

Field Verification of Social and Environmental Issues of Selected Water Sector Projects in Punjab – Pakistan

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Abstract

Irrigation helps in increasing the agricultural yield and the irrigation projects are carried out for the welfare of people. The importance of environment for sustainable development of irrigation projects has been realized. Environmental Impact Assessment is being increasingly used as a tool for appropriate environmental planning. In Pakistan, PEPA (Pakistan Environmental Protection Act), 1997 establishes the framework to carry out Environmental Assessment of development projects. Various national and international agencies have developed Environmental Assessment Guidelines and Checklists for systematic evaluation of environmental impacts and their mitigation. The Social and Environmental Management Unit of Punjab Irrigation and Drainage Authority developed checklist for assessment of irrigation projects in 2007. The present study was conducted on three water sector projects namely: Concrete Lining of Dhudi Minor, Improving Nikki Deg Drain System and Rehabilitation of Khanki Barrage. The field verification of social and environmental issues of the projects was carried out according to the checklist of Social and Environmental Management Unit. The most noticeable impacts which were identified include: extended canal closure, emissions and effluents, waste generation and disposal, effect on flora, public health and safety, land acquisition, and social issues. The mitigatory measures proposed: proper project scheduling to minimize the canal closure periods, waste disposal through proper planning, preparation of detailed resettlement action plans and compensation, location of labor camps away from the settlements, avoiding unnecessary cutting of trees, and deployed machinery should be in good working condition. The recommendations of the study are to review and improve the checklists through a gradual and phased process into a more comprehensive social and environmental assessment process; capacity building of all the stakeholders; collaboration between different institutions, agencies and industries for environmental friendly and sustainable development of projects.

Key Words: Irrigation; Environmental Impact Assessment (EIA); social and environmental checklist; emissions and effluents; social issues; sustainable development

1. Introduction

The water applied artificially to the soil in order to supplement the natural supply of water and to get better crop production is known as irrigation. Worldwide, the irrigation facilities were present in 278.8 Mha (689 million acres) of agricultural area in the year 2000. The areas equipped with irrigation infrastructure include: 68% in Asia, 17 % in America, 9 % in Europe, 5 % in Africa and 1 % in Oceania [1].

In Indus Basin, the irrigation development was started in the middle of 19th century under British Rule [2]. In Pakistan, after independence, the international border divided the irrigation system

between Pakistan and India which resulted in dispute over sharing of river waters between two countries. The dispute was resolved after signing the Indus Basin Treaty in 1960. According to the treaty, India has the right for three eastern rivers (Sutlej, Beas and Ravi), while three western rivers (Indus, Jehlum and Chenab) were under the control of Pakistan. In order to transfer the water from western rivers to eastern rivers, a system comprised of two storage dams, eight inter-link canals and six barrages was constructed [3].

The Punjab Irrigation Network which is one of the largest contiguous systems in the world was designed in order to bring more land under canal command [4]. It consists of irrigation canals, drains, tube wells, small dams and flood protection infrastructure. The irrigation facilities to the Punjab

are provided through this grand network consisting of over 37014.912 Kilometers of irrigation canals [5]. This irrigation network is subjected to major infrastructure and operational challenges and safety concerns due to ageing and system design constraints. The major challenges are water shortages, progressive deterioration of irrigation infrastructure, lack of transparency and inequities in water distribution, progressive deterioration of water quality of canals, drains and rivers due to disposal of untreated industrial and municipal effluents, and over exploitation of groundwater. The rehabilitation and up-gradation of irrigation systems, modernization of barrages, lining of irrigation channels, improving canal operations and checking water theft, and institutional reforms needs to be implemented [3].

The irrigation projects are carried out for the well-being and prosperity of people. In the past the main concern was to get increased agricultural yield without giving attention to associated environmental changes. But now, it has been realized that the environment is also relevant for the welfare of people and for sustainable development. Environmental Impact Assessment (EIA) is used to assess the social and environmental impacts of the project prior to decision-making. It comprises of data collection, predicting environmental impacts, finding measures to reduce adverse impacts, formulating environmental management and training plans and monitoring arrangements. EIA is useful in achieving environmental and socio-economic benefits [6 & 7].

The United States of America was the pioneer to establish EIA legislation, which is known as National Environmental Policy Act (NEPA) in 1969 which was enacted in 1970 [8 & 9]. The EIA requirements were introduced in Australia, Canada and New Zealand by the mid 1970s. Initially the World Bank adopted the procedures for EIA. Now EIA is required by different international development banks and donor agencies for the projects funded by these banks and agencies [10]. The number of developed and developing countries has their own EIA process [11].

In Pakistan, the first commitment towards environmental improvement was Pakistan Environmental Protection Ordinance (PEPO), 1983 which was later replaced by Pakistan Environmental Protection Act, 1997. The Pakistan Environmental

Protection Ordinance established the Pakistan Environmental Protection Council (PEPC) and Pakistan Environmental Protection Agency (Pak-EPA) at the federal level and four Pakistan Environmental Protection Agencies at provincial level [12 & 13]. The Environmental assessment is prerequisite for all public and private development projects after the approval of Pakistan Environmental Protection Act [14]. The implementation of EIA process in Pakistan is less developed due to lack of awareness at the government level [15]. The EIA projects carried out in Pakistan by donor agencies such as World Bank, Asian Development Bank etc. followed the respective agency's guidelines [12].

The International Commission on Irrigation and Drainage (ICID) has developed the checklist to assess the environmental impacts of irrigation projects [16]. The Food and Agriculture Organization (FAO) has developed the checklist for developing countries in order to address environmental issues of irrigation and drainage programs [17].

The Asian Development Bank (ADB) and World Bank (WB) classify the projects into different categories in order to carry out environmental review according to the procedures for that category. The categories include category A, B and C. Category A includes the projects which require Environmental Impact Assessment (EIA) and have significant adverse environmental impacts. For example: Dams and reservoirs, large scale projects of forestry and production, industrial plants, Irrigation, drainage, and flood control etc. Category B includes the projects that require Initial Environmental Examination (IEE) and have environmental impacts less adverse than those of Category A. For example: Agro-industries, Electrical Transmission, Water supply and sanitation, Irrigation and drainage (small scale) and Renewable energy etc. Category C includes the projects that have minimal or no adverse environmental impacts and environmental analysis is not required, e.g. Forestry research, education, Marine research etc. [18 & 19].

In Pakistan, PEPA (Pakistan Environmental Protection Act), 1997 establishes the framework to carry out Environmental Assessment of different projects. However, the guidelines for social and environmental issues of irrigation and drainage projects have not developed. In Punjab, Social and

Environmental Management Unit (SEMUR) of Punjab Irrigation and Drainage Authority (PIDA) has developed the checklist for social and environmental assessment of irrigation projects [20].

It would be seen from the table 1 that the major environmental parameters are covered by all checklists. However, these checklists differ in the detailed coverage of various parameters. The ICID and FAO checklists are comparatively more comprehensive and identify much more number of items as compared to SEMUR checklist. The ADB and WB format for environmental assessment is different in the sense that specific checklist for different projects have not been specifically mentioned.

The present study was carried out to observe the field verification of social and environmental issues of selected water sector projects.

Table 1: Comparison of ICID, FAO and SEMUR Checklists

Description	ICID		FAO		SEMUR		
	Status	No. of Items	Status	No. of Items	Status	No. of Items	
Major Items	Hydrology	✓	5	✓	5	✓	2
	Pollution	✓	5				
	Soils	✓	5	✓	5	✓	1
	Sediments	✓	6	✓	6		
	Biology and Ecology	✓	8	✓	5	✓	5
	Socio-economic	✓	10	✓	10	✓	7
	Health	✓	9	✓	3	✓	1
	Imbalances	✓	5	✓	3		
	Water quality			✓	4	✓	2
	Air quality			✓	1	✓	1

Source: ICID (1993), FAO (1995), SEMUR (2007)

1.1 Legal Provisions for IEE/ EIA

Pakistan Environmental Protection Act (PEPA), 1997 is the law on environment which deals with the protection, conservation, rehabilitation and improvement of the environment, prevention and control of pollution, and promotion of sustainable development. Section 12 of PEPA, 1997 provides broader framework for review of Initial

Environmental Examination (IEE) and Environmental Impact Assessment (EIA) Regulations and its approval. The detailed review and categorization of projects requiring IEE and EIA have been provided by Pakistan Environmental Protection Agency. These Regulations provide two Schedules which list the categories of project requiring IEE and EIA. The project falling in any category specified in schedule I require IEE while the projects falling under any category specified in schedule II require EIA.

The water sector projects which require IEE include: (i) Dams and reservoirs with storage volume less than 50 million cubic meters or surface area less than 8 km², (ii) Irrigation and drainage projects serving less than 15,000 hectares, (iii) Small-scale irrigation systems with total cost less than Rs. 50 million. The water sector projects which require EIA include: (i) Dams and reservoirs with storage volume of 50 million cubic meters and above or surface area of 8 km² and above, (ii) Irrigation and drainage projects serving 15,000 hectares and above (iii) all projects situated in environmentally sensitive areas [21].

However, it is pointed out that despite these mandatory provisions environmental assessment of very few projects is being carried out. The projects for which environmental assessment and resettlement plans are being prepared almost entirely relate to foreign aided projects. This is predominantly because the international financing agencies have strong social and environmental safeguards, which have to be met before qualifying for donor financing. It was in this backdrop that environmental checklists were developed by SEMUR of Punjab Irrigation and Drainage Authority as an initial step for taking care of social and environmental issues in the water sector projects.

2. Materials And Methods

The water sector projects i.e. concrete lining of Dhudi Minor, improving Nikki Deg Drain system and rehabilitation of Khanki Barrage were visited. The environmental impacts of these projects were assessed and field checking of social and environmental issues was carried out by following the checklist developed by Social and Environmental

Management Unit of Punjab Irrigation and Drainage Authority. The checklist is a customized version in order to assess the environmental impacts of irrigation projects as a first step. It is relevant to mention here that generally the social and environmental assessment of small to medium scale irrigation projects is not practiced. So the checklists have been developed to familiarize irrigation engineers and managers to the environmental and social assessment process of development projects. The checklists include: (a) Sample Reporting Form, (b) Primary Baseline Data, (c) Secondary Baseline Data and (d) Checklist of typical Social and Environmental Impacts during Execution of Proposed Project.

The sample reporting form provides the following information about the project:

- i) Name of project,
- ii) Location of project,
- iii) Nature / Type of project,
- iv) Stage of project
- v) Executing Authorities / Agencies of project.

The primary baseline data which is collected at the project site comprised of five major types of data: i) Land acquisition, ii) Displacement of households, assets, livelihoods, iii) Rapid social assessment and consultation with communities in project area with particular attention to vulnerable groups, iv) Changes in water availability or water allocation and v) Water supply for drinking and livestock. The secondary data which comprised of environmental and socio-economic baseline data include i) Environmental assets, resources and conditions and ii) Assessment and screening – potential impacts of project activities. The checklist assesses impacts of a project on physical, biological and social environment. The physical environment include: Land and soil, Surface water hydrology, Groundwater hydrology, Surface water quality, Groundwater quality, Air quality, Noise and vibration. The biological environment includes Flora, Fauna, Forests/game reserves, Wetlands and Sensitive environmental areas/ hot spots. The social environment include Socio economic loss, Displacement/resettlement, Ethnic and cultural norms, Infrastructures/utilities, Vulnerable groups, Health hazards, Scenic and

aesthetic quality and Cultural heritage and Archeological sites [20].

3. Projects Visited

The study was carried out on three irrigation projects namely: concrete Lining of Dhudi Minor, improving Nikki Deg Drain System and rehabilitation of Khanki Barrage. The first two projects were under execution while the third project is yet to be implemented. The study sites are shown in figure 1.

3.1 Concrete Lining of Dhudi Minor

Dhudi Minor which falls in the saline zone of District Faisalabad is off-taking from Lakhuana Distributory. It has length of 12.49 kilometers with the designed head discharge of 0.89 m³/sec and tail discharge of 0.03 m³/sec. The breadth and depth of the channel is 2.56 m and 0.49 m, respectively. It irrigates an area of 425 m² through 22 outlets. The area under irrigation of this minor is fertile but due to shortage of canal supply and population pressure the benefits of fertile land are not being achieved as desired. Most of the channel is earthen and due to consistent trespassing and weather action, the maintenance condition became deplorable. Precious quantity of water is being wasted due to leakages and breaches, and water theft is also common practice resulting in shortage of water supply to the tail. It was therefore imperative to remodel the Minor using concrete lining [22].

The Dhudi Minor at RD: 9000-20000 was visited on 5 July, 2007. The work was completed in the reach from RD: zero to 12000 while the lining work was in progress from RD: 12000-16000. The work was in various stages of execution. The work was being executed in the following steps:

- i. Construction of diversion
- ii. Filling the channel prism with soil and its compaction in layers
- iii. Cutting of compacted soil for carving out channel prism
- iv. Laying of 1 ½ inch base coarse
- v. Construction of 3 inch thick concrete lining
- vi. Curing of concrete

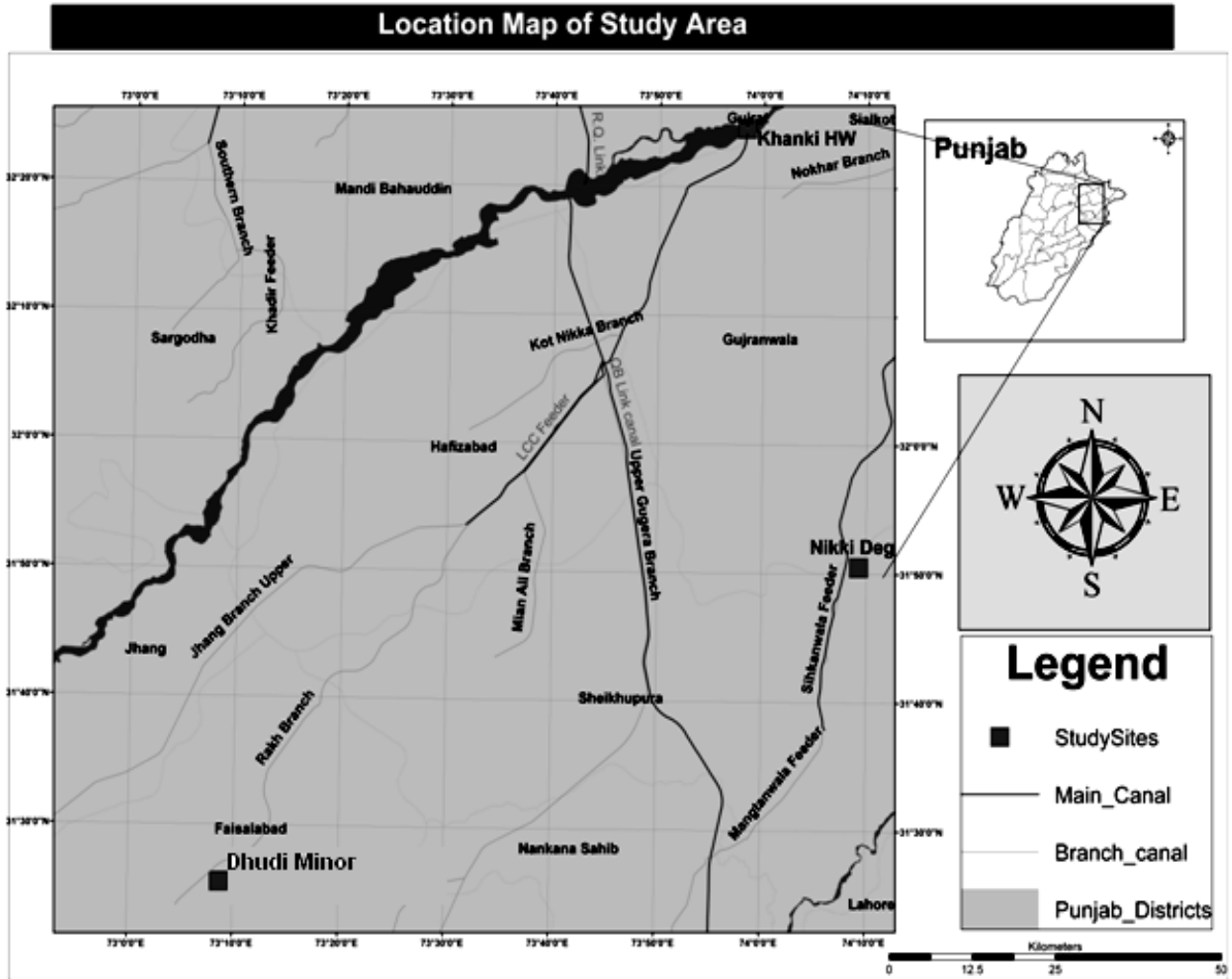


Fig. 1: Location map of the study sites

- vii. Completing the earthen banks
- viii. Fixing / Construction of outlets

3.2 Improving Nikki Deg Drain System

Nikki Deg drain system is one of the main offshoots of the Deg Nullah. The upper catchments area of Deg Nullah in India has high rainfall that generates large floods in the Nullah, which ultimately flows into Pakistan. The designed discharge of Nikki Deg Drain is 181.34 m³/sec. The bed width is 30.48 m. The bank width parallel to the bank is 3.66 m while non parallel bank is 1.52 m. The present problem is that large areas contiguous to the Deg to the Deg Nullah can not be cropped during the Kharif Season due to flooding. The Nikki Deg drain

and main Deg Nullah is choked with silt. The proposed project would serve to improve the situation by preventing the area from stagnation of water during low flow periods and by flushing out poor quality water during peak flows in drain [23].

The Nikki Deg Drain 8 km away from Muridke on Muridke-Sheikhupura road was visited on 15 July, 2009. At the upstream section, the work had not been carried out because of stay order by the Court. In this range the drain was existing in its original condition. The bridge at Waseem-Sajjad road at RD: 147 was inspected. The piling work was being done at the bridge site. The upstream and downstream earthen banks had been constructed to keep the working area dry. The head of Nikki Deg Drain at bifurcation point

from main Deg Nullah had also been plugged to allow construction of the bridge. Mainly, the work was being executed in the following steps:

- i. Drain excavation
- ii. Bridge construction

3.3 Rehabilitation of Khanki Barrage

Khanki weir, and off-taking Lower Chenab Canal (LCC), system is one of the oldest and largest irrigation networks of the sub-continent. Khanki weir was originally constructed in 1892. It has a designed discharge capacity of 800,000 cusecs and irrigates 3 million acres of cultivable area in the Central Punjab. The main purpose of the weir is to divert irrigation supplies to Lower Chenab Canal (LCC). It had history of damages while repairs and modifications were also implemented to improve the safety of the weir. The objective of the New Kahnki Barrage project is to

keep the L.C.C. system running at the required level to sustain and improve the agricultural production in its command area [24].

The Khanki Barrage and its left marginal bank were visited on 18th March, 2011. The wetting channel had been provided along the bund for additional safety. The following activities will be carried out:

- i. Temporary restoration of the existing structure (till new barrage is constructed)
- ii. Construction of new barrage.

4. Results and Discussion

The activities, impacts and mitigation measures of the projects are provided in the SEMU checklist. During the field visit, appropriate activities, related impacts and mitigation measures were identified which are presented in table 2, table 3 and table 4:

Table 2: Field Checking of Environmental Issues of Dhudi Minor

Activities	Impacts	Mitigation Measures
Construction of diversion	<ul style="list-style-type: none"> • Excavated material will cause air pollution. • Disturbance to biodiversity of the area. 	<ul style="list-style-type: none"> • Sprinkling of water on excavated material should be done regularly. • The knowledge about the ecosystem of the area and its importance should be imparted to the contractor and his staff.
Filling the channel prism with soil and its compaction in layers	<ul style="list-style-type: none"> ▪ Air pollution due to movement of soil. ▪ Noise pollution due to the working of machinery. 	<ul style="list-style-type: none"> ▪ Proper care should be taken for reducing air pollution. ▪ Proper tuning and maintenance of machinery should be done.
Cutting of compacted soil for carving out channel prism	<ul style="list-style-type: none"> • Excavated material may cause dust pollution by wind erosion or movement of machinery. 	<ul style="list-style-type: none"> • Proper controlled management of compaction process.
Laying of 1 ½ inch base coarse	<ul style="list-style-type: none"> • Ergonomic problems may cause to workers at the work site. • The construction material may cause adverse impacts on the health of workers. 	<ul style="list-style-type: none"> • Personal Protective Equipments (PPEs) should be used.
Construction of 3 inch thick concrete lining	<ul style="list-style-type: none"> • Ergonomic problems may cause to workers at the work site. • The construction material may cause adverse impacts on the health of workers. 	<ul style="list-style-type: none"> • Personal Protective Equipments (PPEs) should be used.
Completing the earthen banks	<ul style="list-style-type: none"> • Air pollution due to wind action. • Transportation problem arises during the work 	<ul style="list-style-type: none"> • Sprinkling of water on excavated material. • Work should be done at less traffic hours.
Construction of outlets	<ul style="list-style-type: none"> • It may impact canal water supplies to the farmers. 	<ul style="list-style-type: none"> • Proper design and construction of outlets should be ensured.

Table 3: Field Checking of Environmental Issues of Nikki Deg Drain System

Activities	Impacts	Mitigation Measures
Drain Excavation	<ul style="list-style-type: none"> Disposal site of excavated material may have potential for environment degradation 	<ul style="list-style-type: none"> Proper utilization of excavated material will be done.
	<ul style="list-style-type: none"> Excavated material will cause dust pollution 	<ul style="list-style-type: none"> Regular sprinkling of water should be done on excavated material.
	<ul style="list-style-type: none"> Impacts on biodiversity (flora and fauna) Air and noise pollution due to machinery Steep slopes of the drain prism may cause slippage of excavated material into the drain Affects of camp site and machinery equipment yards 	<ul style="list-style-type: none"> The knowledge about the ecosystem of the area should be imparted to the contractor and his staff. Proper maintenance of machinery and use of silencers. Good management practices for maintenance of drain section. Camp site should be located away from the settlements and Personal Protective Equipments should be provided to the workers.
Bridge Construction	<ul style="list-style-type: none"> Disruption to traffic Noise and vibration due to machinery Affects of camp site and machinery equipment yards Dust cause due to excavated material 	<ul style="list-style-type: none"> Proper arrangement for movement of traffic across the drain should be made. Proper maintenance of machinery and use of silencers Camp site should be located away from the settlements and Personal Protective Equipments should be provided to the workers. The knowledge about the social system of the area should be imparted to the contractor and his staff Proper utilization of excavated material will be done. Regular sprinkling of water should be done one excavated material.

Concrete Lining of Dhudi Minor

Name of Project: Concrete Lining of Dhudi Minor

Location of Project Civil District Faisalabad

Nature / Type of Project: Canal Lining Project

Executing authorities / agencies: Hafizabad Irrigation Division of Faisalabad, Irrigation Zone Punjab Irrigation Department (PID)

During the field visit, following points were noted:

i) The lining of Dhudi Minor is the project to improve the irrigation infrastructure and to

ii) enhance irrigation efficiency and agricultural production.

iii) At the time of visit, lining work was under progress. It was noted that the work was being carried out without constructing diversion channel and by closing Dhudi Minor. It was apprehended that the unscheduled canal closure may cause problems for farmers and may damage the crops. The work therefore needs to be stepped up in order to minimize the adverse impacts of long unscheduled closure.

iv) Health and safety condition of the workers was not up to the mark. Proper practices should be followed for ensuring health and safety of the workers.

- v) In the built-up area, where lining work had yet to be started, domestic effluent was being discharged into the channel. The relevant irrigation and drainage authorities should stop the effluent disposal into the Distributory.
- vi) As a result of lining, the seepage losses would be reduced and resultantly the recharge to the aquifer may be reduced which may impact on the availability of drinking water. Since the groundwater of the area is brackish so the arrangements need to be made for providing drinking water to the settlements.
- vii) To minimize dust pollution the water was being sprinkled. The contractor's camp site was located away from the nearby settlements.

Improving Nikki Deg Drain System

<i>Name of Project:</i>	Improving Nikki Deg Drain System
<i>Location of Project</i>	District Gujranwala, Sheikhupura and Sialkot
<i>Nature / Type of Project:</i>	Improvement of drainage system
<i>Executing authorities / agencies:</i>	Rachna Drainage Division of Lahore, Irrigation Zone Punjab Irrigation Department (PID)

During the field visit, following points were noted:

- i) The project of Improving Nikki Deg Drain System is planned to provide relief to the local population and to reduce flooding and improve the overall environmental conditions of the area.
- ii) The discussion with the field officers of Irrigation Department indicated that 700 acres of land was needed to be acquired for the project execution. However, it was observed that land acquisition was still under process while the construction work had been started without completing the land acquisition process and without paying the land cost to the owners. In addition, the land acquisition was not being done in some reaches reportedly on the grounds that the affected farmers had given the land free

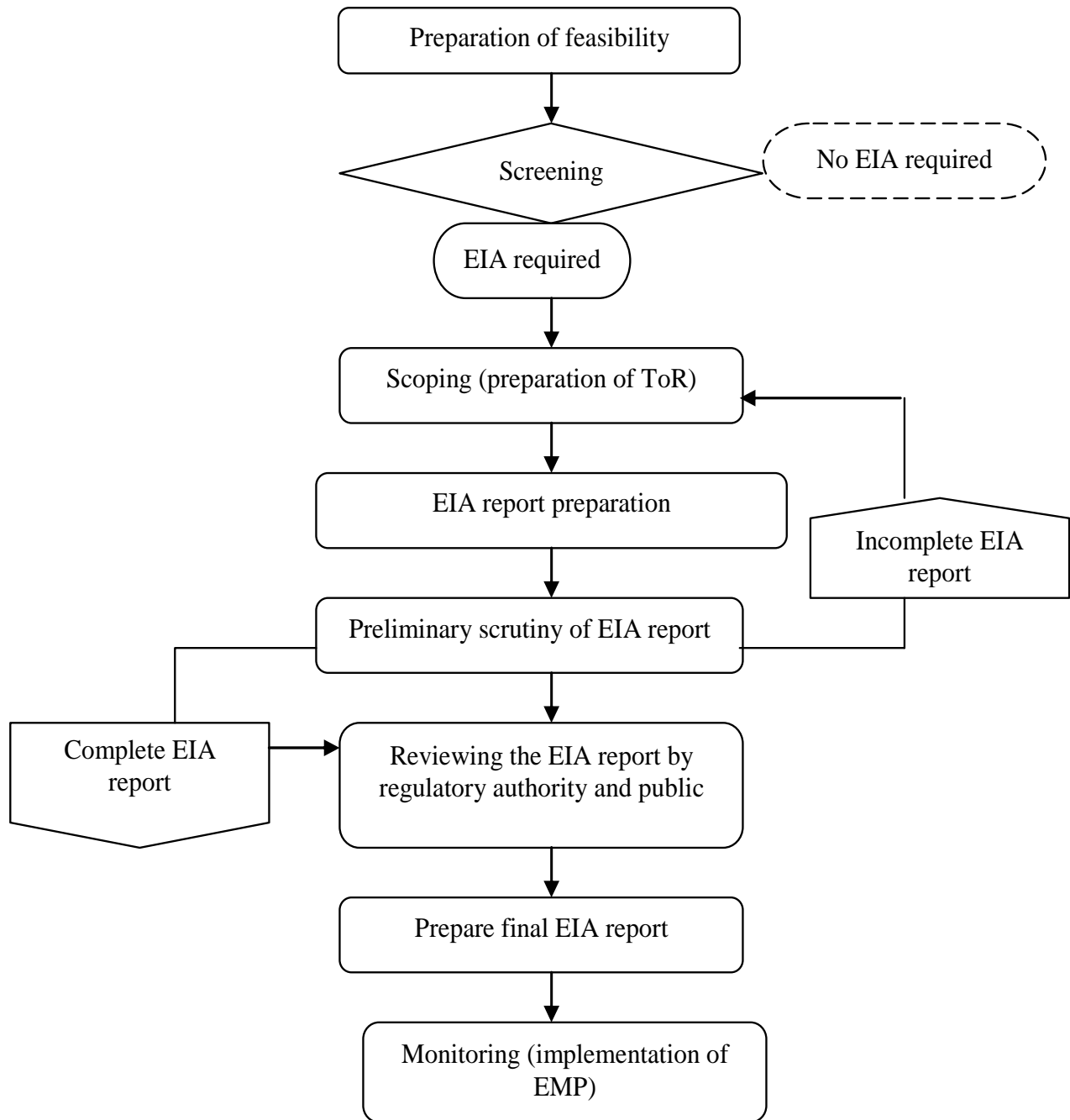
of cost. This aspect needs to be verified at the site.

- iii) The industries located close to Nikki Deg Drain were disposing untreated effluents into the Drain which was causing serious environmental hazard. This aspect needs to be attended by the responsible agencies (Environmental Protection Agency and Punjab Irrigation Department) on urgent basis.
- iv) The site slopes of the drain (0.5 horizontal to 1 vertical) were too steep and it was apprehended that this slope would not be sustainable and the excavated material could slip into excavated drain section thereby reducing the carrying capacity of the drain. The construction planning appeared to be the sub-optimal because the construction of bridge was being done right in middle of the rainy season and the drain had been closed to allow the bridge construction. As a result the work already carried out could not be made use of and in addition the works in progress could be damaged in case of flooding in Deg Nullah.
- v) Health and safety concerns for the workers were not up to the mark. Proper arrangements need to be made for ensuring health and safety of the workers. The contractor's camp site was located away from the nearby settlements.

Rehabilitation of Khanki Barrage

The Environmental Impact Assessment (EIA) of the Khanki Barrage is earmarked for financing by Asian Development Bank (ADB). Therefore, proper EIA has been carried out by the consultants [25] by following the process prescribed in the legal framework as depicted in figure 2. Initially, EIA of the Khanki Barrage was prepared in 2005 and updated in 2009 which was approved by Environmental Protection Department (EPD). The EIA has again been revised and got approved from EPD in 2011. The project implementation will commence in 2012.

The major impacts and their mitigation measures identified in Environmental and Social Impact Assessment (ESIA) are summarized in Table 4 [26].



EIA: Environmental Impact Assessment
ToR: Terms of Reference
EMP: Environmental Management Plan

Source: PEPA, 1997 [7]

Fig. 2: Environmental Impact Assessment Process

Table 4: Major Environmental Issues of Khanki Barrage

Activities	Impacts	Mitigation Measures
Dismantling of Old existing Headworks	Dust pollution, noise emission, damage to aquatic life and safety hazards	<ul style="list-style-type: none"> • Ensure that no blasting material will be used for the dismantling of the old Headworks. • Ensure that dismantled material i.e. debris of concrete and stone masonry will be disposed off in depression located on the left side down stream of the barrage.
Construction of new Barrage	Waste generation and disposal, Dust, smoke and other potential pollutants, handling of fuels, lubricants and chemicals, Land acquisition, Social issues, Public health and safety issues, Aesthetic/ scenic quality	<ul style="list-style-type: none"> • Ensure that all the waste generated from different locations must be disposed off according to the Waste Disposal Plan. • Ensure that material suitable for recycling stored separately in three bin system. • Ensure that the dumping area has been leveled properly after disposal of waste material. • Ensure that all equipment and vehicles are properly tuned and maintained in good working condition. • Ensure that no contaminated effluent is released into the environment. • Ensure that other hazardous substances are handled and stored according to standard safety practices. • Ensure that operating vehicles are checked regularly. • Ensure the use of Personal Protective Equipment (PPE) wherever required. • Ensure that no oil/lubricant or other toxic materials are released into the river. • In case private land acquisition has to be undertaken, a Land acquisition and Resettlement Plan will be prepared. • Ensure that women are informed through traditional means of communication of the presence of foreigners (if any) in their area. • Ensure that conflicts with village leaders and local communities are avoided. • Ensure no machinery is left unattended in the project area. • Ensuring that all materials, gears and equipments (including personal protective equipment) needed to carry out the job safely has been provided to the workers. • Carry out complete restoration of the construction sites. Remove all waste, debris, unused construction material, and spoil from the worksites. • Do the maximum plantation along the road and barrage side.

The potential issues identified during the field visits include the following:

- Health and education facilities may be provided.
- The negative impacts on physical, biological and social environment needs to be addressed properly.
- Health and safety of the workers should be ensured by proper arrangements and Health, Safety and Environment (HSE) plan needs to be developed and followed during project implementation.
- Tree plantation especially of indigenous species should be carried out.

- Ensure that the activities should not deteriorate the downstream water quality.
- The Pulkhoo Nullah joins Chenab River just upstream of Barrage. The water of Pulkhoo Nullah is polluted because of addition of untreated effluent en-route. Therefore, its water quality needs to be closely monitored.
- The camping sites should be located away from the nearby settlements.
- Old Barrage is an antique structure and some of its parts should be preserved as a historic monument.
- The islands should be developed within the pond area for livestock and tourism.
- The public park should be developed at the Barrage.
- The donor's guidelines provide for compensation of even the non-title holders while the local guidelines do not provide for such compensation. This is the main difference between the social and environmental framework of the two systems. In order to qualify for financing, the donor guidelines have to be implemented.

5. Conclusions & Recommendations

5.1 Conclusions

The conclusions are provided in two categories i.e. generic conclusions and field visits related conclusions.

A) Generic Conclusions

The following conclusions which are of general nature and recognized by the experts are reiterated below:

- i. Irrigation helps to improve the agricultural productivity by providing needed quantity of water to the crops at proper time. Irrigated agriculture also significantly contributes towards alleviating poverty in the rural areas. The irrigation network therefore needs to be managed properly for optimizing the benefits to the farming communities.

- ii. Due to deferred maintenance over time, the health of irrigation system has progressively deteriorated. This has adversely affected the efficiency of the network and the agricultural productivity is being impacted. It has also given rise to a host of environmental and social issues. These include inadequate, unreliable and inequitable supplies of water for command areas, over exploitation of groundwater, build up of salinity and increasing pollution of water bodies.
- iii. The Social and Environmental Management Unit of Punjab Irrigation and Drainage Authority has developed checklist for irrigation projects with the objective that these projects are more responsive towards social and environmental challenges. The field formation of Irrigation Department has been made responsible to incorporate the environmental considerations in all water sector development projects.

B) Field Visits Related Conclusions

- i. During the field visits of the projects it was observed that mitigation measures were not being properly implemented. In particular, the following main impacts of the projects were noted:
 - Extended canal closure resulting in stoppage of irrigation supplies thereby reducing the agriculture production.
 - Dislocation of local people and damage to crops leading to social issues.
 - Disruption of communication means on banks of canals and drains.
 - Effects on social settings of the area due to establishment of contractor's camp and imported labor.
 - Air and noise pollution due to machinery deployed for the construction activity.
 - Cutting of trees, bushes and plants during the site clearance phase.
 - Public health and safety issues.
 - Aesthetic/ scenic quality.

ii) For addressing the adverse impacts of the project the following mitigation measures were identified:

- Proper project scheduling in order to minimize the canal closure periods.
- Preparation of properly detailed resettlement action plans and provision of funds for payment of adequate compensation to the affected population.
- Provision of proper crossing arrangements during the construction phase. Also construction materials should not be heaped on canal roads.
- The labor camps should be located at a fair distance from the settlements. Also training of labor about the local social values.
- The deployed machinery should be in good working condition. Also noise and air pollution should be monitored.
- Avoiding unnecessary cutting of trees and land clearance beyond project corridor.
- Avoiding conflicts with local communities.

5.2 Recommendations

The following recommendations are made for improving the process of incorporating the social and environmental aspects. Like the conclusions, recommendations are presented in two categories. The first category of recommendations related to outcome of the field visits while the second category of recommendations is more generic in nature.

A) Field Visits Related Recommendations

- Environmental Assessment through simplified procedures of checklists developed by Social and Environmental Management Unit for water sector projects is a good starting point. The process needs to be refined through a gradual and phased process. This should culminate into a more comprehensive social and environmental assessment process.

- Interventions for addressing social and environmental impacts of development projects involve small investments but add value and contribute significantly towards sustainable development. Therefore, project proponents need to accord particular attention and provide the requisite resources for implementation of the needed environmental and social interventions.

- The checklists need to be improved and made more specific as a result of lessons learnt through field verification exercise. Need is indicated to incorporate certain descriptive categories and include the following information:

- Identify stakeholders
- Assess public perceptions
- Conflict management
- Public participation and communication.

- A GIS based social and environmental information system for the secondary base line data need to be established and displayed on the website for facilitating the process of completing the checklists.

- More seminars and awareness raising programs need to be arranged for training and capacity building of all the stakeholders including engineers, Farmer Organizations, staff of Punjab Irrigation and Drainage Authority and other related organizations.

- The contracting industry in Pakistan does not have adequate awareness, know how or professionals for this purpose. This aspect needs attention of the policy makers and the project authorities. Focused programs for capacity building of the construction industry needs to be undertaken along with regulatory regimes by making EMP a part of the bidding documents and by putting in place effective monitoring system.

B) Generic Recommendations

- A more close interaction needs to be developed between the field staff of Irrigation Department and Social and Environmental Management Unit of Punjab

Irrigation and Drainage Authority for effective management of social and environmental issues of irrigation sector projects.

- Steps for promoting collaboration between educational institutions, project implementation agencies and industries needs to be put in place for environmental friendly and sustainable implementation of development projects.

6 References

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