincial EPA. The categories of projects, for which an EIA or IEE has to be carried out, are defined in the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000.</p> <p><i>Taking cognizance of the Act, the ESMF distributes the PPAF interventions into several categories for environmental assessment. Owing to their very small size and community driven nature, most interventions require in-house Environmental Review (ER) or Integrated Environmental Review (IER). However, for relatively major interventions, IEE or EIA are prescribed.</i></p>
	Provincial Wildlife Protection Acts/Ordinances	<p>These provincial laws (for the four provinces of Pakistan) have been enacted to protect the wildlife resources directly and other natural resources indirectly. These classify wildlife by degree of protection, i.e., animals that may be hunted on a permit or special license, and species that are protected and cannot be hunted under any circumstances. The Acts/Ordinances specify restrictions on hunting and trade in animals, trophies, or meat. The Acts/Ordinances also define various categories of wildlife protected areas, i.e., National Parks, Wildlife Sanctuaries and Game Reserve.</p> <p><i>The Wildlife protected areas are listed in the Annexure-3. The ESMF advises against any PPAF interventions in these areas. However, in case it does become inevitable, an IEE or EIA, as applicable, becomes a prerequisite.</i></p>
	Antiquity Act, 1975	<p>The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The Act is designed to protect 'antiquities' from destruction, theft, negligence, unlawful excavation, trade and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to</p>

		<p>prohibit excavation in any area that may contain articles of archeological significance.</p> <p><i>The protected areas of historical, anthropological or cultural interest (listed in Appendix 4) will be avoided while locating the proposed facilities. Where the location of facilities in such areas becomes necessary, prior approval of the concerned regulatory body will be obtained, and an IEE or EIA carried out as applicable.</i></p>
World bank Safeguard Policies		
OP 4.01	Environmental Assessment	<p>This OP requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable. This OP also categorizes the projects on the basis of the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.</p> <p><i>The PPAF-III project has been classified as Category B, and the present ESMF has been developed in response to this OP.</i></p>
OP 4.04	Natural Habitat	<p>The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. Through this OP, the WB therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions.</p> <p><i>Owing to the small size and environmental enhancing nature of most interventions the proposed project is likely to have no or positive effect on natural habitats. Further, the protected areas (listed in Appendix 3) will be avoided while locating the proposed facilities. Hence this OP is not triggered.</i></p>
OP 4.36	Forestry	<p>The objective of this Policy is to assist the WB's borrowers to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests.</p> <p><i>Most of the proposed project interventions are likely to have a forest conservation / reforestation effect. Financial support for livestock will normally be limited to stall fed animals. In case of grazing animals, the ESMF includes safeguard / mitigation measures for rangelands. Hence this OP is not triggered.</i></p>
OP 4.09	Pest Management	<p>Through this OP, the WB supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical</p>

		<p>pesticides.</p> <p><i>Pesticides and chemical fertilizers are on the negative list of PPAF. Hence this OP is not triggered.</i></p>
OP 4.11	Cultural Property	<p>The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination.</p> <p><i>The protected areas of cultural interest (listed in Appendix 4) will be avoided while locating the proposed facilities. Where the location of facilities in such areas becomes necessary, prior approval of the concerned regulatory body will be obtained, and an IEE or EIA carried out as applicable.</i></p>
OP 4.10	Indigenous People	<p>The OP defines the process to be followed if the project affects the indigenous people (ie, people having the following characteristics: self-identification as members of a distinct indigenous cultural group and recognition of this identity by others; collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories; customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and an indigenous language, often different from the official language of the country or region). The Project will not support any interventions in the Kalash valleys and there are no other Indigenous groups in the Project's geographic area. Hence this Policy is not triggered. However, during implementation should any IP group get identified and impacted, an IPDP will be prepared, cleared by the Bank and implemented</p>
OP 4.12	Involuntary Resettlement	<p>This policy includes safeguards to address and mitigate the impoverishment risks (dislocation, asset loss, income loss, and others) associated with the involuntary resettlement.</p> <p><i>Any land required for project interventions will be voluntarily provided by the community. The Project does not involve any involuntary resettlement. The form (as provided in the ESMF) for donated land will be duly completed and documentation maintained</i></p>
OP 4.37	Safety of Dams	<p>The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams the WB finances.</p> <p><i>PPAF only supports the construction of 'mini dams', (with a height of less than 10m and reservoir area of less than 2.5 ha). These dams are designed with regard to safe discharge</i></p>

		<i>of highest floods ever experienced and are built at locations, which ensure that in case of unlikely failure, no loss of life or property takes place.</i>
OP 4.20	Gender and Development	<p>This policy aims at addressing the gender disparities and inequalities that are barriers to development. In sectors and thematic areas where the CAS has identified the need for gender-responsive interventions, the Bank's assistance to the country incorporates measures designed to address this need. Projects in these sectors and thematic areas are designed to adequately take into account the gender implications of the project.</p> <p><i>The Project will ensure gender participation in the design, implementation and O&M of various facilities, by specifying minimum percentage of women in community organizations and project management committees. The track record of PPAF indicates that more than 50 percent of its micro-credit and infrastructure beneficiaries are women. In case of health and education related interventions, the proportion of female beneficiaries exceeds 60 percent.</i></p>
OP 7.50	Projects in International Water	<p>This OP defines the procedure to be followed for projects the WB finances that are located on any water body that forms a boundary between, or flows through two or more states.</p> <p><i>This OP is not applicable since the project does not involve any works on international waters.</i></p>
OP 7.60	Projects in disputed areas	<p>Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a proposed project is located is dealt with at the earliest possible stage.</p> <p>Project interventions will take place in all federating units of the Country, including Azad Kashmir. However, owing to being small scale, community based and demand driven, with little impact on the ecology or natural resource endowment of the areas where they are located, they will not in any way change the strategic status quo, and no problem of any nature is likely to emerge.</p>

DETAILED DESCRIPTION OF ENVIRONMENTAL ISSUES RELEVANT TO PPAF INTERVENTIONS

4.1 Water Resource Development

4.1.1 Water Resource Development: Facts/issues

Ground water is not only a significant source for drinking water but also one of the most important sources of irrigation water.

Pakistan with 2,053 m³ per person, rank eighth in per capita fresh water withdrawal among the 130 countries listed in the 1995 World Development Report. Out of total developed water resources of the country agriculture sector is the major user of water (96%) followed by domestic (3%) and industrial sectors (1%).

However, rapid population growth (2.6% per annum), increased urbanization and industrialization, mismanagement in development and use of water resources for various purposes as well as extended drought has resulted in water scarcity. Of all the environmental concerns that Pakistan faces, the lack of adequate water of good quality is probably the most serious. The quality of both surface water and groundwater has been identified as one of the water resource issues in Pakistan as the access to clean domestic water in the urban and rural sub-sectors is low in terms of quantity as well as quality.

Water withdrawals have increased markedly since 1960, but there has no significant improvement in water use productivity (crop output per unit of water). Yet water renewable sources are finite and Pakistan has reached the limits of surface and ground water withdrawals. The mean value of inflow into the Indus Basin is 180 billion m³, with a 20% chance of not exceeding 160 billion m³. Out of this approximately 125 billion m³ are diverted at canal heads that 69% of the average inflow, but more than 77% of the inflow in low flow years. Only 30% of the diverted water reaches the crop roots. The rest is lost in canals and watercourses or during application in the field.

4.1.2 Availability of Groundwater

Pakistan is blessed with extensive groundwater resource, which has been built due to direct recharge from natural precipitation, river flow, and the continued seepage from the conveyance system of canals, distributaries, watercourses and application losses in the irrigated lands during the last century.

This groundwater source has a potential of about 55 MAF, out of which about 48.7 MAF is being exploited by over 662,000 private tube wells and about 18,620 public tube wells for domestic, agricultural and industrial purposes. Province-wise groundwater usage is 42.7 MAF in the Punjab, 3.5 MAF in Sindh, 2 MAF in NWFP, and 0.5 MAF in Balochistan.

Groundwater use is nearing the upper limit in most parts of Pakistan. Outside the Indus Basin, water is even more limited. In Balochistan the water-table has been declining continuously. A number of studies have estimated that the deficit in Quetta sub-basin is about 21,000 AF per year and that the aquifer storage will be exhausted in 20 years. In Quetta Valley, the water table is falling by up to two meters every year.

Over pumping of groundwater due to extended drought has affected the water quality adversely. According to a recent study about 70% of the 560,000 tube wells of Indus Basin are pumping sodic water. Such water can be highly injurious to soil health creating sodicity problems resulting in reduced permeability and infiltration rates in heavy textured soils.

4.1.3 Quality of Groundwater

The quality of groundwater in Pakistan varies from fit for irrigation to moderately saline to sodic. Thus the tubewell owners in the marginal quality groundwater areas are bound to use the tubewell water in conjunction with the surface water on their farms. Of the annual recharge of ground water, estimated at 57 billion m³, more than 51 billion m³ (that is 89%) are drawn up by tube wells and used.

A- Total dissolved solids (TDS) and fluoride

The quality of groundwater is area specific and generally ranges from fresh with Total Dissolved Solids (TDS) less than 1,000 mg/l near the major rivers to highly saline with salinity exceeding 3,000 mg/l TDS.

In Punjab province about 80% of the area has fresh groundwater (with TDS less than 1,000 mg/l). Generally, the saline water is encountered in the middle of Doabs (area between two rivers). Cholistan Desert in the Southern Punjab is well known for highly brackish waters, which cannot be used for drinking purposes. Groundwater with high fluoride content is found in the Salt Range, Kasur and Mianwali. There are also reports of high fluoride content, ranging from 65 to 120 mg/l in groundwater in Bahawalpur area. The effluent from tanning industries in Kasur has caused high TDS, chromium, sodium and sulphide contents in groundwater.

In Sindh, about 28% of the area has fresh groundwater suitable for irrigation. Close to the edges for the irrigated lands fresh groundwater can be found at 20-25 m depth. Large areas in the province are underlain with groundwater of poor quality. The areas with non-potable highly brackish water include Thar, Nara and Cholistan. In Tharparkar, including Umerkot, the situation is further complicated by the occurrence of high fluoride in at many locations. In Karachi, in general, the groundwater is saline and unfit for drinking purposes. The main reason for saline groundwater in Karachi is the salt-water intrusion from sea.

In NWFP, abstraction in excess of recharge in certain areas such as Karak, Kohat, Bannu and D.I. Khan has lowered the water-table and resulted in the contamination from the underlying saline water.

In Balochistan, the Makran coastal zone and several other basins contain highly brackish groundwater. In the absence of alternative sources of water local

communities use groundwater with TDS as high as 3,000 mg/l for drinking purposes. In Mastung Valley, groundwater has been found to have high fluoride content.

B- Arsenic in groundwater in Pakistan:

Arsenic is a non-metallic constituent, present naturally in groundwater due to some minerals and rocks. It has no taste or odour in water. Arsenic is poisonous and severe toxicity has been reported after ingestion of only 100 mg of the element. Chronic toxicity can result from a build up of lower intakes. Arsenic is not geologically uncommon and occurs in natural water as arsenate and arsenite. Additionally, arsenic may occur from industrial discharge or insecticide application.

Recent studies (e.g. Ahmad *et al*, 2004) have identified arsenic contamination of groundwater as a serious concern in Pakistan. It is mainly prevalent in Punjab and Sindh provinces. NWFP and Balochistan had comparatively little arsenic contamination except in one district in NWFP (i.e. Mardan). Some of the water samples from Mardan indicated presence of arsenic of over 50 ppb. WHO guidelines for drinking water recommend 10 ppb threshold value.

In Punjab, three southern districts viz, Multan, Rahim Yar Khan and Bahawalpur had the highest levels of arsenic contamination. In other districts (such as D. G. Khan, Layyah, Muzaffargarh, Sargohada, Jhang, Gujrat, and Jhelum have high arsenic concentration in groundwater. Highest concentration of 972 ppb was found in Water samples tested from union council Agra in taluka Gambat (district Khairpur).

Analysis of available data on prevalence of arsenic reveals that arsenic contamination is predominant in the Indus plain. For example, all those districts identified as high in arsenic contamination (i.e. Multan, Bahawalpur, Rahim Yar Khan in Punjab province, and Khairpur, and Dadu in Sindh province) are lying in alluvial deposits along the Indus River. Also within a given district, areas lying closer to the river Indus system were found to have relatively higher arsenic concentration than those away from the river system. In Tharparkar, areas closer to the sea were found to have a higher arsenic level than those away from it.

According to the Pakistan Council of Research in Water Resources (PCRWR) survey, in Sindh, arsenic contamination (above 10 ppb) mainly exists at a depth of less than 150 ft. Arsenic contamination was less than 10 ppb for depth over 150 ft. However in Punjab it showed a different pattern where arsenic contamination was found at all depths and in some specific areas (e.g. in district Muzaffargarh), arsenic contamination increases with depth.

Ingestion of arsenic through drinking water causes arsenic poisoning or arsenicosis¹. The findings of epidemiological study in Punjab by Institute of Public Health suggest

¹ Arsenicosis is the effect of arsenic poisoning, usually over a long period such as from 5 to 20 years. Drinking arsenic-rich water over a long period results in various health effects including skin problems (such as colour changes on the skin, and hard patches on the palms and soles of the feet), skin cancer, cancers of the bladder, kidney and lung, and diseases of the blood vessels of the legs and feet. However, absorption of arsenic through the skin is minimal and thus hand-washing, bathing, laundry, etc. with water containing arsenic do not pose human health risks. (Reference: www.who.int)

that though prevalence of dermatological lesions related to arsenicosis was low, yet a large proportion of the population was at risk of developing arsenicosis if it remained exposed for a longer duration to the existing high level of arsenic in water.

4.1.4 Pollution of Water Resources

Water quality is affected by a number of factors, including industrial and municipal effluents. Other important sources of water pollution include agri-chemical residues and sedimentation from upland erosion. Some pollutant may persist from centuries, while other assimilated relatively quickly. The pollution of water does not have equal weight everywhere. Major areas of concern are listed below in order of importance:

1. Contamination of ground water with toxic substances, particularly where ground water is drawn for drinking and household purposes; as centuries may be needed to flush heavy metals and synthetic chemicals from ground water;
2. Contamination of river waters, particularly where aquatic life is affected and river water is used for drinking purposes.
3. Contamination of seawater, particularly areas with low levels of mixing, such as harbors and estuaries.

Following are some of the reasons for the pollution of water resources:

- Surface water resources are getting polluted due to discharge of untreated industrial effluents from major industrial estates at Karachi, Lahore, Faisalabad, Gujranwala, Peshawar and Hattar.
- Sewage treatment plants installed in major cities are operating intermittently or under capacity.
- In some cities municipal wastewater is not treated and is simply discharged into rivers/streams.
- There is no proper disposal of municipal, and hazardous solid waste, which is dumped in open without any proper sanitary landfill, the leachate from these dump sites eventually pollute the surface and ground water.
- Agriculture saline run off.
- Use of pesticides and fertilizers, which has grown rapidly. Indiscriminate use can lead to the pesticide contamination and fish kills, excessive nutrient loading of water ways, and uncontrolled algae growth. Pesticides are of particular concern because of their bio-accumulation in fish and animal tissues.

4.1.5 Water Issues

A- Scarcity of water:

- As result of extensive agricultural growth, water scarcity is also becoming a serious problem in Pakistan. Water availability has declined from 5,300 m³ per capita in 1951 to 1,610 m³ per capita today, and the country is estimated to be short of 4.32 billion m³ (3.5 MAF) of water in winter season. Estimates by International Water Management Institute indicate that Pakistan is among the 17 countries-which together contain 8% of the world's population- that are likely to face the most severe water scarcity by 2025.

- Overexploitation of fresh groundwater bodies in upland and desert areas with little surface water.
- Low efficiency and delivery and use in both domestic and agriculture sectors.

B- Water diversion and losses:

- The amount of water that is diverted to the fields is greatly reduced until it reaches its final destination and it may be further lost on the field due to improper application. Thus only 30% of the total diverted water supplies actually reach the crops they are to support.
- Water losses due to poor maintenance of the irrigation and distribution systems. More than 14 MAF, water losses occur annually at field level due to mismanagement and unawareness of handling the precious resource.

The issue of extra water available for irrigation is more of a concern than is the management of the existing quantity of the resource. The need is to introduce Better Management Practices, which entail modern irrigation methods that ensure minimum water loss and maximum irrigation efficiency (WWF's Freshwater and Cotton Project). Researches of the project have proven that the farmers can save 40% of the water by applying such methods and ending up with same yields.

C-Pollution of freshwater bodies and natural streams:

- Pollution of freshwater bodies and natural streams/rivers particularly those near urban centers. The existing water resources are under threat due to untreated discharge of municipal and industrial wastes to river and other surface water reservoirs.
- The streams were becoming increasingly smelly due to rapid rise in pollutants and the only solution is to launch treatment of the nullahs.

D-Water logging and salinity in irrigated areas:

- Increased use of tubewell water in the saline groundwater zones has resulted in the deterioration of the soils and groundwater quality, which has led to the problem of permanent upcoming of saline groundwater.
- Surface groundwater suffers with the problems of exceeded turbidity, electrical conductivity, pH, sodium, iron, fluoride, sulfate, TDS and potassium than WHO guideline values.
- The Indus River carries the fifth greatest sediment load in the world.
- Agriculture consumes over 90% of annual freshwater withdrawals, largely through the Indus Basin Irrigation System (IBIS). The IBIS is plagued by serious problems resulting from over irrigation, inadequate drainage, low efficiency and reliability of deliveries, inequities in distribution and wasteful use of water. These problems, in turn have major contributors to severe water logging and salinity.

E-Use of Pesticides and fertilizers:

- Excessive and indiscriminate use of pesticides & fertilizers results in deterioration of water quality as well as incorporation of harmful chemicals into groundwater supplies & ultimately in the food chain.

F-Heavy Metal contamination in water:

- Leather tanning and Chemical sectors are discharging 3,600 tonnes of chrome and 24 tonnes of mercury per year respectively mainly to ground water and river sediments.
- Some of the steel industries discharge effluent to ground water and surface water inlands.
- Electroplating industries have been reported from Sialkot and Gujranwala discharging the chrome and nickel contaminating ground water.

G-Droughts

- Persistent droughts have culminated in output losses equivalent to about 12% of agricultural GDP. These events have severe impacts on the economy as a whole and in particular on the million of the poor families in rural areas, who are less healthy and less educated, rely on natural resources as a safety net.
- Drought conditions devastated livelihoods, increased the incidence of malnutrition and waterborne diseases, intensified migration and caused further stress on water, vegetation cover and land resources. In Balochistan, where 70-80% of income of nomadic population is derived from livestock, households lost 40-50% of their livestock. Without access to tube well irrigation, small holders in the upland areas with land holdings of less than half acre lost all fruit trees. Women had to go longer distances to fetch water, as underground water resources receded, and surface resources dried up.

4.1.6 Water Related Environmental Health Risks

- Water related environmental health risks impose the most significant environmental health burden.
- The commonly encountered infectious and non infectious waterborne diseases are diarrhea, dysentery, cholera, helminthiasis and enteric fever.
- Data from the World Health Organization (WHO) indicate that Pakistan and Bhutan rank second among 31 Asian countries in annual diarrhoeal episodes among young children. 26% of children under the age of 5 suffered with Diarrhea in Pakistan (2 weeks prior to the Multiple Indicator Cluster Survey, MICS, 1995).
- Exposure to waterborne diseases is an important contributing factor to infant mortality. Infectious and childhood diseases are responsible for two-third of the burden of diseases in Pakistan (Ministry of Health; Pakistan Development Forum 2005).
- Poor people are more prone to adverse health impacts because of their inadequate nutrition, unhygienic living conditions, lack of access to health facilities and greater exposure to polluted water.

In rural areas the poor rely on ponds that catch rainwater, on rivers and springs, and on groundwater extracted through the dug wells and hand pumps. In many areas irrigation and drainage canals are used both for waste disposal and as a source of household water supply. Even piped drinking water in poor urban localities is often highly contaminated.

- Both WHO & Pakistan Standards and Quality Control Authority (PSQCA) determine water quality standards that go far beyond the current capacities of water management organizations in urban & rural areas in Pakistan. It can safely be said that almost none of the drinking water provided through public service providers meets the WHO or PSQCA standards.
- Environmental risks account for more than one-fifth of the burden of diseases. Among these risks one is the exposure to water borne disease factors that cause diarrhea (12% of the total burden of the disease).

4.1.7 Specific Interventions for Water Resource Development

A) Tube Wells – Drinking Water

Environmental Guidelines

- a) Serious depletion of ground water aquifers is happening due to higher level of ground water abstractions in non-irrigated areas in general, and especially in following districts:

- ⌚ Balochistan: Quetta, Pishin
- ⌚ NWFP: Karak, Kohat, Bannu, and D.I.Khan

Installation of drinking water tube well in these districts needs special local level justification in the IER.

- b) Contaminated water with coliforms, fecal coliforms, florides, and nitrate causes moderate to high significance health impacts to the community. Test reports are needed for these parameters for the nearby tube well, and at bore hole stage for the proposed drinking water tube well.

- c) High prevalence of arsenic contamination has been reported in the following districts of Pakistan:

- ⌚ Punjab: Multan, R.Y. Khan, Bahawalpur, D.G. Khan, Layyah, Muzaffargarh, Sargodha, Jhang, Gujrat, and Jehlum
- ⌚ Sindh: Dadu, Khairpur, Nawabshah, and Tharparker
- ⌚ NWFP: Mardan

These districts are on the negative list for the drinking water tube wells. For installing drinking water tube well in these districts under local level urgencies and demands produce following test reports:

- ⌚ Arsenic ground water test report for the nearest tube well under WHO guidelines
- ⌚ Arsenic ground water test report from the bore hole dug for the proposed tube well under WHO guidelines

- d) Individual negative environmental impacts of drinking water tube wells are marginal on aquifers depletion; however, their cumulative impacts are moderate to high.

- e) Health impacts due to use of contaminated water for drinking purposes are moderate to high for the community health.

Mitigation Measures

- a) Attach the test report of the nearest tube well water quality with the proposal.
- b) Conduct water [testing](#) at borehole stage and confirm that the water is not contaminated by coliform, fecal coliform, nitrate, arsenic, and fluoride. Attach the test report with the completion report.

- c) Attach battery of taps and animal turf with water storage tank attached to the tube well.
- d) Design and implement proper drainage and safe wastewater disposal system to avoid creation of stagnant pool.
- e) Community is informed that the water tank needs to be cleaned every three months.

B) Tube Wells – Irrigation in Irrigated Areas

Environmental Guidelines

- a) New tube wells for irrigation can cause reduction in the yield of existing tube wells in the area, and can also draw down the ground water table.
- b) Over irrigation may lead to water logging and salinization of the soils.
- c) Quality of the ground water may be degraded with the intrusion of saline water due to over pumping.
- d) Irrigation water with high Total Dissolved Solids (TDS) may lead to salinization of the soils. Acceptable limit is 1,500 ppm.
- e) Poor organizational arrangements and in-equitable distribution of additional water may lead to social conflicts.
- f) Mostly water shortages are found at the tail of watercourse or distributory in the irrigated areas.

Mitigation Measures

- a) Conduct water [testing](#) at the borehole stage and confirm that test results show that the TDS of the water is not more than 1,500 ppm. Attach test report with the design report
- b) Design proper drainage and safe disposal system and implement the same to avoid creation of stagnant pool.
- c) Train community on irrigation efficiencies, watercourse maintenance and proper drainage.

C) Hand Pumps

Environmental Guidelines

- a) Individual and cumulative impacts of ground water draw down for hand pumps are not significant in irrigated areas; however, cumulative impacts have moderate significance in desert and dry areas.
- b) Shallow water table is commonly contaminated with coliforms, fecal coliforms, fluorides, and nitrate. These contaminants cause moderate to high significance health impacts on the communities. Test reports are needed for these parameters for the nearby hand pump at the proposal stage, and at bore hole stage for the proposed hand pump.

Mitigation Measures

- a) Conduct water [testing](#) at the borehole stage and confirm that the water is not contaminated by coliform, fecal coliform, nitrate, and fluoride. Attach test report with the completion report
- b) Design proper drainage system and implement the same to avoid creation of stagnant pool.

D) Open Well***Environmental Guidelines***

- a) Open wells are commonly contaminated with coliforms, fecal coliforms, fluorides, and nitrate. These contaminants cause moderate to high significance health impacts on the communities. Test reports are needed for these parameters for the nearby open well at the proposal stage, and at bore hole stage for the proposed open well.
- b) Open wells water mostly gets contaminated with dropping of surface contaminants in the well.

Mitigation Measures

- a) Conduct water [testing](#) at the borehole stage and confirm that the water is not contaminated by coliform, fecal coliform, nitrate, and fluoride. Attach test report with the completion report
- b) Make proper arrangements to ensure that surface contaminants will not mix with the open well water.

E) Rain Water Harvesting Pond***Environmental Guidelines***

- a) Rainwater harvesting ponds commonly remain under the threat of contamination by human pathogens, animal manure, agricultural chemicals, and algae growth. These ponds, if not properly managed, serve as mosquitoes breeding areas. These contaminants cause moderate to high significance health impacts on the communities. Three monthly test reports are needed for coliforms, fecal coliforms, and nitrates at the operational stage of the pond.
- b) Community is mostly trained and educated about the ways and means of ensuring that the pond remains safe from the intrusion of surface contaminants.
- c) Physical features are added in the design to ensure that surface contaminants shall not mix with the pond water.

Mitigation Measures

- a) Prepare pond management plan and train the community accordingly.
- b) Ensure by making proper arrangements that surface contaminants will not mix with the pond water.

F) Check Dam

Environmental Guidelines

- a) Check dams normally do not cause environmental impacts. It is suggested that wherever possible use local materials to avoid the transportation of material and ensure that the structure design ensures the safety of people in case of break down.

Mitigation Measures

- a) Ensure that location and structure designs have incorporated safety aspects.
- b) Wherever possible use local materials for construction.

G) Delay Action Dam

Environmental Guidelines

- a) Delay action dams are constructed to recharge the groundwater aquifer. Maximum permissible height for dams constructed under PPAF funding is 10 Meter.
- b) Delay action dams may cause erosion, and land slides. Mostly for the designing of delay action dams information for geology, hydrology, topography and soil erosion profile of the area is generated and analyzed. If these potential risks are within manageable limits then mostly mitigated by incorporating measures like slope stabilization, and watershed management.
- c) Delay action dams should not cause large displacement of people and inundation of cultivable land and orchards. Small population, if displaced, then should be properly compensated under market or kind compensation mechanisms.
- d) Intensive community consultations are needed for the site selection. The proponent should identify more than one alternative sites. Comparative analyses of the sites are presented to the community and under open discussion consensus is achieved.
- e) Delay action dams may cause obstruction to the movement of commuting people and wild life. Alternate pathways and routes are provided in the design to mitigate such impacts.
- f) Being relatively large structure, delay action dams always remain under the threat of wash away under heavy floods and torrential rains, blockage due to the movement of large rocks, porous berms due to increase in mice population, poor maintenance, and fast silt accumulation. These risks are mitigated by providing right capacity spillways, proper site selection, periodic removal of blockage essentially after torrential rains, proper maintenance of berms, and watershed management.
- g) Communities in the surroundings and especially down stream communities are informed about the risks attached with the break down of the dam and actions to be taken by the community in case of break down.

Mitigation Measures

- a) Prepare geological, hydrological, topography, and soil erosion profile of the area and confirm that technically a safe dam can be constructed on the site.

- b) Conduct alternate site location, dam height, and risk management technical analyses for the project and report conclusions.
- c) Generate and incorporate verifiable information about the consultations conducted for the project, report the consensus and terms and conditions raised by the community for the project.
- d) Adopt proper market mechanism for the compensation of displacement of people, acquisition of land and other assets.
- e) Wherever possible use local labour and material for construction.
- f) Prepare disaster management plan. Inform communities about the risks attached to break down and over flooding during floods and torrential rains. Train the communities for the possible actions to be taken at time of occurrence of such accident and event
- g) Implement slope stabilization and watershed measures to control soil erosion and slope stabilization.
- h) If dam and reservoir obstruct the pathways and routes of commuters and wildlife then construct alternate pathways and routes for commuters and wild life.
- i) Prepare maintenance manual, and train communities accordingly for its implementation.

H) Water Tanks

Environmental Guidelines

- a) Water tanks without practicing frequent cleaning may lead to bacterial contamination of water. Frequent cleaning is always advisable for the safe drinking water from the water tanks.
- b) It is always safe to test the intake water to these tanks for coliforms, fecal coliforms, fluorides, and nitrates as per WHO guidelines. Water tanks are mostly located at a safe distance from the sources of surface contamination.

Mitigation Measures

- a) Conduct water [testing](#) of intake water to the water tank and confirm that the water is not contaminated by coliform, fecal coliform, nitrate, and fluoride. Attach test report with the design report.
- b) Inform the community about the frequency of cleaning the tank; mostly tanks are cleaned every three months.

I) Water Channels

Environmental Guidelines

- a) Water channels, if not properly constructed, cause upstream and downstream soil erosions. During construction special care needs to be taken to avoid all the reasons of community disturbances attached to falling of debris, alternate route for existing channel, and blasting – if involved.
- b) During operations leakages from water channels lead to land slides that may cause physical damage and human loss in the downstream communities. Due to this reason polyethylene sheets are laid on the bed of the channel in loose soil areas, and a mixture of clay, earth, and grass is applied on the walls of the channel. In

loose soil areas trapezoid channels are constructed, in semi-loose areas semi circular channels are constructed, and in rocky areas rectangular channels are constructed to avoid seepage and leakage. Further to these mitigations, in loose and semi-loose soil areas a berm of 3-5 feet width is maintained, whereas, in rocky areas a berm of 2 feet width is maintained.

- c) Water channels divert water from upstream main water source, and distribute water to the downstream farmers along the alignment. Diversion and distribution of water is a serious issue among the farmers community. Intensive consultations are conducted with the farmer communities for the selection of point and source of diversion, alignment of the channel, water distribution system along the channel, construction design and cost, etc.

Mitigation Measures

- a) Include upstream and downstream slope stabilization as part of the design and implement the design accordingly.
- b) Make proper arrangements for the safety of the community during construction such as falling of debris, alternate route for existing channel, and blasting.
- c) Secure community consensus on channel route, point of diversion, water distribution system, and cost of the project.
- d) Ensure channel alignment does not disturb any environmentally sensitive and culturally important area.

J) Watercourse

Environmental Guidelines

- a) Watercourses are lined pfor decreasing the water losses occur at the watercourse level and improving the availability at the tail. In most of the cases lining is not meant for increasing the command area of the watercourse.
- b) In the agricultural lands there are small precincts (katcha areas) which are not cultivated. These precincts serve an important function of bio-pest reserves at the farm level. With the increase of water availability due to lining, there is a threat that the farmers will also start cultivation on these precincts. Cultivation of these precincts will lead to loss of an important bio-pest management function made available by the nature.

Mitigation Measures

- a) Secure community consensus on water course route, point of diversion, water distribution system, and cost of the project.

K) Karezes

Environmental Guidelines

- a) Karezes divert water directly from upstream sources and transfer water to the users through a long tunnel. During water conveyance water is exposed to natural (fluoride, arsenic etc.) and human (coliform, fecal coliform, and nitrate)

- contaminants. Due to these conditions, it is always safe to test the Karezes water for the above stated contaminants before use for human consumption.
- b) During Karezes construction and maintenance some times blasting is conducted to break the hard rock. Blasting with poor safety practices can lead to injuries and in some cases loss of life. It is instructed that blasting should be conducted after applying all the safety precautions promoted for safe blasting.
 - c) Land subsistence is a threat attached to karezes. For new Karezes land subsistence issue is handled at the design level, and for existing Karezes this issue is managed through proper maintenance and reinforcement.
 - d) Karezes need periodic maintenance and cleaning along with water [testing](#). It is advised to the proponent of the project to devise maintenance, cleaning, and water [testing](#) schedules on the basis of on ground conditions.

Mitigation Measures

- a) Conduct water [testing](#) for coliform, fecal coliform, fluorides, arsenic, and nitrate as per WHO guidelines. Attach test report with the design report.
- b) Adopt safety measures for blasting.
- c) Include land subsistence control measures in the design report and implement the same.
- d) Prepare schedules for maintenance, cleaning and water [testing](#) for the operational stage and train community for the execution of activities as per schedules.

L) Land Leveling

Environmental Guidelines

- a) Land leveling of agricultural farms is conducted for uniform spread of water through out the farm. Land leveling, if not properly executed, then it cause increased soil run-off that leads to loss of topsoil. Topsoil loss causes the decrease in the crop yield.
- b) Land leveling in the mountain areas along with soil run-off and top soil loss can also lead to soil erosion due to the application of heavy equipment.

Mitigation Measures

- a) Educate farmers about the relationship between topsoil loss and decrease in crop yield. Train farmers about effective methods of land leveling.
- b) In mountain areas: Ensure that light equipment is used for land leveling, along with slope stabilization measures.

4.2 Technological Innovation

The links between energy, environment and sustainable development pose difficulties for policy planners.

While modern energy services are vital for economic development, the increase in the combustion of conventional fuel sources for the provision of those services is significantly contributing to adverse environmental effects such as indoor and urban air pollution, transboundary air pollution and global climate change. One of the challenges is therefore how to deal with the environmental implications of the rapid growth in energy demand that has been a characteristic feature of this region.

In a recent ESCAP study, the following policy options and issues were identified as the keys for developing and implementing sustainable energy goals in the region:

- a) Improving energy efficiency by continuing efforts to evaluate existing energy efficiency and energy intensity and to identify energy-saving potential with its accompanying environmental benefits in key sectors;
- b) Institutional strengthening and capacity-building to encourage institutions and policy makers to make decisions or choose options while taking into account goals of sustainable energy production, use and management that are cost-effective;
- c) Supporting the development, use and active promotion of cost-effective renewable energy technologies, in particular hydro, solar and biomass, by seeking assistance from multilateral funding institutions such as the World Bank, through the Global Environment Facility, from the Asian Development Bank and the private sector;
- d) Expanding access to energy services to meet rural energy needs where the provision of energy services remains inadequate for reasons ranging from the dispersed nature of communities living in rural and remote areas, the lack of adequate infrastructure and the low income levels of the rural poor;
- e) Reforming the energy sector by enhancing the performance of electric power, hydrocarbon and renewable energy sectors through private-sector participation;
- f) Transferring advanced power generation technologies, particularly those with the potential to contribute both to improving efficiency and providing environmental benefits. Technological options combining new and conventional power generation, such as wind energy, hydro-power, desalination, biomass gasification, solar photovoltaic and natural gas-fired provide a new array of technological choices, which can now be actively promoted in the region.

4.2.1 Wind Mills

If properly designed and well placed, wind mills can provide a reliable source of energy. A wind-powered water pump can be used for irrigation and supplying potable water. Larger wind mills may compete favourably with other forms of electrical generation.

Economic cost-benefit analysis against other energy sources is needed before selecting wind power as an energy source. The strength and constancy of the wind is especially important in this calculation, as is the proven ability of the wind mill to withstand high wind events. Since historical meteorological data are often absent for rural areas in Pakistan, wind power needs to be approached cautiously. High winds

may damage the machines, endangering people and animals. One potential adverse effect associated with wind-driven water pumps is that standing water from spillage around the pump can become a health risk. An automatic shut-off mechanism can potentially solve the problem. As with any water system, over-grazing near the water supply can be a serious problem, especially in arid and semi-arid environments.

The other possible wind-related environmental issues are noise, and effects on birds, land use and visual aesthetics. Although wind energy is a relatively clean means of generating electricity, there are associated impacts. One of these is the potential of an array of turbines to alter the visual quality of the landscape, especially when located in a scenic area. In addition to aesthetic concerns, noise associated with spinning wind turbine rotors has generated complaints from the public. Another environmental concern associated with wind energy is the impact on wildlife. Wind turbines in some areas are responsible for killing birds—including some protected species—that are accidentally caught in the rotor blades.

Some of these environmental concerns can be addressed by more careful siting of wind turbines. Other concerns, such as the noise of spinning rotor blades, may be partially solved by design refinements that successfully reduce aerodynamic and mechanical noise.

4.2.2 Micro-Hydel Power Projects

Only 11 per cent of the hydro-power potential has been developed to-date. Hydro-power development could have serious ecological and social impacts if not properly managed. Alternate and renewable energy sources have as yet been largely undeveloped.

Micro-hydro installations range in size from a few kilowatts to 100 kilowatts. They are of two general types:

Run-of-the-river micro-hydro installations involve no reservoir. They rely instead on the natural flow of the river or stream to provide motive power to the turbine(s). They typically involve diverting a portion of river flow through a spillway, side channel, or pipeline. The diverted water is returned to the river downstream from the turbine.

Impoundment micro-hydro installations use a dam to create a reservoir either to stabilize electricity supply against variations in flow; to provide greater head, or pressure, to power the turbine(s); or both. The reservoir may also be used for irrigation.

a) Potential Environmental Impacts and Causes

The single most important factor in determining the extent of environmental impacts from micro-hydro projects is whether or not an impoundment needs to be created. Dams on the scale considered for funding programs should be constructed only with the assistance of skilled professionals. Even with assistance, not all the problems associated with dams may be immediately apparent.

(i) Run-of-the-river

For run-of-the-river operations, the greatest impacts occur during the construction phase. The primary concerns are the impacts on the stretch of river from which water is diverted to support the micro-hydro operation; the method of returning the water back to the stream; and effects on downstream users. Impacts are generally on-site and relatively easy to assess. Potentially adverse impacts are summarized in Table 4.1.

Table 4-1: Environmental Impacts of Run-of-the-River Micro-Hydro Projects

Activity Phase	Impact
Construction	<ul style="list-style-type: none"> ⌚ Movement of soil may increase erosion, which may increase sedimentation of the waterway affecting downstream users (humans, fisheries and wildlife). ⌚ Increased activity along the stream and transmission line route may disrupt wildlife. ⌚ Construction and placement of pipeline may block waterway temporarily or permanently. ⌚ Construction and placement of pipeline and construction of transmission line routes may disturb wetland, floodplains or agricultural land. ⌚ Increased activity along the stream and transmission route may disrupt recreational/cultural/subsistence activities there. ⌚ Power transmission lines/pathway may result in destruction of wetlands or other sensitive habitat. ⌚ Decrease in downstream water flow may affect downstream users (humans, fisheries, and wildlife).
Operation	<ul style="list-style-type: none"> ⌚ Decrease in stream flow between point of diversion and water return point may affect fisheries and wildlife. ⌚ Decreased stream flow between point of diversion and water return point may change the flooding pattern (regime), harming wetlands. ⌚ Re-entry pipe may cause increased scouring of stream bank where water is returned to the stream.

(ii) Impoundment micro-hydropower

If the project requires the creation of an impoundment, potential environmental impacts may be greater than for run-of-the-river systems. As with run-of-the-river installations, environmental impacts may result during both construction and operation. Primary concerns are the stretch of the river from which water is removed; the area that is being flooded; and downstream users, including humans, fish, and wildlife.

⌚ Dams

Reservoirs are often used to supply irrigation water during dry seasons, provide power, and prevent flooding. Like other water diversions, dams exacerbate low-flow states and the potential adverse impacts of reduced flooding. Creation of new dams may require local populations to relocate and deprive villages of farmlands or forests. Shallow reservoirs can become clogged with weeds, impeding water flow and preventing livestock from reaching drinking water. Reservoirs may also be breeding grounds for vectors carrying diseases like malaria.

Note that impoundment micro-hydro power projects typically triggers an Initial Environmental Examination (IEE) under PEPA 1997. Potential environmental impacts of micro-hydro power projects are summarized in Table 4.2.

Table 4-2: Environmental Impacts of Impoundment Micro-Hydro Projects

Activity Phase	Impact
Construction and operation	All the impacts caused by construction of run-of-the-river hydro, plus:
Construction	<ul style="list-style-type: none"> ⌚ Movement of soil at the impoundment location may increase erosion. ⌚ Increased activity at the impoundment location may disrupt wildlife. ⌚ Impoundment construction may result in disturbing wetlands, floodplains, or agricultural land. ⌚ Increased activity at the impoundment location may disrupt recreational and cultural activities, or disrupt the local resident's way of life.
Operation	<ul style="list-style-type: none"> ⌚ Change in water temperature in the impoundment may affect water quality in the impoundment and discharge from the impoundment. ⌚ Submersion of land covered by the impoundment destroys existing habitats and ecosystems and creates new (aquatic) habitats and ecosystems; it may reduce the amount of land available for growing crops. ⌚ The impoundment may create a breeding ground for pests and disease. ⌚ The impoundment may change the overall water flow pattern (regime), which may alter water flow in the stream. ⌚ The impoundment may change general hydrology of the area, altering habitat along stream banks. ⌚ Altering normal stream flow reduces the availability of nutrients and sediment downstream for crops and fish. A dam can also threaten fish migrations. ⌚ Insufficient attention to an area's geology and topography may result in designing a dam that is too weak. Failure of the impoundment may cause flooding, erosion and downstream destruction.

(iii) Mitigation:

Since the proper operation and maintenance of micro-hydro facilities are essential to minimizing environmental damage, community involvement is particularly critical for these projects. Given that impoundment micro-hydro projects are likely to require an IEE, the basic axiom of environmental impact assessment should be underlined:

Consider the full range of alternatives to achieves project results and weigh environmental costs of the project against its economic benefits.

The mitigation measures, which apply to small-scale construction, also apply to construction of micro-hydro installations. Please see section (4.3.1 on Construction). General guidelines for mitigating micro-hydropower impacts include:

- ⌚ Avoid stockpiling soil in wetlands or floodplains. Stockpile soil in already disturbed areas.
- ⌚ Do not block stream flow during construction.

- ⌚ Following construction, return topsoil to its original location, and restore land contours to match the original topography.
- ⌚ Avoid construction during wildlife breeding seasons.
- ⌚ Ensure that construction does not harm the habitats of endangered or threatened species.

Mitigation of operations-phase impacts depends on both careful design and proper operation and maintenance (O&M) of the system. In the case of impoundment structures, proper O&M is especially vital to:

- ⌚ maintain critical downstream flows
- ⌚ safeguard the integrity of the impoundment structure—the water level in the reservoir must not be allowed to exceed the rated level, and required maintenance must be performed promptly.

4.2.3 Biogas Digesters

Technologies, such as anaerobic digestion, used for the conversion of organic materials to biogas are far from new. However, their application is not widespread. Biogas production involves the biological fermentation of organic materials (e.g., agricultural wastes, manures or industrial effluents) in an oxygen-deficient environment to produce methane. The system also produces carbon dioxide and traces of hydrogen sulphide. The gas can be used either directly to be burned for cooking or lighting, or indirectly to fuel combustion engines delivering electrical power. The slow diffusion of this technology is related to (a) the initial cost of construction; (b) the lack of organizational and community involvement, particularly for larger, community-level digesters; or (c) insufficient training opportunities in construction and maintenance.

The operation of a biogas digester presents several potential environmental problems, but these problems can be minimized with proper planning and operation. For example, if the digester is built close to a livestock shed, the excrement may be deposited directly without unnecessary handling. However, special precautions are required if human wastes are used in digesters. For example, humans and some animals share similar faeces-borne parasites and pathogens. For this reason, even treated faecal waste is extremely dangerous and is not recommended for applying as sludge to soil where root and vegetable crops are cultivated.

The disposal of liquid overflow (supernatant) from the digester may occasionally have adverse effects. Normally this liquid is clear and odourless and has some value as a dissolved fertilizer. If water is scarce, the supernatant may be recycled into the digester with new organic feedstock. Otherwise, it can be used to water plants or moisten compost materials. However, with an improperly working digester, the supernatant may be dark and offensive. If it is not recycled, this liquid should be buried or mixed with soil at an isolated spot.

As with natural gas, biogas composition should be tested and precautions taken to prevent leaks and losses. Surveillance is also important, since biogas is usually odourless and difficult to detect. In closed rooms, leaking gas can lead to asphyxiation or explosion.

In areas where manure or dung is considered a free community resource, the installation of biogas digesters can cause unwanted changes in local economics. For

example, if manure suddenly becomes more valuable than usual, it can become a marketable commodity that is no longer available to the poor. In the initial planning stages, the question of who stands to lose or gain from an energy project is one that deserves attention. Thus, community input is important.

4.2.4 Solar Energy

The sun is an important source of clean and abundant energy in many parts of Pakistan. But the use of solar energy is not yet widespread, for both technical and economic reasons. While the cost of converting solar energy into electricity continues to fall, it is still high enough to discourage widespread application in many developing countries. All forms of forage production capture solar energy. Adverse environmental impacts associated with solar energy include:

- ⌚ pollution caused during the manufacture of solar devices;
- ⌚ acid battery spillage; and
- ⌚ improper disposal of batteries.

These impacts, which are usually manageable, should be weighed against solar power's potential to reduce deforestation and improve air quality for women and children. To maintain a photovoltaic system, people need only clean the panel surface regularly. However, trained individuals must do the cleaning to avoid damage to the cells. Systems must also be protected against theft and vandalism.

4.2.5 Specific Interventions for Technological Innovations

A) Wind Mills

Environmental Guidelines

- a) Serious depletion of ground water aquifers is happening due to higher level of ground water abstractions in non-irrigated areas in general, and especially in following districts:

- ⌚ Balochistan: Quetta, Pishin
- ⌚ NWFP: Karak, Kohat, Bannu, and D.I. Khan

Installation of windmill in these districts needs special local level justification in the IER.

- b) Contaminated water with coliforms, fecal coliforms, florides, and nitrate causes moderate to high significance health impacts to the community. Test reports are needed for these parameters for the nearby tube well, and at bore hole stage for the proposed windmill.
- c) High prevalence of arsenic contamination has been reported in the following districts of Pakistan:

- ⌚ Punjab: Multan, R.Y. Khan, Bahawalpur, D.G. Khan, Layyah, Muzaffargarh, Sargodha, Jhang, Gujrat, and Jehlum
- ⌚ Sindh: Dadu, Khairpur, Nawabshah, and Tharparker
- ⌚ NWFP: Mardan

These districts are on the negative list for the deep drinking water abstractions. For installing windmill in these districts under local level urgencies and demands produce following test reports:

- ⌚ Arsenic ground water test report for the nearest tube well under WHO guidelines
 - ⌚ Arsenic ground water test report from the bore hole dug for the proposed windmill under WHO guidelines
- d) Individual negative environmental impacts of windmill are marginal on aquifers depletion; however, their cumulative impacts along with other tube wells in the area are moderate to high.
- e) Health impacts due to use of contaminated water for drinking purposes are moderate to high for the community health.

Mitigation Measures

- a) Attach the test report of the nearest tube well water quality with the proposal.
- b) Conduct water **testing** at borehole stage and confirm that the water is not contaminated by coliform, fecal coliform, nitrate, arsenic, and fluoride. Attach the test report with the completion report.
- c) Attach battery of taps and animal turf with water storage tank attached to the windmill.
- d) Design and implement proper drainage and safe wastewater disposal system to avoid creation of stagnant pool.
- e) Community is informed that the water tank needs to be cleaned every three months.

B) Micro Hydel (less than 5 MW)

Environmental Guidelines

- a) Micro hydels should only be implemented with community consultations and consensus to avoid social conflicts.
- b) Micro hydels should not cause changes in the down stream flows, existing irrigation system and ensure that down stream users and fish life is not disturbed.
- c) Soil erosion mitigation measures are mostly needed for most of the slopes linked to micro hydel.

Mitigation Measures

- a) Compensate the effected persons of the project under market price mechanism – *provide verifiable information in the completion report*
- b) Empirical information incorporated in the design, and completion reports to confirm that the project will not change the down stream flows, irrigation system, and water uses will not be affected by the project.
- c) Soil erosion is mitigated by implementing check dams, and retention walls, and other slope stabilization measures.

d) Smooth sediment flows are ensured by design, implementation, and operations.

C) Micro Hydel (5 to 50 MW)

IEE is an important tool for incorporating environmental concerns at the project level. IEE is prepared at the project planning stage as part of feasibility study to ensure that the project is also feasible under environmental criteria.

In general, PPAF funded projects rarely require an IEE as a part of their environmental assessment. At present only one project that is 'Micro-hydel – 5 to 50 MW' requires an IEE.

Pakistan Environmental Assessment Procedures 1997 proposes a standard format for IEE. The same format is adopted for conducting IEE for the selected PPAF interventions. Following is the standard format for conducting IIE:

Executive Summary

Provide an executive summary where the IEE is more than 30 pages long.

Introduction

This section should include the following:

- Purpose of the report, including identification of the project and the Proponent (including a contact person, and details of any consultant associated with the IEE preparation), a brief description of the nature, size, and location of the project, and other pertinent background information.
- Extent of the IEE study, scope of the study, magnitude of effort, persons performing the study.

Description of project

Furnish sufficient details to give a brief but clear picture of the following (include only applicable items):

- Type and category of project
- Objectives of project
- Alternatives considered, and reasons for their rejection.
- Location (use maps and photographs showing general location, specific location and project site layout. Include land uses on the site and surroundings, details of population centers and nearby dwellings, road access, topographic and vegetation features of the site, and other sensitive land uses such as national parks, wild life reserves or archaeological sites.
- Size or magnitude of the operation, including capital cost, and associated activities. Proposed schedule for implementation.
- Description of the project, including drawings showing project layout, components of the project, etc. This information should be of the same extent as is included in feasibility reports, in order to give a clear picture of the project, its context and its operations.

- Details of restoration and rehabilitation plans at the end of the project life.
- Government approvals and leases required by the project.

Description of the environment (in area affected by project)

Furnish sufficient information to give a brief but clear picture of the existing environmental resources including the following (to the extent applicable, including photographs where relevant):

- physical resources topography, soil, climate, surface water, groundwater, geology /seismology;
- ecological resources fisheries, aquatic biology, wildlife, forests, rare or endangered species;
- human and economic development where applicable including, but not limited to:
 - population and communities- numbers , locations(summarize information in map form),composition, employment
 - industries, including known major development proposals
 - infrastructure—including water supply, sewerage, flood control/drainage, etc.
 - institutions
 - transportation—roads , rail, harbours, airports, navigable rivers
 - land use planning-including dedicated use areas
 - power sources and transmission;
 - agricultural and mineral development.
 - quality of life values (including, but not limited to):
 - socio-economic values
 - public health
 - recreational resources and development
 - aesthetic values
 - archaeological or historic treasures
 - cultural values

Screening of potential environmental impacts and mitigation measures

Using the Sectoral guidelines, which contain a checklist of environmental parameters for different sectors, screen out “no significant impacts” from those with significant adverse impact by reviewing each relevant parameter according to the following factors or operational stages. Mitigation measures, where applicable, should also be recommended:

- environmental problems due to project location;
- environmental problems related to design’
- environmental problems associated with the construction stage;
- environmental problems resulting from project operations;
- potential environmental enhancement measures: and
- additional considerations.

Environmental monitoring program and institutional requirement

This section of the report must describe the management plan and monitoring surveillance programs, including periodic progress reports to be established and continued by the proponent following granting of environmental approval. The Responsible Authority must be assured that all necessary environmental protection measures are carried out in future as planned. The program must be accompanied by the details of the institutional capacity of the proponent, including staff training and equipment which will be provided to ensure implementation and operations.

Conclusions

This section should include an evaluation of the screening process and should highlight whether significant environmental impacts exist which need further detailed study or an EIA. The IEE report should present the conclusions of the study briefly and concisely.

D) Micro Hydel (more than 50 MW)

Guidelines for Conducting an EIA

The guidelines for conducting an EIA for PPAF interventions are compiled by summarizing the PEPA EIA guidelines.

In order to follow the guidelines, understanding of the following basic definitions is pre-requisite:

- 1) Environmental components include geology, topography, soils, water resources, air quality, fauna, flora, biodiversity, ecosystems, economics, culture, religion, and local values.
- 2) Environmental impact essentially means deviations from a baseline situation (adverse/ beneficial, cumulative, direct, indirect, short, medium, long, irreversible, and reversible).
- 3) Assessment includes identifying/ predicting impacts, quantifying them, and assessing their significance.

The basic outline of the environmental impact assessment should address the following issues for evaluating the impacts of development. An EIA report shall, at a minimum, include complete information on the following topics:

a) Title and Executive Summary (include addresses and telephone numbers of the applicant(s), representative, and EIA preparer)

b) Project Description

- 1) Purpose and Justification
- 2) Location (including maps and lot numbers)
- 3) Proposed construction actions

c) Existing Environmental Setting (Baseline information including historical data)

1) *Natural Environment*

- a. Physical features (e.g. climate, topographic maps, geology)
- b. Natural Resources
 - i. Water
 - ii. Soils
 - iii. Biological
 - iv. Unique Feature (e.g. wetlands, etc.)
- c. Habitat
- d. Plants
- e. Animals

2) *Human Environment*

- a. Land Use (e.g. zoning, land use plans, etc.)
- b. Existing Infrastructure
 - i. Water
 - ii. Sewer
 - iii. Power
 - iv. Roads (access)
 - v. Drainage
- c. Unique Features (e.g. archaeological/cultural)

d) *Alternatives* (Considered/Selected)

- 1) Alternative locations
- 2) Alternative designs/site layouts
- 3) No Action Alternative
- 4) Preferred alternative (and reasons for selection)

e) *Alternatives compared* (impact analysis/comparative matrix)**f) *Project Impacts* (preferred alternative)**

- 1) Construction impacts
 - a. Permanent
 - b. Temporary
- 2) Operational
 - a. Direct
 - b. Indirect
- 3) Social/Cultural impacts
 - a. Infrastructure impacts
 - b. Cost of Living
 - c. Quality of Life
- 4) Cumulative Impacts (similar or dissimilar projects with observed or predicted impacts)

- 5) Estimate the significance or magnitude of environmental impacts and identify relevant criteria utilized to determine significance.
 - a. Based on existing statute, regulation or standard
 - b. Based on information specific to this study
 - c. Compared to existing studies
 - 6) Determine if the project requires an Environmental Impact Statement (EIS) based on Section F or a finding of no significant impact.
- g) *Mitigation*** - (Measures proposed to avoid, reduce or compensate for project impacts which are not significant)
- 1) Construction mitigation
 - a. Description of each proposed mitigation technique
 - b. Effectiveness of mitigation
 - c. Environmental monitoring
 - 2) Operational mitigation
 - a. Description of each proposed technique
 - b. Effectiveness
 - c. Environmental monitoring
- h) *Compliance with environmental statutes and regulations***
- 1) Water
 - 2) Air
 - 3) Pesticides
 - 4) Solid and Hazardous Wastes
 - 5) Protected or endangered species
 - 6) Protected habitat
- i) *Conclusions***
- j) *Appendices*** (supporting data)
- 1) Baseline Studies/Surveys
 - 2) Infrastructure Engineering Reports
 - 3) Archaeological Survey
 - 4) Other Data/Reports

C) Desalination Plant

Environmental Guidelines

- a) If the desalination tank is properly cleaned and maintained, there is rare possibility of water contamination under desalination process. Its poor efficiency can lead to higher value for TDS, but WHO has dropped this indicator from the drinking water indicators. Just for double- checking, **testing** of discharge water for coliform, fecal coliform, and nitrate is advised but not essential.

- b) Extracted salt can lead to local level soil contamination. Salt should be properly buried or disposed of by other alternative ways.
- c) Periodic cleaning of raw water tank is required to ensure that salt deposition and bacterial growth is not happening.

Mitigation Measures

- a) Conduct water **testing** of discharged water for coliform, fecal coliform, and nitrate.
- b) Dispose off the extracted salt by burring or other alternative means
- c) Prepare manuals and schedules for the cleaning of raw water tank, desalination water, and storage tank. Train community on the tanks cleaning.

D) Biogas Digesters

Environmental Guidelines

- a) Biogas plant is an environmentally friendly product. It does two functions; (a) Supply clean energy at the local level, and (b) generate bio-fertilizer (slurry) as a bye product. Biogas plant operations are relatively complex as compared to other PPAF CPI's. If the plant is operated under prescribed manual then they normally do not cause environmental impacts.
- b) Seepage from biogas well can cause groundwater contamination. Seepage control measures are incorporated in the design to mitigate this impact.
- c) Population safety from the emissions of the plant is normally achieved by locating plant at a safe distance from the villages.
- d) H₂S generation can cause serious environmental impacts in the form of community health. This issue is normally mitigated by incorporating H₂S treatment arrangements and by installing a right height stake.

Mitigation Measures

- a) Design and construct closed biogas well.
- b) Install water stoppers at the joints, use sulphate resistant cement for base and sub-base structures, use puddlo or other alternate material for plaster, and do bitumen coating at outer surface of underground structure to avoid seepage.
- c) Ensure sludge conveyance to the well is proper and 100% sludge is transferred to the well.
- d) Install proper arrangements for the monitoring of H₂S emissions.

- e) Prepare a comprehensive operating manual for the plant – the manual should cover major environmental concerns such as H₂S emissions controls, safety measures for cleaning the well, solid waste management, and seepage controls. The manual should also provide plant monitoring arrangements and frequency of monitoring for environmental indicators.
- f) Train community about the operations of the plant. The training should include; impacts of seepage to the groundwater, hazards of H₂S gas, and safety measures for handling H₂S gas emissions.

E) Solar Energy

Environmental Guidelines

Solar energy is environmentally friendly product, as such it does not cause any negative environmental

Mitigation Measures

Educate communities about the proper use and maintenance of solar energy plants such as regular cleaning of photovoltaic cells.

F) Energy Efficient Innovations (stoves)

Environmental Guidelines

Efficient cooking stove is environmentally friendly product. It causes positive environmental impacts in the form of decrease in deforestation, and improvement of females' health due to low emissions of carbon monoxide.

Mitigation Measures

Train people especially females about the proper use and operations of efficient cooking stoves

4.3 Access/Circulation

Some of the most significant adverse environmental impacts associated with road improvements may include:

A - Soil erosion

Soil erosion is often caused by failing to keep water off road surfaces. Roads that cross hilly or steep terrain without following contours or minimizing grades are especially susceptible to erosion, as are roads that collect water and do not have enough side drainage to handle heavy precipitation or abnormal flooding. Roads may also contribute to soil erosion through the development of multiple tracks, as travellers try to avoid standing water and ruts. Multiple track development occurs wherever inadequate attention is paid to keeping standing water off the road surface. Abandoned roads, if not properly

decommissioned, can also become gulleys, with severe erosion impacts. Other barren areas associated with roads can contribute to soil erosion, including building material sources, work areas, temporary routes, excessively wide shoulders, and turnout or parking areas.

B- Degradation of water quality

Water quality may be damaged by soil erosion and the siltation of nearby rivers, streams, lakes and wetlands. The chief indirect cause of siltation is agricultural development. Such development tends to increase significantly with the expansion of new roads into previously inaccessible areas, but can also occur with the rehabilitation or upgrading of existing roads. Siltation also occurs as a secondary effect of soil erosion resulting from road improvements. Adverse impacts on water quality may also be associated with poor management of fuel and lubricants at road camps, vehicle maintenance depots and fuelling areas.

C- Adverse effects on water quantity

Large quantities of water are needed to help prepare and compact the road surface during road construction and maintenance. Although this demand for water is temporary, it may significantly affect local water supplies. In arid and semi-arid areas, drawing water for road improvements may harm farm production, especially if the water is taken during dry seasons. Roads and quarries or “borrow pits” may also create artificial ponds and lakes (impoundments) that breed mosquitoes or harbour water-borne diseases. Road builders may create such ponds inadvertently, by damming gullies or other small catchment areas or streams, or intentionally, by constructing retention basins and settling ponds to minimize erosion and sedimentation.

D - Altered hydrology

Roads crossing areas with high water tables or wetlands may act like dams to block surface and sub-surface water flows. This is especially true where large quantities of initial material must be added to raise the road above the land surface, and where new material must be added annually to keep the road elevated. Under these circumstances, land on one side of the road can become much wetter than it was before the improvement, while land on the opposite side may be drier. This may adversely affect crop production, the composition of species in the local ecosystem, and road stability. Alternatively, poorly installed culverts in wet or meadow areas may concentrate water and then form gullies upslope and/or down slope of the road. These gullies can subsequently drain the area and contribute to drying up the wetland.

E- Deforestation

Opening up new roads for expanded agricultural development puts adjacent forests at risk, especially where no effective forest management systems are in place. Typically, the most significant impact on forests results from the clearing of land for farms. However, once a road is in place, it also provides access to people wanting to supply fuel wood.

F- Damage to valuable ecosystems and habitats

International concern over the protection of biodiversity continues to grow. Inadequate attention to biodiversity issues in road improvement projects can lead to the loss of species locally and to significant adverse effects on threatened or endangered species. New roads, or the rehabilitation of existing roads, may disrupt the integrity of plant and animal populations and permanently alter sensitive ecosystems.

The construction of new roads may also lead to the introduction of exotic or non-indigenous flora and fauna that may severely destabilize local plant and animal communities. Road access can also contribute to poaching and the trapping of exotic species. High-speed roads can significantly raise animal mortality (road kill).

G- Declines in scenic quality

Construction of new roads or the realignment of existing roads may adversely affect view sheds (scenic vistas). Under some circumstances, such damage can lower tourism revenues. The cumulative effects of poorly located and poorly managed quarries and borrow pits supplying building materials for road projects may also cause significant loss in scenic values.

H- Adverse impacts on human health and safety

Potential concerns include:

- ⌚ *Dust and noise.* Depending on local conditions and the vicinity of houses and communities, dust and noise may damage human health during construction and, especially, once the road is in use. The health of road construction and maintenance staff may also be adversely affected by noise and dust produced from construction, road rehabilitation and maintenance.
- ⌚ *Spread of water-borne diseases.* Where poor road design and maintenance result in poor drainage and areas of standing water, the risk of water-borne disease such as cholera or malaria increases. The same is true for standing water found in open quarries and borrow pits.
- ⌚ *Traffic hazards.* Road improvements, especially those that allow increased vehicular speed, can lead to significant increases in accident rates for both human and animal populations.
- ⌚ *Road works hazards.* The operation of road works machinery often endangers both operators and labourers during construction and road maintenance. Poorly planned borrow pits and quarries for road works can also pose threats, ranging from falls from quarry faces to drowning in quarry pits that have become standing water reservoirs.

I- Change local culture and society

The development of new roads, or rehabilitation of existing ones, often improves personal livelihoods. Access to educational opportunities and to social services, including health care, is often a key rationale for road improvements. However, socio-

cultural values may also be altered and the stability of communities adversely affected by exposure to rapid social change or tourism. Road construction and maintenance may also provide income for local labourers and farmers. However, under some circumstances it could compete with farms for labour during harvest and planting seasons.

4.3.1 Construction Activities

Virtually all small-scale development activities — housing, sanitation, water supply, roads, healthcare, energy, etc. — involve some amount of construction. Construction is one or more of a set of diverse activities: demolition; site-clearing; grading, levelling, and compacting soil; excavating; laying pipe; installing equipment; or erecting structures. The development benefits of construction come not from the construction itself, but from the buildings and infrastructure which are its result.

The details of the construction carried out in support of any particular development activity or site will have a number of unique aspects. Construction activities in general, however, share a set of common features and potential adverse environmental impacts.

This section addresses a number of these common elements. It is intended to apply to the types of projects mentioned above, as well as the construction of schools, health posts, storage silos, market or community centres, irrigation schemes, and any similar small-scale construction projects. It is only intended to identify key issues and illustrate potential mitigation measures associated with the construction process.

Construction projects may cause both direct and indirect potential adverse environmental impacts. An example of a direct impact is the filling of a wetland to use as a project site. Indirect impacts are induced changes in the environment, population, and use of land and environmental resources. Examples of indirect impacts include:

- ⌚ in-migration of population to take advantage of schools, health posts or other infrastructure;
- ⌚ effects on fish spawning associated with siltation of streams from soil erosion at a construction site; or
- ⌚ the spread of disease from insect vectors breeding in flooded and abandoned quarries and borrow pits (areas from which construction materials were excavated, or “borrowed”).

Another example could be a construction project’s use of unsustainably extracted timber, which may contribute to the degradation of a forest some distance away. Direct impacts often receive more attention, but indirect effects can be just as significant.

Direct and indirect impacts of *associated* or *ancillary* activities also need to be considered. For example, construction of a small-scale irrigation system may require construction of a new road or improvement of an existing road so that materials and equipment can reach the project site. The road is an associated or ancillary activity, with its own set of environmental impacts. The size and scope of both indirect and ancillary effects may be magnified over time, or through the cumulative effects of building many small facilities.

Construction can also have significant effects on public health—for example, the spread of communicable diseases is often associated with workers and construction camps. Standing water in quarries and borrow pits may become sources of contaminated water and disease-bearing insects.

All potential impacts should be considered and mitigated to the extent possible, but the most significant impacts should be addressed first. As with any project, the best way to accomplish this is by careful planning and incorporation of mitigation measures into project design. Environmental impacts of special concern include:

(i) Damage to sensitive or valuable ecosystems

Construction in wetlands, estuaries or other sensitive ecosystems may destroy or significantly damage exceptional natural resources and the benefits they provide. This damage may reduce economic productivity, impair essential ecosystem services (such as flood control or breeding habitat for food fish), or degrade the recreational value of these resources.

Compaction of the soil and grading of the site may alter drainage patterns and water tables, changing access to water by animals, people and vegetation, and may degrade water resources as well (see below). Improper extraction of construction materials such as wood, stone, gravel, or clay may damage terrestrial ecosystems (e.g., wood may come from relatively undegraded forests).

(ii) Sedimentation of surface waters

Removal of natural land cover, excavation, extraction of construction materials and other construction-related activities can result in soil erosion. Erosion can, in turn, lead to sedimentation in receiving waters. Sedimentation may reduce capacity of ponds and reservoirs, increasing flood potential, or substantially alter aquatic ecosystems by changing streambed, lakebed and estuary conditions.

(iii) Contamination of ground and surface water supplies

Toxic materials are often used in construction. Examples include solvents, paints, vehicle maintenance fluids (oil, coolant), and diesel fuel. If these are dumped on the ground or wash into streams they may contaminate ground or surface water supplies. This may harm the health of the local community, as well as populations living down gradient and downstream. Aquatic and terrestrial ecosystems may also be damaged. Where sanitary facilities for construction crews are inadequate, human waste may contaminate water resources.

(iv) Adverse social impacts

Construction may displace local inhabitants, or reduce their access to environmental resources. (For example, farmers' income or subsistence may be reduced.) Construction on or near culturally important sites (cemeteries, worshipping areas, meeting places) may generate conflict with the local community. If the new facility provides a valuable service not available elsewhere, it may cause migration to the

area. Noise and dirt from the site may disturb neighbours. If local labour is not used, this may also generate resentment.

(v) Spread of disease

An influx of construction workers from other regions or construction of a new road may introduce new diseases to the local population or increase the incidence of local infection.

Specific types of facilities such as those for healthcare, sanitation, and solid waste can also increase the spread of a variety of diseases unless they follow proper waste-handling procedures.

Table 4-3: Environmental Impacts and Mitigation for Construction-Related Aspects of Development Projects

Issue or aspect of activity	Impact <i>The activity may...</i>	Mitigation
Site Selection		
Site occupied or used by local residents	⌚ Displace untenured residents or reduce farmers' or pastoralists' lands	⌚ Find alternative location. If that is not possible: <ul style="list-style-type: none"> • Provide equivalent land and/or accommodations or fair monetary compensation, provided these are accepted voluntarily and without coercion.
Dwellings located close by	⌚ Facility and/or construction disturbs neighbours, creating noise and dust	⌚ Build as far as practical from neighbours. ⌚ Concentrate noisiest types of work into as short a period as possible, and during least disruptive times of the day. Take measures to keep dust to a minimum.
Site has historic, cultural, or social importance	⌚ Offend local population; damage local social fabric	⌚ Find alternative site.
Site contains habitat for important ecosystems, animals or plants	⌚ Destroy or harm plants or animals of ecological, cultural, and/or economic importance	⌚ Find alternative location. If that is not possible: <ul style="list-style-type: none"> • Limit access to the site; • Design any infrastructure (if unavoidable) to create least impact; • Minimize disturbance of native flora during construction ; • Remove, without destroying, large plants and ground cover where possible ; • Replant recovered plants and other flora from local ecosystem after construction.

Issue or aspect of activity	Impact <i>The activity may...</i>	Mitigation
Site has important scenic, archaeological or cultural / historical features	⌚ Destroy or harm these sites	⌚ Find alternative location. If that is not possible: <ul style="list-style-type: none"> • Limit access to site. • Design any infrastructure (if unavoidable) to create least impact; • Minimize disturbance of site during construction.
Site is wetland or abuts body of water	⌚ Destroy or harm valuable and sensitive ecosystems and organisms	⌚ Find alternative site. Wetlands and riparian ecosystems (those sited next to a body of water) are extremely sensitive. Wetlands provide important environmental services such as water storage, bird and animal habitat, flood control, and filtering toxins and nutrients from runoff. If no alternative is available: <ul style="list-style-type: none"> • Set back any infrastructure as far as possible from the water body/wetland and minimize the amount of wetland destroyed by infrastructure footprint or construction; • Re-vegetate as soon as possible.
Site is steeply sloped	⌚ Cause erosion and damage to terrestrial and aquatic ecosystems during construction or use	⌚ Find alternative site. If that is not possible: <ul style="list-style-type: none"> • Design facility and apply construction practices that minimize risk, e.g., use hay bales to control erosion during construction. Pay particular attention to potential erosion and redirection of water flows during design and construction; • Re-vegetate as soon as possible; • Maintain design features.
Area is heavily wooded	⌚ Degrade forest, contributing to flooding potential	⌚ Find alternative location if area is old growth or relatively undegraded forest. If that is not possible: <ul style="list-style-type: none"> • Design so as to minimize clearing or disturbance; • Avoid destroying rare or unique species. Consult with local populations about current use of forest and preferences for preservation.

Issue or aspect of activity	Impact <i>The activity may...</i>	Mitigation
Site prone to flooding	<ul style="list-style-type: none"> ⌚ Be destroyed and/or subject workers or inhabitants to risk of injury or death ⌚ Cause environmental damage from accidental release of toxic, infectious or otherwise harmful material during flooding ⌚ Contaminate drinking water 	<ul style="list-style-type: none"> ⌚ Find alternative site or design infrastructure so it is raised above flood plain, if possible. ⌚ Design infrastructure to minimize risk, e.g., design with proper grading and drainage. ⌚ Maintain design features such as drainage structures. ⌚ Avoid constructing sanitation or other facilities that will use and store harmful materials at flood-prone sites. If that is not possible: <ul style="list-style-type: none"> • Choose closed disposal systems, instead of septic tanks or detention ponds.
Area and/or site prone to landslides	<ul style="list-style-type: none"> ⌚ Be destroyed and/or expose workers or inhabitants to risk of injury or death ⌚ Cause environmental damage from accidental release of toxic, infectious or otherwise harmful material ⌚ Contaminate water supplies 	<ul style="list-style-type: none"> ⌚ Find alternative site on stable ground. If that is not possible: <ul style="list-style-type: none"> • Design infrastructure to minimize risk, e.g., plant trees all around facility; • Maintain protective design features; Avoid constructing sanitation or other facilities that will use and store hazardous or bio-hazardous materials at landslide-prone sites. If that is not possible: <ul style="list-style-type: none"> Choose closed disposal systems, instead of septic tanks or detention ponds.
Construction		
Construction crews and camps	<ul style="list-style-type: none"> ⌚ Contaminate surface water and spread disease via solid waste and faeces generated by camps ⌚ Deplete local fauna and flora (especially game and fuel-wood) via poaching and collection by construction crews 	<ul style="list-style-type: none"> ⌚ Use local or regional labour, if possible. ⌚ Provide temporary sanitation on site, e.g., pit latrine. ⌚ Set guidelines prohibiting poaching and collection of plants/wood with meaningful consequences for violation such as termination of employment. Provide adequate quantities of food and cooking fuel; both should be of good quality.

Issue or aspect of activity	Impact <i>The activity may...</i>	Mitigation
Use of heavy equipment	<ul style="list-style-type: none"> ⌚ Cause erosion due to machinery tracks, damage to roads, stream banks, etc ⌚ Compact soil, changing surface and groundwater flows and damaging future use for agriculture ⌚ Contaminate ground or surface water when machinery repairs result in spills or dumping of hydraulic oil, motor oil or other harmful mechanical fluids. 	<ul style="list-style-type: none"> ⌚ Minimize use of heavy machinery. ⌚ Set protocols for vehicle maintenance such as requiring that repairs and fuelling occur elsewhere or over impervious surface such as plastic sheeting. Prevent dumping of hazardous materials.
Demolition of existing structures	<ul style="list-style-type: none"> ⌚ Bother or endanger neighbours via noise, dust, and debris from demolition ⌚ Contaminate soil, groundwater or surface water from demolition waste containing residual amounts of toxic materials (e.g., leaded paint) 	<ul style="list-style-type: none"> ⌚ Recover all reusable material. ⌚ Determine whether toxic materials are present. If possible, dispose of waste in a lined landfill.
Site clearing and/or levelling	<ul style="list-style-type: none"> ⌚ Damage or destroy sensitive terrestrial ecosystems in the course of site clearing/preparation ⌚ Produce areas of bare soil which cause erosion, siltation, changes in natural water flow, and/or damage to aquatic ecosystems 	<ul style="list-style-type: none"> ⌚ Minimize disturbance of native flora during construction. ⌚ Remove, without destroying, large plants and ground cover where possible ⌚ Use erosion control measures such as hay bales. ⌚ Replant recovered plants and local flora as soon as possible.
Excavation	<ul style="list-style-type: none"> ⌚ Cause erosion, siltation, changes in natural water flow, and/or damage to aquatic ecosystems when excavated soil is piled inappropriately ⌚ Expose inhabitants and crew to risk of falls and injuries in excavation pits 	<ul style="list-style-type: none"> ⌚ Cover pile with plastic sheeting, prevent runoff with hay bales, or similar measures. ⌚ Place fence around excavation.
Filling	<ul style="list-style-type: none"> ⌚ Block water courses when fill is inappropriately placed ⌚ Destroy valuable ecosystems when fill is inappropriately placed ⌚ Result in land subsidence or landslides later if fill is inappropriately placed, causing injuries or damage 	<ul style="list-style-type: none"> ⌚ Do not fill the flow-line of a watershed. ⌚ Be aware that in arid areas, occasional rains may create strong water flows in channels. A culvert may not supply adequate capacity for rare high volume events such as flash floods. ⌚ Design so that filling will not be necessary.

Issue or aspect of activity	Impact <i>The activity may...</i>	Mitigation
Source of building materials	<ul style="list-style-type: none"> ⌚ Damage aquatic ecosystems through erosion and siltation ⌚ Harm terrestrial ecosystems via harvesting of timber or other natural products ⌚ Spread vector-borne diseases when stagnant water accumulates in active or abandoned quarries or borrow pits and breeds insect vectors 	<ul style="list-style-type: none"> ⌚ Identify the most environmentally sound source of materials within budget. ⌚ Develop logging, quarrying and borrowing plans that take into account cumulative effects. ⌚ Monitor adherence to plans and impacts of extraction practices. Modify as necessary. ⌚ Fill in quarries and pits before abandoning. ⌚ Control runoff into pit.
Decommissioning		
Hazardous abandoned structures	<ul style="list-style-type: none"> ⌚ Buildings with collapsing roofs and walls, open latrines or septic systems, accumulation of rubble 	<ul style="list-style-type: none"> ⌚ Remove or bury all abandoned construction materials and rubble. ⌚ Fill in and close all latrines and septic systems.

4.3.2 Specific Interventions for Access/Circulation

A) Culverts

Environmental Guidelines

- a) Under size culverts can cause local level flooding, and erosion of embankments. Design right size culverts
- b) Construction waste is normally left at the site. Construction waste should be properly disposed after the completion.

Mitigation Measures

- a) Design a right size culvert with respect to project peak flows to avoid flooding, and erosion.
- b) Properly dispose waste construction material

B) Street Surfacing/Lining

Environmental Guidelines

- a) Dust emission during street surfacing/lining is the most common environmental issue. Water spray on the construction site and alternate route for the commuters is the easiest method for controlling dust. Along with this periodic compaction of the soil at the street under surfacing/lining and alternate route.
- b) Construction waste is normally left at the site. Construction waste should be properly disposed after the completion.

Mitigation Measures

- a) Provide and instruct the contractor about the schedule of water spray and compaction of both street under surfacing/lining and alternate route.

- b) Properly dispose waste construction material.

C) Bridges

Environmental Guidelines

- a) Under environmental criteria factors of disturbance to natural habitat, disruption to wildlife, and inconvenience to commuters are considered for the site selection of the bridge.
- b) In some cases blasting is involved for clearing the right of way for the bridge. Blasting without proper arrangements and safeguards can lead to injuries and life losses. There are standard safety procedures for blasting; these standards should be adopted by the project.
- c) Bridge construction might involve acquisition of land, houses, buildings and other physical infrastructure. Wherever acquisition is involved that should be executed with the consent of the stakeholders, and the stakeholders should be properly compensated at market prices under the agreed rates between proponent and stakeholders.
- d) In most of the cases trees are cut to clear the right of way. Simple compensation for tree cutting is that plant two trees for every tree cut.
- e) Dust emission during the construction is mitigated by periodic water sprinkling.
- f) Temporary safe alternate routes are provided to the commuters to avoid inconvenience.
- g) Waste construction material, debris, and spoil heaps should be properly disposed. Generally waste construction material and debris are thrown in the rivers/streams. This is seriously a wrong practice; it can cause blockage in water body and consequently local level flooding.
- h) Communities in the vicinity are properly informed about the construction activity, timings, schedules, and safeguards for securing community consent and avoiding any unpleasant accident.

Mitigation Measures

- a) Prepare environmental profile of the area, the profile should provide information about the important ecological, cultural, reserve forests, bio-diversity, and other important features of the area.
- b) Inform communities about detailed activity plan, secure community consent, and implement all the safeguards agreed with the community.
- c) Acquire land and buildings on market rates in agreement with the stakeholders. Make proper formal arrangements for the payment of compensations, and generate verifiable information for the payment of compensation.
- d) Adopt safety measures for blasting.
- e) Use pre-stress structures wherever possible.
- f) Include and implement stabilization of downstream slopes or banks as part of the design.
- g) Minimize tree cutting, and plant two trees for every tree cut along the new road.
- h) Provide and instruct the contractor about the schedule of on-site and alternate route water-sprinkling schedule.
- i) Properly dispose waste construction material and spoil heaps.

D) Cause Ways

Environmental Guidelines

- a) Causeway repair or construction can lead to down stream slope destabilization and soil erosion. This environmental impact is normally mitigated by: construction in dry seasons, using pre-stress structures, in case of on-site construction of slab light weight rollers are used, and earth works are executed for the stabilization of downstream slopes.
- b) Dust emission during the construction is mitigated by periodic water sprinkling.
- c) Temporary safe alternate routes are provided to the commuters to avoid inconvenience.
- d) Waste construction material and debris should be properly disposed. Generally waste construction material and debris are thrown on the downstream slopes. This is seriously a wrong practice; it can cause inconvenience and accidents for the downstream communities along with marginal ecological losses.
- e) Downstream communities are properly informed about the construction activity, timings, schedules, and safeguards for securing community consent and avoiding any unpleasant accident.

Mitigation Measures

- a) Inform the downstream communities about detailed activity plan, secure community consent, and implement all the safeguards agreed with the community.
- b) Schedule construction preferably in dry season.
- c) Use pre-stress structures wherever possible, in case of on-site construction of slab, use lightweight rollers.
- d) Include and implement stabilization of downstream slopes as part of the design.
- e) Provide and instruct the contractor about the schedule of on-site and alternate route water-sprinkling schedule.
- f) Properly dispose waste construction material.

E) Retaining Wall

Environmental Guidelines

Retaining wall normally does not cause environmental impacts. It is suggested that wherever possible use local materials to avoid the transportation of material and ensure that the structure design ensures the safety of people in case of break down.

Mitigation Measures

- a) Location and structure design ensures the safety of people.
- b) Wherever possible local material has been used for construction.

F) Link Roads (plain areas)***Environmental Guidelines***

- a) Link road construction might involve land acquisition, houses, buildings and other physical infrastructure. Wherever acquisition is involved that should be executed with the consent of the stakeholders, and the stakeholders should be properly compensated at market prices under the agreed rates between proponent and stakeholders.
- b) In most of the cases trees are cut to clear the right of way. Simple compensation for tree cutting is that plant two trees for every tree cut.
- c) Dust emission during the construction is mitigated by periodic water sprinkling.
- d) Temporary safe alternate routes are provided to the commuters to avoid inconvenience.
- e) Waste construction material and debris should be properly disposed. Generally, waste construction material and debris are left unattended on the site.
- f) Communities along the road should be properly informed about the construction activity, timings, schedules, and safeguards for securing community consent and avoiding any unpleasant accident. Preferably work should not be executed during night.

Mitigation Measures

- a) Inform communities about detailed activity plan, secure community consent, and implement all the safeguards agreed with the community.
- b) Acquire land and buildings on market rates in agreement with the stakeholders. Make proper formal arrangements for the payment of compensations, and generate verifiable information for the payment of compensation.
- c) Minimize tree cutting, and plant two trees for every tree cut along the new road.
- d) Provide and instruct the contractor about the schedule of on-site and alternate route water-sprinkling schedule.
- e) Properly dispose waste construction material.

G) Link Roads (Mountain Areas)***Environmental Guidelines***

- a) Most important environmental threat associated with the link roads in mountain areas is that they might open-up ecologically sensitive and important areas such as reserve forests, bio-diversity areas etc. Access to these areas lead to exploitation of important natural resources. These resources are performing known and unknown multiple ecological functions. No community development project is allowed to threaten such important areas. It is strategically attempted not to open-up these areas.
- b) Second most important negative environmental impact attached to link roads in mountain areas is that the construction of such roads leads to serious land erosion and landslides. This impact is mostly mitigated by up and down stream slope stabilization, thick vegetation, and by using lightweight rollers or other manual means of compaction.

- c) In some cases blasting is involved for clearing the right of way for the road. Blasting without proper arrangements and safeguards can lead to injuries and life loss. There are standard safety procedures for blasting; proponent should adopt these procedures.
- d) Link road construction might involve land acquisition, houses, buildings and other physical infrastructure. Wherever acquisition is involved that should be executed with the consent of the stakeholders, and the stakeholders should be properly compensated at market prices under the agreed rates between proponent and stakeholders or any other arrangement agreed on consensus basis among stakeholders.
- e) In most of the cases trees are cut to clear the right of way. Simple compensation for tree cutting is that plant two trees for every tree cut.
- f) Link road repair or construction can lead to down stream slope destabilization and soil erosion. This environmental impact is normally mitigated by: construction in dry seasons, using pre-stress structures, in case of on-site construction of slab light weight rollers or manual compaction means are used, and earth works are executed for the stabilization of downstream works.
- g) Dust emission during the construction is mitigated by periodic water sprinkling.
- h) Temporary safe alternate routes are provided to the commuters to avoid inconvenience.
- i) Waste construction material and debris should be properly managed. Generally waste construction material and debris are thrown on the downstream slopes. This is seriously a wrong practice; it can cause inconvenience and accidents for the downstream communities along with marginal ecological losses.
- j) Downstream communities are properly informed about the construction activity, timings, schedules, and safeguards for securing community consent and avoiding any unpleasant accident.

Mitigation Measures

- a) Prepare environmental profile of the area, the profile should provide information about the important ecological, cultural, reserve forests, bio-diversity, and other important features of the area.
- b) Inform the downstream communities about detailed activity plan, secure community consent, and implement all the safeguards agreed with the community.
- c) Acquire land and buildings on market rates in agreement with the stakeholders or any other arrangement agreed on consensus basis among stakeholders. Make proper formal arrangements for making compensations, and generate verifiable information for compensation.
- d) Adopt safety measures for blasting.
- e) Schedule construction preferably in dry season.
- f) Use pre-stress structures wherever possible, in case of on-site construction of slab, use lightweight rollers or manual compaction.
- g) Minimize tree cutting, and plant two trees for every tree cut.
- h) Include and implement stabilization of downstream slopes as part of the design.
- i) Provide and instruct the contractor about the schedule of on-site and alternate route water-sprinkling schedule.
- j) Properly manage waste construction material.

4.4 Wastewater Management

4.4.1 Water Supply and Sanitation

There are many definitions of sanitation and sanitary latrines. The UNICEF study referred to above statement that, “The excreta disposal system may be considered adequate if it is private or shared (but not public) and hygienically separates the human excreta from the human contact” and “does not have an unacceptable impact on the environment.” Improved sanitary latrines in this context include the following technologies:

- a) Connection to public sewer
- b) Connection to septic system
- c) Pour flush latrine
- d) Simple pit latrine
- e) Ventilated pit latrine

Over the past three decades, international experience has shown that water supply and sanitation activities are most effective and sustainable when they adopt following participatory approach:

- 1) Acts in response to genuine demand,
- 2) Builds capacity for operation and maintenance and sharing of costs,
- 3) Involves community members directly in all key decisions,
- 4) Cultivates a sense of communal ownership of the project, and
- 5) Uses appropriate technology that can be maintained at the village level. Also important are educational and participatory efforts to change behavioural practices.

The following information will help in assessing the impacts from a variety of rural and urban water supply and sanitation systems which include:

- ⌚ Hand-dug wells, small-diameter boreholes, wells with hand pumps and small dams
- ⌚ More complex water systems, including well or surface water source pump, storage tank and distribution to stand posts, extensions of existing urban water lines into unserved or under-served peri-urban zones
- ⌚ Sanitation systems covered here include: individual latrines; community latrines; small-scale septic systems; sewerage system; water stabilization ponds

4.4.2 Present Status of Water Supply and Sanitation

Nature has blessed Pakistan with adequate surface and groundwater resources. However, rapid population growth, urbanization of continued industrial developments have placed immense stress on water resources of the country. The extended droughts and non-development of additional water resources have further aggravated the water scarcity situation. Per capita water availability in Pakistan has been decreasing at a very high rate. The existing water resources are under threat due to rapid degradation, soil erosion, deforestation and untreated discharge of municipal and industrial wastes

to rivers and other water bodies. The increasing gap between water supply and demand has led to severe water shortage in almost all sectors.

Safe and clean water is the first line of defense in protecting public health and protecting the basic values that are fundamental to the quality of life. The water shortage and increasing competition for multiple uses of water adversely affects the quality of water. In this regard, the results of various investigations and surveys by several agencies have indicated that water pollution has become a serious problem in Pakistan. Most of the reported health problems are directly or indirectly related to water.

A- Sources of Drinking Water

The main sources of drinking water in Pakistan are groundwater. Hand pumps and motor pumps together provide 61 % of households with drinking water, rising to 70 % in rural areas. Motor pumps form an increasingly relevant part of this.

Punjab has the best rural water supply amongst the provinces. The vast majority of the rural population has either ripped water or water from a hand pump or motor pump. It is pointed out that according to the Pakistan Integrated Household Survey, water from a hand pump is, generally, cleaner than from a dug well or river/canal/stream. Only 7 % of the rural population depends on a dug well or on a river, canal or stream.

The situation in Sindh is considerably worse: some 24 % of the rural population depend on dug well/river/canal/ sources. The situation in rural Sindh also appears to have deteriorated over the recent period.

The rural water supply situation in NWFP is worse and is worst of all in Balochistan. In these two provinces, 46 and 72 % of the rural population, respectively, depend on water from a dug well or from a river/canal/stream. This is thought to include a large number of households depending on 'karez', which were subsequently classed with river/canal/stream.

B- Water Availability

Groundwater is one of the main sources of drinking water in major cities of Pakistan. Groundwater is pumped from private and government tube wells and used for drinking but also for gardening, washing and other purposes. City development authorities manage hundreds of tube wells for public water supply. Some of them are connected to distribution networks. Water from different sources are first collected in a sump and then supplied to the recipient area. Chlorination is usually done within the sump in cases where the water is pumped into a distribution network.

C- Groundwater Availability

For the purpose of drinking water sources Pakistan can be divided into five major zones:

- i) The sweet groundwater area where water is easily accessible for human consumption;
- ii) The groundwater areas where canal or river water is available;
- iii) The mountainous and hilly areas in the north where spring water is frequently available;
- iv) The eastern desert belt where groundwater may be available only at a greater depth; and
- v) Coastal belt of Pakistan where, generally, saline groundwater is available.

However, recent estimates of the availability and use of groundwater of an acceptable quality indicate that this resource has been heavily overexploited affecting both the quality and quantity of the groundwater.

D- Installation of Water Supply Schemes

In Pakistan, household themselves are the largest single supplier of drinking water, having arranged their own supply in 61% of cases. Provincial and Local Government in the form of Local Government and Rural Development Department (LG&RDD), the Public Health Engineering Department (PHED) and other local government bodies installed the water supplies of some 26% of households. They installed 94% of all piped water supplies; however Local Government was least important in Punjab and played the largest role in NWFP.

4.4.3 Sanitation in Pakistan

According to Pakistan Integrated Household Survey 2001-2, in Pakistan as a whole, 43% of the households do not have the toilet. This varies greatly between urban and rural areas. While, only 5% of urban households and 59% of rural households have no toilet. Rural areas have much poorer sanitation provisions than they do drinking water provision. However, there seems to have been some improvements in rural sanitation, with the slight improvement in the proportions of households without a toilet and an increase in the proportions of household using flush toilet. Rural Punjab has the highest proportion of household having no toilet at all, at 68%. Rural NWFP has the lowest, at 36%.

In Pakistan, only half the urban excreta are disposed off in the sewers or in open drains, the remainder is deposited on the roadside, into the waterways, or incorporated in solid waste. Solid and liquid excreta are the major sources of water pollution in the country and the cause of water borne and water washed diseases. Most of the excreta that reach sewers are not treated. Sewage treatment plants exist only in Karachi, Islamabad and a few military cantonments and most of them operate intermittently. Much of the untreated sewage goes into the irrigation system, where the wastewater is reused and discharged into the streams and rivers. Vegetables grown from wastewater have serious bacteriological contamination problems.

Thus the main challenges that Pakistan faces for sanitation are:

- No or unsafe disposal of excreta away from the dwelling units.

- Effective operation and maintenance mechanism for sanitation facilities is lacking.

4.4.4 PCRWR study on Water Quality Monitoring

Pakistan Council of Research in Water Resources (PCRWR) monitored water quality of 21 major cities, six rivers and 10 storage reservoirs and lakes during 2001.

Conclusions of the Study:

- Most of the drinking water samples are found fit for consumption with respect to physiochemical and aesthetic water quality parameters
- In none of the cities, all samples were safe from bacterial contamination. In Gujrat, Khuzdar, Loralai, and Ziarat, all the samples were found contaminated with coliform and E.Coli bacteria.
- Arsenic excess of safe limits in Multan, Bahawalpur, Sheikhpura, Lahore, Kasur, and Gujranwala
- Fluoride excess of safe limits in Loralai, Quetta, Kasur, Karachi, and Bahawalpur
- Iron excess of safe limits in Sukkur, Bahawalpur, Hyderabad, Loralai, Multan, Quetta and Lahore.
- Turbidity of water exceeding recommended levels in almost all the cities except Faisalabad, Kasur, Lahore, Sheikhpura, Sailkot, and Mangora.

4.4.5 Potential Environmental Impacts of Water Supply and Sanitation Schemes

A- Depletion of Fresh-water Resources

This may occur when projects do not adequately assess the quantity of available surface and groundwater, historically and seasonally. Other causes include poor mechanisms for regulating withdrawals and use of water, and insufficient monitoring and maintenance of leaks. Depletion of surface water sources destroys the resource itself, damages aquatic life, reduces economic productivity, diminishes downstream use, and curtails recreational possibilities. Exhaustion of groundwater can lead to land subsidence (sinking of the land's surface), altered groundwater flow in other locations, and loss of economic productivity. Overdrawing wells can alter groundwater flows or cause aquifers in coastal areas to experience salt-water intrusion, potentially leading to loss of drinking water sources locally or in downstream or down-gradient locations. Both these situations increase the cost of future water supply systems. In addition, depletion of water resources may lead to poorer water quality, health impacts, and elevated costs of potable water supplies in downstream or down-gradient locations.

B- Debilitating disease and death

Water supply and sanitation projects may cause increased incidence of infectious water-borne diseases such as cholera, non-infectious disease such as arsenic poisoning, and water-enabled diseases such as malaria. Especially serious is the contamination of surface and groundwater supplies with infectious organisms from human excreta. Contamination may be caused by poorly designed, operated or maintained sanitation facilities, such as sanitation systems that transfer sewage to receiving waters without treatment, or pit latrines located in areas with high water tables. Infectious diseases may also be spread by improper use of wastewater to grow food crops. Failure to test new sources of water, especially groundwater, for possible natural chemical contaminants, such as arsenic, can have devastating consequences (also refer 3.1).

C- Increased disease transmission from standing, stagnant water

Poor design, operation and/or maintenance of water supply improvements can lead to pools of stagnant water near water taps, water pipes and storage tanks. Improper or ineffective practices for disposing of excreta and solid waste make this problem worse. These pools form an excellent breeding place for disease vectors (mosquitoes that carry malaria, etc.). They can also increase transmission of water-related diseases, especially when the wet spots are clogged or contaminated with solid waste or excreta.

Table 4.4 and Table 4.5 contain details of potential environmental impacts, their causes and mitigation measures of water supply and sanitation projects respectively:

Table 4-4: Potential Environmental Impacts of Water Supply Projects, Causes and Mitigation Measures

Problems	Possible Impacts	Possible Causes	Mitigation Measure
1. Depletion of fresh water resources (surface and groundwater)	<ul style="list-style-type: none"> ⌚ Destruction of aquatic life ⌚ Loss of economic productivity ⌚ Loss of recreation areas ⌚ Land subsidence ⌚ Increased cost of water supplies in the future or in down-gradient locations 	<ul style="list-style-type: none"> ⌚ Overestimation of water supplies ⌚ Underestimation of water demand ⌚ Over-pumping of water resources ⌚ Waste and leakage of potable water ⌚ Poor practices, leading to excessive use, waste and leakage 	<ul style="list-style-type: none"> ⌚ Monitor water levels in wells or impoundment structures to detect overdrawing ⌚ Promote water conservation practices (e.g. water recycling and re-use where appropriate, rationing during the dry season, use of control valves and reducer pipes, etc.). ⌚ Include focus on proper use as part of behaviour change and education program
2. Degradation of the quality of potable water sources	<ul style="list-style-type: none"> ⌚ Concentration of pollution in surface water sources ⌚ Poorer quality water, with associated health problems ⌚ Increased water treatment costs in the future or in down-gradient locations 	<ul style="list-style-type: none"> ⌚ Depletion of surface and groundwater resources (see above) ⌚ Reduced stream flows ⌚ Runoff/drainage from improper solid and liquid waste or excreta disposal ⌚ Salt water intrusion 	<ul style="list-style-type: none"> ⌚ On coastal areas, keep withdrawals within safe yield limits to avoid overdrawing, possible salt water intrusion and contamination of the well ⌚ Don't let animals graze or be watered up- gradient from wellhead
3. Creation of stagnant (standing) water	<ul style="list-style-type: none"> ⌚ Increase in vector-borne diseases ⌚ Contamination of standing water with faecal matter, solid waste, etc., leading to health problems 	<ul style="list-style-type: none"> ⌚ Drainage systems lacking or poorly designed ⌚ Leakage from pipes/wastage from taps 	<ul style="list-style-type: none"> ⌚ Monitor and repair leaks from cracked containment structures, broken pipes, faulty valves and similar structures
4. Degradation of terrestrial, and aquatic, habitats	<ul style="list-style-type: none"> ⌚ Loss of biodiversity ⌚ Loss of economic productivity ⌚ Loss of natural beauty ⌚ Loss of recreational values ⌚ Soil erosion / sedimentation 	<ul style="list-style-type: none"> ⌚ Improper siting of facilities (within wetlands or other sensitive habitats, etc.) ⌚ Poor construction practice ⌚ Leakage/wastage from pipes and taps 	<ul style="list-style-type: none"> ⌚ Survey for, and avoid, wetlands, estuaries or other ecologically sensitive sites in the project area.
5. Increased human health risks	<ul style="list-style-type: none"> ⌚ Arsenic poisoning ⌚ Water-related infectious diseases 	<ul style="list-style-type: none"> ⌚ Failure to test water quality before developing the water resource ⌚ Lack of ongoing water quality monitoring ⌚ Biological contamination from inadequate protection of wells and water supply points 	<ul style="list-style-type: none"> ⌚ Ensure water is fit for drinking, for example, based on World Health Organization (WHO) guidelines, and ensure regular ongoing water testing by the community (of the water source and at various points along the water supply system).

Table 4-5: Potential Environmental Impacts of Sanitation Projects, Causes and Mitigation Measures

Problems	Possible Impacts	Possible Causes	Mitigation Measure
1. Increased human health risks from contamination of surface water, groundwater, soil, and food by excreta, chemicals and pathogens	<ul style="list-style-type: none"> ① Increased disease transmission associated with excreta (diarrhoeal, parasitic, etc.) ② Malnutrition caused by above diseases ③ High infant mortality ④ Reduced economic productivity ⑤ Poor quality surface and groundwater ⑥ Increased cost of water treatment for down-stream users 	<ul style="list-style-type: none"> ① Disposal of excreta or wastewater directly on land or into surface water without adequate treatment ② Improper siting of sanitation facilities near water supplies ③ Improper operation of sanitation facilities ④ Failure of sanitation facilities due to lack of maintenance ⑤ Improper use of wastewater in food production ⑥ Inadequate protection of groundwater 	<ul style="list-style-type: none"> ① Avoid disposal of excreta or wastewater directly on land or into water sources without adequate treatment. ② Avoid locating sanitation systems where the water table is high ③ Avoid the entry of contaminants from the sanitation system into the water source /supply system. ④ Protect water source and supply system from run-off or seepage of contaminants by using lids or covers on wells, well casing above ground level, fences, etc. ⑤ Avoid creating stagnant water ponds to reduce risks of water-borne diseases. ⑥ Implement a community education, training, and capacity building program to properly use, operate, and maintain the sanitation systems ⑦ WHO guidelines recommend (1) treat wastewater to reduce pathogen concentrations, (2) restrict use to crops that will be cooked, (3) use application methods that reduce contact with edible crops, and (4) minimize the exposure of workers, crop handlers, field workers and consumers to waste. ⑧ Wastewater used in aquaculture should have <math><10^3</math> faecal coliforms per 100 ml to minimize risk to public health.
2. Ecological harm from degradation of stream, lake, estuarine and marine water quality and degradation of land habitats	<ul style="list-style-type: none"> ① Health problems from contact with contaminated water ② Fish contamination ③ Eutrophication ④ Loss of biodiversity ⑤ Reduced economic productivity ⑥ Soil erosion and sedimentation 	<ul style="list-style-type: none"> ① Disposal of excreta or wastewater directly into sensitive areas without adequate treatment ② Improper operation or failure of sanitation facilities due to lack of maintenance ③ Improper siting of facilities (within wetlands or other sensitive habitats, etc.) ④ Poor construction practice 	<ul style="list-style-type: none"> ① Avoid disposal of excreta or wastewater directly into water bodies without adequate treatment. ② Minimize soil exposition during construction of structures (e.g. minimize vegetation clearing; minimize time when soil surfaces are exposed to rain and wind; resurface and re-vegetate exposed areas; implement buffer zones of vegetation; etc.).

4.4.6 Specific Interventions for Wastewater Management

A) Sanitation Schemes

Environmental Guidelines

1) General:

There are two sets of arrangements for the safe disposal of municipal wastewater (i) Latrines + T-hodies + Covered Drains/Sewerage System + Safe Disposal, and (ii) Latrines + Covered Drains/Sewerage System + Oxidation Pond + Safe Disposal. Both arrangements if properly constructed do the desired level of treatment. After this level of treatment the wastewater can be discharged to any natural water body, municipal and irrigation system. In case, if the water is discharged to irrigation system then make it sure that water is not applied to vegetable crops.

2) Latrines:

Conventional or flush latrines should be linked with P-traps; this will substantially reduce the possibilities of spread and contact of pathogens and other pollutants with the humans at the household level. Health improvement impact of effective latrines is only realized if the community is also trained on better hygienic and sanitation practices e.g. washing hands with soap after defecation, no open defecation in and outside house, and daily or twice a day cleaning of latrine.

3) Septic Tank:

Wastewater can be treated at the household level by installing septic tanks. In the presence of septic tanks, there is no need to construct oxidation ponds. It is important that septic tank should be lined with concrete, unlined septic tanks cause groundwater contamination. The community needs to be trained for the proper cleaning and maintenance of the septic tank.

4) Drains:

Open drains do not serve the purpose of safe sanitation. In open drains the possibility of human-pollution contact remain high, these drains only serve the purpose of conveyance, and throughout conveyance human-pollution interaction remain active. This interaction causes serious negative impacts on the community health. Whenever drains will be improved or lined then these must be converted into covered drains. During construction of drains, alternative drainage system is provided to reduce the inconvenience to the community and reducing the possibility of human-pollution interaction.

Water is sprinkled periodically throughout the construction period for controlling dust emission. At the completion of the construction work, the debris of construction material should be properly disposed.

5) Oxidation Ponds:

Depth of the pond determines about the type of treatment process happening in the pond. Normally facultative ponds are 3-4 ft deep, and treatment happens through anaerobic conditions at the bottom and aerobic conditions at the surface. Anaerobic ponds are 10-15 ft deep, and treatment happens through anaerobic conditions. Anaerobic pond more or less functions as septic tank. Lining of both types of ponds is essential to eliminate the possibilities of groundwater contamination due to seepage. Brick or concrete lining is very expensive, 6 inches lining by puddle clay is equally effective by function and it is also very cost effective. In case facultative or anaerobic pond has been constructed then there is no need to construct septic tanks at the household level.

Mitigation Measures

1) Latrines

- ⌚ Install P-traps to both conventional and flush latrines
- ⌚ Train community on better hygienic and sanitation practices

2) T-Hodies or Septic Tank

- ⌚ Line the T-hodies or septic tank with brick or concrete lining
- ⌚ Inform community about the frequency of cleaning

3) Drains

- ⌚ Construct only covered drains
- ⌚ Sprinkle water periodically during construction
- ⌚ Provide alternate drains during construction

4) Oxidation Pond

- ⌚ Line the pond with 6 inches puddle clay
- ⌚ Inform community about the pond cleaning method and frequency
- ⌚ Inform community and ensure that the treated wastewater will not be applied to the vegetable crops

4.5 Other Projects

4.5.1 Solid Waste Management Schemes

Pakistan, like other developing countries, faces serious environmental problems. Rapid population growth (average annual growth rate of 2.61 percent a year) and impressive GDP growth (of about 6 percent a year) have put enormous pressure on the country's natural resource base and have significantly increased levels of pollution. Solid waste generation in Pakistan ranges between 0.283 to 0.612 kg/capita/day and the waste generation growth rate is 2.4 percent per year.

Solid waste collection by government owned and operated services in Pakistan's cities currently averages only 50 percent of waste quantities generated; however, for cities to be relatively clean, at least 75 percent of these quantities should be collected. To achieve this level, a large capital investment is required.

Municipal collection of household waste is quite irregular and limited to influential areas. As a result solid waste remains scattered throughout the remaining area. Number of dustbins and constructed filth depots are too less in comparison with urban population. Furthermore, most of them are not located according to community's requirements. Moreover, the people are also dominantly inhabitable to make use of such facilities. Municipal street sweeping services are irregular and limited to main roads and influential areas. Many vehicles available with respective municipalities are reported out of order while remaining is used for many other purposes besides the misuse by staff. The operations of loading and unloading of municipal solid waste are generally manual. Physical layout of cities which are characterized with narrow and blind streets restricts the extension of municipal services to these areas.

The most of municipalities have been unable to manage some reasonable piece of land either owned or on lease for the disposal of waste, owing to the lack of funds. The scavengers play an important role in solid waste management as they separate recyclable at various stages of existing solid waste management but there is little support for recycling. During their operation they have been found spreading the waste further and making it more complex to deal with.

There is poor management of hazardous waste, under the current disposal practice; no proper method is being employed. Hazardous hospital and industrial wastes are being simply treated as ordinary waste. Open burning of waste especially non-degradable components like plastic bags are adding to air pollution. Municipalities do spend considerable portion of their budgets on solid waste management but as a return receive limited tax which is insufficient to meet their operation and maintenance costs. This is one of the main reasons why these municipalities can not afford latest techniques and equipment to make solid waste management a profitable enterprise and to achieve the desired standards of environmental quality.

Demand for solid waste management services will grow as urban populations grow and as per capita waste generation rates grow; the latter is projected at one to three percent per year. The increased quantity of waste will also place greater demands on disposal services, thereby exacerbating an already poor situation since present disposal methods for solid waste are totally inadequate. Disposal is by open dumping,

primarily on flood plains and into ponds, causing significant environmental damage. The refuse is burnt to reduce its volume and lengthen the life span of the dumpsite. However, refuse does not burn well and smouldering dumps produce clouds of smoke that can be seen from miles away, smell bad, and create a breeding ground for flies and rats. The result is unsightly and unsanitary conditions. This land could be used for more productive purposes and potentially valuable recyclable materials are lost.

Some of the more commonly reported occupational health and injury issues in solid waste management include:

- ③ Back and joint injuries from lifting heavy waste-filled containers and driving heavy landfill and loading equipment;
- ③ Respiratory illness from ingesting particulates, bio-aerosols, and volatile organics during waste collection, and from working in smoky and dusty conditions at open dumps;
- ③ Infections from direct contact with contaminated material, dog and rodent bites, or eating of waste-fed animals;
- ③ Punctured wounds leading to tetanus, hepatitis, and HIV infection;
- ③ Injuries at dumps due to surface subsidence, underground fires, and slides;
- ③ Headaches and nausea from anoxic conditions where disposal sites have high methane, carbon dioxide, and carbon monoxide concentrations; and
- ③ Lead poisoning from burning of materials with lead-containing batteries, paints, and solders.

Some of the more commonly reported environmental health and injury issues in solid waste management include:

- ③ Contaminated leachate and surface runoff from land disposal facilities affecting down gradient ground and surface water quality;
- ③ Methane and carbon dioxide air emissions from land disposal facilities adding to global warming, and subsequently vector-borne disease abundance and pathogen survival;
- ③ Volatile organic compounds in air emissions and inconclusive evidence on altered cancer incidence, birth defects, and infant mortality, as well as psychological stress for those living near solid waste incinerators or inadequately controlled land disposal facilities;
- ③ Animals feeding on solid waste providing a food chain path for transmitting animal and human diseases;
- ③ Uncollected wastes retaining water and clogged drains, thus leading to stagnant waters which encourage mosquito vector abundance;
- ③ Uncollected wastes providing food and breeding sites for insect, bird and rodent disease vectors.

Unfortunately, none of the cities in Pakistan has a proper solid waste management system right from collection of solid waste up to its proper disposal. Much of the uncollected waste poses serious risk to public health through clogging of drains, formation of stagnant ponds, and providing breeding ground for mosquitoes and flies with consequent risks of malaria and cholera. In addition, because of the lack of adequate disposal sites, much of the collected waste finds its way in dumping grounds, open pits, ponds, rivers and agricultural land. Environmental degradation is

not only well advanced already, but also is getting progressively worse as the country's population, urbanization and industrialization increase, and as its economy develops generally.

Improper waste management activities can increase disease transmission or otherwise threaten public health. Rotting organic materials pose great public health risks, including, as mentioned above, serving as breeding grounds for disease vectors. Waste handlers and waste pickers are especially vulnerable and may also become vectors, contracting and transmitting diseases when human or animal excreta or medical wastes are in the waste stream.

Potential impacts of landfills or dump sites of solid waste are discussed below:

A- Odour Nuisance and Air Pollution

Putrefaction of waste in sunlight during daytime results in bad smells and reduced visibility. The wind also carries waste, dust and gases caused by decomposition. When waste is burnt heavy metals like lead, toxic gases and smoke spreads over residential areas.

B- Health Hazards

- ⌚ Infections and diseases can spread from dump sites into the general population. Skin and eye infections are common in areas surrounding dump sites.
- ⌚ Dust in the air at dumpsites can cause breathing problems in children and adults. Flies breed on uncovered piles of rotting garbage and spread diseases like diarrhoea, dysentery, typhoid, hepatitis, and cholera. Mosquitoes transmit many types of diseases like malaria and yellow fever.
- ⌚ Dogs, cats and rats living around refuse carry a variety of diseases including plague and flea born fever.
- ⌚ Intestinal, parasitic and skin diseases are found in workers engaged in collecting refuse.

C- Groundwater Contamination

The most serious problem related to on-land disposal of solid waste is groundwater contamination. As water filters through any material, chemicals in the material may dissolve in the water, a process called leaching. The resulting mixture is called leachate. As water percolates through domestic solid waste, it makes a leachate that consists of decomposing organic matter combined with iron, mercury, lead, zinc, and other metals from rusting cans, discarded batteries and appliances. It may also contain paints, pesticides, cleaning fluids, newspaper inks, and other chemicals. Contaminated water can have a serious impact on all living creatures, including humans, in an ecosystem.

Table 4-6: Mitigation Measures for Solid Waste Management Projects

Major Adverse Effects	Associated Mitigation Measures
Conflicts over existing or planned land uses, activities, and infrastructures.	<ul style="list-style-type: none"> ⌚ Ensure community involvement in locating and preparing the initiative's sites and access routes, as well as in developing responsibilities for managing the initiative's operations (including possible collection fees).
Nuisances (e.g. noise, foul odours, airborne dust, traffic), health risks (transmission of diseases), and risks of accidents.	<ul style="list-style-type: none"> ⌚ Plan site preparation/construction activities and operations according to a schedule compatible with the climate and the population's activities. ⌚ Locate solid waste management site(s) well away from and downwind of human settlements and vulnerable areas. ⌚ Promote environmental training, health and safety training, as well as the use of adequate protective clothing and equipment (e.g. masks, overalls, resistant gloves, boots with thick soles, and so on) to workers. ⌚ Prevent access to solid waste management site(s) by unauthorized persons and wildlife (through vigilance, warning signs, and security fences). ⌚ Minimize the handling of waste and quantities of waste to be disposed of; ensure adequate solid waste segregation; and maximize containment. ⌚ Provide specific and regularly cleaned and maintained enclosed collection vehicles or carts (with tarpaulin covers), and ensure collection is sufficiently frequent (in line with quantities and climate). ⌚ For solid waste landfills: spread and compact adequately sorted incoming refuse, and cover with soil, daily; ⌚ Raise community awareness of the importance of waste reduction, recovery/ re-use and recycling to reduce waste disposal requirements and extend the life of disposal sites.
Degradation of water quality.	<ul style="list-style-type: none"> ⌚ For solid waste landfills: siting where the underlying soils are relatively impermeable and have a high capability for containing contaminants (e.g. clays); siting well above the underground water table and where topography is relatively flat; use a landfill liner/sealer (e.g. clay or geosynthetic) if leachate risks entering groundwater; siting well away and down gradient from surface waters and groundwater recharge areas or sources ⌚ Ensure separate collection, storage, transportation, treatment, and disposal of hazardous wastes (e.g. biomedical, heavy metals, tires, oil, batteries, paint, solvents, acidic solutions, etc).

4.5.2 Natural Resource Management

Undoubtedly, making more sustainable use of natural resources is essential for the future productivity of the forests, agriculture, environment, economy and society. In terms of Natural Resource Management (NRM), there is a clear need to gauge the dependence of the local communities on their surrounding natural resources. This would help in the designing poverty reduction schemes that would be based in prudent NRM. The productivity of natural resources is often underestimated due to sheer absence of monetary values against which, the productivity can be gauged and assessed. If a factor or resource does not have a financial value, it is highly likely that it would remain absent in all national income accounting.

According to IUCN, Pakistan continues to incur economic losses from environmental degradation and weak NRM. The effect of degradation and biodiversity loss on productivity and public health are estimated to be 3% of GDP per year. This estimate would probably be higher if the economic costs of toxic waste, biodiversity losses, freshwater and coastal resource depletion were included, especially the losses from the oil spill in 2003. The productivity lost as a result of land degradation is US\$ 353 million/year according to some (anonymous) estimates.

Brandon (1995) estimated the loss of rangeland productivity to be around US\$ 90 to 160 million/year. The lack of sufficient forest management and continual deforestation affects the national economy. Forestry output had a share of 1.3% in agriculture and 0.3% share in the GDP of 2002-2003. Shrimp exports that form about 80% of the total fish exports from Pakistan may decrease in the next few years due to the reported decline in shrimp populations mainly caused from pollution and over-fishing.

A) Forests and Rangeland

Forests in Pakistan are categorized under three sub categories:

- a) Productive Forests: where timber extraction is conducted on a commercial scale
- b) Protected Forests: where all logging is banned.
- c) Heritage Forests: which are unique and have a heritage value

For management purposes, forests are further divided into Guzara and reserve forests. Guzara are the parts of a protected reserve forest where the communities have the user rights. But with increasing populations, pressure on the reserves has increased tremendously. There are ways to protect and manage forests. Local communities can be made the custodian through joint forest management models. These forests mostly serve as the watershed of the important rivers of Pakistan. Downstream users of freshwater like WAPDA and Irrigation Department, can pay for low sediment, good quality water to the communities, who in turn can be mobilized to manage this resource in return for an annual remuneration. This way environmental management can be used for poverty alleviation.

Deforestation is perceived to be a significant environmental problem in Pakistan, partly because of its implications for economic and biodiversity loss, and also because of poor people's dependence on forests. Forests also play an important role in protecting against soil erosion, sedimentation, and flooding; and they contribute to carbon sequestration.

Deforestation has led to a severe shortage of fuel wood and building materials in many areas. Crop residues and animal manure, which were previously returned to the soil to add valuable nutrients, are being burnt for fuel.

Various estimates indicate that Pakistan has been losing its small area of forest (less than 5 percent of the land area) at an annual rate of 2.9 to 3.1 percent – three times the rate in other South Asian countries. Woody biomass is decreasing between 4 and 6 percent a year as the majority of households use firewood for cooking and heating, a practice which has strong environmental health implications.

Brandon (1995) estimated 20-35% loss in rangeland productivity with a lost carrying value of US\$ 92.6 million based on a 6.5-11.4 million head lost carrying capacity. In the absence of complete data, the livestock population trends have been used to suggest that these losses may increase by about 7-9% (using the Brandon ratios) over a period of 5 years (MINFAL) – implying that the foreign exchange earnings for FY-2003 of PKR 51.5 billion could have been higher. The estimated increase in livestock population between 1986 (NCS) and 2003 (ES FY-2003) appears to be a 51%, and about 11% between FY-1999 and 2003.

B) Wetlands and Biodiversity

The human population in and around mangrove forests is estimated at 1.2 million people, of which 0.9 million reside in the Indus Delta (Salman 2002/IUCN May 2003), and about 135,000 people depend on the mangroves resources for livelihood (Shah 1998). The annual value of catch from mangrove-dependent fish species is estimated at US\$ 20 million, shrimps, particularly important, have a domestic value of US\$ 70 million. Reduced water freshwater flows and consequent ecosystem degradation had a negative effect on livelihoods, namely; a steady decline in crop and fish production with an increase in salinity, and (from a case study) approximately 300,000 households have lost about \$70,000 in crop damage and \$45,000 from decreased fish catch.

Yet another cause of degradation of wetlands is the problem of seawater intrusion. In rivers with high flows salt water intrusion into freshwater areas is prevented. Due to low water levels in the River Indus, salt water intrusion from the sea is persistently advancing and threatens further damage to the fragile ecosystems of the Indus Delta and associated wetlands. Dams and barrages built upstream on the River Indus have resulted in erosion and degradation of the Indus Delta and have affected the number of species in that eco-region. Due to a loss in surface moisture riverine forests may soon be rendered barren.

Pakistan's ecosystems, ranging from semiarid to coastal, marine, forest, and mountain, supports a great wealth of flora and fauna. The World Conservation Union (IUCN) Red List of Threatened Animals (IUCN 1996) lists as threatened species 124 animal species present in Pakistan: 65 mammal, 45 bird, 11 reptile, 2 fish, and 1 insect species. Critically endangered species include the Balochistan bear, Chiltan goat, and Ganges shark. The 2004 Red List shows that 2 plant species and 46 animal species are on the extreme vulnerability list. Six more animal species are listed as critically endangered.

Biodiversity is under serious threat region as natural resources are rapidly depleted. The dramatic increase in human activity over the past 100 years, such as developments on natural landscapes, the clear-cutting of forests, polluting of rivers and streams, damage to the protective ozone layer of the atmosphere and rapid population growth in almost every habitable area, is bringing to an end the richness of nature's biodiversity. Biodiversity loss has become a global phenomenon, raising serious concern, particularly amongst the scientific community, who believe that mankind is now witnessing the sixth major mass extinction of organisms.

The Indus River system supports a great variety of terrestrial and aquatic biological diversity, but much of it has been declining because of the intensification of agriculture and the systematic loss over time of vegetative cover (e.g., riverine and mangrove forests). Near-shore fisheries are declining in certain areas because of pollution and overexploitation both in the coastal areas of Pakistan in the Indus River itself.

The ecological trend of greatest concern in the country is the continuing loss, fragmentation and degradation of natural habitats. This is affecting with out exception forests, rangelands, and freshwater and marine ecosystem. Of equal concern is the decline in many native species of animals and plants. Some species are already extinct, many are internationally threatened, and more still are of national concern. The degradation of agro-ecosystems and the accelerating loss of domestic genetic diversity are areas that need to be looked into (**Biodiversity Action Plan of Pakistan 2000**). There are six fundamental causes of loss of biodiversity:

- a) The unsustainably high rate of human population growth and consumption;
- b) Economic systems that fail to value the environment and its resources;
- c) Inequity in the ownership, management and flow of benefits from both use and conservation of biological resources;
- d) Deficiencies in knowledge and its application;
- e) Legal and institutional systems that promote unsustainable exploitation;
- f) The steadily narrowing spectrum of traded products from agriculture, forestry and fisheries.

In addition to individual species, Pakistan's Biodiversity Action Plan of 1998 identifies 10 critically threatened ecosystems: Indus Delta and coastal wetlands, Indus River and wetlands, Chagai desert, Balochistan juniper forest, Chilgoza forests in the Suleiman Range, Balochistan subtropical forests, Balochistan rivers, tropical deciduous forests in the Himalayan foothills, temperate Himalayan forests, and trans-Himalayan alps and plateau. These ecosystems contain species richness of local and global significance. The government of Pakistan has received financing from the Global Environment Facility (GEF) to protect, in three major national parks (Machiara, Chitral Gol, and Hingol), sites that are home to several endemic, threatened, and vulnerable species of birds and other animals.

The shift to global economic integration that basically allows market forces to establish the rules for economic development is now the main determinant of how natural resources will be used. Recent lessons, however, indicate that blindly embracing the philosophy of global market integration without putting in place the necessary policy structures and institutional reforms and accounting for the cultural diversity of the respective countries could do more harm to, rather than help, their efforts to achieve economic prosperity. As past experience has shown, the rapid depletion of natural resources that directly contributed to habitat loss was driven by the strong desire of many countries to join the ranks of the industrialized economies.

C) Coastal Resources Management

Coastal and marine habitats are among the ecosystems most seriously affected by the loss of biodiversity. While a number of countries in the region embarked on

conservation efforts to protect these zones more than 20 years ago and appear to have succeeded, the challenges remain formidable. Efforts to conserve marine habitats still lag behind, along with the forestry sector, due to special problems of ownership, land use and control. Most urban agglomerations are situated in resource-rich coastal zones, which contribute significantly to national and regional economies. Unfortunately, the urbanization process is not without its environmental costs. The movement of people to coastal cities is causing an increase in domestic and industrial effluents, more areas of landfill, increased dredging, more mangrove clearance, more discharges of agricultural chemicals and increased coastal and estuarine sedimentation.

4.5.3 Specific Interventions for Other Projects

A) Solid Waste Bins

Environmental Guidelines

- a) Solid waste bins, if not properly located, designed, and managed, become threats to community health. Location of solid waste bins can also lead to social conflict in the community. The community must be fully involved while deciding the locations of solid waste bins.
- b) Odor from bins is managed by timely pick-up of solid waste.
- c) Burning of the solid waste at the bin site is the general practice of municipal workers. It is hazardous and can cause serious health hazards for the community. Community must be informed about hazards of the solid waste burning.
- d) Small bins are mostly located in front of common walls of houses and maximum possible distance from the boundary wall to avoid the social conflicts. Large bins are located 100 meter away from the residential areas in rural areas, and near the open spaces in the built-up or urban area.

Mitigation Measures

- a) Locate small bins in front of common walls and at a maximum possible distance from the boundary wall.
- b) Locate large bins at distance of 100 meter from the residential areas or near the open space in the area.
- c) Train communities on solid waste management, hazardous and non-hazardous waste, impacts of solid waste burning, methods of waste reduction, reuse, and recycling.

B) NRM Project

Environmental Guidelines

- a) Natural resource management projects can be forestation, rangeland management, watershed management, bio-diversity conservation, wildlife conservation etc. Objectives of these projects are to improve the present status of the specific natural resource. Intervention of such projects focus on preventing, conserving, and enhancing the present status of the natural resource, and taking measures to

ensure that in future the factors responsible for depletion will be mitigated and controlled for the sustainability of the natural resource.

- b) If holistically developed under ecological criteria then mostly these projects do not cause negative environmental impacts, rather these are environmentally friendly projects.

Mitigation Measures

- a) Ensure that the project qualify the ecological requirements of the project area.
- b) Ensure that the project interventions will not lead to natural resource over-harvesting.
- c) Ensure that the project intervention will not cause negative impacts on the other natural resources in the project area.

C) Security Lights

Environmental Guidelines

- a) Security lights are installed on the demand of community. Security lights serve two functions, (i) security of the area, and (ii) convenience for the people to commute in the night. Community should decide about the location of the security lights with the technical assistance of the partner organization.
- b) It is preferable to use energy saver bulbs and tube lights

Mitigation Measures

- a) Secure consensus in the community about the location of the street lights.
- b) Use energy savers for electricity conservation.

4.6 Social Sector Development

4.6.1 Healthcare Facilities

Small-scale healthcare activities, such as rural health posts, immunization posts, reproductive health posts, mobile and emergency healthcare programs, and urban clinics and small hospitals, provide important and often critical healthcare services to individuals and communities that would otherwise have little or no access to such services. Although small-scale healthcare activities provide many important benefits to communities, they can also unintentionally do great harm through poor design and management of waste management systems.

Healthcare waste is dangerous. If handled, treated or disposed of incorrectly it can spread disease, poisoning people, livestock, wild animals, plants and whole ecosystems.

The healthcare wastes generally fall into three categories:

- i) **General** healthcare waste, similar or identical to domestic waste, including materials such as packaging or unwanted paper. This waste is generally harmless

and needs no special handling; 75–90% of waste generated by healthcare facilities falls into this category.

- ii) **Hazardous** healthcare wastes including infectious waste (except sharps and waste from patients with highly infectious diseases), small quantities of chemicals and pharmaceuticals, and non-recyclable pressurized containers.
- iii) **Highly hazardous** healthcare wastes including sharps, highly infectious non-sharp waste, stools from cholera patients, and bodily fluids of patients with highly infectious diseases. They also include large quantities of expired or unwanted pharmaceuticals and hazardous chemicals, as well as all radioactive or genotoxic wastes.

a) Major Impacts from Improper Waste Handling

i - Disease transmission

Transmission of disease through infectious waste is the greatest and most immediate threat from healthcare waste. If waste is not treated in a way that destroys the pathogenic organisms, dangerous quantities of microscopic disease-causing agents—viruses, bacteria, parasites or fungi—will be present in the waste. These agents can enter the body through punctures and other breaks in the skin, mucous membranes in the mouth, by being inhaled into the lungs, being swallowed, or being transmitted by a vector organism.

People who come in direct contact with the waste are at greatest risk. Examples include healthcare workers, cleaning staff, patients, visitors, waste collectors, disposal site staff, waste pickers, drug addicts and those who knowingly or unknowingly use “recycled” contaminated syringes and needles.

Although sharps pose an inherent physical hazard of cuts and punctures, the much greater threat comes from sharps that are also infectious waste. Again, healthcare workers, waste handlers, waste-pickers, drug addicts and others who handle sharps can become infected with HIV/AIDS and hepatitis B and C viruses through pricks or reuse of syringes/needles. These infections may be fatal.

Contamination of water supply from untreated healthcare waste can also have devastating effects. If infectious stools or bodily fluids are not treated before being disposed of, they can create and extend epidemics.

ii - Chemical and toxic threats

Chemical and pharmaceutical wastes, especially large quantities, can be health and environmental threats. Since hazardous chemical wastes may be toxic, corrosive, flammable, reactive, and/or explosive, they can poison, burn or damage the skin and flesh of people who touch, inhale or are in close proximity to them. If burned, they may explode or produce toxic fumes. Some pharmaceuticals are toxic as well.

When chemical and pharmaceutical waste is disposed of in unlined landfills, especially unlined pits, these wastes may contaminate ground and surface water—particularly when large quantities are disposed of. This can threaten people who use the water for drinking, bathing and cooking, and damaging plants and animals in the local ecosystem.

Burning or incinerating healthcare waste, while often a better option than disposal in an unlined pit, may create additional problems. Burning or incineration of healthcare waste may produce toxic air pollutants such as acid gasses, Nitrogen Oxides (NO_x), particulates, dioxins and heavy metals and distribute them over a wide area. Dioxins and heavy metals are of particular concern. Dioxins believed to be potent cancer-causing agents, do not biodegrade, and accumulate in progressively higher concentrations as they move up the food chain. Heavy metals such as mercury and cadmium are toxic and/or cause birth defects in small quantities and can also concentrate in the food chain. In short, disposal of large quantities of hazardous chemicals and pharmaceuticals is a serious problem.

b) Mitigation Options

i - Facility siting and design

To minimize the potential spread of disease and environmental impact when planning a new facility, healthcare planners/developers should:

- ⌚ Select a location with easy access to safe drinking water. The drinking water source should be dedicated exclusively to the facility, if possible, to reduce the risk of spreading disease.
- ⌚ Install adequate sanitation facilities to prevent the spread of disease from infected patients.
- ⌚ Avoid locations adjacent to schools to minimize children's risk of exposure.
- ⌚ Pick a location where waste can be safely buried (e.g., above the water table and protected from scavenging) or easily transported off site for safe disposal in a sanitary landfill.

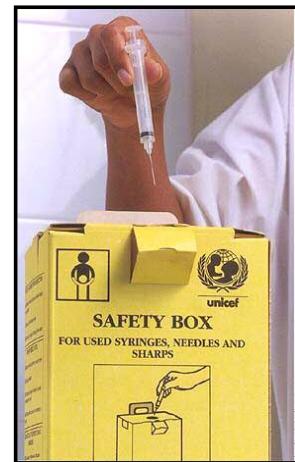
ii - Waste management program

Healthcare facilities require a sound healthcare waste management system to minimize damage to health and the environment caused by their wastes. A comprehensive minimal program includes the following practices:

- ⌚ Written waste management plan
- ⌚ Clearly defined responsibilities
- ⌚ Written internal rules
- ⌚ Staff training
- ⌚ Protective clothing
- ⌚ Good hygiene practices
- ⌚ Vaccinated workers
- ⌚ Designated storage locations for waste
- ⌚ Waste minimization
- ⌚ Waste segregation
- ⌚ Waste treatment
- ⌚ Final disposal site
- ⌚ Periodic reviews

A small facility does not need to do everything at once. Taking just following four steps can dramatically reduce risk and improve the health and safety of facility personnel, patients, and the surrounding community:

1. *Segregate the waste.* Begin with sharps. Separate hazardous and general waste, if possible.
2. *Give workers minimal training in how to safely handle hazardous waste, including:*
 - ⌚ personal hygiene—make soap and water readily available.
 - ⌚ sharps handling, especially how to avoid being pricked with hypodermic needles that could transmit HIV/AIDS, viral Hepatitis B or C, or other blood-borne diseases.
 - ⌚ use of protective clothing—provide thick gloves and aprons for staff handling healthcare waste.
3. *Motivate staff to follow new practices.*
4. *Safe disposal of the healthcare waste on site* (rural facilities). Ideally, burning should be conducted in a single-chamber incinerator. Second in desirability is burning in a drum or brick incinerator. If no other option is available, burning may be conducted in open pits. Alternatively, bury in small pits (e.g., 2 meters in depth and 2 meters on each side), but above the water table or lined with clay or plastic liner, and protected by a fence or other effective barrier (e.g., rows of thorny brush).



4.6.2 Specific Interventions for Social Sector Development

A) School

Environmental Guidelines

- a) If it is an existing school then mostly no difference of point of view exists in the community about the location of the school. In case of new schools the proponent should locate the school with the consent of the community. New schools should not be located along the major roads and highways. In general school physical conditions and services should be better than the conditions prevailing in students' homes.
- b) **Drinking Water Tank:** Mostly drinking water tanks are not cleaned in the schools and students drink contaminated water. This is a serious health hazard for the students. These tanks must be cleaned every three months. Proponent of the project should make it a point to inform the school management about the

importance of cleaning of the water tank. Water should be tested for coliform, fecal coliform, fluoride and nitrate. In case the school is located in the district of arsenic contamination of the groundwater, then some other source of water supply should be used such as surface water or shallow water.

- c) **Latrines:** Many rural schools do not have latrines. Students go for open defecation. Proponent of the project should include latrines as essential part of the project. At the same time wherever latrines are available their hygienic conditions are pathetic. Conventional or flush latrines with P-traps should be constructed; this will substantially reduce the possibilities of spread and contact of pathogens and other pollutants. Latrines are linked with the septic tank to avoid dispersal of pollutants in the community. It is recommended that lined septic tanks should be constructed for latrines. Health improvement impact of effective latrines is only realized if the students are also trained on better hygienic and sanitation practices e.g. washing hands with soap after defecation, no open defecation in and outside school, and daily or twice a day cleaning of latrine.

Mitigation Measures

- a) Conduct the water **testing** of the tank water for coliform, fecal coliform, fluoride and nitrate and confirm that tank water is not contaminated by these contaminants. Attach test report with the proposal.
- b) Use surface and shallow water sources in the arsenic contaminated districts. Ensure that water from these sources is not contaminated by arsenic.
- c) Construct latrines linked with p-traps and septic tanks
- d) Train teachers and management of the school about the importance of water tank cleaning, good hygiene practices, and proper sanitation services.

B) Basic Health Unit/Dispensary

Environmental Guidelines

- a) Basic health units and dispensaries due to poor working practices are one of the important sources of spread of different diseases in the community. Most important poor practices are: improper sterilization of equipment, reuse of used needles & syringes, and unsafe disposal of hazardous waste.
- b) Complete set of sterilization equipment should be provided to the BHU/dispensary. The management of BHU/dispensary should be trained on the scientific method of sterilization.
- c) Used needles and syringes crushing equipment should be provided, the management should be instructed to essentially practice the crushing of used needles and syringes.
- d) Hazardous waste generated by BHU/dispensary is safely disposed by providing disposal pit located within the BHU/dispensary. Lined and covered pit is constructed with a capacity to accommodate six months to one-year hazardous waste. The pit should be designed in manner that it is sealed and only a small hole with a cap is available for disposing and compacting the hazardous waste. Once the pit is full to its capacity, then it is completely sealed and a new pit is constructed within the premises.

Mitigation Measures

- a) Provide sterilization equipment and crushing machine.
- b) Construct safe hazardous waste disposal pit within the premises.
- c) Train management and staff of BHU/dispensary on the issues of hazards of poor sterilization, reuse of needles & syringes, poor hygiene practices and unsafe disposal of hazardous waste.

4.7 Credits

4.7.1 Agriculture Projects

Good agricultural practices allow sustainable use of the natural resources— soil and water—needed for crop production. Indeed, myriad programs address agricultural productivity, by introducing a new technology, an improved input or a new approach into the existing local farming system. However, these farming systems may be unsustainable from an environmental perspective. This is not because farmers do not understand their

“environment”—far from it—but because of off-farm externalities, such as market forces or a lack of savings. To feed their families or generate household income, farmers are frequently constrained to make trade-offs— shortened fallow periods, lack of crop rotation and other poor land-use measures—which undermine sustainability of the farming system and cause environmental harm. These linkages among poverty, hunger and environmental degradation are the reasons why environmental effects must be taken into account when planning agricultural initiatives.

The increasing demand for fresh water for domestic and industrial use is another limiting factor to agricultural productivity. It is estimated that, around 90 % of all the freshwater in Pakistan is already used for agriculture. Water is a critical source of asset development through livestock and irrigation. Irrigation can boost productivity, but farmers are increasingly in competition with other users, and water deficits will ultimately mean food deficits. Poor irrigation management has lowered groundwater tables, damaged soils and lowered water quality (see also section 4.8.2).

A- Natural habitat destruction or degradation

Agriculture can adversely affect a variety of ecosystems. These impacts may come from expanding the area used for crop or livestock production or from using environmentally unsound practices on existing farms. The most common problems include:

- ⌚ **Degradation of marginal lands:** For a variety of reasons—population pressure, lack of access to land or social equity issues—marginal or degraded lands may be used for agriculture. This new land use may be unsuitable because of inherent constraints on variables such as climate, vegetation, slope, soil depth, and soil texture and water availability. Expansion on to these sub-optimal lands not only causes further degradation, but also displaces previous land uses (fire-wood gathering, livestock grazing, hunting, medicinal plant gathering, etc.).

- ⌚ **Deforestation:** Natural forests are often degraded by encroachment, by excessive or uncontrolled harvesting, by roads dividing them into smaller blocks, or by being cleared for crop or livestock production. Slash-and-burn agriculture, where the land is cleared by burning ground cover, replaces the protection given by perennial tree vegetation with short-lived crops that also remove scarce soil nutrients. It is true that when forests are burned to clear the trees for planting, the resulting ash enriches the soil. Unfortunately, these burned areas rapidly lose the initial fertility the ash gives them, and the deforested area— already more liable to runoff, flooding and soil erosion—becomes increasingly fragile. Destruction of forest areas also leaves local populations without the fuel wood, timber, and non-wood forest products they use both to meet household needs and to earn an income.
- ⌚ **Desertification:** Desertification is the degradation of land in arid, semiarid and sub-humid areas. The process of desertification includes deterioration of vegetative cover due to over-grazing, wood cutting, and burning; wind and water erosion resulting from improper land management; and salinization due to improper use of irrigation water. This results in a loss of soil depth and fertility, reduced regeneration and a progressive transformation of the initial ecosystem to a less productive system, culminating in barren desert. In extreme cases, the capacity to support the local population is lost, and residents may leave in search of food and employment elsewhere.

B- Biodiversity loss

Increasing homogenization of crops and livestock is replacing diverse varieties with uniform genetic stock. These pure stands may be more vulnerable to a catastrophic disease outbreak, may need more inputs than local crops or livestock to produce well, and may have less market value than better-adapted, more popular local varieties. In addition, farmers generally remove wild plant and animal species from their lands to reduce the negative effects of pests, predators and weeds. However, there are complex interactions between crops and their wild neighbours: certain insects, plants and micro-organisms may play a key role in crop reproduction, soil fertility, controlling pests and floods, and ensuring clean water supplies.

C- Soil erosion

Unsustainable practices—such as badly managed open-furrow agriculture, a crop grown in the wrong way or place, deforestation, or draining wetlands—can all cause soil erosion. As the soil erodes, less rainfall is absorbed and the excess runs off. This runoff removes the fertile topsoil necessary for crop production and can have disastrous, off-site consequences, including gully formation, landslides, siltation and sedimentation of water bodies, downstream flooding, and damage to productive infrastructure. The wind can also erode away the soil particularly in arid and semi-arid areas.

D- Reduction of soil fertility

Soil fertility is dependent on three major nutrients (nitrogen, phosphorous and potassium), various trace elements, and organic matter content. A productive soil contains sufficient quantities of each of these factors. The factors can be removed by repeated cropping without fertilization, rainfall leaching, lack of a restorative fallow, and removal or burning of crop residues, either alone or in combination. The subsequent decline in soil fertility often occurs in conjunction with soil erosion, with each problem exacerbating the other.

E- Reduction in water quality

Eroded topsoil is transported by runoff into water bodies. Once in the slower-moving water, the soil settles, altering the terrain, water depth and water clarity. Incorrectly applied agrochemicals, fertilizers or manures can migrate from a farmer's field to local water sources, causing environmental harm and adversely affecting human health and activities. Animal manures transported from fields into water bodies through rainfall, runoff or irrigation can pollute local drinking water sources and spread human and animal diseases. Nutrients from manures/fertilizers can also cause nutrient loading in local water bodies, resulting in degraded water quality, reduced wildlife, fish populations, and toxic algal blooms. Moreover, such reductions in water quality can impact other uses of water bodies as well, such as drinking water, sanitation, fishing, aquaculture, recreation and tourism, and other farms. The direct environmental impacts of irrigation are discussed in Section 4.8.2.

F- Chemical deterioration/ unbalanced fertilizer use

Chemical deterioration may result in:

- ⌚ The loss of soil nutrients (mainly nitrogen, phosphorus and potassium) or organic matter. In part, nutrients are lost through erosion; in addition, they can be "depleted" by the crops themselves, particularly if the same crops are grown on the same land year after year.
- ⌚ Acidification, which may occur either because of excessive application of acidifying fertilizer or because of drainage in particular types of soil; and
- ⌚ Pollution of various origins (waste accumulation, excessive use of pesticides, oil spills etc.), can strongly reduce the agricultural potential of lands.

Where soil fertility has declined, as a result of prolonged cultivation or erosion, farmers attempt to maintain crop yields. The primary method available for doing so is application of fertilizer. In the short term, a yield response is most readily and cheaply obtained from nitrogenous fertilizer. Where phosphate deficiencies have been recognized and counteracted by phosphatic fertilizer, deficiencies of other nutrients, including sulphur and zinc, occur.

The short-term measure of combatting fertility decline by application only of macronutrients, and particularly nitrogenous fertilizer, is leading to a greater problem of nutrient imbalance in the medium term.

Table 4-7: Potential Environmental Impacts and Mitigation Measures for Small-scale Agricultural Activities

Category	Problem	Root Cause	Mitigation Measure
Land degradation	⌚ Loss of soil from marginal areas	⌚ Water and wind induced soil erosion combined with inappropriate land use.	⌚ Reduce pressure on marginal areas through alternative income sources and/ or changed land uses. ⌚ Encourage re-vegetation of degraded and marginal areas to reduce runoff.
	⌚ Soil infertility: significant increase in fertilizers necessary for crop production	⌚ Nutrient exhaustion due to farming techniques.	⌚ Rotate crops. ⌚ Allow land to lie fallow. ⌚ Intercrop with legumes or other nitrogen- fixing species. ⌚ Practice low- tillage farming. ⌚ Combine crop and tree production (agro forestry).
	⌚ Land barrenness: sand dunes encroaching on productive agricultural land	⌚ Desertification due to climate change, poor land-use practices and farming techniques.	⌚ Use trees, grass, grass mats, or mesh to stabilize dunes and prevent their spread. ⌚ Plant vegetative windbreaks to reduce soil erosion from wind. ⌚ Re-vegetate denuded areas to reduce soil erosion from runoff. ⌚ Take other conservation and prevention measures, such as livestock improvement programs, to reduce crop and herd quantities and improve quality.
Runoff from land use	⌚ Polluted and eutrophic lakes and rivers ⌚ Low fishery yields	⌚ Poor water quality caused by being downstream from agrochemical and fertilizer use on cropland	⌚ Vegetate areas around fields to prevent nutrient runoff from croplands leaving 50m wide strips between waterways and croplands.
Siltation	⌚ Flooding	⌚ Deposition of silt in rivers and water bodies from erosion.	⌚ Re-vegetate critical watershed areas and apply soil and water conservation measures to the upstream areas for better erosion control.
	⌚ Changes to river deltas, coastlines, and estuaries	⌚ Destruction of coastal areas from erosion and siltation.	⌚ See above measures for erosion control along river and critical watershed areas. ⌚ Protect mangroves from agricultural and other uses.
Degradation of protected habitats	⌚ Biodiversity loss ⌚ Decrease in wild plant and animal species	⌚ Biodiversity loss due to habitat destruction and competition from foreign species.	⌚ Create corridors connecting protected habitats. ⌚ Re-vegetate areas in and around fields to create habitat. ⌚ Use appropriate native plant and tree species.

4.7.2 Irrigation Projects

An array of adverse environmental impacts may be associated with irrigation, and some of the most severe may be in newly irrigated areas. Modifications to existing irrigation projects may also generate new, unanticipated impacts, which vary according to the stage of implementation. Also, after years of operation, cumulative impacts may emerge.

A- Soil salinity

Intensified agricultural production on irrigated lands can reduce soil fertility over time by increasing soil salinity. The level of soil salinity determines what crops can be grown, impacts crop germination and yields, and may make soils more difficult to work. Excessively saline soils force farmers to abandon fields. Excess irrigation can also raise the water table and is often associated with salinized arid regions, where large areas of arable land have become unusable. Excessive salt can cause irreversible damage to the soil structure, particularly in clay soils.

B- Hydrology

Diverting water for irrigation affects watersheds by altering rivers' flow regimes (patterns of flow volume) and affecting the depth of the water table. Without irrigation, rivers may experience large seasonal variations, flooding during the rainy season (flood regime) and carrying small water volumes during dry seasons (low-flow regime).

- (i) **Low-flow regimes:** Irrigation reduces the volume of water available during low-flow regimes, which may leave too little water for downstream uses such as drinking water, hydropower, transportation, and other irrigation projects. In addition, reduced water quantity often translates into reduced water quality, because there may not be enough water to dilute pollutants to acceptable limits. Turbidity also increases as flows are diminished. If the river is linked to wetlands, reduction in water volume or quality may harm critical animal habitats, fisheries, and flora as well as drinking water supplies.
- (ii) **Flood regimes:** Irrigation reduces river flooding conditions, which may be helpful in that it reduces the potential for property damage and loss of life. On the other hand, irrigation also alters natural irrigation and fertilization of flood plains, disrupting traditional agricultural practices. Fisheries and aquaculture projects in estuaries and coastal areas may be adversely affected by reduced floodwaters. Diverting floodwaters leaves less water to recharge groundwater supplies and wetlands. Floods are important for transporting sediment downstream. When they are reduced, the decrease in flow may contribute to greater siltation upstream, making rivers less navigable.

C- Water table

Modifying the volume of water in rivers has a similar effect on groundwater levels. Less river water means less groundwater recharge and lower water tables. This may

cause springs and wells to dry up, leaving populations to collect water from more distant sources, or it may make water less potable, possibly increasing the risk from diseases such as guinea worm, dysentery and typhoid. Long-term reductions in water table levels can lead to land subsidence (slumping). Conversely, problems such as irrigation canal leakage and over-irrigation lead to water logging and raise groundwater levels on and around farm plots. Water logging implies higher numbers of waterborne pathogens, afflicting plants, livestock, and humans.

D- Erosion and sedimentation

The effects of sedimentation on rivers are compounded by any changes in flow regimes caused by irrigation structures. Increased upstream sedimentation can also clog irrigation intakes, pumps, filtration operations and in-field channels. Poor design, construction and placement of irrigation water inlet points can all result in soil erosion at the head of an irrigated field. The eroded soil may accumulate in the middle or at the tail ends of the field where the water velocity decreases, interfering with in-field water distribution.

E- Human health

On one hand, irrigated agriculture can improve human health through greater food security, better nutrition, improved local infrastructure and higher incomes that allow access to medicines and health services. On the other hand, irrigation also supports many waterborne diseases in both humans and animals, including malaria, dengue, roundworm, tapeworm, guinea worm, cholera, typhoid, hepatitis and leishmaniasis.

For example, stagnant or low-flow water bodies, such as clogged irrigation canals, waterlogged fields and rivers under extremely low-flow regimes, breed malaria-carrying mosquitoes. Lowered water tables in arid regions can increase the incidence of sand flies, which transmit leishmaniasis. Using polluted wastewater for irrigation can spread roundworms and tapeworms in both livestock and humans. Last, pollutants, including pesticide residues, excess nutrients from fertilizers, and saltwater intrusions in groundwater, all threaten drinking water resources, leading to increased morbidity and mortality.

F- Toxic substances

Modern agriculture practice uses a variety of toxic and potentially toxic substances. Pesticides and herbicides can endanger human and animal health, persist in nature, and interfere with natural pesticide controls (such as predatory insects). Excessive application of agrochemicals may result in the build-up of a number of these elements. Use of sewage or industrial wastewater can spread disease and contaminate soils and food; sewage sludge may also contaminate soils with heavy metals, which can have toxic effects on ecosystems and human health.

G- Nutrient pollution

Fertilizers are normally used in commercial irrigated farming projects, but overusing them puts excess nutrients in the ecosystem. Nitrates, which are water-soluble, are

quickly transported into rivers and estuaries. Phosphates attach to soil particles, but may eventually seep through to contaminate groundwater or be carried in rainwater runoff to rivers, streams and lakes. As phosphate concentrations rise, they may contribute to rapid growth of aquatic vegetation and algae. Excess nitrates in water sources can be toxic to aquatic life and young children. Also, if wastewater sludge is used as fertilizer or deposited in irrigated fields, rainwater runoff may transport them into open water bodies where they may spread diseases such as cholera, hepatitis and worms.

H- Impacts on ecosystems

Diverting water for irrigation leaves less available for downstream ecosystems, including wetlands, mangroves, and coastal estuaries. Discharge water from irrigated fields may contain larger concentrations of salt, less dissolved oxygen, more pollutants, and a greater silt load than the incoming flow. It also tends to have a higher temperature than receiving rivers and streams. These changes can encourage weed growth and adversely affect fish and bird populations. Reduced water volumes downstream in wetlands decreases local groundwater recharge and hampers wetlands' natural water treatment functions. A long-term reduction in water flow to wetlands will cause them to shrink in size and will alter the composition of wetland vegetations.

Increased erosion and consequent siltation of water bodies adversely affects fisheries and aquaculture. Land clearing for irrigated agriculture, particularly for monoculture crops, may destroy sensitive and important animal and plant habitats.

I- Socio-economic impacts

Although irrigation is usually introduced to improve economic conditions and support development, it may wreak social and economic havoc. New irrigation schemes can disrupt communal land-use rights and highlight discontinuities between traditional and legal land rights. Individual water rights may need to be negotiated, particularly for small plots. Changes to field layouts may be necessary and some cultivated land may be lost, which will require adequate compensation. Even successful irrigation projects can harm downstream users by reducing water volumes and/or quality.

Irrigation generally benefits landowners more than tenants or communal land users. While women and children may benefit from higher income and improved nutrition, they may also lose access to lands traditionally used to collect fuel wood or grow vegetables.

Table 4-8: Potential Environmental Impacts and Mitigation Measures for Irrigation Schemes

Category	Problem	Root Cause	Mitigation Measure
Soil problems	⌚ Waterlogged soil	⌚ Over-watering; inadequate drainage	<ul style="list-style-type: none"> ⌚ Provide lined water courses / canals in highly permeable areas to prevent leaks. ⌚ Install and maintain subsurface drainage system.
	⌚ Salt build-up on irrigated land	⌚ Irrigation system does not adequately leach salts from soils	<ul style="list-style-type: none"> ⌚ Adjust crop patterns (fallow times, crop selections, etc) to prevent further salt build-up. ⌚ Plant salt- tolerant crops ⌚ Design system to allow leaching with excess water. ⌚ Maintain subsurface drainage system
Water problems	⌚ Dry wells for drinking water and irrigation	⌚ Groundwater depletion	⌚ Reduce off- take or pumping to allow natural aquifer recharge.
	⌚ Salt water in wells for drinking water and irrigation	⌚ Saline intrusion in coastal aquifer due to excessive groundwater pumping	⌚ Reduce groundwater pumping to allow natural freshwater recharge to lower salt concentration in the aquifer.
	⌚ Water quality problems for downstream users	⌚ Discharged irrigation water is saline or contaminated	⌚ Do not discharge irrigation drainage water into fresh water bodies.
	⌚ Reduced water quantity for downstream users, waterways and wetlands; intermittent streams run dry.	<ul style="list-style-type: none"> ⌚ Too much water diverted for irrigation ⌚ Poor understanding of stream flows and available water 	<ul style="list-style-type: none"> ⌚ Reassess water available for irrigation; may need to irrigate a smaller perimeter. ⌚ Use pipes instead of open channels to prevent water loss from evaporation.
Social problems	⌚ Increased inequity	⌚ Inequitable access to irrigation waters or crops	⌚ Design and manage system to improve access by “tail- enders” (users whose fields are farthest from the water source).
	⌚ Poor water quality downstream from a dam	⌚ Insufficient water flow from dam, or poor- quality water behind the dam	<ul style="list-style-type: none"> ⌚ Use dam operations to maintain minimum flow conditions to dilute pollutants. ⌚ To prevent anoxic conditions in reservoirs, clear organic matter, such as plants, bushes, grass, before filling.

4.7.3 Livestock Sector

Properly managed, livestock production can enhance land and water quality, biodiversity, and social and economic well-being. However, when improperly managed, livestock production may cause significant economic, social and environmental damage. Increasing livestock production has the potential to increase environmental harm. The following information is intended to help identify potential adverse environmental impacts and to suggest mitigation options to address them.

Livestock development is imperative for strengthening of national economy as it has full potential for job creation, meeting the food requirements and taking very active part in export drive in globalization.

Livestock Development

Livestock contribute nearly 9.4 % to the national GDP of Pakistan, and account for close to 39 % of the agricultural GDP. More than 70 % of the population is directly involved in livestock in one way or another. This is particularly important for those people in poverty. Nearly 70 % of poor people rely on livestock as a primary source of food and/or income. Livestock provides meat, milk, eggs, wool and hides are source of cash income and reduce income risk. The pace of development in Pakistan has left the livestock sector far behind in the past but now the importance of this sector has been realized and government is according due priority for the development of this sector.

In order to transform livestock production activities from traditional to commercial, a long-term development strategy and action plan need to be drawn up. Need for comprehensive and sustainable livestock development policies and action plans both at federal and provincial levels. The population of Pakistan is expected to reach 217 million by 2020. This combined with higher household incomes will generate a significant increase in the annual demand for meat products by more than 50 %. Pakistan government needs to get underway required changes now to address those increases in demand.

It also provides draught power to work fields for crops, and they provide transportation for people and goods. Livestock are an integral element of soil management and fertility, providing enriched manure which sustains organic content and provides a natural fertilizer.

While the unfolding of the livestock revolution is likely to result in a rapid increase in the demand for quality livestock services, the policies and institutions in a number of countries are not geared up to meeting that challenge. There are no mechanisms in place to identify the constraints to livestock production, the service needs of poor livestock keepers and the ways and means to deliver them at minimum cost.

While those trained in veterinary science argue that it is poor animal health which is the main constraint to livestock production, the nutritionists point to the poor availability of feed and fodder and the breeders to poor genetics. There is a whole range of services that are needed to enhance the capacity of poor households to exploit the full potential of livestock production. These include health and production services such as clinical care, preventive health and provision of pharmaceutical

supplies, feed and fodder supply, artificial insemination, livestock research and extension, and other market services such as credit, livestock insurance and delivery of market information, output marketing and milk collection

- ⌚ **Public sector:** ensuring the health of the national herd including disease surveillance, compliance monitoring, quarantine, quality control of remedies and vaccines, planning for emergencies and reporting to international bodies and neighbouring countries; oversight of food safety, import and export inspection and certification according to international standards; regulation, monitoring and support of other partners in the animal health care system; accreditation of personnel; creation of an enabling environment for the private sector; and general formulation of livestock development policy.
- ⌚ **Private sector:** clinical diagnosis and treatment; production and distribution of remedies and vaccines; artificial insemination; management of herd health and production programmes; marketing livestock, products and others.
- ⌚ **Shared responsibility:** disease diagnosis and reporting; compulsory [testing](#); accreditation; tick and tsetse fly control; food hygiene and inspection; continuing education and training; diagnostic support; animal welfare; notifiable disease control; disease emergency response; zoonosis control; research; and advice and extension.
- ⌚ **Market efficiency and information:** The first fundamental ability of the state to target subsidies and to manage the delivery systems is weak and there are significant leakages. Large ruminants (cattle and buffaloes) are raised for meat, milk and draught power for farming and rural transportation.

In Bangladesh and Pakistan, for example, small ruminants form a much larger share of the total population of ruminant animals compared to other countries. This could perhaps be due to a larger proportion of non-vegetarians in the population in these two countries, with goat meat being the preferred meat in the region. Livestock production is oriented towards production of milk. A significant proportion of the livestock in this region is owned by small and marginal farmers and landless households, who also account for a large share of poor households. Except in egg and poultry meat production, there are no big players in livestock production.

In general, access to livestock services is poor. Market infrastructure is generally poor resulting in high transactions costs. Private investment in livestock marketing and processing is constrained due to the nature of the production systems, poor market infrastructure and government interventions in input and output markets. Overall, livestock productivity is low and livestock extension support either non-existent or very weak and poorly targeted. In production and health services, the emphasis is on curative health and breeding services. For the most part, government is the direct provider of these services. Private sector participation in livestock service delivery is negligible. While some co-operatives and non-profit non-governmental organizations do participate in the provision of these services, the coverage from these sources is limited and concentrated in a few areas.

Water

The amount and quality of water is critical to all aspects of the livestock industry. While the direct consumption of water to satisfy the thirst of the animal is relatively small, large quantities of water are used in getting animal products to the consumer. The largest demand for water, however, is for production of forage and feeds. Some estimates show that about a metric ton of water is needed to produce a kilogram (2.2 lb) of grain. 5000 liters of water are needed to produce 1 kg of Rice and 250 gms of beef need 5.1 cubic meters of water. Much of the water involved in this process on range and pasture lands evaporates from the soil surface or is transpired through brush and undesirable weeds. Therefore, improved water management and better water conservation practices are essential to the improvement in quality vegetation. Herein lies an opportunity for research.

Livestock Issues

A- Over-grazing

Over grazing has brought down the productivity of the rangelands to as little as 15-40% of their potential. Over the last five decades, a five fold increase in goats and a four fold growth in the number of sheep, that is primarily range animals, have led to over-grazing (PARC, "Combating Desertification in Pakistan", UNEP/ESCAP, 1994). Three fourths of the animals are of nondescript species, and the livestock sector is caught in a downward spiral of too many sick animals chasing too little feed.

Over-grazing of rangeland reduces the density of vegetation and the amount of organic matter generated. This, in turn, increases soil erosion from wind and water and decreases soil fertility through loss of nutrients. In arid and semi-arid areas these impacts may also contribute to desertification. Fortunately, ecosystems in these areas demonstrate considerable resilience and often recover when grazing pressure is reduced, either through traditional methods or through modern management practices.

B- Poor balance of livestock species

Each species or breed of livestock has foraging preferences and will graze favoured areas and plants while neglecting others. Browsing animals, such as goats and camels, prefer the leafy tops of shrubs. By contrast, grazers tend to consume ground-level grasses and leafy plants. A poor balance between browsers and grazers can change the mix of plants in ways that degrade the area. For example, too many grazers can diminish the number and populations of herbaceous plant species and allow woody plants to become dominant, changing, possibly irreversibly, the character and utility of the ecosystem.

C- Harm to wildlife and domestic stock and loss of wildlife habitat

The loss of habitat caused by livestock production in grazing and mixed farming systems may be one of the greatest threats to wildlife. Human population growth and density, and the accompanying increase in livestock, often leads producers to expand livestock grazing ranges into wild lands and the conversion of wild lands to mixed farming use.

D- Slaughter of wildlife by livestock owners/managers

Another danger to wildlife is intentional slaughter by livestock owners/managers. Fear that the wildlife will prey on livestock and damage crops is a common motivation, as is the belief that the wildlife are competing with livestock for fodder, the desire to prevent spread of disease to livestock, and concern for human safety.

E- Clearing of forest and wild lands

Vegetation is typically altered or destroyed when forests/wild lands are cleared or are burned to promote new growth. This changes local ecosystems and may contribute to global warming. Fires to burn vegetation are dangerous and degrade air quality.

F- Degrade water quality and reduce water supplies

Where water is scarce, either chronically or seasonally, the diversion of water to sustain livestock potentially limits its availability for other purposes. This is of particular concern in arid and semi-arid regions, where the construction of boreholes to supply livestock can lead to unsustainable withdrawal rates and the dangerous depletion of aquifer reserves.

G- Harm to human health

Using water for farm animals may make it less available for the many other uses that influence health, such as bathing, washing, cooking, and drinking. Moreover, excessive contamination by enteric micro-organisms, toxic pesticides or nitrates may render water unfit for human consumption and may be especially dangerous to children. Pesticides or other vector control treatments used on livestock represent threats to the health of livestock managers, their families, and others exposed directly or through water use. These substances may be toxic, cause birth defects, alter children's proper development, and promote cancer.

H- Odour

Concentrated manure stored at livestock facilities can generate strong and unpleasant odours, damaging the quality of life of nearby residents. This problem is most evident when facilities are located in densely populated areas.

Table 4-9: Environmental Mitigation Measures for Livestock Projects

Major Adverse Effects	Associated Mitigation Measures
Adverse effects on wildlife, such as loss of habitat, increased poaching and killing, and the introduction of diseases to wildlife.	<ul style="list-style-type: none"> ① Plan and implement range management strategies (choice of species, animal numbers, and grazing areas) that minimize adverse effects on wildlife and avoid excessive competition. ① Rehabilitate degraded areas nearby as wildlife habitat.
Ecosystem degradation and loss of biodiversity associated with over population, over-grazing, trampling, excess harvesting of fodder and forage, and removal of vegetation.	<ul style="list-style-type: none"> ① Limit animal numbers, mix species to maximize use of forage potential and choose the size and the composition of herds according to the seasonal and temporal availability of water and plants. ① Control the length of grazing time and succession of use in particular areas (rotational grazing to allow plant re-growth, use of dry-season grazing reserves, and so on). ① Restrict animal access to unstable or fragile areas (e.g. steep slopes, degraded areas, where soils are fine or weak, or have complex drainage and fertility cycles, and so on) by defining and/or fencing off critical areas. ① Promote soil erosion control measures (e.g. plant live fences or wind- breaks; promote reforestation and vegetated buffer strips; promote the reseeding of grasses;).
Human health hazards or nuisances (foul odours) by the introduction of diseases and the possible contamination of water supplies for human use by animal manure and urine.	<ul style="list-style-type: none"> ① Keep manure away from household areas and water bodies. ① Consider using a biogas system (methane). ① Avoid creating stagnant water ponds.
Degradation of surface water and groundwater quality and quantity	<ul style="list-style-type: none"> ① Protect permanent water sources from animals, especially when temporary sources are available during the wet season.

4.7.4 Fisheries

Fisheries make a significant contribution to Pakistan's exports. The level of effort per unit catch has been rising with increased harvesting and landings of large and medium-sized shrimp have collapsed a number of years in a row in recent years.

River stretches with organic pollution include the River Ravi below the city of Lahore, where the dissolved oxygen falls below 4 mg/l, which is the minimum requirement for most aquatic life. And since fertilizers and pesticides take decades to work their way through soil to water bodies, there are no grounds for complacency about the low levels of nutrient pollution currently recorded.

According to a 1988 study, pollution load had already cut the fish production of River Ravi below Shahdara by 5,000 tonnes per year. The situation will get worse unless the effluents are treated prior to discharge. The River Indus below Sukkur is also receiving waste volumes larger than the assimilative capacity at low flows. On the other hand, most other river stretches still have capacity to absorb more raw municipal effluent.

4.7.5 Specific Interventions for Credits

A) Agriculture /cropping

Environmental Guidelines

- a) Overuse of synthetic fertilizer can lead to soil contamination and drop in yield in the long term. Application of synthetic fertilizer under best practices delivers the best results. Poor storage is also an issue, this lead to local level soil contamination and health hazards. Alternatively farmers should also be informed about the benefits of using organic fertilizer, crop rotation, and land fallowing. These alternatives lead to reduction in the use of synthetic fertilizer and these are also cost effective.
- b) Pesticides are on the negative list of PPAF credits. Pesticides use hazards are well documented. Proponent should inform farmers about the benefits and methods of integrated pest management.

Mitigation Measures

- a) Educate farmer about the disadvantages of overuse of fertilizer, storage requirements of fertilizer, benefits of organic fertilizer, crop rotation, and land fallowing, hazards of using pesticides, and integrated pest management.

B) Livestock /poultry/fish farming

Environmental Guidelines

- a) Rangelands in Pakistan are under stress due to over grazing. Dry and non-irrigated areas of Balochistan and NWFP are the most effected areas. Over grazing lead to desertification in the dry plain areas, and soil erosion in the mountain areas. Extending credit in these areas for grazing livestock will further increase the problem. In such areas credit can only be extended for stall fed livestock. At the same time through out Pakistan borrowers need to be informed about better species of livestock and best health practices for the livestock.
- b) Poultry farms are known for their foul smell. Poultry birds are also prone to many diseases and there are possibilities of disease spread in the nearby communities. Due to these reasons it is safe to locate the poultry farms away from residential areas. Creditor should ensure that the poultry farm of the borrower qualify this criteria. Poultry farm management practices are very poor in Pakistan. The creditor is in the best position to educate the borrower about the best management practices for cleanliness and hygiene. Further to this most of the poultry farms are using low quality chicken feed, for example protein is extracted from tannery waste and then used for the preparation of chicken feed. In most of the cases along with the protein, chrome is also extracted and through chicken feed it enters into the food cycle. Low quality chicken feed is one of the most important reasons behind the occurrence of diseases in poultry.

- c) Fish farming ponds are mostly without any safety railings, this is a safety hazard for the local population. Fish ponds if not properly managed then they serve as a mosquito and other insects breeding areas, this is a serious health hazard for the nearby community. Other issue attached to the fish farming is the introduction of exotic species; this can be disastrous for the local species. The creditor should educate the borrower about these issues and guide him/her about the best management practices.

Mitigation Measures

Livestock:

Educate borrower about better species of livestock and best health practices for the livestock.

Poultry Farming:

Educate borrower about hazards of feeding low quality chicken feed, best hygiene and sanitation practices, and birds' diseases management and its risk for the community in case of spread.

Fish Farming:

Educate farmer about the disadvantages of introducing exotic species, better management practices for pond, and importance of fencing for the community safety.

C) Commerce/retailing/petty trading

Environmental Guidelines

- a) These credits are extended to very small enterprises. These enterprises are normally well integrated in the communities; these are considered more as convenient stores rather than social nuisance. Normally such credits do not cause any negative environmental impact.

Mitigation Measures

- a) Ensure that no social disturbance will be caused by the enterprise and the enterprise is not involved in the trading of items mentioned in the CED negative list.

D) Handicrafts/cottage

Environmental Guidelines

- a) In some of the handicrafts hazardous dyes and chemicals are used. Such chemicals cause skin allergy, cancer and same type of fatal diseases. Creditor should be in full knowledge about the operations of the enterprise and if required should educate the borrower about the health hazards of using hazardous dyes and chemicals.

- b) Child labour is the common feature in such enterprises. Children are more prone to the hazards of chemicals and fatigue, at the same time it is against the laws of Pakistan. Creditor should take special notice of this issue and ensure that the credit would not strength the enterprise that is involved in the non-compliance of child labour laws.

Mitigation Measures

- a) Educate borrowers about the hazards of using hazardous dyes and chemicals, acid handling and usage, and proper disposal of lubricants.
- b) Inform borrowers that hiring child labour is a crime under the laws of Pakistan.

E) Food/agriculture processing

Environmental Guidelines

- a) Large amount of pesticides are applied on the fruit crops. If not properly washed at the time of processing then residues of pesticides are left on the surface of the fruits. This negligence may lead to serious health hazards for the consumers. Many preservatives are used for food packaging; these preservatives should be of good quality otherwise these would serve as health hazards for the consumers. Proper hygiene practices should be practiced to avoid the contamination of the processed food. Creditor should educate the borrower about these hazards and how to manage these hazards.

Mitigation Measures

- a) Educate borrowers about the hazards attached to poor washing, hygiene practices, and better use of preservatives.

Environmental Guidelines

Loan should not be used for pesticide trade.

Mitigation Measures

Educate borrowers that the pesticide trade is on the negative list of PPAF CED.

G) Manufacturing/ light engineering/ workshop

Environmental Guidelines

- a) These enterprises generally generate nominal amount of emissions of wastewater, lubricants, and air. These emissions can be managed properly with good disposal practices and ventilation arrangements. Wastewater should be disposed in the municipal or local drain rather than on the road/street, lubricant can be collected separately and reused, and ventilation can be improved by making small alterations in the structure.

- b) Occupational health and safety is a serious issue in these enterprises. The owners and workers need training about best practices for occupational health and safety. PO can organize these training sessions for different type of borrowers.
- c) Child labour is the common feature in such enterprises. Children are more prone to the hazards of pollution and fatigue, at the same time it is against the laws of Pakistan. Creditor should take special notice of this issue and ensure that the credit would not strength the enterprise that is involved in the non-compliance of child labour laws.

Mitigation Measures

- a) Educate borrowers about the best environmental practices for waste disposal, and benefits of proper ventilation.
- b) Train borrowers on best occupational health and safety practices.
- c) Inform borrowers that hiring child labour is a crime under the laws of Pakistan.

H) Micro Enterprise

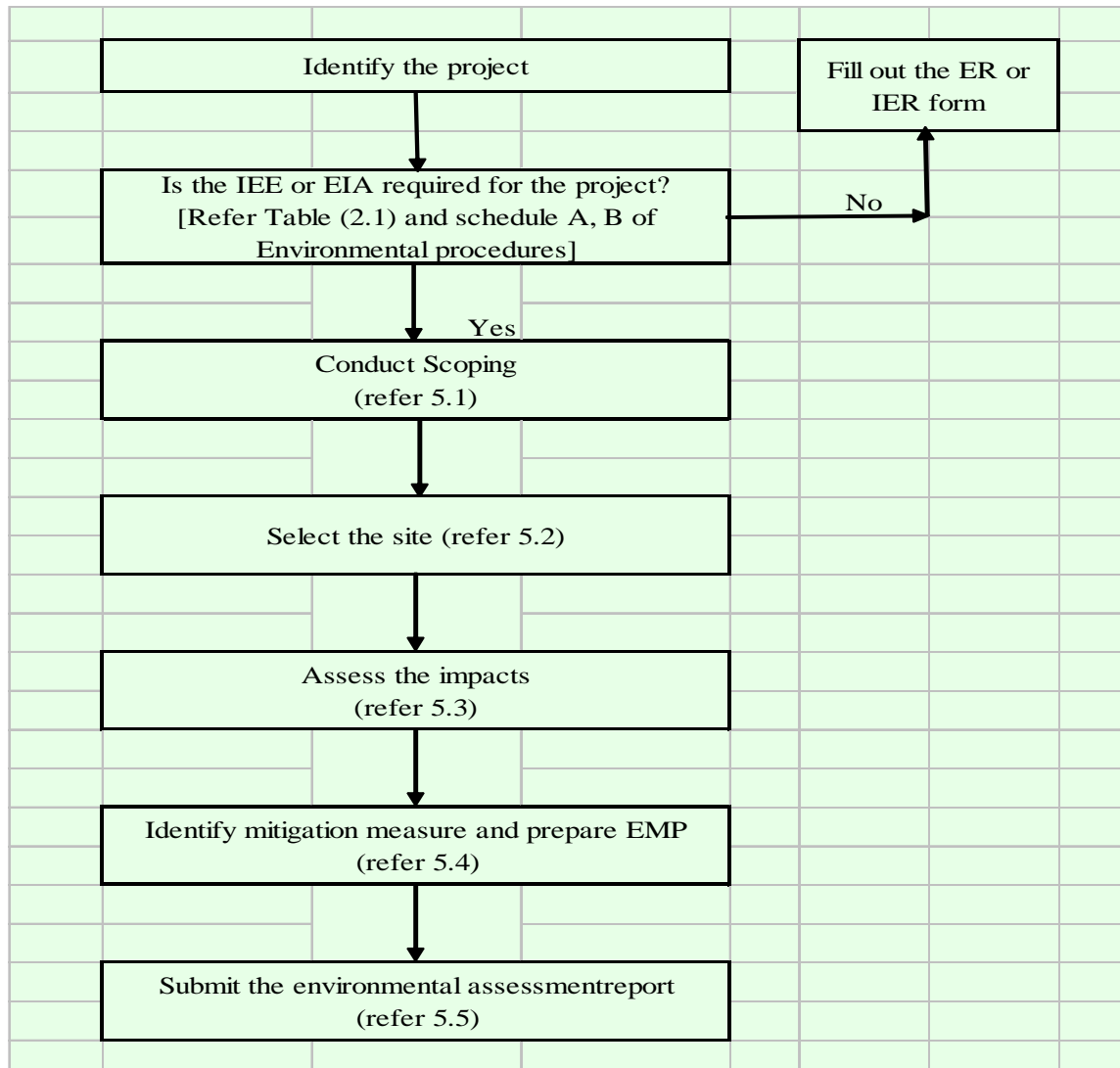
Environmental Guidelines and Mitigation Measures

- a) Same as that of Manufacturing/ light engineering/ workshop

GENERAL FRAMEWORK FOR IEE AND EIA/SIA

As discussed in Chapter 3, national legislation requires conducting of an EIA/SIA for projects listed in a category-A, an IEE for projects listed in category-B. More specifically, the Table-2.1 in the EMF manual, which has been prepared after initial screening of the CPI and CED interventions, contains the list of PPAF projects which either qualifies for EIA/SIA or IEE. This chapter provides the framework for conducting and IEE or an EIA. Figure 5.1 shows the overview of IEE or EIA process.

Figure 5-1: Overview of IEE/EIA Preparation Process



5.1 Scoping

Scoping is a vital early step, which identifies the issues that are likely to be important during the environmental assessment and eliminate those that are not. It is a process of interaction between the interested public, government agencies and the proponent. Scoping refers to the process of identifying, as early as possible:

- ⌚ the appropriate boundaries of the environmental assessment;
- ⌚ the important issues and concerns;
- ⌚ the information necessary for decision-making; and
- ⌚ the significant impacts and factors to be considered.

A typical list of steps for scoping is: (These steps are only indicative, and should be tailored to meet the requirements of the particular situation.)

(i) Prepare an outline of the scope, with headings such as:

- ⌚ objectives and description of the proposal
- ⌚ the context and setting of the proposal
- ⌚ alternatives
- ⌚ issues, and
- ⌚ timetable

(ii) Further develop the outline of the scope through discussion with key stakeholders, assembling available information, and identifying information gaps.

(iii) Identify the issues of concern.

(iv) Evaluate the concerns from both a technical and subjective perspective, seeking to assign a priority to important issues.

(v) Develop a strategy for addressing and resolving each key issue, including information requirements.

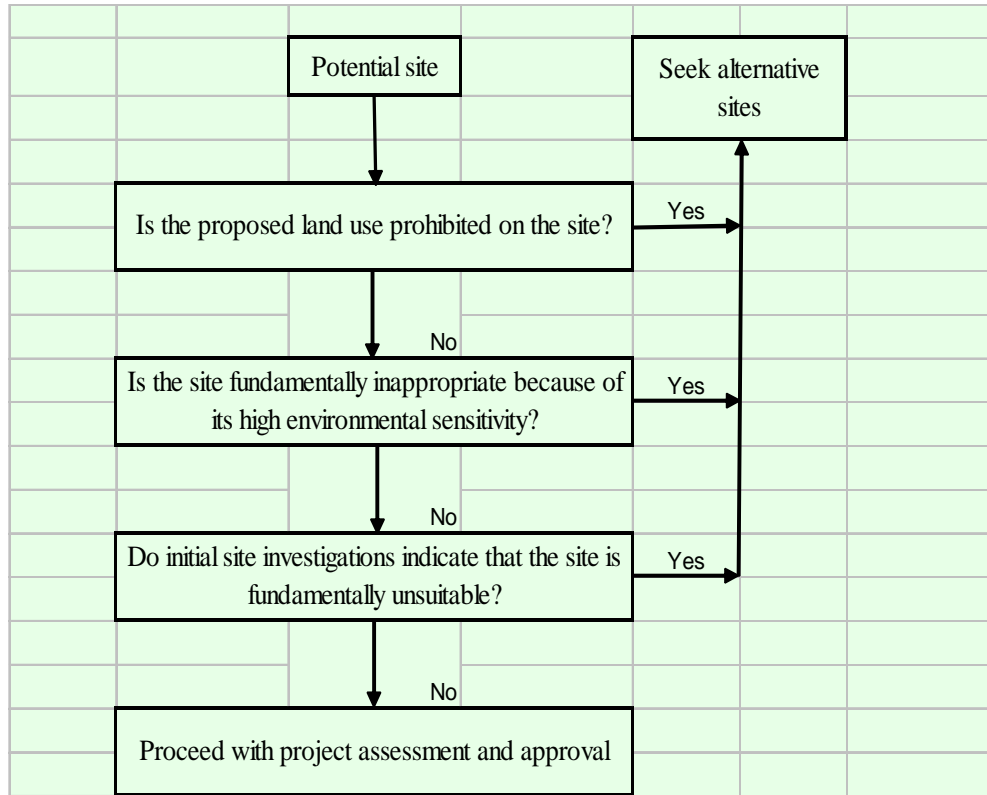
5.2 Site Selection

Initial site investigations can help ensure a potential site's suitability before proceeding with a more detailed assessment. The initial site investigations should exclude fundamentally unsuitable sites.

The principles of site selection are shown in Figure 5.2.



Figure 5-2: Site Selection Principles



5.3 Assessing Impacts

Assessing usually involves three tasks:

- ⌚ impact identification;
- ⌚ detailed analysis of the impacts to determine their nature, magnitude, extent and effect; and
- ⌚ judgment of the significance of the impacts (whether they matter and whether something needs to be done to mitigate them).

(i) Impact identification:

This is done with the aid of various tools and methods to ensure that all significant impacts are identified. These tools and methods include checklists, matrices, networks and geographical information systems. Care should be taken to make sure that any extreme environmental features peculiar to the region in which the project is proposed are adequately catered for (e.g. flood, drought, temperature, seismic activity, land instability, disease vectors etc.).

(ii) Impact analysis and prediction

Once the range of impacts has been identified, the potential size and nature of each one must be predicted. Prediction draws on physical, biological, socio-economic, and anthropological data and techniques and may employ mathematical models, physical models, socio-cultural models, economic models, experiments and expert judgments.

In many cases, this work will be carried out by specialists in the areas of interest. To prevent unnecessary expense, the sophistication of prediction methods used should be kept in proportion to the scope of the Environmental/Social Report and the importance of the particular impact. Where possible impacts should be predicted quantitatively. This makes comparison between alternatives, and with baseline conditions, more meaningful.

Aspects of impacts which should be considered include:

- ⌚ **Nature.** The most obvious impacts are those that directly relate to the proposal (e.g. loss of wetlands, relocation of households, increased air emissions). Indirect impacts are usually less obvious, occurring at a later time or in a place other than where the original impacts occurred (e.g. pesticides in the breast milk of mothers in cities due to the use of agricultural pesticides, environmental degradation of a river mouth resulting from dam building high in the catchment).
- ⌚ **Magnitude.** Note that while in general the sheer size of an impact contributes to its significance, sometimes small impacts can be very important (e.g. very small quantities of some toxic substances can cause large scale health problems for humans and animals).
- ⌚ **Extent and location.** An indication of the location, distribution and size of the area(s) likely to be affected should be given for each impact, direct and indirect.
- ⌚ **Timing.** Impacts from all stages of the life of the project should be considered (e.g. during construction, operation and decommissioning). Some impacts will occur immediately while others may be delayed, sometimes for many years (e.g. siltation of a dam).
- ⌚ **Duration.** Some impacts may be short term, such as the noise arising from equipment during construction. Others may be long term, such as inundation of land after a dam is built.
- ⌚ **Reversibility.** Once the cause of an environmental impact has been removed, the pre-existing environmental condition may be (more or less) restored to its original state. If impacts are reversible (either naturally or with human assistance) then restoration is very much easier. However, some impacts are irreversible.
- ⌚ **Likelihood (risk).** Not all impacts share the same likelihood of occurrence. Some can be predicted to occur, more or less definitely, whereas others are less certain. In all cases some estimate should be made of the uncertainty or 'margin for error' involved in the prediction.

(iii) Significance of the Impacts:

Once impacts have been analysed, it is important to determine their significance that is, whether they are acceptable, require mitigation, or are unacceptable to the community. The significance of an impact is determined by the joint consideration of the impact characteristics and the importance (or value) attached to them.

Determining the importance of the various issues can sometimes be approached by comparing the likely or predicted impacts with current standards. Key bases for assessing impact significance are:

- ⌚ level of public concern (particularly over health and safety);
- ⌚ scientific and professional judgment;
- ⌚ disturbance and disruption of valued ecological systems; and
- ⌚ degree of negative impact on social values and quality of life.

5.4 Mitigation and Impact Management

The purpose of mitigation in the environmental assessment process is to:

- ⌚ look for better ways of doing things so that the negative impacts of the proposal are eliminated or minimised, and the benefits are enhanced; and
- ⌚ make sure that the public or individuals do not bear costs which are greater than the benefits which accrue to them.

When significant impacts are identified in the construction, operational or decommissioning phases of a project, collaboration is needed between the project designers and the environmental assessment team to see if design or planning changes can mitigate these problems. For instance, earthworks could be avoided during the rainy season to minimise surface runoff.

To ensure that the commitments in the Environmental Report, subsequent review reports, and Environmental Approval conditions are fully implemented an environmental management plan (EMP) is required. A detailed EMP is not usually considered necessary for the Environmental Report. The Environmental Report should contain a comprehensive outline of the structure of the EMP with a summary of the environmental management and pollution prevention principles which would be followed when undertaking the detailed design, construction and operation of the project. For issues where there are high levels of risk or uncertainty, details of management procedures to deal with any adverse outcomes should be included in the EMP outlined in the Environmental Report.

The EMP should provide a framework for managing or mitigating environmental impacts for the life of the project. It should also make provision for monitoring the effectiveness of the proposed environmental protection measures and procedures.

5.5 Reporting

A general format for an Environmental Report will include:

A- Executive or non-technical summary

This is the part of the report that most people will read. It is often the only part that people will read (including decision-makers). A two to four page executive summary should contain:

- ⌚ title and location of the proposal
- ⌚ a brief outline of the proposal
- ⌚ the major impacts
- ⌚ recommendations for mitigation and compensation
- ⌚ proposed monitoring plan

B- Introduction

This section should include the following:

- ⌚ Purpose of the report, including identification of the project and the Proponent (including a contact person, and details of any Consultant associated with the IEE/EIA/SIA preparation), a brief description of the nature, size, and location of the project, and other pertinent background information; and
- ⌚ Extent of the IEE/EIA/SIA study, scope of the study, magnitude of effort, persons performing the study

C- Description of project

Furnish sufficient details to give a brief but clear picture of the following (include only applicable items):

- ⌚ Type and category of the project.
- ⌚ Objectives of project.
- ⌚ Alternatives considered, and reasons for their rejection.
- ⌚ Location (use maps and photographs showing general location, specific location, and project site layout. Include land uses on the site and surroundings, details of population centres and nearby dwellings, road access, topographic and vegetation features of the site, and other sensitive land uses such as national parks, wild life reserves or archaeological sites.)
- ⌚ Size or magnitude of the operation, including capital cost, and associated activities.
- ⌚ Proposed schedule for implementation.
- ⌚ Description of the project, including drawings showing project layout, components of the project, etc.
- ⌚ Details of restoration and rehabilitation plans at the end of the project life.
- ⌚ Government approvals and leases required by the project.

D- Description of environment (in area affected by project)

Furnish sufficient information to give a brief but clear picture of the existing environmental resources including the following (to the extent practicable, including photographs where relevant):

- ⌚ **physical resources** topography, soils, climate, surface water, groundwater, geology/seismology;
- ⌚ **ecological resources** wildlife, forests, rare or endangered species fisheries, aquatic biology;

- ⌚ **human and economic development** where applicable including, but not limited to:
 - population and communities—numbers, locations, composition, employment
 - infrastructure—including water supply, sewerage, flood control/drainage, etc., roads
 - land use planning—including dedicated use areas
 - power sources and transmission;
 - agricultural and mineral development.
- ⌚ **quality of life values** (including, but not limited to):
 - socioeconomic values
 - public health
 - archaeological or historic treasures
 - cultural values

E- Potential environmental impacts and mitigation measures

This should include:

- ⌚ an assessment of any impact on the local population (including gender issues);
- ⌚ the relevant environmental data and predictive methods used and any underlying assumptions made;
- ⌚ any gaps in knowledge and uncertainties encountered;
- ⌚ compliance with relevant environmental standards;
- ⌚ the assessed significance of the impact, stating the standards or criteria used as a basis for judgment; and
- ⌚ possible measures for avoiding or mitigating the impact.

F- Environmental management plan and monitoring plan

This is the ‘action oriented’ part of the Environmental Report. It summarises the mitigation measures which have been adopted to ensure that they are implemented, and that the impacts are in accordance with predictions. It is a plan for monitoring and managing the impacts during implementation and operation. Environmental management and monitoring plans should:

- ⌚ contain a description of the proposed mitigation actions;
- ⌚ contain a schedule for implementation;
- ⌚ assign responsibility for implementation;
- ⌚ present the monitoring program to assess performance;
- ⌚ present the proposed reporting and reviewing procedures; and
- ⌚ outline any training needs that are required to ensure that the plans can be implemented successfully. Monitoring should be restricted to **the necessary minimum program** needed to protect the environment.

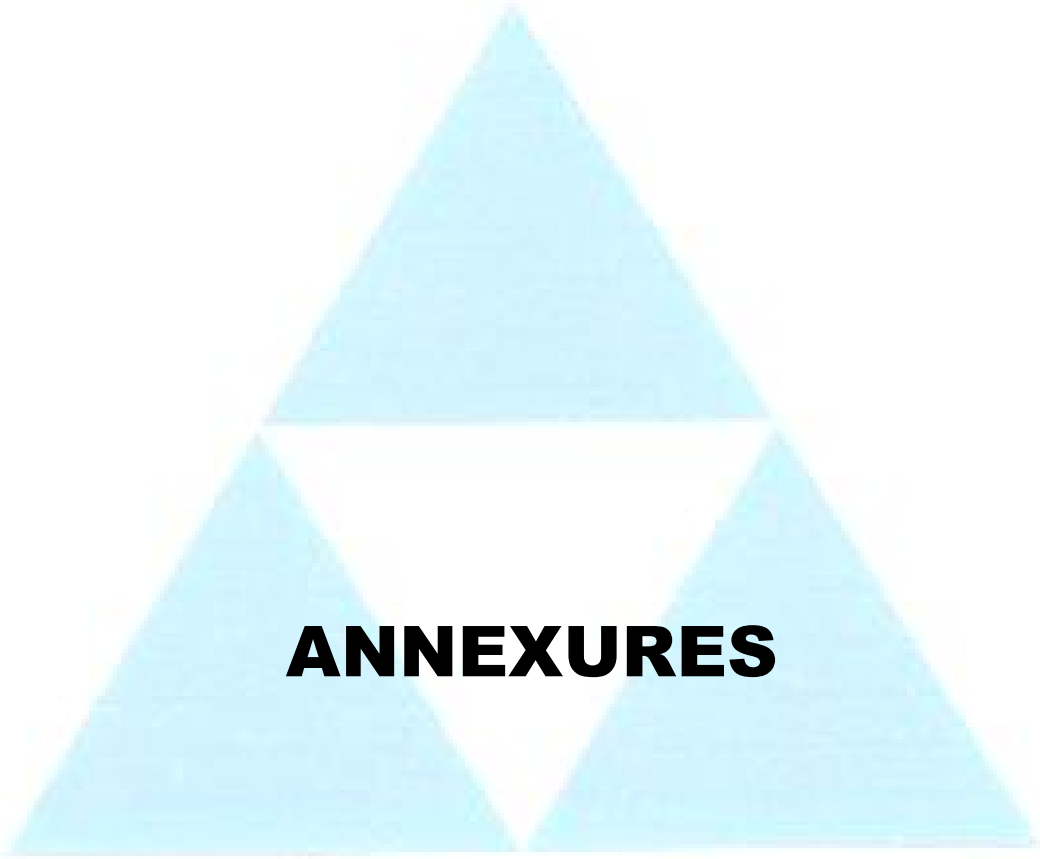
G- Conclusions

This section should include an evaluation of the screening process and should highlight whether significant environmental impacts exist, which need further detailed study. The report should present the conclusions of the study briefly and concisely.

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ANNEXURES

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ANNEXURE-1

PAKISTAN ENVIRONMENTAL PROTECTION ACT (1997)

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ANNEXURE-2

RELEVANT WORLD BANK OPERATIONAL POLICIES

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ANNEXURE-3

WILD LIFE PROTECTED AREAS

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ANNEXURE-4

**SITES OF ARCHAEOLOGICAL AND HISTORICAL
SIGNIFICANCE**

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