Environmental and Social Impact Assessment (ESIA)
Rehabilitation of the Bakolori Irrigation Scheme

Final Report

TRANSFORMING IRRIGATION MANAGEMENT IN NIGERIA (TRIMING) PROJECT – P123112

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Foreword

The Government of Nigeria (GoN) has identified investments in the agricultural sector as effective means to reducing poverty. The GoN recognizes that “higher levels of investments in agriculture, both by the public and private sector, can yield much better results if reforms are undertaken to streamline not only incentive structures for the farmers, but also the institutional framework in which agriculture and related activities take place.” Seeds and irrigation are highlighted as priority assets, which can be catalysts for raising productivity on the supply side. The overall management of water resources (where agriculture is the largest consumer) is also highlighted as a challenge requiring attention. Solutions through greater efficiency in water use are recognized as critical with more focus given to better management of water in areas of large and medium irrigation projects. This also requires putting in place more holistic water resources management strategies. Other key water management activities identified in the Twelfth Plan include: steps to greatly improve governance in water management through Water Users Associations, a focus on on-farm works and the rehabilitation and physical modernization of existing major irrigation systems, and integration of these activities with existing surface reservoir based canal irrigation.

In order to respond to the above challenges the GoN has requested the World Bank to support the preparation of a Transforming Irrigation Management Project in Nigeria (TRIMING) PROJECT. In addition to the policy and institutional focus, TRIMING intends to support on-the-ground Integrated Water Resources Management in the following three basins; Sokoto-Rima Basin, Upper Benue Basin and the Hadejia-Jama’are-Komatugu-Yobe Basin (HYKYB). The TRIMING Project will also support dams operational and safety management improvement.

From an Environmental and Social Safeguards point of view, The TRIMING project is rated as Category A. It triggers seven safeguards policies, namely; Environmental Assessment (OP 4.01), Safety of Dams (OP 4.37), Involuntary Resettlement (OP 4.12), Pest Management (OP 4.09), Physical and Cultural Resources (OP 4.11), Natural Habitats (OP 4.04) and, Projects on International Waterways (OP 7.50).

The following safeguards instruments have been prepared and subjected to public consultations and disclosures.

1. **Resettlement Policy Framework (RPF)** for the TRIMING Project
2. **Environmental and Social Management Framework (ESMF)** for the TRIMING Project.
3. **A Pest Management Plan (PMP)** for the TRIMING Project
4. **Environmental and Social Impacts Assessment (ESIA)** for the Bakolori Irrigation Scheme

This report corresponds to document # 4 above, Environmental and Social Impact Assessment (ESIA) for the Bakolori Irrigation Scheme Rehabilitation Project.
**GABATARAWA**

Gwamnatin Tarayyar Nijeriya ta fahimci cewa zuba jaruka a sashen aiyukan gona ce kadai sahiiyari hanyar da za a bi domin saukaka talauci. Gwamnatin ta gane cewa “zuba manya-manyan jaruka, daga sashen Hukumomin Gwamnati da kuma Kamfunnan al’umma, a cikin aiyukan gona zai iya haifar da sakamako nagari idan manufar yinkurin gyara da ake yi, bata takaitu ga tallafa wa manoma da kayan aiki ka burum, sai in ta hada da (samarda) ingantattun kafafen da zasu tallaba wa dukkan nau’oin aiyukan gona”.


Ta fuskar Alinta Muhalli da Tattalin Zamantakewa kuwa, an kimanta SHIRIN (TRIMING) a matakai A. Shirin na da manufon ingantawa, kamar haka, Tantance Ingancin Muhalli (mai lamba OP 4.01), Kiblamewar Hadurra a Madatsu Ruwa (OP 4.37), Sake Matsugunnan (mazauna yankunan) da aka ambata a sama (OP 4.12) – Dakarvi Kwarin da ke Barazana amfanin gona (O P 4.09), sai kuma Shirye-shiryan kyautata alaka akan amfani da hanyonyin ruwa na Kasa-da-kasa (O P 7.50). Wannan jerin bayanai ne na matakatan kiyaye hadurra da aka tanada, wadanda sai an tuntubi jama’ah masana kan cancantarsu kafin aiwatar da su.


3. An kirkiro shirin dakile miyagun kwari masu barazana ga lafiyar Dan-Adam da muhalli ne domin samar da kubutaccen yanayi daga aibin kwarin.


Wannan daftari na da muwafaka da daftarin na 4 (ESIA) da aka zo da bayaninsa a sama.
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### Abbreviations

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<th>Full Form</th>
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<tr>
<td>ADP</td>
<td>Agricultural Development Projects</td>
</tr>
<tr>
<td>BIP</td>
<td>Bakolori Irrigation Project</td>
</tr>
<tr>
<td>BIPMO</td>
<td>Bakolori Irrigation Project Management Office</td>
</tr>
<tr>
<td>BOD</td>
<td>Biochemical Oxygen Demand</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>DID</td>
<td>Department of Irrigation and Drainage</td>
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<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
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<td>ESMF</td>
<td>Environmental and Social Management Framework</td>
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<td>ESMP</td>
<td>Environmental and Social Management Plan</td>
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<td>EA</td>
<td>Environmental Assessment</td>
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<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>FMARD</td>
<td>Federal Ministry of Agriculture and Rural Development</td>
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<tr>
<td>FMWR</td>
<td>Federal Ministry of Water Resources</td>
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<tr>
<td>FRSC</td>
<td>Federal Road Safety Corps</td>
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<tr>
<td>HCF</td>
<td>Health Care Facilities</td>
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<td>HA</td>
<td>Hydrological areas</td>
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<td>IPM</td>
<td>Integrated Pest Management</td>
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<td>IVM</td>
<td>Integrated Vector Management</td>
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<tr>
<td>ITD</td>
<td>Inter Tropical Discontinuity</td>
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<tr>
<td>NCWR</td>
<td>National Council of Water Resources</td>
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<tr>
<td>NESREA</td>
<td>National Environmental Standards Regulatory Enforcement Agency</td>
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<tr>
<td>NTCWR</td>
<td>National Technical Committee on Water Resources</td>
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<tr>
<td>NIHSA</td>
<td>Nigeria Hydrological Services Agency</td>
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<tr>
<td>OHS</td>
<td>Occupational Health and Safety</td>
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<tr>
<td>PS</td>
<td>Permanent Secretary</td>
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<tr>
<td>PCU</td>
<td>Project Coordination Unit</td>
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<td>PSC</td>
<td>Project Steering Committee</td>
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<tr>
<td>RPF</td>
<td>Resettlement Policy Framework</td>
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<tr>
<td>RBDAs</td>
<td>River Basin Development Authorities</td>
</tr>
<tr>
<td>SRRB</td>
<td>Sokoto-Rima River Basin (SRRB)</td>
</tr>
<tr>
<td>SRRBDA</td>
<td>Sokoto-Rima River Basin Development Authority</td>
</tr>
<tr>
<td>SID</td>
<td>State Irrigation Departments</td>
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<tr>
<td>SMAs</td>
<td>State Ministries of Agriculture</td>
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<tr>
<td>SMH</td>
<td>State Ministry of Health</td>
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<tr>
<td>SMW</td>
<td>State Ministry of Water Resources</td>
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<tr>
<td>SWAs</td>
<td>State Water Agencies</td>
</tr>
<tr>
<td>TDS</td>
<td>Total Dissolved Solids</td>
</tr>
<tr>
<td>WUAs</td>
<td>Water Users Associations</td>
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Executive Summary

Preamble

This executive summary presents a brief of the main findings of the Environmental and Social Impact Assessment (ESIA) conducted for the proposed rehabilitation works for the Bakolori Irrigation Scheme, in Zamfara State, Nigeria. The objective of the ESIA is to examine the environmental, social, economic, health, physical, and biological impacts in the project command areas, and propose enhancement measures for identified positive impacts and proffer prevention/mitigation measures for identified negative impacts; develop a monitoring plan, and institutional and budgetary requirements for the implementation of the ESIA Report's Environmental and Social Management Plan (ESMP) through all the phases of project implementation.

This executive summary provides key information on the environmental and social aspects, potentially significant impacts, and mitigation measures, which need to be addressed during the implementation of the proposed project.

This ESIA report was prepared by Hospitalia Consultaire Ltd, an independent consultant firm.

Introduction

The Federal Government of Nigeria is implementing the Transforming Irrigation Management in Nigeria (TRIMING) Project with support from the World Bank. The Project Development Objective (PDO) of the Transforming Irrigation Management in Nigeria (TRIMING) is to improve access to irrigation and drainage services and to strengthen institutional arrangements for integrated water resources management, with the overall aim to support agricultural productivity improvement in selected large-scale public schemes in Northern Nigeria.

The principal proposed investment components of the TRIMING Project are the following:
Component 1: Water Resources Management and Dam Operation Improvement
   Subcomponent 1.1: Support to Integrated Water Resources Management
   Subcomponent 1.2: Dam Operations Improvement and Safety

Component 2: Irrigation Development and Management
   Subcomponent 2.1: Irrigation Infrastructure Investments
   Subcomponent 2.2: Improving Irrigation Management

Component 3: Enhancing Agricultural Productivity and Supply Chains
Subcomponent 3.1: Matching grants for improvement of productive water use in agricultural processing and mechanization
Subcomponent 3.2: Support to Research and Development.

Component 4: Institutional Development and Project Management
Subcomponent 4.1: Project Management and Monitoring & Evaluation
Subcomponent 4.2: Institutional Development and Governance

Various documents have been prepared in line with the TRIMING Project, and they include: an Environmental and Social Management Framework (ESMF), a Pest Management Plan (PMP), a Resettlement Policy Framework (RPF) and, an Environmental and Social Impact Assessment (ESIA) which is specific for the Rehabilitation of the Bakolori Irrigation Scheme.

The TRIMING Project is pioneering the investment into the rehabilitation of the Bakolori Irrigation Scheme in Zamfara State, Nigeria. The Bakolori Irrigation Scheme was commissioned in 1979, and construction of a major portion of the scheme was completed by 1983. The scheme consists of a total of 23,000 hectares of which 15,000 hectares was planned for sprinkler irrigation and 8,000 hectares for gravity fed surface irrigation. The sprinkler systems installed in the area developed for pump irrigation are no longer functioning; not only that, several components of the scheme have depreciated over the years. These ultimately affect agricultural productivity and defy the major aim for the establishment of the scheme.

Objectives of the Rehabilitation of the Bakolori Irrigation Scheme

Rehabilitation of the Bakolori Irrigation Scheme will give rise to the optimization of agricultural productivity in the area. It will restore and augment the productivity of farming in the area, create employment, and assure food security.

Aim of the ESIA

The aim of the study is to assess the potential environmental and social impacts of the proposed rehabilitation of the Bakolori Irrigation scheme including the dam and prepare an Environmental and Social Impact Assessment (ESIA) that includes a detailed Environmental and Social Management Plan (ESMP). The ESIA will establish modalities of implementing the rehabilitation works in line with the Nigeria Environmental policies and laws and the World Bank Safeguard policies detailing mitigation measures as well as institutional roles and responsibilities in the operationalization of the ESMP.

Policy, Legal and Administrative Framework

The chapter identifies and summarizes all the triggered Nigerian environmental regulations and legal instruments (as they apply to the environment, water resources and agriculture), World Bank safeguards, and relevant international guidelines and legal instruments applicable
to irrigation and agriculture. Major national policies with bearing on the environmental component of the project, and institutional bodies with direct water quantity and quality management responsibilities, as well as the regulatory framework within which each agency operates are also presented.

The Bakolori Dam Irrigation Rehabilitation Project is rated a Category A (equivalent to Category I in the Nigeria EIA Act) project in accordance with the Environmental Assessment Policy (OP 4.01) of the World Bank because of the potential scale of impacts in terms of socio-economic impacts, soil quality, food security, water quantity, water quality, water access, farm land access, access to markets, pest management, and health; The impacts resulting from these issues have been assessed and enhancement and mitigation/prevention measures for beneficial and negative impacts respectively proposed.

The identified World Bank safeguard policies triggered by the rehabilitation of the scheme include Environmental Assessment (OP 4.01), Involuntary Resettlement (OP 4.12), Safety of Dams (OP 4.37), Physical and Cultural Resources (OP 4.11), Pest Management (OP 4.09), Natural Habitats (OP 4.04), and International Waterways (OP 7.50).

**Project and Process Description**

The project would rehabilitate the Bakolori dam and irrigation project as a subproject. This is intended to improve the productivity of farming in the area, improve market access, create employment, and generally improve the quality of life in the area.

The Bakolori dam located at Talata Mafara on River Sokoto was designed to function as a multi-purpose dam for irrigation, water supply, fisheries, livestock development, hydropower generation, flow regulation and flood protection.

Over the years, the Bakolori Irrigation Scheme has depreciated badly primarily due to a lack of maintenance. There are multiple failures with the infrastructures within the system. Components of the scheme such as the supply canals, irrigation network, and drainage systems have shown tremendous damages over the years. The canals and drainages are heavily silted and the structures are severely cracked with budes. The access road located within the scheme is eroded and have potholes and cavitation along the length. Most of the pumping stations are not functional. About 90% of the gates along the main canals, secondary canals and tertiary canals have been either vandalized or damaged due to lack of maintenance. The sprinkler irrigation systems have failed. The control gates and drainages are also silted. One of the main drains is silted and a section destroyed by erosion thereby cutting off completely a section of the access road. The electric power lines, sprinkler pipes, parts of the gate control are vandalized. Buildings in this area including the maintenance stations and staff quarters are all dilapidated. Within the project area, River Sokoto, River Bobo and the Gora River tributary all have shallow depths with flood plains along both sides.
of their banks. These rivers often overflow their banks during the rainy season hence a series of dykes were constructed along the flood prone locations to protect the irrigation areas. Several breaches have occurred at certain reaches of the flood dykes.

Agricultural produce extensively cultivated within the scheme are not adequately exploited due to lack of access to markets by the farmers, and lack of storage and processing facilities. Water User Associations (WUAs) have been established in the Bakolori irrigation command area, but they appear to be weak and do not fulfill their intended purposes. The structure and functions of the WUAs are discussed in detail in Annex 10 of this report.

A summary of the proposed rehabilitation actions for the Bakolori irrigation scheme are outlined as follows:

Proposed rehabilitation works for the Hydroelectric Power plant

- Replacement of the electrical components including the generators, 7 x 6.6kV switch gear panels, and a remote control system with SCADA;
- Refurbishment of other components including transformers, 33kV indoor switchgear panel and 33kV outdoor switch yard;
- Refurbishment of the outlet works gates and valves.

Proposed rehabilitation works for the Irrigation Network (Main Canals, Secondary and Tertiary canals)

- De-siltation of canals
- The concrete panels of the primary canals will be removed and replaced
- Minor cracks on the panels will be sealed
- Removal of grasses, weeds and shrubs from the canals
- The gates and some sections of the secondary canals will need to be rehabilitated.
- Repair of cracks, bulging, sliding and uplifting of the slabs for the lined secondary canals.
- Reinforcement of embankment for the tertiary canal will be carried out.

Proposed rehabilitation works for the Drainage Networks (Main drain, secondary, Tertiary and field drain)

- De-siltation of the entire drainage network.
- Repair of cracks on the entire drainage network.
- Construction of a new main drain within the sprinkler system irrigation area.
- Flood draining from farms.
- The drains shall be cleared of silt, debris, vegetation, weeds, trees to avoid blockage.
- Construction of walls for the secondary and tertiary drains.
- All spoils should be conveyed to borrow pits.
Proposed rehabilitation works for the Road Networks

Access Road
- Removal of vegetation from the access roads.
- Removal of weak surface dressing on the road.
- Grading and backfilling of the road with laterite.
- Compacting and surface dressing of the access road
- Construction of drainages along the access road

Service Road
- Erosion management
- Road stabilization.

Field Track
- Weed management
- Drain management

Proposed rehabilitation works for the Flood dykes
- The flood dykes will have to be rehabilitated to maintain a design height as well as to prevent the ingress of floodwater from the rivers within the project area.

Proposed rehabilitation works for the Standard Structures

These include the gates on the main and secondary canals, outlet structures, gates and weirs on the secondary canal, delivery structures, wastewater structures and crossing structures. The crossing structures include bridges, culverts and gates. Proposed rehabilitation works will include:
- Mechanical works
- Civil Works

Description of the state of the environment and Baseline Studies

The project area is located in Zamfara State, North-Western Nigeria and lies at latitude 12° 10’ N and longitude 6° 15’ E. Zamfara State shares an international border with Republic of Niger to the north and interstate boundaries with Katsina State to the east, Sokoto State to the west, and Kebbi and Niger states to the south. The Bakolori Irrigation Scheme spans across 3 Local Government Areas; Talata Mafara, Maradun and Bakura.

The project site is nearly gentle and undulating, and lies at an elevation of 341m above mean sea level. Sokoto and Bobo Rivers are the main natural surface waters in the project area.
Traditionally, three land types are recognized in the Bakolori project area in terms of soil types and uses:

1. **Fadama**: rich soils subject to seasonal flooding,
2. **Firkin**: impermeable clay soils subject to water logging and cracking in the dry season (vertisols) and,
3. **Fako**: upland, low fertility sandy soils.

**Land tenure**

It is imperative to state that except in the Government Reservation Areas (GRAs) that constitute less than 5% of total land holding within the BIP; most if not all other land, is owned by the farmers prior to and after the development of the Bakolori irrigation scheme.

**Land Use and Irrigation Services & Management**

It is noted that in line with the discussion on land tenure above, land in the project area is partly owned by households and partly by government (Bakolori Project). Individuals or households own land transferred to them mainly by inheritance. This is the reason why many of the project-affected persons living in the area for dam reservoir construction were given land in the Jankarawa area for their land acquired by the project.

Generally, land in the irrigation area belongs to the local people (95%). A small percentage of the land is owned by the Bakolori Irrigation Project Office (5%) of which part is leased to farmers on an annual basis. The annual cost for land lease from the BIP per hectare is ₦17,000 (about $107). The BIP charges ₦22,500 ($140) per annum per hectare to cover irrigation services (water charges). The Bakolori Irrigation Scheme also renders extension services to farmers on lands not belonging to the project for an annual service charge of ₦5,000 ($30) per hectare.

**Summary of Key Social Information**

<table>
<thead>
<tr>
<th>Population (2013 estimate – Based on estimates from the 2006 National Census figures)</th>
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<tr>
<td><strong>Total Population</strong></td>
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<tr>
<td><strong>Male Population</strong></td>
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<tr>
<td><strong>Female Population</strong></td>
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<tr>
<th>Education of Respondents</th>
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<tbody>
<tr>
<td>No formal Education (%)</td>
</tr>
<tr>
<td>Primary School Completed (%)</td>
</tr>
<tr>
<td>Secondary School Completed (%)</td>
</tr>
</tbody>
</table>
Higher Institution Attended/Completed (%)  Male: 3%, Female: 0%

Poverty and Household Size

In general, not more than 5 percent of the farmers live above the poverty line. In contrast, 50 percent of the civil servants live above poverty threshold just as 10 percent of traders also live above poverty line. This result however, dwelled only on income earning of the people and did not capture the contribution of subsistence food production to welfare which is very prevalent in the project area. Households on income of less than N100,000 per annum have on the average 9 children while those on income of N100,000 to N199,000 have 8 children on the average. Interestingly, households on income level above N300,000 have 7 children and less on the average. There is therefore, a negative correlation between household size and household income in the project area.

Legacy Issue, Gender and Vulnerability

- 95% of land is owned by the people and 5% by BIP
- Small landholding (1-5 hectares) is prominent among farmers
- About 55% of farmers own 1-5 hectares in the command area while about 70% of them own about 1-5 hectares outside the command area
- Disputes over involuntary resettlement existed between 1976 and 1979 but has been put to rest.
- Initial settlers have been given land and assisted to erect their houses in the Jankarawa area.
- There exist a documented evidence of land acquisition and resettlement implementation
- However, the farm land in the Jankarawa lacks irrigation services and the people drink borehole water and vendor served water due to lack of portable water.
- Women are not discriminated against in land lease in the command area
- Land lease is based on application and willingness to lease, irrespective of gender
- Women and disabled groups however, complained about marginalization in distribution of fertilizer and other farm inputs.
- The disabled persons in the community are organized under the aegis of Vulnerable’ User Group (VUG)
- Members of VUG own and participate in farming within and outside the command area

Resolution of legacy/land related conflicts

- BIP should ensure availability of potable water and irrigation water services to communities in Jankarawa in line with agreed terms during the public consultation.
- BIP should ensure coordination and partnership between the nomadic herdsmen and farmers parties by setting up a committee from among the parties.
- Dedicated grazing route and grazing area for cattle and other animals would go a long way to reducing the incidences of conflicts between farmers and pastoralists.
- Land redress mechanism should be explored where new disputes emerge as contained in the resettlement policy framework.
- Most disputes that arise within the scheme are mainly intra-family and over water usage.
- Most disputes and conflicts are resolved through family, community and native courts.

Water Users Association (WUA)

- WUAs in the project area are registered with both federal and state agencies.
- The WUAs lack requisite skills and coordination to carry out mapped out responsibilities due to lack.
of training and also inoperativeness/inefficiency of irrigation services

- In addition to rehabilitation of the scheme and improving water efficiency management, it was recommended that members of the WUAs be trained in farm level management and effective communication among others.

**Key Concerns from Baseline Survey and Public Consultation**

- Some critical issues identified were, siltation of the canals (primary, secondary and tertiary).
- Waterlogging of farms due to poor drainage, poor access to farms, and dilapidated major roads in the irrigation scheme.
- Prevalent diseases noted in the area were Malaria, Schistosomiasis, and dysentery/diarrhea.
- Marginalization or inefficiency in the distribution of fertilizers among farmers especially the vulnerable groups (disabled and women)
- Infestation of birds on farms (Quelea bird) is a key concern to farmers
- There is lack of credit to boost farming in the area as well as poor state of access and service roads
- Market for goods and services is narrow and undeveloped
- Value chain for agriculture – modern production technique, processing facilities, storage facilities and transportation services are not in place in the area

**Baseline Data**

Baseline data were acquired during field trips made to the project area and associated communities; some critical issues identified were, siltation of the canals (primary, secondary and tertiary), waterlogging of farms due to poor drainage, poor access to farms, and dilapidated major roads in the irrigation scheme. Prevalent diseases noted in the area were Malaria, Schistosomiasis, and dysentery/diarrhea.

**Gender Issues**

The Muslim and Hausa/Fulani males dominate the project area. Traditionally decision-making is the responsibility of the family head who usually is a man. Men carry out most of the farming activities such as tilling, seeding, weeding and harvesting. The women are involved mainly in winnowing of rice after they are harvested. Women however, also own and can apply for land lease from the government. Most women cultivate crops such as tomato, maize, pepper and rice. At the Talata Mafara market, women were seen selling foodstuff and other daily needs. At the farms, the women were seen providing/selling refreshment such as *Akara* (bean-cake), *Kwaidakwa* (made form soya beans) and *Kosai* (made form cassava) to men working in the field and passers-by.
Pests and weed management

During interactions with the project area Water Users Associations, a major complaint received in all the areas was that of Typha grass which has proliferated all over the area and provides breeding, hiding, and rooting sites for Quelea birds that are a major pest of cereals, the major arable crops of the area. One of the problems observed from field visit and questionnaire administration (see annex 9) to the farmers was the issue of pests and weeds on farmlands. The most problematic of the pests were Quella birds and rodents that attack rice farms. Procedures for handling and management of pesticides have been documented in the Pest Management Plan (PMP) for the TRIMING Project, which has been publicly disclosed in Nigeria and in the World Bank InfoShop.

Markets

The largest market within the project areas is located in Talata Mafara, patronized by merchants from various states in the country. Access to markets for the direct sale of farm produce remains a major source of concern for the farmers. This will be a major incentive for improved productivity in the Bakolori Irrigation Scheme if achieved. Farm produce are most often sold to middlemen in the farm areas. Only limited processing and packaging such as drying, sieving and bagging are done on the products before they are sold. There is a dearth of food processing facilities in Zamfara State and neighbouring States.

Storage facilities

The common storage facility available is the rhombus (traditional, mud constructed stores) while the majority of the markets only have basic open sheds, which have many limitations in terms of security, pest infestation and produce deterioration. The vast majority of farmers who sell produce store quantities ranging from 40kg to 200kg.

Processing

Only limited processing and packaging such as drying, sieving and bagging are done on the products before they are sold. Processing activities, which add value to crop production, are very limited in the project areas. The most common processing facility is small, village mills (driven by a petrol engine), which are used, for the de-husking of rice and the milling of crops such as maize, sorghum and millet, into flour mainly for family consumption.

Due to this lack of value addition, coupled with the lack of storage, the value and quality of the produce is restricted and this in turn, reduces the incentive for improved crop production.
Fishing

There are active fishing activities in the dam reservoir and in the rivers. In the primary and secondary canals fishing has markedly diminished in recent years because of their being silted. Fish farmers around the dam reservoir reported a 200% increase in catch and between 120 to 150% in the rivers within the Command area since the construction of the dam. On the contrary, fishers further downstream, outside the Command area reported drastic loss of over 200% in fish catch compared to catches before the dam was constructed. This has affected their livelihood.

Transportation

Means of transporting goods from the farm centers include the use of Lorries, camels, horses and donkeys. Use of Lorries is the preferred economical option but inaccessible roads into the tertiary and secondary routes and further road dilapidation within the main access roads put a constraint on use of Lorries in the area.

Project Alternatives

Alternative to the project was evaluated based on Power supply requirements for the Bakolori Irrigation Scheme, and the rehabilitation options for the Sprinkler served Irrigation systems.

Alternatives based on Power Supply

A. Solar Energy
B. Wind Energy
C. Decentralizing power generation using multiple diesel generation units
D. Construction of a dedicated electricity distribution station connected to the national grid
E. The Do-Nothing option

Alternatives to the Rehabilitation option for the Sprinkler served Irrigation systems

A. Rehabilitation of the Sprinkler Irrigation Infrastructure
B. Conversion of the whole project command area to gravity fed surface irrigation with repair of the pumping stations in the Jankarawa area
C. Construction of tube wells across the span of the irrigation area
D. Do-Nothing Approach

The Preferred Option: This would be to apply alternatives as they best fit into the feasibility and engineering designs and implementation of tasks in order to achieve the objectives of the
project. Option “B” above most meets the wish of the farmers and indeed will be most effective in achieving the objectives of the rehabilitation project, and will also be more amenable to maintenance considering the technical capacity available and the maintenance culture in the area.

**Potential Impacts and Mitigation Measures**

The beneficial (positive) Environmental and socio-economic impacts of the rehabilitation works will include the following:

*Environmental*
- Improved performance of irrigation and water resources for the Bakolori Irrigation Scheme.
- Optimization of the irrigation scheme in Bakolori
- Improved infrastructure in the dam, which would improve dam operations.
- Enhancement of the capacity of the Bakolori Irrigation Scheme in the supply of water to the 3 local governments.
- Removal of breeding sites for quella birds and other pests
- Removal of weeds and de-silting of drainage canals which will reduce waterlogging of the farmlands
- De-silting of the ditches is expected to reduce flooding in farm lands which in turn will reduce salinity problems
- The irrigation rehabilitation project will improve and increase access to water for farming and irrigation activities in the Bakolori Scheme Area – Bakura, Talata Mafara and Maradun LGAs
- It will ensure sustainability of irrigation water services provision in the long term, meeting the needs of present population in the Bakolori scheme area.
- Encourage behavioral changes in hygiene and sanitation amongst the peoples of Bakura, Talata Mafara and Maradun.

*Social*
- It will serve as a positive benchmark for future developments and rehabilitation of irrigation dams under the TRIMING Project
- Improvement of public goodwill and satisfaction towards governance in Zamfara State
- Increased opportunity to develop agriculture, livestock farming and other businesses in the Bakolori scheme area and surrounding communities.
- Increase opportunities for job creation and employment
• Encourage training and capacity building for the Bakolori irrigation scheme and increase public awareness on irrigation services.
• The rehabilitation of the access roads within the Bakolori Irrigation Scheme will ultimately lead to opening up of markets to the farmers.
• Create potential for private sector involvement and participation especially in the areas of Public Private Partnerships (PPP) and sub-contracting to companies to manage critical aspects of the project such as the Bakolori Dam infrastructure, hydro-electric systems and water distribution facilities (primary and secondary canals).
• During the construction phase, some construction materials will be sourced from local businesses and stores. This will inject income into the local economy benefitting local businesses.
• Reduce health risks disease infestations.
• Improved water resources management and sustainable dam operation
• Employment creation
• Increased agricultural production
• Increased income to households, farmers and investors
• Increased internally generated revenue to state and federal government
• Improved households capacity to support children education and welfare
• Restoration and augmentation of the productivity of farming in the area
• Strengthen the Water User Associations (WUAs) and help them fulfill their intended functions
• Improved market for agricultural goods and services
• Improved physical development of the area through infrastructural upgrade and investments

The anticipated positive impacts which are huge notwithstanding, the envisaged rehabilitation and expansion works required for the rehabilitation of the irrigation schemes and dam could impact the flora and fauna; drainage and water resources and associated siltation; cultural property; landscape and general aesthetics; health and safety aspects; and potential cumulative impacts. The impacts on these environmental and social media will have some adverse impacts on the project sustainability and the community, which, if not identified early and mitigated may offset the envisaged potential positive impacts of the project. This ESIA also identifies some specific plans such as the Occupational Health and Safety (OSH) considerations for the proposed rehabilitation works (Annex 6); a Waste management Plan (Annex 7); and the general environmental and social management conditions for construction contracts (Annex 8). These specific sections will guide the Contractors, PCU and other major project stakeholders in ameliorating the negative impacts of the rehabilitation works.
Environmental and Social Management Plan (ESMP)

A matrix table format of the ESMP is described in detail in chapter 7 of this report. All impacts are discussed according to the respective phases during project implementation. The impacts have been described, as they would impact on different environmental and social sensitivities with emphasis on occupational health and safety at all phases. The chapter also includes mitigation measures and mitigation costs, and institutional responsibilities in the implementation of the ESMP.

The roles and responsibilities for monitoring the environmental and social impacts and mitigation measures are also stated.

Cost of Implementing the ESMP

The total cost for the implementation of the ESMP for the rehabilitation works for the Bakolori Irrigation Scheme Project is estimated at USD 1,649,512 (One Million, Six Hundred and Forty Nine Thousand, Five Hundred and Twelve US Dollars, Fifteen Cents). The breakdown is given below:

Budget and Responsibilities

<table>
<thead>
<tr>
<th>Item</th>
<th>Responsibility</th>
<th>Cost Breakdown</th>
<th>Cost Estimate in Nigerian Naira (₦)</th>
<th>Cost Estimate in Us Dollars (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitigation</td>
<td>Contractor, PCU, SRRBDA, BIPMO</td>
<td>184,560,800</td>
<td>1,153,505</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>PCU, SRRBDA, BIPMO</td>
<td>5% of Mitigation Cost</td>
<td>9,228,040</td>
<td>57,675.25</td>
</tr>
<tr>
<td>Monitoring</td>
<td>PCU, SRRBDA, BIPMO</td>
<td>25% of Mitigation Cost</td>
<td>46,140,200</td>
<td>288,376.25</td>
</tr>
<tr>
<td>SUB- TOTAL</td>
<td></td>
<td></td>
<td>239,929,040</td>
<td>1,499,556.5</td>
</tr>
<tr>
<td>Contingency</td>
<td></td>
<td>10% of Sub-Total</td>
<td>23,992,904</td>
<td>149,955.65</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>263,921,944</td>
<td>1,649,512.15</td>
</tr>
</tbody>
</table>

Recommendations:

Some interventions that will improve the realization of the Rehabilitation of the Bakolori Irrigation Scheme are highlighted as follows:

Improved crop marketing

This could be achieved by mitigating the existing constraint to crop produce marketing through the construction of storage and processing facilities as well as the provisions of
credit. Furthermore, farmers and traders could be trained in improved handling, transport and storage techniques. It is therefore expected that the following tentative proposals and recommendations will improve crop marketing and add value to agricultural produce:

- Upgrading and improvement of service roads and village market infrastructure within the project area
- Standardize unit weights and measures for agricultural commodities to mitigate fraudulent activities.
- Provision of credit to both farmers and traders through participating banks and micro-finance institutions to facilitate local supply.
- Training of farmers and traders in improved handling, transport and storage techniques.
- Establishment of a market information system to provide regular and timely information to farmers and traders.
- Provision of crop storage facilities through private companies, farmers’ co-operatives and/or the project office.
- Facilitate and support private investment in crop processing facilities, e.g. Rice mills, and flour mills.

**PPP Principles for the TRIMING Project Schemes**

The Pre-feasibility design established some mechanisms that maybe adapted for the eventual PPP structures:

- Try to work with structures which already ‘work’ in Nigeria, that is, avoid large organizations.
- Avoid agents’ problems, which are particularly acute.
- Avoid the need for regulation, which supposes effective and accountable governance.
- Attempt to use market-based mechanisms, which clearly do work in Nigeria.
- Leverage demonstrated willingness of people to pay in “proximate” transactions, which is open to competition (Motor pumps, threshing, milling, taxis, mobile phones, water porters, roadside food sellers, market stalls, etc.).
- Do not take a supply/input driven approach.
- Try to implement a flexible approach that responds to demand, even if this is ‘less efficient’.
- Supply driven approaches (“built it and they will come”) have historically failed completely in both schemes. Services have not worked in Nigeria due to inefficient weakness of effective government, and large scale, centralized organization means “invincible” market based mechanism are to be preferred.
Other recommendations proffered in the report include:

- Improving the Capacity for Sustainable Management of the Scheme
- Bakolori Irrigation Project Management Office
- Farm level Water Users Association Invention
- Resolution of legacy/land related issues
- Synergy with existing institution
- Increased water use efficiency
- Enhancing and improving soil fertility through Sustainable Land Management (SLM)
Furthermore, the Pre-feasibility Report for the Feasibility Studies and Design for Irrigation and Water Resource Management Investment in Sokoto-Rima Basin in Northern Nigeria advised on PPP possibilities for the Irrigation Assets Operation and Maintenance. The figure below shows the procedure by which the assets (arranged from upstream to downstream) could be managed by different parties.
River Training

The River training assessment carried out by the Atkins-Enplan Consortium for the Pre-feasibility report is highlighted in this report.

The river training sets out an initial assessment of managing flood risk by the reinstatement/construction of embankment downstream of Bakolori dam. Although the history of embankment failure in Sokoto catchment triggered by lateral movement of the river strongly indicates that embankment immediately adjacent to channels are not always a sustainable means of managing flood risk, embankments are still likely to be a significant component of the flood risk management package in both catchments.

Public Consultation

The public consultation formed a very important forum for stakeholders to raise their opinions about the rehabilitation project. The consultation process was carried out in 3 phases:

Phase I: Focal Groups Discussions with farmers groups, Women Farmers Groups, Water Users Associations (WUAs), Women Farmers Groups, Women Water Users Association and the Disabled, under the aegis of the Vulnerable User Groups.

Phase II: Consultation with Bakolori Irrigation Project Office, relevant Zamfara State Ministries, Sokoto-Rima River Basin Development Authority, Federal Ministry of Water Resources, and Federal Ministry of Environment, and stakeholders from the 3 LGAs.

Phase III: The General Public Consultations for the ESIA which were conducted on the 7th of November, 2013 and 10th of December, 2013 within the premises of the Bakolori Irrigation Project Office, following public notifications via newspaper advertisement, notices in local government headquarters and relevant government ministries and agencies, letters and oral communications.
Some of the issues raised by the stakeholders during the Public Consultation are indicated in the table below:

<table>
<thead>
<tr>
<th>Focal Group Consultation- Women Groups</th>
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</thead>
<tbody>
<tr>
<td>Date</td>
<td>Location</td>
</tr>
<tr>
<td>28th October – 6th November</td>
<td>Bakolori Irrigation Project Office</td>
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<table>
<thead>
<tr>
<th>Vulnerable Users Group</th>
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<tbody>
<tr>
<td>Date</td>
<td>Location</td>
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<tr>
<td>28th October – 6th November 2013</td>
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<table>
<thead>
<tr>
<th>General Public Consultation 1</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Date</td>
<td>Location</td>
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<tr>
<td>7th November 2013</td>
<td>Premises of the Bakolori Irrigation Project Office</td>
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<table>
<thead>
<tr>
<th>General Public Consultation 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Location</td>
</tr>
<tr>
<td>10th December 2013</td>
<td>Meeting Hall, Talata Mafara, Zamfara State</td>
</tr>
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</tbody>
</table>

Translations into Major Languages in the Project Area

In order to ensure that members of the communities in the project area participated effectively, the stakeholder forums were mostly conducted in the Hausa language, which is the language spoken by all members of the project community. The executive summary of
this ESIA report will be translated into the Hausa language for easy understanding by the stakeholders in the project area.

Disclosure

The ESIA/ESMP will be disclosed publicly through the Federal/State Ministries of Environment at designated locations in Federal Capital Territory, and Zamfara State, and, at the World Bank “Info-Shop”.

**ABINDA AKA ZARTAR A TAKAICE**

Wannan takaitaccen abinda aka zartar yana gabatar da abubuwan da aka tattannya game da muhimman bayanai da suka shaﬁ muhalli da kuma tautance halin zaman jama’a wanda akayi domin gabatar da shawara game da aiyukan farfado da tsariu noman Rani na Bakolori a jihar Zamfara Nigeria. Makasudin shiriu tantance Haliu zaman jama’a (TH2J) shine don ya duba muhalli, haliu zaman jama’a tattalin arziki lafiya, jiki da tsarina tsare-siare a dairar da aka tsara wannan wato (Bakolori); da gabatarda shawara don samar da gabatan da shawara don samarda bayanai da suka shaﬁ taṣirin mai inganci da sanarda matakai don fahimtar taṣirin domin shawara da shawara don suka sahﬁ jama’a tasiri mai inganci da suka shawara da suka dabaibaye cigaba wadanda ke bukatar a kawar das u domin samun nasarar wannan shirin.

Wannan takaitaccen abinda aka zartas ya badu sahīhin bayanin day a shafī muhalli da abubuwa da suka sahī jama’a taṣirin mai inganci da abubuwan da suka dabaibaye cigaba wadanda ke bukatar a kawar das u domin samun nasarar wannan shirin.

Kampanin Hospitalia Consultaline Ltd ya shirya wannan ruhoton mai suna (TH2J).

**GABATARWA**


**Babban**

*Kashi na 1*: Gudunar da Albarkatun Ruwa da inganta taʃiyar da madatsin ruwa wato (dam dam).

*Sashen Kashi 1.1:* Tallafi ga gudanar da Albarkatun ruwa.

*Sashen kasha 1.2,:* Taʃiyarwa, ingantawa da kiyaye haddurra a madatsun ruwa.

*Kashi na 2*: Raya noman rani da gudanar dashi

*Sashen kasha 2.1:* Jarurukan da aka saka don noman rani

*Sashen Kashi 2.2,:* Inganta gudanar da noman rani


*Kashi na 4*: Raya humkar nowa da gudanar da shirin aiyukan noman rani.

*Sashen Kashi 4.1:* Gudanar da aiyukan noman rana da anna nasarar shirin.

Sake farfado da aiyukan noman rani na Bakolori yaza bijiro da karfafa aiyukan gona a fadin Bakolori zaya maito sunnan ya Karfafa aiyukan gona, ya samar da aiyuka, sannan ya kawo yaƙar ciwake.

**Burin ko Makasudin (TH2J)**

Duiya da suka shafi kare manufolin da baiyana abubuwan da ka iya kawo koma baya ga shirin sannan da bayyana abubuwan da ka iya kawo koma baya ga shirun sannan da bayyana rawa da alhakin da hukuma zata take wajen aiwatar da TH2J.

Tsarin Manufa, doka da aiwatarwa.

Sashen kasha 4.2 ciyar da hukumar (noman rani) gaba.

Makasudan sake farfado da Aiyukan noman Rani na Bakolori.

Aiki da bayanin Tsarin sa
Aiki zaya farfado da madattsar ruwa ta Bakolori sannan noman rani a matsayin wani bangare na cikin makasudin wannan cikin shine domin ya inganta cikin gona a wannan yankini, ya inganta da samar da kasuwannin, ya samar da aiyukan ya sannan ya kyautata rayuwa.


Gabatar da tsarin farfado da Naurar Samar da wutar lantarki mai Aiki da Ruwa

- Sabunta kayan samar da wuta da suka hada da generators, 7x6.6kv makyalli, da madaukan gear da abinda ke daidaite wuta.
- Yima sauran sassa garan bawul wadanda suka hada a transformer da makyallin ciki da waje masu darajar 33kv.
- Gabatar da tsarin farfado da samar da ruwa manyan makwararai masu bi man manyan da kanana
- Yashe makwararai
- Cirewa da sake kankaren makwararai
- Cike ko like tsaga a makwararai
- Cire ciyayi da danginsu daga makwararai
- Kofofi da bangarorin makwaran da ke bi ma manya na buakatar ingantawa
- Gyara tsaga, tulluwa, karkata da dagawa na slab slab na makwararai masu darajia ta biyu
- Inganta da karfafa gefen kananan makwararai
Gabatar da Tsarin Aiyukan Gyaran Tsanyoyin Fitar da ruwa (Manyan Tsanyoyin, Matsakaita da kananan Tsanyoyin fitar da ruwa)

- Yashe magudanan ruwa dukansu
- Gyara tsage tsage na dukan magudanan ruwa
- Gina sabon magudanar ruwa a wurin ban ruwa mai feso ruwa a sama.
- Magudanar ruwa mai hana ambaliya a gonaki
- Yashe magudanar ruwa, da kankare duka abinda zaya hana ruwa gudana.
- Gina bangaye ga magudanan ruwa.
- Duka abinda aka yashe za’a rufe a rami

Tsarin Farfado da Gyran Hanyoyin

- Kawadda tsirrai kamar su geza, sabara da sauransu daga hanyoyi
- Kawadda cikon da akayi marar nagarta
- Yi ma hanya ciko da burji sanna da katseta
- Daddabe hanya da ga yangi
- Gina magudanun ruwa a gefen hanya.

Hanyoyin da suka ratsa Fadamu

- Kula da zaizayar kasa.
- Inganta hanya

Hanyoyin ratsa fadama a kafa

Tsarin aiyukan farfado da makaran Ambaliyar Ruwa

- Za’a gyaggyara makaran haana ambaliyar ruwa yadda za a samar da wani tsari wanda tashinsu zaya hana ruwa Konawa cikin fadama daga koguna.

Tsarin Aiyukan Farfado Da Gine Gine

Wannan ya shafi makwararari da magudanan ruwa, gadoji, kwalbati da mabudar ruwa. Wannan ya shafi aiyukan da suka danganci

- Injunan aiki noman rani
- Aiyukan kula da abubuwan da aka gina

Bayanin Halin da Muhalli ke ciki da Kuma nazarin yanayi.


Wurin aikin noman rani lafiyayyen wuri ne da ke 341 mita sama da teku. Kogunan sokoto da Bobo sune suka ba wannan shire rowan dayake bukata. A yanayin wannan yanki a kwai nau'I uku na kasar nomad a za’a iya amfana daga gareta a tsarin aikin Bakalori.

1. Fadama: - kasa mai inganci sai dai tana tare da fargabar ambaliyar ruwa.
2. Firkin:- kasa mai yambu mai iya tsagewa da rani
3. Fako:- kasa marar inganci

**Mallakar Kasa**
Yana da muhimmanci a sani cewa banda inda gwamnati ta kebe (GRA) wanda yake bai kai kasha 5 cikin dari ba 5% duk illahirin kasar mallakar manomace kafin da bayan kirkiro shirin noman rani na Bakalori.

**Amfanin da Kasa Wanda ya Shafi Aikin Noman Rani da Gudanar Dashi**
Abin lura shine dangane da bayanai na amfani da kasa, kasar noma a tsarin aikin noman rani na Bakalori, wani sashe na kasa mallakar Iyalaice wani sashe kuma mallakar hukumace (Aikin Bakalori) daidaikun magidanta sun mallaki kasa ta hanyar gado. Wannan shine yasa masu wuraren da aikin madatsar ruwa ya shafa aka musanya masu wasu a jakarawa a mamadin nasu da dam ya lakume.

Mafi yawancin kasar noman rani a wannan wuri mallakin jama’ar dake zaune ne a wuri kwatankwacin (95%). Kashi 5% na kasar noma a wuri kadan ke mallakin ma’aikatar Bakalorin wanda wani sashenta akan ara ma manoma duk shekara abinda manomi kan biya a shekara don samun filin noma shine Naira dubu sha bakwai N17,000:00 akan kowace hectre. Hukumar noman rani ta Bakalori tana amsar Naira dubu ashirin da biyu da dari biyar N22,500:00 a shekara akan hectar daya don samar da abubuwan da ake bukata na noman rani kamar kudin rowan da shuka kan bukata. Bakalori tana samar da shwarwari, taki, da bayanai kan dabarun noman rani ga manoman da filin nomansu ba mallakin hukukumar Bakalori bace akan kudi Naira dubu biyar N5,000 kacal.

**Takaitaacen Bayani kan Alumma**
Yawan Jama’a (2013 kuma akan kidayar jama’a ta kasa 2006)

<table>
<thead>
<tr>
<th>Jimlar yawan Jama’a</th>
<th>738,529</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yawan Mazaje</td>
<td>370,608</td>
</tr>
<tr>
<td>Yawan Mata</td>
<td>367,920</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ilimin wadanda suka amsa tambayoyi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adadin marasa ilimin Zamani</td>
</tr>
<tr>
<td>Wadanda suka kamala katutun firamare</td>
</tr>
<tr>
<td>Wadanda suka kamala makarantar sakandire</td>
</tr>
<tr>
<td>Makarantun gaba da sakandire</td>
</tr>
<tr>
<td>Maza 30%  Mata 84%</td>
</tr>
<tr>
<td>Maza 20%  Mata 5%</td>
</tr>
<tr>
<td>Maza 15%  Mata 1%</td>
</tr>
<tr>
<td>Maza 3%  Mata 0%</td>
</tr>
</tbody>
</table>

**Danganta Girman Iyali da Fatara**
Mafi yawancin baifi 5% na manoma ba ke rayuwa a wadace ba. Sabanin kasha 50% na ma’aikata masu amsar albash da ke rayuwa a cikin wadata. Kash a go ma 10% na masu saye da sayarwa na zuke rayuwa a wadace. Wannan sakamako na zuke rayuwa a wadace. Wannan sakamako ya rataya ne kadai g a abin da ke shiga hannun mutanen abinci da jama’a kanyi wa abokan zama ba. Magidanta da ke samun kasa da N100,000:00 a shekara suna da matsakaicin yawan iyali na mutane tara. Magidanta. Amma magidanta ma su samun N100,000 zuwa N199,000 na da girmaniyali na mutum takwas (8). Abin sha’a aya anan shine magidanta da ke samun sama da N300000 a shekara suna da yara 7 ko kasa da haka. A haka ana iya ganin rashin daidaiton samun magidanta a shekara tsakanin girman iyali da abinda ke shigo da iyali na samu.
Abubuwan Lura, Jinsi Da Abubuwan da Suka Shafi Jinsi.
- 95% na kasar noma mallakar al’umma ce, kashi 5% na hukumar Bakolori ne.
- Mafi yawan cinin kasar noman da mutane suka mallaka 1.5 heceter ne.
- Kusan 55% na manoma sun mallaki 1.5 heceter a inda hukumar Bakolori ta ke, kuma 70% na su sun mallaki hectar daya zuwa biyar (1-5) a inda ba mallakar hukumar Bakolori ba.
- Wadanda (Manoma) suka fara zama an basu musayar wurare a Jakarawa kuma har sun gina gidaje sun tare a can.
- Akwai rubutataccen tsari matsayin shedar mallakar kasar noma da musayar matsugunai da ake wanzar wa.
- Kasar noma ta Jakarawa ba ta da kayan da ake bukata domin noman Rani, wannan ya sanya mutane ke sayen ruwa daga yan garuwa.
- Babu banbanci tsakanin maza da mata manoma wajen bayar da filin noma a Bakolori.
- Bayar da filin noma ya danganta da nuna bukatar mai so a rubuce (Mace ko Namiji).
- Mata da nakassasu sukan koka game da rashin maid hankali gare su wajen rabon filayen noma, rabon takin zaman da sauran kayan bukatu na noma.
- Nakassasu a cikin al’umma an hallara su a karkashin kungiyar marasa karfi masu bukatar amfani da filayen noma.
- Yan kungiyoyin mara sa karfi ma su nakasa sun shiga a cikin ma su amfana da filin nama a ciki da wajen Bakolori.

Zartas da Mallakar Fili da Warware Matsalolin da Su ka Wanzu akan haka.
- Hukumar noman Rani ta Bakolori za ta tabbatar da samun ingataccen ruwan sha da na noma ga al’ummar Jakarawa kamar yadda aka tsara lokacin da aka yi tuntubar jama’a.
- Hukumar Bakolori za ta tabbatar da tarayya tsakanin manoma da makiyaya ta hanyar kafa kwamitin tuntuba a tsakanin su.
- Tabbar da makiyaya ko burtaloli don shanu da sauran dabbobi za ya daka tar da tashin tashina tsakanin manoma da ma su kiwo.
- Akwai bukatar samo hanyoyin daidaita wurare a inda ake samun rashin jituwa. Wannan lalle ne ya kasance a sake matsugunai ga al’umma.
- Wawancin rashin jituwa dangane da filayen noma sukan faru ne a tsakanin dangi akan abinda ya shafi amfanin da ruwa don noma.
- Yawancin wannan rashin jituwar akan warware su a tsakanin iyalai, al’umma da gidajen shari’a.
Bayanan tushe da suka shafi manoma

Abubuwan da suka shafi jinsi
Mazajen hyausa /Fulani musulumi sune suka rinjaye a wannan wurin na noman rani. A aladance, wanda ke yanke hukunci kan abinda ya daace a iyali shine maigida wanda yake dama namiji ne a gidan. Mazaje suka daukar yawancin dawainiyar aiyukan gona kamar su huda, shuka, noma, hakkidin da girbi mata kuma suka gyaran shinkafa bayan an girbeta. Mata suke mallakar filayen nomai sannan kuma suke sune iya bidar hukuma ta basu ta hanyar nuna bukatar haka a rubuce. Yawancin mata suke shuka amfanin gina irinshu tumatur, masara, barkono da shinkafa.
A kasuwar talata mafare an iya ganin mata suke aunan da staba da sauran kayayakin amfanin yau da kullum. A cikin goni kuma an iya ganin mata suke saida kayan kwale ga manoma irinsu kosai, dannarogo, da kuma da mazaje masu aiki a filayen nomai da masu wucewa.

Kulawa da kwari da ciyayi
Lokacin Da Aka Tuntub I Kungiyar Masu Amfani da ruwa babban kuhan da ahya samu a wannan wuri shine na wata irin aiyawa mai ba jan baki

Kasuwanni
Kasuwawa mafi girma a wannan projue yana talata mafare wadda ma auno daga wurare dabanan daga ciki da wajen kasannan ke juya dayen amfanin gona wannan kasuwa tana karfa wa manoman na rani na borolon. A kwai bukatar hanyoyin sarya kayan da aka nooma na zamanin domin karin riba ga manoma.

Adana amfanin gona
Runbuna sune aka fi amfan dai suke wajen adana amfanin gona.
(ana yin su da laka) amma eno yawan manoma na shanya amfaninsa a filin Allah wanda yin haka ne da matsalolin tsaaro, banna daga kwari da bakin amfanin gona mafi yawancin manoma na adana amfanin gona da yakai kili zuwa kili 200.

Sarrafam amfanin gona
Takaitaccen amfanin gona manoma ke iya sawyawa ta hanyar babar dadi, chashewa, da durewa a buhunna kafin a kai masaida sarafam amfanin gona na kara masa daraja zake yake akwai karancin wuraren yin hakan a wuhirin noma na baholai abu wuraren sarafam amfanin

Rasinn hanyoyin daraja kayan amfanin gona da adanasu na kawo koma bayan gab a manoman kwaringwawar fadada noman ire-iren wadannan kayan gona.

**Kamun Kifi**

Harkokin kamun kifi na gudana sosai a cikin kwaryar datsin da kuma cikin kogunan. A cikin manya da kananan mashigan ruwan kuwa harkar haman kifin tana ja da bayan ne a cikin yan-shekarunun, saboda cunkushewar mashigan ruwan. Su kuwa Masuntan da ke daua da kwaryar datsin su suwa masu cewa lallai kamun kifi ya bunkasa da kimanin kashi 200%, amma a cikin ainihin kogunan, tun daga sadda aka gina datsin, bunkasar bata bata wuce tsakanin kashi 120% zuwa 150% ba. A dalilin haka ne su masunta, dake kamun kifi can nesa cikin koramu, suke kufan koma bayar–fiye da kashi 200%–na yawan kifin da suke kamawa in an kwatanta da wanda suke kamawa kafin gina dam din. Wannan ya yi tasiri sosai ga salon rayuwarsu.

**Sufuri**


**Zabin da ke Akwai a Shirin**

An yi tsokaci kan zabin da ke akwai kan ababen da ake bukata domin samar da wutar lantaki ga shirin noman rani na Bakolori, da kuma zabi daga damammakin da ke akwai na yin garambawul ga na’urorin ban-ruwa masu hajijiya. Ga zabin da ke akwai a kan samar da karfin wutar lantarki ta amfani da:

A. Hasken Rana
B. Karfin Iska
C. Ciccira Tattalar Wutar Lantarki ta Amfani da Man Desel
D. Jawo wutar kaitsaye (zuwa filayen noman ranin) da Matarar Wutar Lantarki ta Kasa–ko kuma
E. Aki yin komi

Damammaki hudu (4) da za a iya zaba domin yin garambawul ga na’urorin ban-ruwa masu hajijiya

A. Garambawul ga na’urorin ban-ruwa masu hajijiya
B. Sauya dukkan tsarin ban-ruwan ya koma na yin kwarare kan duka filin da ake noman ranin–wanda in za a yi haka to lallai sai gyara cibiyar da ke turo ruwan daga yankin Jankarawa
C. Hahhaka rijiyoyo a kan dukkan fadin wurin da ake noman ranin–ko kuma
D. Aki yin komi
Zabin da Aka fi Natsuwa da Shi:
Wannan na nufin aiwatar da shawarwarin da aka bayar a ciki nazarin da aka gudanar kan yiwuwar aikin, da kuma la’akari da taswirar da Injiniyoyi suka zana, domin ta haka ne za a cimma manufofin shirin. Zabi mai lamba “B” a sama shine yafi dacewa da bukutun manoma kuma lallai shine za ya fi inganci wajan samun nasarori a ciki aikin garambawul din, kuma za ya saukin kulawa dagalokaci zuwa lokac; musamman in aka yi la’akari halin ko inkula da keg a (mutanen) yankin.

Matsalolin da ka Taso da Dabarun Ture Dukar Nauyi
Alfanun shirin alkinta Muhalli da Zamantakewar Al’ummah da yadda wadatursu zata tabu a dalilin yin garambawul sun hada da:

Abin da Ya Shafi Muhalli
- Karin gagewa kan (aiyukan) noman rani da albarkatun ruwa a Shirin Noman Rani na Bakolori.
- Tabbacin kyautatuwar lamurran noman rani a Bakolori
- Inganta kayaiyakin da ake bukatar datsi ya zamo yana da su wadanda za su kara zimmar yadda ake amfani da datsi.
- Bayyanar da alfanun Shirin Noman Rani na Bakolori, saboda samar da wutar lantarki da shirin za ya yi ga Yankin Kananan Hukumomi Uku (3).
- Kawar da wuraren hayayyafar tabbari yin garambawul sun hada: M. H. BALARABE
- Haka za ya tabbatar da dorewar noman rani, a yankin na Bakolori, da biyan bukutun mutane na ruwa a yanzu da can gaba.
- Karfafa guwar (mutane) su rungumi canje-acnjen dabai’u game da tsbta da kiwon lafiya a tsakanin mutanen Bakura, Talata Mafara da Maradun.

Abin da Ya Shafi Zamantakewa
- Wannan za ya zama wani ma’aunin yadda za a tunkari aiyukan raya kasa, yin garambawul ga na’urorin noman rani da Madatsai a nan gaba.
- Kara samun dammar inganta aiyukan noma kiwon dabbi’u da sauran harkokin kasuwanci a wadannan yankuna na Bakolori da kewayensu.
- Samar (wa al’ummah) da aiyukan yi.
Karfa guwa kan dagewa da bayar da horo a kan shirin noman rani na Bakolori da karuwar wayar da kan jama‘ah game da harkokin noman rani.

Hakika, gyara hanyoyin zurga-zurga a cikin yankin da ake gudanar da wannan Shiri na Noman Rani a Bakolori, a karshe za ya bude kasunni ga manoma.


Lokacin fara aiyuka, za a bukaci wasu kayaiyaki a yankin gudanar da za a gudanar da aiyukan, ba sai anje wani wuri ba, saboda haka wata dama ce ta samun Karin kudi ga jama‘ar da ke yankin.

Rage kamuwa da wasu cututtuka. Samun cigaba wajan alkinta albarkatun ruwa da dorewar amfanar datsin.

Kirkiro da sabin aiyukan yi (ga marasa shi).

Karin samara da amfanin gona.

Karin samun wadata ga magidanta da masu zuba jari (cikin sabgar).

Samun karuwar kudin shiga ga Gannatin Jihad a ta Tarayya.

Kara wa magidanta dammar iya daukar nauyin iyalinsu. M. H. BALARABE

Ma‘ido da wa aikin gona matsayinsa, a yankin, na kasancewa hanyar sana’a (dan kyautata rayuwa).

Karfa Kungiyoyin Masu Sana‘ar Ruwa da taimaka masu simma guri sana’arsu.

Habaka kasunnin amfanin gona da kayan aikin ta.

Yayawa da (kawata) yankin tayar tayar da sabin gine-ginen ma‘aikatu, wuraren sana’a (da gidaje).

Lallai mubitman nasarorin da ake hange suna da yawan gaske amma, duk da haka, maganar da ake yi ta aikin garambawul da fadadawar wannan aikin na noman rani da datsi na iya haifar da matsalolin raunawanwa ko kashewar wasu shuke-shuke da dabbobi, toshewar magudanan ruwa ko cikewarsu, wuyata samuwar (wasu) albarkatun ruwa, sauya asalin tsarin gari, matsalolin kamuwa ciiwace-ciiwace da kawar da kariya daga hadari; da kuma dai wasu abubuwan da ka iya zama matsala. Duka wadannan abubuwa ne da ke iya zame wa al’umma damuwa, idan kuwa ba a tanadi yadda za a fukancesu ba tun farko, to suna iya tarna ke duk nasarorin da ake hasashen za a samu–su zame wa aiken kadangaren bakin tulu (a kasheka a kasha tulu, a barka ka bata ruwa). Wannan tsari na ESIA ya gano wasu dabaru da aka dorasu kan tunani yadda za a kare Lafiyar masu Sana’hui da karesu daga Hadurra (OSH); domin Karin bayani a kan wannan sai a duba (Goyo na 6); shirin kwashe shara (Goyo na 7); da daukaci ka’dojin alkinta muhalli da zamantakewar al’umma da sharuddan yin manyan aiyukan raya kasa (Goyo na 8).

Shirin Alkinta Muhalli da Zamantakewar Al’umma (ESMP)

An yi bayani dalla-dalla a kan wannan tsarin jadawali na EMPS a Babi na 7 na wannan rahoto. A ciki an tattauna dukkan ababen da ake hararo faruwar, gwargwadon yadda ake iyawa, a
kowane matakun aiwatar da shirin. An yi bayaninsu gwargwadon yadda ake hangen zasu faru daga yanki zuwa yanki, ko jama’ah zuwa jama’ah, bisa kokari bayar da kariya ga masana’antunsu, lafiyarsu da hadurra, tare da la’akari da irin yadda su mutanen ke tunanin al’amurra. Babin ya hada da dabarun ije wa kai dukar nauyi da kuma kudin da za a biya a inda tunkude daukar nauyin ya faskara; ya kuma zayyana nauyin day a doru a kan hukumomi masu ruwa da tsaki wajan aiwatar da tsarin na ESMP.
Haka kuma an yi bayanin su wanene masu daukar nauyi da alhakin sa ido su ga lallai ba saba ka’idar alkinta muhalli da zamantakewa ba tare da daukar matakan ijewar nauyi ko biyan kudi maimakon aibatawa in an tabbatar da ita. M. H. BALARABE.

Kudin Aiwatar da ESMP

Kasafi da Hakkin Aiwatarwa
A saka jadawalin a nan!

Shawarwari
Wasu matakun kawo dauki da za su tabbatar da cin nasarar yi wa Shirin Noman Rani na Bakolori garambawul sune:

Habaka kasuwancin amfanin gona
Ana iya samun nasarar kaiwa ga habaka kasuwancin amfanin gona ta hanyar dauke nauy-enauyen da ke wajan sayar ga amfanin gana, ta daukar matakan giggin manya-manya rumbunan adana amfanin da kuma samara da hanyar “tallafin rance” (ga manoman). Dadin dadawa, ana iya horas da manoma da masu saye da sayarwa dabaru sarrafa kayansu kamar wajan sufuri da adana (amfanin). Saboda haka ne ake gabatar da waddannan shawarwari domin kyautata kasuwancin amfanin gonad a karin daraja garesu:

- Kawar da zamba (a tsakanin mai saye da sayarwa) ta amfani da ababan awo na baidaya.
- Samar da hanyoyin tallafin rance da Bankuna ga manoma da masu saye da sayarwa dan isar da amfanin ga kananan mabukata.
- Horar da manoma da masu saye da sayarwa ingantattun dabaru sarrafa kayansu kamar wajan sufuri da adana (amfanin).
- Kakkafa kasunni da tsarin samar da bayanai kan abinda kasuwa take ciki da samar da bayanai ga manoma kuma akai-akai cikinlokacin daya dace.
- Samar da rumbunan zamani ta hannun kamfunnan masu zaman kansu, kungiyoyin manoma ko kuma daga ofishin (gudanar da ) shirin.
• Samar da dammar zuba jari a cikin harkar sarrafa amfanin gona, misali ma’aikutun cashe Shinkafa ko ta gurza Filawa.

**Manufar Tsarin Shigar Daidaikun Mutane Cikin Shirin TRIMING**

Nazarin da aka gudanar tun kafin rattaba tsarin a kan takarda ya shata wasu dabaru wadanda a karshe dai sune dauka wajan tsarin shigar da daidaikun mutane:

- A kokarta yin amfan da tsarin gudanarwa mai sauki, ba mai dauke tarin bangarori ba.
- A bar dogaro akan ajan-ajan (‘yan shiga tsakani) saboda matsalolinsu na kasancewar (mafi yawansu) ‘yan-gada-gag ne.
- In bay a zama dole ba a kauce wa cewar sai an jira mi ka’ida ta shimfida, yin haka na nuna babu wata munamuna cikin gudanarwar.
- A kokarta dogaro da yanayin da kasuwa ta nuna, wannan shi ke aiki a Nijerya.
- Samar da dammar da mutane za su gasayya (ba hamayya ba) da juna neman bukatu da zasu biya ayi masu kamar (Famfuna, Na’urur sussuka, Nika, Tasi, Wayar salula, ‘Yan-dako, Masu sayar da abinci, Masu Akwaku da dai makamantansu),
- Guji dabi’ar bayar da abin sayarwa da kwatankwacin aiki (da wani ya yi/ko wasu suka yi).
- Jarraba yin aiki da salon in an ciza a busa wajan bukatan mutane, koda yin kuwa ba za ya bayar da cikakkiyar fa’ida ba.
- Tarihi ya nuna tsarin bayar da kan tana huda bai taba yin nasara ba a Nijeryi saboda tsananin gazawar cikakkiyar gwamnati; kuma tsarin tattara a hannun hukuma/jami’i daya tak yana nakasa karfin kasuwa na ta tallabi kanta dakanta.

**Karin shawarwari da rahoton ya tanada**

Shawarwarin sunc:

- Habaka tsarin gudanar da Shirin yadda za y adore cikin nasara.
- Kafa Ofishin Gudanar da Harkar Noman Rani na Bakolori.
- Kirkirar ‘Yar Karamar Kungiyar Masu Amfani da Ruwa (a cikin ganar).
- Sasanta (rigingimun) gadon fili (na noma) ko wasu matsaloli masu alaka da haka.
- Hadin kai da jam’an da aka iske.
- Kara inganta samara da ruwa.
- Tattalawa da habakar da albarkar kasa ta hanyar Alkinta Filaye Maidorewa (SLM).

**Horar da magudanan koguna**

Acikin wannan rahun, an yi tsokaci dangane da binciken da “Atkins-Enplan” Suka yi akan tantance bukatar inganta magudanan koguna.

Binciken horar da magudanan koguna, ya zayyana inganta/gina ganuwa a sashen tsallaken Dan din Bakalori a matsayin matakin farko na dabarar magance faruwar ambaliya. Ko da shi ke, tarihin yankewar irin wadannan ganuwoyi a yankin na Sokoto, wanda ke faruwa a sanadin canzawar magudanan koguna nuna a zahiri cewa gina irin wadannan ganuwoyi, watau ganuwoyi kare ambaliya dab da magudanan koguna ba iace DABARAR kare aukuwar
ambaliya mafi a’ala ba, duk da haka mai yiwuwa ne wannan dabarar ta zama daga cikin mukhimman shawarwarin da shirin magance bala’in ambaliyar zai kunsa.

**Tuntubar Jama’ah**
Tuntubar jama’ah mukhimmin dandali ne da masu ruwa da tsaki cikin sagar za su iya baiyanar da ra’ayinsu a kan maganar aikin garambawul. An gudanar da tuntubar a kan matakai uku (3):

**Mataki na I:** Tattaunawa a tsakanin kummomin manoma, Mata Manoma, Kungiyoyin Masu Amfani da Ruwa (WUAs), da Masu Tawaya.

**Mataki na II:** Tuntuba da Ofishin Noman Rani na Bakolori, Irin Wannan Ma’aikata Ta Jihar Zamfara, Hukumar Raya Kogin Sokoto-Rima, Ma’aikatar Albarkatun Ruwa ta Tarayya, Ma’aikatar Muhalli ta Tarayya, da masu ruwa da tsaki na Kananan Hukumomin nan (3) Uku.

**Mataki na III:** Tuntuba da daukacin al’ummah a kan tsarin ESIA wanda aka yi ranar 7 ga watan Nuwamba, 2013 da 10 ga watan Disamba, 2013 a harabar Ofishin Shirin Noman Rani na Bakolori, bayan da a ka bayar da sanarwa ga jama’a cikin jarida, takardun gayya da gayyatar baki.

**Fassara da Manyan Harsuna Yankin da ake Shiri**

**Sanarwa**
Za a bayar da sanarwar wannan Shiri na ESMP a Ma’aikatun Muhalli na Tarayya da na Jiha a wuraren da suka dace a Babban Birnin Tarayya, na Jihar Zamfara, da kuma, a “Cibiyar Samun Bayanai” ta Bankin Duniya
CHAPTER ONE: INTRODUCTION

1.1 Background

The Federal Government of Nigeria is implementing the Transforming Irrigation Management in Nigeria (TRIMING) Project with support from the World Bank. The main objective of the TRIMING Project is to achieve improvement and expansion of the neglected irrigation infrastructure on a viable and sustainable footing, addressing problems of low agricultural productivity, low employment opportunities and lack of performance in the operation and maintenance of the irrigation schemes.

The Project Development Objective (PDO) of the TRIMING Project is to improve access to irrigation and drainage services and to strengthen institutional arrangements for integrated water resources management, with the overall aim to support agricultural productivity improvement in selected large-scale public schemes in Northern Nigeria.

The TRIMING Project consists of four components:

Component 1: Water Resources Management and Dam Operation Improvement
   Subcomponent 1.1: Support to Integrated Water Resources Management
   Subcomponent 1.2: Dam Operations Improvement and Safety

Component 2: Irrigation Development and Management
   Subcomponent 2.1: Irrigation Infrastructure Investments
   Subcomponent 2.2: Improving Irrigation Management

Component 3: Enhancing Agricultural Productivity and Supply Chains
   Subcomponent 3.1: Matching grants for improvement of productive water use in agricultural processing and mechanization
   Subcomponent 3.2: Support to Research and Development

Component 4: Institutional Development and Project Management
   Subcomponent 4.1: Project Management and Monitoring & Evaluation
   Subcomponent 4.2: Institutional Development and Governance

Various documents have been prepared in line with the TRIMING Project, and they include: an Environmental and Social Management Framework (ESMF), a Pest Management Plan (PMP) a Resettlement Policy Framework (RPF) and, an Environmental and Social Impact Assessment (ESIA) which is specific for the Rehabilitation of the Bakolori Irrigation Scheme. This report focuses on the Environmental and Social Impact Assessment (ESIA) for the Rehabilitation of the Bakolori Irrigation Scheme which spans across 3 Local Government Areas; Talata Mafara, Maradun and Bakura LGAs in Zamfara State, Nigeria.
Construction of the Bakolori dam on the Sokoto River began in 1974 and was completed in 1978 after which it took three years to fill. The reservoir has an optimal capacity of 450 million m$^3$ and feeds 23,000 hectares for the Irrigation Scheme. Almost 65% of the land (15,000 hectares) was irrigated by sprinkler systems. Gravity fed surface irrigation is used in the remaining 8,000 hectares. The site hosts approximately 22,000 farmers (USAID 2010). However, due to inadequate maintenance over the years, the Bakolori Irrigation Scheme has fallen into a state of disrepair with multiple failures within the system. The sprinkler irrigation system has been inoperative since 2003, and only the gravity fed surface irrigation system is partially functional. The hydroelectric power system of the Bakolori Dam is currently inoperative. Power generation turbines installed during construction are currently not functional. The dam, reservoir and irrigation works have suffered from a lack of maintenance. Currently there may be some degree of siltation of the reservoir and there are many poorly drained areas within the command area. Lack of maintenance of infrastructure and poor staffing of the Bakolori Irrigation Project is a critical issue that has led to the worsened state of the irrigation scheme.

The proposed rehabilitation works for the Bakolori Irrigation Scheme therefore aims to achieve improved performance of irrigation and water resources infrastructure and improved management of the scheme (including the recruitment of appropriate personnel and provision of extension services) for higher agricultural productivity. The principal proposed investment components are the following: Irrigation Infrastructure Development and Management; Water Resources Management and Dam Operations Improvement; Improving Agricultural Service Delivery and Project Management and M&E.

This ESIA study will therefore, aim to identify potential and significant adverse environmental and social impacts and to propose means of mitigating them to acceptable levels. The ESIA will also consider the capacity of existing institutions to manage the predicted environmental and social issues and implement an Environmental and Social Management Plan (ESMP) for this purpose. This ESIA study will also update and complete the USAID Environmental Assessment Irrigation rehabilitation Program for Bakolori Irrigation Scheme and benchmark the report with the World Bank safeguards policies.

The TRIMING Project intends to rehabilitate the Bakolori Irrigation Scheme, which will optimize agricultural productivity in the area. The sub-projects will restore and augment the productivity of farming in the area.

This ESIA is prepared in compliance to the Federal Government of Nigeria (FGN) Environmental Impact Assessment (EIA) Law, and the Federal Ministry of Environment Guidelines. It is also compliant to the Environmental and Social safeguards Policies of the World Bank. The World Bank has various instruments for addressing the environmental and social impacts of projects. The rehabilitation of the Bakolori Irrigation Scheme will trigger some of the World Bank Safeguard Policies including Environmental Assessment (OP 4.01);
Physical Cultural Resources (OP 4.11); Involuntary Resettlement (OP 4.12); Safety of Dams (OP 4.37); Pest Management (OP 4.09); Natural Habitats (OP 4.04) and Projects on International Waterways (OP 7.50).

Specifically, for the Rehabilitation of the Bakolori Irrigation Scheme, the donor agency has requested for the preparation of an Environmental and Social Impact Assessment (ESIA).

Hospitalia Consultaire Limited has been engaged as the consulting firm to carry out this ESIA study.

1.2 Aim of the ESIA

The aim of the study is to assess the potential environmental and social impacts of the proposed rehabilitation of the Bakolori Irrigation scheme and prepare an Environmental and Social Impact Assessment (ESIA) that includes a detailed Environmental and Social Management Plan (ESMP) which will include necessary mitigation measures. The ESIA will establish modalities of implementing the rehabilitation works in line with the Nigeria Environmental policies and laws and the World Bank Safeguard policies.

1.3 Objective of the ESIA

The specific objectives of the proposed studies are:

- To conduct an Environmental and Social Assessment of the planned rehabilitation works for the Bakolori irrigation scheme in order to identify and assess their potential environmental and social impacts;
- To carry out consultations with relevant stakeholders, including potential project-affected persons, to obtain their views and suggestions regarding the environmental and social impacts of the proposed rehabilitation of the Bakolori irrigation scheme including the dam. The outcome of the consultations which is reflected in this ESIA report will be incorporated into the project design as appropriate;
- Develop a spatial analysis of the area of influence of the project and prepare a map base with appropriate overlays.
- To assess the capacity of existing agencies and institutions to monitor and manage the ESMP.
- To prepare and cost an Environmental and Social Management Plan (ESMP) detailing mitigation measures as well as institutional roles and responsibilities in the operationalization of the ESMP;
- Establish and benchmark the existing state of the environment and identify sensitive components of the existing environment within the project area and area of influence.
• Assist project design and planning by identifying those aspects of location, construction and operations, which may cause adverse environmental, social, health and economic effects, including strong focus on land issues - ownership, tenure, conflict;

• Recommend measures during construction, commissioning and operation to avoid and mitigate identified adverse impacts and also enhance beneficial impacts.

• Identify existing and expected environmental regulations that will affect the development and advise on standards and targets;

• Identify any future environmental issues and concerns which may affect the development of the project, including cumulative and induced impacts;

• Recommend an environmental management program for the rehabilitation of the scheme including compliance, monitoring, auditing and contingency planning;

• Provide the basis for co-operation and consultation with regulatory and non-regulatory authorities and the public;

1.4 **Scope of Work**

The Consultant is required to carry out the following:

• Conduct an Environmental and Social Impact Assessment of the proposed rehabilitation in order to identify and assess their potential environmental and social impacts;

• Carry out consultations with relevant stakeholders including potentially project affected persons (PPAPs), to obtain their views and suggestions regarding the environmental and social impacts of the proposed rehabilitation of the Bakolori irrigation scheme including the dam. The outcome of the consultation will be reflected in the ESIA report and incorporated into the project design as appropriate;

• Prepare and cost an Environmental and Social Management Plan (ESMP) detailing mitigation measures as well as institutional roles and responsibilities in the operation of the ESMP;

• Assist project design and planning by identifying those aspects of location, construction and operations which may cause adverse environmental, social, health and economic effects;

• Recommend measures during construction, commissioning and operations to avoid and ameliorate these effects while increasing beneficial impacts;

• Identify existing and expected environmental regulations that will affect the development, and advise on standards, consents and targets;

• Identify any environmental issues which may, in the future, affect the development;

• Recommend an environmental management program for the rehabilitation of the scheme including compliance, monitoring, auditing and contingency planning,
• Provide basis for co-operating and consultation with regulatory and non-regulatory authorities and the public.

1.5 Implementation Modalities

The Federal Government of Nigeria will be implementing the credits provided by the Banks through the Federal Ministry of Water Resources (FMWR). The Project Steering Committee (PSC) headed by the Permanent Secretary (PS) for the FMWR will ensure the oversight of the project. Overall project coordination will be housed in FMWR, which hosts the Project Coordination Unit (PCU). The PCU will be in charge of the daily coordination, supervision and implementation of the project’s components.

1.6 Technical Approach and Methodology

The methodology used in the conduct of the Environmental and Social Impact Assessment (ESIA) for the project is based on guidelines as proposed by the following:

• Guidelines documented under the World Bank Environmental Assessment Operational Policies OP 4.01.

The guidelines collectively advise that Environmental and Social Impact Assessment Studies are essential to examine the potential environmental and social threats and benefits (impacts) associated with rehabilitation works for the Bakolori irrigation scheme developments and/or investment lending operations. They agree that the ESIA is an essential tool for identifying beneficial and adverse impacts and integrating environmental and social concerns into the development process.

Initial consultations and meetings were conducted between the Federal Ministry of Water Resources and Hospitalia Consultaire Ltd., to facilitate processes critical to the ESIA implementation. Consultations were also carried out with the members of the Federal Ministry of Environment domiciled in Abuja, the World Bank, Atkins-Enplan (Consultant developing the Feasibility and Engineering Designs for the Sokoto-Rima River Basin Development Authority Irrigation Schemes) and other consultants that developed the Environmental and Social Management Framework (ESMF) and Resettlement Policy Framework (RPF) and the Pest Management Plan (PMP) for the TRIMING Project.

Literature review was carried out on the following:

• Feasibility and Engineering Designs for the Sokoto-Rima River Basin Development Authority Irrigation Schemes)
• Environmental and Social Management Framework (ESMF) for the TRIMING Project
• Resettlement Policy Framework (RPF) for the TRIMING Project
• Pest Management Plan (PMP) for the TRIMING Project.
• USAID Environment Assessment for the Irrigation Rehabilitation Program
• Draft Status Report for the Review of the Public Irrigation Sector in Nigeria
• Inception Report (Draft) for the Feasibility Studies and Design for Irrigation and Water Resources Management Investment in Sokoto-Rima Basin in Northern Nigeria
• Bakolori Dam & Hydropower Part 1 Prelim design report - Northcroft Nigeria
• Bakolori Dam & Hydropower Part 1 site assessment - Northcroft Nigeria
• Bakolori Dam & Hydropower Part 2 Feasibility Northcroft Nigeria
• Bakolori IP Appraisal. Afrimedev
• Bakolori and Zobe Dam Safety Report.

Stakeholder engagement and consultation was considered highly important for the achievement of the rehabilitation project and was carried out thoroughly during the preparation of this ESIA report. Consultations with the stakeholders were carried out in 3 phases outlined as follows:

• Focal Group Discussions with Farmers Groups, Water Users Association, Women Water Users Association and the disabled under the aegis of the Vulnerable User Group.
• Consultations with the Federal Ministry of Water Resources, Sokoto-Rima River Basin Development Authority, Bakolori Irrigation Project Office, Institute of Agricultural Research, Ahmadu Bello University (Talata Mafara field office), relevant Zamfara State Ministries, and stakeholders from Bakura, Maradun and Talata Mafara LGA.
• Two general Stakeholder Public Consultations for the ESIA were held on the 7th of November and 10th of December, 2013 at the premises of the Bakolori Irrigation Project Office.

1.6.1 Data Collection, Sampling and Field Methods

Several field visits were made to the Bakolori Irrigation Project Office, located in Talata Mafara, the Bakolori Dam and the entire irrigation scheme, and the Sokoto-Rima River Basin Development Authority located in Sokoto State. Visits were also made to the Zamfara State Ministries of Agriculture, Ministry of Water Resources and the Ministry of Environment, in Gusau, the Zamfara State capital.
1.7 Brief Description of Zamfara State

Zamfara State was created out of Sokoto State in 1996. Agriculture is the main profession of the populace of Zamfara State with about 80 percent of the population engaged in various forms of agriculture. The main agricultural products cultivated in the state include millet, guinea corn, maize, rice, groundnuts, cotton, tobacco and beans.
Figure 1.0 Map of Nigeria showing boundary of project area
There are several rivers located in Zamafara State and the most prominent three are the Sokoto, Zamfara and Bobo rivers. Zamfara State has a population of approximately 3,278,873 people (2006 census figures). The population is predominantly Muslim, and the State was the first in the country to establish the Sharia system as a form of governance.

1.8 The Federal Ministry of Environment ESIA Process

Figure 1.1 outlines activities to be carried out during the entire lifespan of the ESIA process as stipulated by the Federal Ministry of Environment (FMEnv). This ESIA has been registered with the FMEnv (See Annex 11).

Flow Chart of the FMENV EIA Procedure

![Diagram of the FMENV EIA Procedure]

(EIA Procedural Guidelines, 1995)

Figure 1.1 Flowchart of the FMEnv EIA Process
1.9 The Zamfara State Ministry of Environment EIA Process

The Zamfara State Ministry of Environment EIA Process is outlined in figure 1.2.

![Zamfara State Ministry of Environment EIA Process Diagram]

Figure 1.2: Zamfara State Ministry of Environment EIA Process

1.10 The ESIA Structure

The ESIA Structure and Content is highlighted below

Chapter 1: Introduction
Chapter 2: Legal and Administrative Framework
Chapter 3: Project and Process Description
Chapter 4: Description of the state of the environment (Project Environment and Baseline Studies)
Chapter 5: Analysis of Alternatives
Chapter 6: Potential Impacts and Mitigation/Enhancement Measures
Chapter 7: Environmental and Social Management Plan
Chapter 8: Public Consultation
Chapter 9: Recommendations

Annexures
CHAPTER TWO: POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

2.1 Introduction

This chapter seeks to provide an overview of Nigerian national environmental legislations and policies linking these with other institutional framework policies (agriculture and water), and identifying World Bank safeguards policies that apply to this project.

Some of the legal and safeguards instruments triggered by the project and which thus must be taken cognizance of include:

2.2 National Policy on Environment

Environmental consciousness and awareness regarding the adverse effects of development projects, including agricultural projects, resulted in the articulation of a national framework for environmental protection and national resources conservation. Decree No. 58 of 1988, as amended by Decree No. 59 of 1992, established the Federal Environmental Protection Agency (FEPA) as the main government structure for environmental matters in the country. The FEPA put in place the 1989 National Policy on the Environment, revised in 1995, with sustainable development as its goal. International agencies such as the World Bank, and the French Development Agency, and other development partners usually set environmental criteria for projects they are involved in.

The stated goal of the National Policy on the Environment is to achieve sustainable development in Nigeria, and in particular to:

- Secure a quality of environment adequate for good health and well-being;
- Conserve and use the environment and natural resources for the benefit of present and future generations
- Restore, maintain and enhance the ecosystem and ecological processes essential for the functioning of the biosphere to preserve biological diversity, and the principle of optimum sustainable yield in the use of living natural resources and ecosystems;
- Raise public awareness and public understanding between the environment and development and encourage individual and community participation in environmental improvement efforts; and,
- Cooperate in good faith with other countries, international organizations and agencies to achieve optimum use of trans-boundary natural resources and the prevention or abatement of trans-boundary environmental degradation.

National policies on safety and environmental protection require companies to conduct their business in a socially responsible and environmentally acceptable manner to protect and ensure the safety and health of the environment.
2.2.1 The Federal Ministry of Environment

Procedurally in Nigeria, it is worthy to note that before commencement of an EIA, the FMEenv issues a letter of intent on notification by the proponent, approves the terms of reference, ensures public participation, reviews and mediates. The possible technical activities expected for a proposed project include screening, full or partial EIA Study, Review, Decision-making, Monitoring, Auditing and Decommissioning/Remediation post-closure.

In 1999, the Federal Ministry of Environment was created & FEPA was absorbed into the Ministry. The Ministry of Environment thus became the highest policy making body responsible for addressing environmental issues in Nigeria, including conservation of biodiversity. The act establishing the Ministry places on it the responsibility of ensuring that all development and industry activities, operations and emissions are within limits prescribed in National Guidelines and Standards, and comply with relevant regulations for environmental pollution management in Nigeria as may be released by the Ministry. To fulfill this mandate a number of regulations/instruments are available (see section on National Legal Instruments); however, the main instruments in ensuring that environmental and social issues are mainstreamed into development projects is the Environmental Impact Assessment (EIA) Act No. 86 of 1992. With this Act, the FMEenv prohibits public and private sectors from embarking on major projects or activities without due consideration, at an early stage, of environmental and social impacts that may arise from the project implementation. The act makes an EIA mandatory for all new major public or private sector projects including large-scale agricultural projects, and prescribes the procedures for conducting and reporting EIA studies.

The Federal Ministry of Environment also regulates the use of land for agricultural development, though the emphasis is placed on the conduct of Environmental Impact Assessment for agricultural projects requiring 50 hectares or more. Mandatory study activities as specified in the extant environmental legislation relating to drainage and irrigation projects refer specifically to:

a) Construction of dams and man-made lakes and artificial enlargement of lakes with surface areas of 200 hectares or more.

b) Drainage of wetland, wild-life habitat or of virgin forest covering an area of 100 hectares or more

c) Irrigation schemes covering an area of 5,000 hectares or more.

Procedurally, in Nigeria, it is worthy to note that before commencement of an EIA, the FMEenv issues a letter of intent on notification by the proponent, approves the terms of reference, ensures public participation, reviews and mediates. The possible technical activities expected for a proposed project include screening, full or partial EIA Study,
Review, public consultation and disclosure, Decision-making, Monitoring, Auditing and Decommissioning/Remediation post-closure.

2.2.1.1 National Legal Instruments on the Environment

Environmental Impact Assessment Act No. 86, 1992 (FMEnv)

This Act provides the guidelines for activities of development projects for which EIA is mandatory in Nigeria. The Act also stipulates the minimum content of an EIA and is intended to inform and assist proponents in conducting EIA studies as well as a schedule of projects, which require mandatory EIAs. The EIA Decree No. 86 of 1992 lists drainage and irrigation as a Mandatory Study Activity, thus prescribing that an EIA is to be carried out for irrigation projects.

According to these guidelines:

- **Category I** projects will require a full Environmental Impact Assessment (EIA).
- **Category II** projects may require only a partial EIA, which will focus on mitigation and Environmental planning measures, unless the project is located near an environmentally sensitive area—in which case a full EIA is required.
- **Category III** projects are considered to have “essentially beneficial impacts” on the environment, for which the Federal Ministry of the Environment will prepare an Environmental Impact Statement.

Other National Legal Instruments on Environment

- Federal Environmental Protection Agency (Amendment) Act No 59 of 1992
- The National Guidelines and Standards for Environmental Pollution Control in Nigeria
- The National Effluents Limitations. Regulation 1991
- The National Environmental Policy (Pollution Abatement in Industries and Facilities Generating Waste) Regulations 1991
- National Guidelines for Environmental Audit
- National Policy on Flood and Erosion Control 2006 (FMEnv)
- National Air Quality Standard Decree No. 59 of 1991
- National Environmental Standards and Regulations Enforcement Agency Act 2007 (NESREA Act)
- The constitution of the Federal Republic of Nigeria 1999
2.2.2 Federal Ministry of Water Resources

The Water Resources Decree No. 101 of 1993 gives the FMWR significant power to control and coordinate activities for proper watershed management and resources protection and for public administration of water resources. It confers to the FMWR the responsibility to make proper provision for adequate supplies of suitable water for, amongst others, agricultural purposes in general and irrigation in particular.

The FMWR is the main national coordinating body in the water sector and the implementer of the National Water Policy and water-related sanitation. Its principal functions are to:

- Formulate and implement national irrigation policy;
- Develop and support irrigated agriculture;
- Coordinate the development and utilization of water resources for irrigation and other purposes;
- Update and implement the Water Resources Master Plan;
- Collect, store, analyze and disseminate hydro-meteorological, hydrological and other data;
- Support, monitor and evaluate programmes and performances of the RBDAs and the National Water Resources Institute (NWRI);
- Formulate appropriate water resources legislations;
- Undertake studies and investigations to allow the efficient use of Nigeria’s water resources.

Departments concerned with irrigation in FMWR:

The Department of Irrigation and Drainage (DID); among its major responsibilities are the supervision and monitoring of the River Basin Development Authorities (RBDAs);
The Department of Planning, Research and Statistics;
The Department of Hydrology and Hydrogeology;
The Department of Dams and Reservoir Operations

2.2.2.1 National Legal Framework on Water Resources

Water supply is on the concurrent legislative list, which poses a challenge to coordination and definition of roles between the different tiers of government. The three levels of government, Federal, State and Local, share responsibility for water resources management. This has often led to fragmentation, duplication and lack of inter-sectoral coordination, with each level of government pursuing its independent water agenda. The institutional arrangements in Nigeria's water resources are as follows:
- Federal Government level- FMWR & FMARD (including 12 River Basin Development Authorities (RBDAs) and National Water Resources Institute (NWRI).
- State Government level - Responsible for potable water supply (through state Water Agencies (SWAs).
- Local Government level- responsible for provision of rural water supplies and sanitation facilities.
- Community level- participates in rural water supplies and sanitation.

The guiding principles of the National Water Resources Policy are:

- The water policy shall be subject to and consistent with the Constitution in all matters including the determination of the public interest and the rights and obligations of all parties, public and private, with regards to water.
- All water, wherever it occurs in the water cycle, is a national asset and resource common to all, the use of which shall be subject to national control. All water shall have a consistent status in law, irrespective of where it occurs.
- The objective of managing the quantity, quality and reliability of the nation’s water resources is to achieve optimum, long term, environmentally sustainable social and economic benefit for society from their use.
- There shall be no ownership of water but only a right (for environmental and basic human needs) or an authorization for its use. Any authorization to use water in terms of the water law shall not be in perpetuity.
- The planning and management of Nigeria’s water resources shall take place within a framework, which facilitates awareness and participation among all users at all levels.
- Water resources shall be assessed, developed, apportioned and managed in such a manner as to enable all users to have equitable access taking into account the sustainability of the resource.
- Water quality and quantity are interdependent and shall be managed in an integrated manner, which is consistent with broader environmental management approaches.
- Water quality management options shall include the use of economic incentives and penalties to reduce pollution; and the possibility of irretrievable environmental degradation as a result of pollution shall be prevented.
- The management of water resources shall seek to harmonize human and environmental requirements, so that the human use of water does not individually or cumulatively compromise the long term sustainability of aquatic and associated ecosystems.
- The operational management of water resources and services shall be decentralized to the lowest practicable level in accordance with the established
hydrological areas (HA) as the basic units of water resources management in Nigeria.

- International water resources, specifically shared river systems, shall be managed in a manner that optimizes the benefits for all parties in a spirit of mutual co-operation. Allocations agreed for downstream countries shall be respected.
- Water quality management options shall include the use of economic incentives and penalties to reduce pollution so that beneficiaries of the water services shall contribute to the cost of its establishment and maintenance on an equitable basis.
- The resource base shall be protected against any kind of pollution. The protection measures shall be based on both regulatory and market-based approaches to waste management applying the “polluter pays” principle.
- For the purpose of improving water related environmental conditions, abstraction fees for raw water shall be charged for the commercial use of it.

Selected Statutes related to water resources include:
- Land Use Act (CAP. 202) (1978)
- Lands (Title Vesting, etc.) (Decree No 52) (1993)
- National Water Resources Institute Act, Cap 284 LFN 1990
- Water Resources Decree (Decree No. 101) (1993)

**Water Resources Act 1993, No.101**

This act is to promote the optimum planning, development and use of Nigeria’s water resources and other matters connected therewith. The right to the use and control of all surface and groundwater and of any watercourse affecting more than one State as described in the Schedule to this Act, together with the bed and banks thereof, are by virtue of this Act and without further assurance vested in the Government of the Federation for the purposes of:

- promoting the optimum planning, development and use of Nigeria's water resources;
- ensuring the co-ordination of such activities as are likely to influence the quality, quantity, distribution, use and management of water;
- ensuring the application of appropriate standards and techniques for the investigation, use, control, protection, management and administration of water resources; and,
• facilitating technical assistance and rehabilitation for water supplies.

**National Irrigation Policy**

The Water Resources Decree No 101 of 1993 gave the Federal Ministry of Water Resources (FMWR) significant powers to control and coordinate activities for proper watershed management and resources protection and for public administration of water resources. These powers, assign the Ministry with the responsibility of making proper provisions for the adequate supply of suitable water for, amongst others, agricultural purposes in general and irrigation in particular. In 1995, building on previous efforts aimed at implementing the country's response to the provision of adequate supply of suitable water, a first draft of Nigeria's irrigation policy was developed and circulated. In 2000, an updated second draft was prepared with support from the Food and Agriculture Organization of the United Nations (FAO).

The national irrigation policy is predicated on boosting domestic agricultural production using irrigation to produce quality and quantity where rain-fed production alone cannot meet demand. The primary purpose of the policy is to improve the performance of irrigation services. It also has an equally important secondary purpose to solicit complementary policy and strategy alignment in all the immediately related sectors at federal, state and local government levels. The irrigation policy is predicated on the following principles of integrated natural resource management:

- Equitable allocation of water rights and land ownership.
- Optimize beneficial use of water within the agricultural sector, including use of stored water and the transfer of rights to use water and land.
- Functional inter-sectorial management of water across river basins, predicated on high quality information generation and exchange.
- Environmental responsibility in irrigation.
- Clear operation and regulatory roles between agriculture in production and water in supply and the establishment of a working interface between them.
- Facilitate performance of private and public sector agencies in those activities where they have comparative advantage.
- Ensure coherence of policies, planning and budgets within Federal Ministry of Water Resources (FMWR), Federal Ministry of Agriculture and Rural Development (FMARD) and Federal Ministry of Environment (FMEnv).
- Appropriate scaling of technology and institutions to fit their purpose.
- Being responsive to macro-economic drivers, commodity prices and input costs;
- Sustainable operation, maintenance and management (including cost recovery);
- Better integration with agricultural production systems;
• Support services in irrigated agriculture including credit facilities, fertilizer, seeds, and machinery. It includes access to land and water in with 'support services'  
• Formation of Water Users Associations (WUAs) ·  
• Confirmation of legal status, training and transfer of Operation & Maintenance (O&M) of some levels of the irrigation systems when WUAs are ready:  
• Advice on on-farm water management; and,  
• Research on irrigation including technology, environmental conservation, economics, ecology, health issues, and preservation techniques.

In 2005, a revised National Irrigation Policy Strategy (NIPS) was presented to the National Water Resources Council Technical Committee. The specific policy objectives of the revised NIPS are summarized thus:

• Raise overall irrigation productivity in all public and private initiatives,  
• Achieve a strategic balance between irrigated and rain-fed production,  
• Improve water distribution and availability services to irrigation farmers and work towards full Operation & Maintenance (O&M) cost recovery from water users,  
• Improve and sustain irrigation efficiencies at all schemes, provide extension services and facilitate the provision of inputs and the marketing of outputs,  
• Stabilize the public irrigation sector and transfer O&M to the beneficiaries/private sector,  
• Consolidate the responsibility for overall coordination and regulation of all irrigation development in Nigeria with the FMWR and request that the responsibility for, the coordination and regulation of all agricultural support services shall reside with the FMARD,  
• Remove constraints to private sector engagement and expand the capability of the private sector in both equipment manufacture and supply and in development activities including direct project operation and management

Irrigated agriculture can contribute to poverty reduction through improved food security, job creation and income generation but the overall policy goal is to improve economic and environmental performance of irrigation.

**Nigeria Integrated Water Resources Management Commission**

The functions of the commission include the following:

• Implement regulatory policies on activities relating to the management of water resources in Nigeria;
- Be responsible for economic and technical regulation of all aspects of water resources exploitation and provision of public and private water resources infrastructure;
- Ensure the safety and quality of Water Resources development and public water service by regulating standards for execution and performance;
- Issue Water Resources licenses in accordance with the provisions of the Act;
- Protect suppliers of public water resources services or facilities from unfair practices of other Water Resources developers or service providers which are damaging to competition;
- Protect consumers from unfair practices of licensees and other persons in the supply of Water Resources services and facilities;
- Liaise with relevant national and international agencies and advise the Minister of Water Resources on ways of promoting cooperation for effective and equitable management of trans-boundary waters;
- Arbitrate disputes between all stakeholders especially the licensees and other participants in the Water Resources sector.

**National Inland Waterways Authority**

The main functions of the authority include:

- Provide regulations for inland navigation;
- Ensure the development of infrastructural facilities for a national inland waterways network connecting the creeks and the rivers with the economic centers using the river-ports as nodal points for inter-model exchange
- Ensure the development of indigenous technical and managerial skill to meet the challenges of modern inland waterways transportation.
- Undertake hydrological and hydrographic surveys
- Survey, remove, and receive derelicts, wrecks and other obstructions from inland waterways.
- Issue and control for inland navigation, piers, jellies, dockyards.
- Examine and survey inland watercrafts and shipyard operators.
- Grant permit and licenses for sand dredging pipeline construction, dredging of slots and crossing of waterways by utility lines, water intake, rock blasting and removal.
- Subject to the provisions of the EIA Act, carry out EIA of navigation and other dredging activities within the inland water and its right-of-ways.
Other National Legal Instruments involved in Irrigation subsector are:

- The National Council on Water Resources (NCWR) - is the most important water resources policy formulating body.
- The National Technical Committee on Water Resources (NTCWR) - is a sub-committee of the NCWR. The NTCWR has five specialist sub-committees that are important for information exchanges between federal and state level agencies: dams, water supply, irrigation and drainage, hydrology and hydrogeology, manpower.
- The Federal Ministry of Agriculture and Rural Development (FMARD) was involved in irrigation development in the past as it funded, with World Bank support, a series of state-run Agricultural Development Projects (ADPs), including the promotion of irrigation owned and managed by farmers, particularly in fadama areas, and the provision of extension services to the public sector irrigation schemes of the RBDAs and the State Irrigation Departments.
- The River Basin Development Authorities (RBDAs) are the main bodies in charge of administering and developing Nigeria’s water resources and are responsible for public sector irrigation at the federal level. Their functions are defined in the RBDA Act No. 35 of 1986. They were established in the mid-1970s and the areas of operation are determined by the extent of the river basins they serve.
- State agencies involved in the irrigation subsector are:
  - State Ministries of Agriculture (SMAs): They were responsible for irrigation development before RBDAs were established. Irrigation responsibility within the Ministries is with the State Irrigation Departments (SIDs). In most States they are small and suffer from funding constraints and lack of staff capacity and capability to design, implement and monitor irrigation schemes. Their programmes consist more of plans than actual irrigation development, which amounts to 12 200 ha (2004), of which about 6 700 ha are actually irrigated. The informal division within a State is that schemes larger than 2 000 ha are handled by the RBDA concerned. State Ministries of Water Resources exist in some States, and where they exist the SID has been transferred to them.
  - Agricultural Development Projects (ADPs): They became involved in irrigation in the early 1980s, mainly in small-scale FADAMA development. In most States, they are responsible for extension services.
  - Local Government Authorities are involved in irrigation in some limited instances by making small pumps available to farmers for fadama-type irrigation.

2.2.2.2 River Basin Development Authorities

Introduction

By Decree No 33 of 1973 the Federal Military Government of Nigeria created River Basin Development Authorities with broad based mandates to cover all major aspects of
agricultural production. The situation more or less remained the same with the promulgation of Decree No 25 of 1976 except for the creation of additional River Basin Development Authorities. However, with the promulgation of Decree No. 35 of 1987, the River Basin and Rural Development Authorities were disengaged from all forms of agricultural and extension services as well as from direct agricultural production. Their core mandate thus focused on supply of water for irrigation, human and livestock consumption within their catchment areas.

**Mandate and Responsibilities**

There are currently 12 River Basin Development Authorities (RBDA’s). They are responsible for implementing the ‘Irrigation development policies of the Federal government. The initial mandate of the RBDA’s was rather broad and has since been modified to reflect changing economic realities. Their main functions as outlined in the Federal Government Decree No. 35 of 1987 are as follows:

- To undertake comprehensive development of both surface and groundwater resources for multipurpose use, with particular emphasis on the provision of irrigation infrastructure, flood and erosion control, and water management;
- To construct, operate and maintain dams, lakes, polders, wells, irrigation and drainage systems for achievement of the RBDA’s functions and to hand over all lands to be cultivated on irrigation schemes to farmers;
- To supply water from completed storage schemes to all users for a fee to be determined by the RBDA with approval of the Federal Ministry of Water Resources;
- To construct, operate and maintain infrastructural services such as roads and bridges linking project sites; and
- To develop and keep up-to-date, a comprehensive water resources master-plan, identifying all water resources requirements, through adequate collection and collation of water resources, water use, socio-economic and environmental data of the River Basins.

The RBDA’s are funded directly by the FGN and are expected to recover operation and maintenance costs from the beneficiaries of their schemes. Beyond the statutory limits placed by the FGN on the Board sizes, the actual organograms suggest that each Board is free to create as many positions as its funds can support. Some of the positions are of questionable relevance to irrigation and drainage development, management and control.
2.2.2.2.1 Sokoto Rima River Basin Development Authority (SRRBDA)

Introduction

The Sokoto-Rima River Basin Development Authority was constituted as one of 2 Basin Development Authorities created by Federal Military Government Decree No. 25 of 1976; the other being the Chad Basin Development Authority. Under the provisions of Decree No. 87 of 1979, the area of operation (jurisdiction) of the Authority was modified to include the whole of the then Sokoto State and Katsina Emirate of Kaduna State. The Authority presently covers the States of Sokoto, Kebbi, Katsina and Zamfara with an estimated total land area of 116,134km². Its head office is located along kilometer 10, Sokoto-Gusau road, Sokoto State. Three area offices namely, - Katsina Area Office, Katsina; Kebbi Area Office, Birnin Kebbi, and Zamfara Area Office, Gusau are operated by the Authority. In addition, the Authority has the following Project Offices:

- Bakolori Irrigation Project, Talata Mafara, Zamfara, State
- Jibia Irrigation cum Water Supply Project, Jibia, Katsina State
- Zobe Irrigation Project, Dutsin-Ma, Katsina State
- Goronyo Dam/Middle Rima Valley Irrigation Project, Goronyo, Sokoto State
- Zauro Polder Project, Birin Kebbi, Kebbi State
- Warra Irrigation Project, Warra, Kebbi State

Mandate and Responsibilities

The aims and objectives of the SRRBDA as spelt out in Decree No. 35 of 1987 include:

- Facilitate economic development and improve the welfare of rural dwellers in Nigeria through the production of available and affordable food by improving irrigation farming and other water resources management techniques.
- The management of water resources for sufficient and efficient consumption and utilization.
- Preservation and control of flood and erosion to ensure effective utilization of farmlands and peaceful living for economic development.
- Rendering assistance to other Authorities concerned with rural development in those areas that improve the food lot of Nigerians.

2.2.2.2.2 Bakolori Irrigation Project Office (BIPO)

The Bakolori Irrigation Project (BIPO) is located at Talata Mafara Local Government, Zamfara State. The staff of the project office comprise of a team that is very enthusiastic towards seeing to the success and effectiveness of the Bakolori Irrigation Project. Unfortunately, it is very critically short-staffed, and this has adversely affected their capacity to achieve success.
Management Structure and Staffing

The BIPO as envisaged is supposed to comprise of six departments, viz: (i) Civil & Irrigation; (ii) Agricultural Services; (iii) Electro-mechanical; (iv) Administration; (v) Accounts and Audit, and, (vi) Research, Development, Monitoring & Evaluation.

Presently, the project faces inadequate numbers of personnel both in quantity and quality of skilled and unskilled manpower.

Mandated Responsibilities:

Civil & Irrigation Department
- Canals, dykes and drains
- Roads
- Sprinklers
- Dam & hydrogeological works
- Light vehicles
- Heavy machinery

Service (Agriculture) Department
- Land Management
- Horticulture
- Fisheries

Electro-Mechanical Department
- Water supply
- Electrical Facilities and Management
- Mechanical Facilities and Management

Administration Department
- Registry
- General administration

Accounts and Audit Department
- Main accounts
- Stores

Research, Development, Monitoring & Evaluation Department
- Research
- Monitoring

2.2.2.2.3 Water User Associations

There is a Federated Water Users Association (FWUA), which is registered with the Corporate Affairs Commission in Abuja. It acts as the holding organ overseeing the activities and interests of subsidiary WUAs in the whole project command area. The subsidiary groups under the apex umbrella are registered under section 5 of the Nigerian Cooperative Societies Act and Regulations No 90 of 1993 with Zamfara State Ministry of Commerce, Industry and
Cooperatives. According to the byelaws, the aim of the WUA is to raise the level of agricultural productivity, farm economy, employment and income of members and acting as a growth center in the area of operation of each. A membership fee of ₦20 is charged to join the association, followed by monthly fees of ₦50.

**Responsibilities:**
1. Identify farmers interested in irrigation farming within Bakolori Irrigation Project
2. Serve as a single contact point for services within the project.
3. Assist in collection of land lease charges, water rates and other services and remittance of the funds to the BIPO.
4. Mobilization of members for community works and maintenance of irrigation infrastructure such as tertiary canals, drains, farm roads, culverts and storage facilities.
5. Organization and mobilization of farmers during fertilizer distribution and sales.
6. Ensure the sustainable use of project water resources.

**2.2.2.4 Livestock Herders**
This is an uncoordinated and unregistered body in the project command area. There appears to be a plan to have a formal registered association in the near future. There are two distinct groups of herders in the project area - herders who manage cattle within the irrigation system for other cattle owners (Farmers owning livestock), and the Fulani, nomadic cattle herders who do not have any affiliation with the BIP, they graze their cattle outside of the irrigation system during the wet season and then move into the BIP during the dry season due to the availability of water there.

**2.2.3 Federal Ministry of Agriculture and Rural Development**

The Federal Ministry of Agriculture and Rural Development ensures that the citizenry are provided with credible and timely information on government activities, programs and initiatives in the development of agriculture and food production; while creating an enabling technological environment for socio-economic development of the nation.

**Agriculture Sector Policies**

Sector-specific agricultural policies were largely designed to facilitate agricultural marketing, reduce agricultural production cost and enhance agricultural product prices as incentives for increased agricultural production. Major policy instruments for this purpose included those targeted at agricultural commodity marketing and pricing, input supply and distribution, input price subsidy, land resource use, agricultural research, agricultural extension and technology transfer, agricultural mechanization, agricultural cooperatives and agricultural water resources and irrigation development.
This report shall limit its review to aspects of this policy as it relates specifically to agricultural water resources and irrigation development.

The Agricultural Transformation Agenda

The Agricultural Transformation Agenda (ATA) is focused on building stronger and more inclusive growth in the non-oil sector, employment generation and poverty reduction including economic diversification. The ATA is a direct implementation response by the agricultural sector to the current administration’s Transformation Agenda (2011-2015) which derives from the vision 20:2020 and the 1st National Implementation Plan (NIP). Rather than trying to drive the entire agricultural sector forward at the same time as in many past strategy documents, the ATA focuses on a few key first moves - priority food staples and traditional export crops, and intends to develop these for growth and employment creation, with the expectation that the rest of the sector will subsequently follow.

Women play a prominent role in agriculture and women farmers are identified as a key target group in the ATA. Women are particularly active in trading and processing, which implies that the ATA’s emphasis on value chain development has the potential to benefit women. Also, women are key to improving nutrition outcomes in the country. Reducing women’s workloads through appropriate agricultural technologies, addressing their bargaining power within house-holds by enabling policies that put more income directly into the hands of women, are, for example, some key pathways to improving nutrition outcomes that can be enabled through the agriculture sector.

Agricultural Transformation Agenda also focuses on:

- Deregulation of seed and fertilizer sectors
- Marketing reforms to structure markets
- Innovative financing for agriculture
- New agricultural investment framework.

2.3 Other Acts and Legislations

Land Use Act of 1978

The land-use Act of 1978 states that “…It is also in the public interest that the rights of all Nigerians to use and enjoy land in Nigeria and the natural fruits thereof in sufficient quality to enable them to provide for the sustenance of themselves and their families should be assured, protected and preserved’. This implies that acts that could result in the pollution of the land, air, and waters of Nigeria negates this decree, and is therefore unacceptable.
Furthermore, the Land Use Act of 1978 (modified in 1990) remains the primary legal means to acquire land in the country. The Act vests all land comprised in the territory of each state of the Federation in the Governor of the state and requires that such land shall be held in trust and administered for the use and common benefit of all Nigerians in accordance with the provisions of this Act.

According to the Act, administration of land area is divided into urban land, which will be directly under the control and management of the Governor of each State; and non-urban land, which will be under the control and management of the Local Government. State Governors are given the right to grant statutory rights of occupancy to any person or any purpose; and the Local Government will have the right to grant customary rights of occupancy to any person or organization for agricultural, residential and other purposes.

Others
- Water Resources Decree 1993
- Criminal Code:
- Land Planning Act (cap.303)
- The Waterworks Act 1917
- Rehabilitation, Reconstruction and Development Act, 1990
- Penal Code Act (cap.63)
- Wildlife Conservation and Management Act, Cap376
- Occupational, Health and safety Act (OSHA), 2007
- Public Health Act (Cap. 242)
- Environmental Impact Assessment Act 1996
- Environmental Vibration Pollution (Control) Regulations, 2006. etc.

2.4 Institutional Assessment for Environmental And Social Management

2.4.1 Institutional Roles and Responsibilities

The main institutions with key responsibilities in the implementation of this ESMF are:

2.4.2 The Federal Ministry of Environment (FMEnv)

One of the primary responsibilities of the Federal Ministry of Environment is to ensure that all major development projects in Nigeria are subject to mandatory Environmental Impact Assessment (EIA) pursuant to EIA Act No. 86 of 1992. The FMEnv reviews and approves EA documents for category A projects; especially the complex and more risky ones. For the proposed projects, the respective State Environmental Protection Agency or Authority (SEPA) will be empowered to handle the reviews and approvals.
FMEnv will play a role in monitoring the implementation of this project to ensure that:

- the SEPA's are reviewing the EA documents and clearing them according to Federal Guidelines, State Laws and World Bank Safeguards policies,
- the SEPA's are monitoring the activities of the State Commercial Agriculture Development Offices (SCADOs) during construction and post-construction (i.e. operations stage) at all locations in the state in which the Commercial Agricultural Development Associations (CADAs) and the various Commodity Interest Groups (CIGs) have sub-projects investments.

### 2.4.3 The State Environment Protection Agencies (SEPA’s)

The State Environmental Protection Agencies or Authorities (SEPA’s) are responsible for the following:

- Ensuring that activities planned under this project by the SCADOs comply with their state’s environmental laws and requirements, and that of the Federal Government and the World Bank’s triggered Safeguards Policies,
- Receiving, review, commenting, requiring revisions where necessary and clearing and approving the EA document details of the SCADOs,
- Performing regular and intrusive monitoring regime of the construction, operations and maintenance stages of the activities,
-Preparing periodic monitoring reports on the activities at all stages of operations and to send these reports on a regular basis to the FMEnv, and
- Complying with (consistent with state laws/edicts) the directives of the FMEnv.

### 2.4.4 The State Commercial Agriculture Development Offices (SCADOs)

The SCADOs will be responsible for:

- Complying with all Federal, State and Local Laws regarding the environment and with all social/poverty guidelines, parameters and targets set by the project, and of all triggered World Bank Safeguards policies,
- Ensuring that CADAs and CIGs prepare an EMP report for their planned investments under this project and to submit the EMP to the SEPA's for clearance,
- Implementing all appropriate mitigation measures identified in the EMP into the project planning cycle, technical and engineering designs and drawings, and contracts,
- Ensuring that these mitigation measures are complied with during construction and post construction (i.e. operations) stages of their activities, by self-monitoring of their activities and by periodically reporting to the SEPA's and the FMEnv, and
Complying with any directives that may be issued from time to time from the SEPAs and FMEnv.

2.4.5 Commercial Agriculture Development Associations (CADAs)

The Commercial Agriculture Development Associations (CADAs) are apex organizations of economic interest groups, which have a common interest in agricultural commercialization. They identify, prepare, execute, supervise, operate and maintain their sub-projects. The team of facilitators and other specialists will be deployed to provide related and necessary technical assistance and training support. The CADAs will use participatory planning process and establish a management committee, consisting of a chairperson, secretary, treasurer, commercial agriculture development officer (including disadvantaged groups). The CADAs will play a major role in applying the environmental and social checklist to screen sub-projects.

2.4.6 The World Bank

The World Bank has overall responsibility to ensure that its Safeguard Policies are complied with. In addition, will be responsible for the final review and clearance of the ESIA; as well as review and give “no objection” to the ESIA TOR. The responsibility for preparing the TOR for ESIA resides with the SFCOs.

2.5 Capacity Assessment to Perform Attributed Institutional Roles.

2.5.1 Federal Ministry of Environment

The role of the FMEnv in this project will be that of monitoring. Although the staffing levels at the EIA division of the FMEnv and the Impact Mitigation and Monitoring (IMM) Branch of the EIA division are sufficient with adequate experience to carry out these roles, there is a need for further capacity strengthening.

2.5.2 State Commercial Agriculture Development Office

All technical assistance, institutional building, and productive investment sub-projects will be managed and supervised by the SCADO. A State Coordinator who will manage an interdisciplinary staff that will also include an environmental officer will head the SCADO. The designated environment specialist will be responsible for day to day monitoring and reporting feedback throughout the life of the project, specifically

- ensuring that the ESIA were screened using the environmental and social screening mechanism contained in the prepared ESMF;
- overseeing the implementation of the ESIA and RAPs (if applicable); and
- monitoring of environmental issues during operations

2.5.3 State Environmental Protection Agencies/Authorities (SEPAs).

The SEPAs will perform the following key roles in this project:
• Reviews terms of reference (TOR) for EMPs or ESIAss
• Ensure adherence to EMP/ESIA requirements
• Ensure implementation of EMPs/ESIAs in communities
• Monitor compliance of EMPs for micro-projects
• Enforce state laws.
• Report to the FMEnv

2.6 World Bank Environmental and Social Safeguards

The World Bank has in place a number of operational and safeguards policies, which aim to prevent and mitigate undue harm to people and their environment in any development initiative involving the Bank. The Nigerian EIA Act and the World Bank safeguard policies are similar; designed to help ensure that projects proposed for Bank financing are environmentally and socially sustainable, and thus improve decision-making.

The Bank has twelve safeguards policies and these are:

Environmental:
• OP 4.01 Environmental Assessment;
• OP 4.04 Natural Habitats;
• OP 4.36 Forests;
• OP 4.09 Pest Management;
• OP 4.11 Physical Cultural Resources
• OP 4.37 Safety of Dams;

Social:
• OP 4.12 Involuntary Resettlement;
• OP 4.10 Indigenous People;

Legal:
• OP 7.50 Projects on International Waterways;
• OP 7.60 Projects in Disputed Areas

Others:
• Access to Information Policy

The triggered safeguard policies for this project are discussed below.

Environmental Assessment (OP 4.01)

Environmental Assessment is used in the World Bank to identify, avoid, and mitigate the potential negative environmental and social impacts associated with Bank’s lending operations early on in the project cycle. In World Bank operations, the purpose of Environmental Assessment is to improve decision making, to ensure that project options
under consideration are sound and sustainable, and that potentially affected people have been properly consulted and their concerns addressed. This policy is triggered if a project is likely to have potential adverse environmental and social risks and impacts in its area of influence. The EA has various tools that can be used, including amongst others Environmental & Social Impact Assessment (ESIA) or Environmental and Social Management Plan (ESMP). Effort has been made to identify the potential adverse environmental and social impact associated with the Rehabilitation of the Bakolori Irrigation Scheme.

**Involuntary Resettlement (OP 4.12)**

This policy can be triggered if the project will involve involuntary taking of land and involuntary restrictions of access to property, protected areas, etc. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts. It promotes participation of displaced people in resettlement planning and implementation. The main objective of this policy is to assist displaced persons in their efforts to improve or at least restore their incomes and standards of living after displacement. The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects. OP 4.12 on Involuntary Resettlement is triggered because project intervention may result in some degree of land acquisition and temporary loss of livelihood. Rehabilitation of existing irrigated land, roads and other infrastructure as well as development of new irrigated areas will require land acquisition.

**Safety of Dams (OP 4.37)**

The objectives of this policy are as follows:

- For new dams, to ensure that experienced and competent professionals design and supervise construction: the borrower adopts and implements dam safety measures for the dam and associated works.
- For existing dams, to ensure that any act that can influence the performance of the project is identified, a dam safety assessment is carried out, and necessary additional dam safety provided.

A dam safety assessment has been prepared by the Atkins-Enplan for the Bakolori Dam.

**Physical and Cultural Resources (OP 4.11)**

This policy is to assist countries to avoid or mitigate adverse impacts of development projects on physical cultural resources. For purposes of this policy, “physical cultural resources” are defined as movable or immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above ground, underground,
or underwater. The cultural interest may be at the local, provincial or national level, or within the international community. In the case of a chance find, cultural artifacts will be collected and secured. A *chance find* procedure has been included in this report see Annex 11). Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people’s cultural identity and practices.

**Pest Management (OP 4.09)**
This policy is to (i) promote the use of biological or environmental control and reduce reliance on synthetic chemical pesticides; and (ii) strengthen the capacity of the country’s regulatory framework and institutions to promote and support safe, effective and environmentally sound pest management. More specifically, the policy aims to (a) Ascertian that pest management activities in Bank-financed operations are based on integrated approaches and seek to reduce reliance on synthetic chemical pesticides (Integrated Pest Management (IPM) in agricultural projects and Integrated Vector Management (IVM) in public health projects. (b) Ensure that health and environmental hazards associated with pest management, especially the use of pesticides are minimized and can be properly managed by the user. (c) As necessary, support policy reform and institutional capacity development to (i) enhance implementation of IPM-based pest management and (ii) regulate and monitor the distribution and use of pesticides.

A PMP has been developed by the TRIMING Project and will be adapted for during the project implementation.

**Natural Habitats (OP 4.04)**
The policy is triggered for any project or sub-project with the potential to cause significant conversion (loss) or degradation of natural habitats, whether directly (through construction) or indirectly (through human activities induced by the project).

**International Waterways (OP 7.50)**
The Bank attaches great importance to riparian because it recognizes the cooperation and goodwill of riparian as essential criteria for the efficient use and of protection of the waterway. The riparian must have made appropriate arrangements for these purposes for the entire waterway or any part thereof. It ensures that the international aspects of projects on an international waterway are dealt with at the earliest possible time.

**Access to Information**
The ESIA Report must be disclosed for public comments and reactions and on the Internet prior to implementation of the project.
2.7 Nigeria EIA Guidelines and World Bank EA Guidelines

The Environmental Impact Assessment Act No. 86 of 1992 requires that development projects be screened for their potential impact. Based on the screening, a full, partial, or no Environmental impact assessment may be required. Guidelines issued in 1995 direct the screening process.

According to these guidelines the Nigeria EIA Categories include:

- **Category I** projects will require a full Environmental Impact Assessment (EIA) for projects under this category EIA is mandatory according to Decree No. 86. Projects includes large-scale activities such as agriculture (500 hectares or more), airport (2500m or longer airstrip), land reclamation (50 hectares or more), fisheries (land based aquaculture of 50 hectares or more), forestry (50 hectares or more conversion, etc.
- **Category II** projects may require only a partial EIA, which will focus on mitigation and Environmental planning measures, unless the project is located near an environmentally sensitive area—in which case a full EIA is required.
- **Category III** projects are considered to have “essentially beneficial impacts” on the environment, for which the Federal Ministry of the Environment will prepare an Environmental Impact Statement.

With regard to environmental assessment, the Bank has also categorized projects based on the type of EA required, namely:

- **Category A** - projects are those whose impacts are sensitive, diverse, unprecedented, felt beyond the immediate project environment and are potentially irreversible over the long term. Such projects require full EA. The proposed Bakolori Irrigation Scheme project was categorized as Category A.
- **Category B** - projects involve site specific and immediate project environment interactions, do not significantly affect human populations, do not significantly alter natural systems and resources, do not consume much natural resources (e.g., ground water) and have adverse impacts that are not sensitive, diverse, unprecedented and are mostly reversible. Category B projects will require partial EA, and environmental and social action plans.
- **Category C** - Projects are mostly benign and are likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project, although some may require environmental and social action plans.
- **Category FI** - A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.

This World Bank categorization (A, B, & C) corresponds in principle with the Nigeria EIA requirements of Category I, II and III, which in actual practice is done with regard
to the level of impacts associated with a given project. However, in the event of divergence between the two, the World Bank safeguard policy shall take precedence over Nigeria EA laws, guidelines and or standards. Thus for this ESIA, the Nigeria’s EIA requirements and World Bank operational procedures were harmonized as far as possible, hence it is made responsive to the objectives of good practice. It is especially made responsive with regard to the followings:

- Consideration of environmental and social issues
- Identification and early consultation with stakeholders;
- Prevention of adverse impacts through the consideration of feasible alternatives; and
- Incorporation of mitigation measures into planning and (engineering) design.

2.8 Applicable International Conventions, Treaties and Agreements

Nigeria is signatory to some international agreements and Protocols concerning the environment, notably:

- Convention on Biodiversity
- United Nations Framework Convention on Climate Change (1992)
- Vienna Convention for the Protection of the Ozone Layer
- Montreal Protocol on Substances Depleting the Ozone Layer
- Basel Convention on the Trans-boundary Movement of Hazardous Substances
- Stockholm Convention on Persistent Organic Pollutants
- Bonn Convention
CHAPTER THREE  PROJECT AND PROCESS DESCRIPTION

3.1 Introduction
There is a need to understand the current situation of the Bakolori Irrigation Scheme before identifying all the various rehabilitation and civil works that will be carried out.

3.2 General Overview of the Bakolori Irrigation Scheme and Components
The Bakolori irrigation scheme was commissioned in 1979, and construction of a major portion of the scheme was completed by 1983. In total, 23,000 hectares were developed, of which 15,000 ha were planned for sprinkler irrigation and 8,000 ha for surface irrigation by gravity. The sprinkler systems installed in the area developed for pump irrigation are no longer operational. The area with functioning irrigation is therefore limited to 7,500 ha, irrigated by gravity. Irrigation water is supplied from the Bakolori dam across the Sokoto River and water supply is sufficient for the area currently cultivated. The site hosts approximately 22,000 farmers (USAID 2010). Recent information indicates that there are a total number of 38,400 farmers across the three local governments of Maradun, Bakura and Talata Mafara. Current crops cultivated include rice, maize, cowpea, sweet potato, groundnut, vegetables, sugarcane, millet, and guinea corn. Fishery activities are also ongoing in the project area.

The Bakolori Irrigation Scheme has depreciated badly primarily due to a lack of maintenance over several years. Agricultural produce extensively cultivated within the scheme are not adequately exploited due to lack of market, lack of access roads to the farms, lack of storage or processing facilities and ineffective Water User Associations (WUAs).

WUAs have been established in the Bakolori Irrigation area, but appear to be weak and thus do not fulfill their intended purposes (See Annex 10 for the WUA structure and interventions).

There are multiple failures with the infrastructures within the system. All these gaps constitute the reasons and sub-components of rehabilitation and re-organization, which the TRIMMING project seeks to address.

The following section gives a breakdown of the various components that make up the scheme and their current conditions.

3.2.1 The Dam
The Bakolori dam located at Talata Mafara on River Sokoto was designed to function as a multi-purpose dam for irrigation, water supply, fisheries, livestock development, and
hydropower generation, flow regulation and flood protection. However, since completion there has been a general lack of maintenance resulting in the loss of the hydropower generating capacity, silting of the dam, silting of the primary, secondary and tertiary canal systems, breakdown of parts of the lined primary canal and secondary canals, weeds growth in the canals, silting and weeds growth with resultant blockage of the drainage canals, reduction in the area of land irrigated, and pests infestation of the project command area (especially quelea birds, rabbits and termites).

At the dam site, a large colony of bats roost in the service gallery at the base of the dam. There is coarse vegetation (shrubs and tall grasses) growing in the riprap in several parts. The crest is overgrown with shrubs, bushes, trees and grasses. Parts of the dam system are broken down with ant and termite nests in several places. Erosion (human, animal and water) has eaten off parts of the edges of the crests. The concrete structures on the finger drains of the dam are generally sound but owing to lack of regular maintenance, vegetation has engulfed the chambers. The access covers have been lost / stolen on all but one of the chambers. There is no safe means of access into the chambers. Rocks from the toe drain and other debris have accumulated inside the chambers and there is a risk that there could be snakes trapped inside. Many of the chambers are flooded suggesting a blockage of the outlets.

Generally, the mechanical equipment appears to be substantial but all electrical equipment (meters, panels, notches) have deteriorated and the installed hydroelectric turbines and electricity generating sets are not functional.

### 3.2.2 Canal Conditions

The command is serviced by a 15km long and concrete lined supply canal which is crossed by 35 No culverts, foot and vehicular bridges. It has a reported carrying capacity of $30m^3/sec$ and at the end of the supply canal there is a spillway and automatic siphons to prevent overloading. The two main canals (IL and IR) take off at this point. The culvert outlets across the supply canal that convey surface water from the high left side of the right hand side and down to the river are silted and do not have aprons and wing walls.

The irrigation network consists of the main canal, secondary canal and tertiary canal. The two main canals, Irrigation Left (IL) and Irrigation Right (IR) take off at the end of the supply canal. The IL (15km) and IR (15km) were seen to have cracks and bulges at the concrete panels during field visits. Approximately 30% of the entire lengths of both embankments (left and right) of the canals are eroded below the concrete linings. The inverts of these canals are heavily silted with the attendant growth of grasses. It was also observed that while some farmers make use of their private pumps to siphon water for irrigation from the canals, other members of the community use the water from the canal for domestic
purposes. Some members of the community were seen bathing/swimming, and washing in the canals. In spite of this, others still fetch water for both household and livestock use from it.

There are several secondary canals (some concrete lined and others unlined) spanning over 200 km. The problems associated with the concrete lined secondary canals include cracks, sliding, bulging, uplifting of the slabs and grasses growing through the cracks and joints and silting at some locations.

With the earthen canals the problems are severe as most of the canal embankments have been eroded or are seeping water profusely. Their carrying capacity has been reduced as a result of siltation and infestation with weeds and shrubs and farmers in many locations have also breached them. The tertiary canal system extends to more than 400 km.

3.2.3 Drainage Network

The drainage network was designed to dispose of storm water runoff and irrigation surplus water. It consists of the main, secondary, tertiary and field drains with total lengths estimated to be above 1,000km.
Runoff from the field were originally intended to be collected by the tertiary and field drains and passed into the secondary and main drains. Most of these drains however, are heavily silted and quite a number are overgrown with *Typha* grasses (see Plate 2) and therefore, does not perform its function.

![Plate 2: Drainage channels overgrown with grass](image)

There are two drainage pumping stations serving the project area but only one is presently working. The Pre-feasibility studies and design for the *Irrigation and Water Resources Management Investment in Sokoto-Rima River Basin in Northern Nigeria* indicates that the effectiveness of the stations in evacuating the water from the project area needs to be verified. Site visits did not show any significant water level difference between the upstream and downstream water levels of the drainage station.

### 3.2.4 Roads

There are 3 classes of road found in the scheme; access roads, service roads and field tracks. The access roads (Plate 3) run along the routes of the main supply canals with the greater part surface dressed. The major problems along the surface dressed length are potholes and cavitation. The service roads are laterite constructed and run along the secondary canals. The problems common with this class of roads are potholes, gully erosion, waterlogging and total wash out in some cases.
3.2.5 Canal Gates

Close to 95% of the gates along the main canals, secondary canals and tertiary canals have been either vandalized or damaged due to lack of maintenance. The steering and driving gears are either stolen or damaged due to lack of adequate maintenance. For some of these gates the lifting shafts, the horizontal bars and the spindles had been removed leaving only the gate plates and frames.
3.2.6 Irrigation System

The sprinkler irrigation systems in these areas were converted to surface irrigation. However, the system is not optimized to full capacity because the canals are heavily silted. The control gates and drainages were also silted. One of the main drains was silted and a section destroyed by erosion thereby cutting off completely a section of the access road. The electric power lines, sprinkler pipes, parts of the gate control were vandalized.

3.2.7 Flood Dykes

Within the project area, River Sokoto, River Bobo and the Gora River tributary all have shallow depths with flood plains along both sides of their banks. These rivers often overflow their banks during the rainy season hence a series of dykes were constructed along the flood prone locations to protect the irrigation areas.

Two types of flood dykes were designed and constructed for Bakolori with the following parameters:

- Type A: sectional height that is less than or equal to 1.5m, a 6m crest width, and 2:1 side slope. The crest also serves as a road paved with a base and sub-base of 0.25m and cross slope of 2.5%.
- Type B: sectional height greater than 1.5m, 3m-crest width and side slope of 2:1. Incorporated on the farm side of the dyke is a lower embankment expected as the farm roadway.

Both type A and type B dykes are laid on a compacted foundation layer 0.7m thick below ground level. Un-compacted topsoil is placed and grassed at a 3:1 slope to form slope protection for the dykes. The functionality of the dykes has been reasonably satisfactory although several breaches have occurred at certain reaches. The table 3.0 shows the lengths of each type of dyke within the command area.

<table>
<thead>
<tr>
<th>S/No.</th>
<th>River</th>
<th>Left Bank</th>
<th>Right Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Type A(km)</td>
<td>Type B (km)</td>
</tr>
<tr>
<td>1.</td>
<td>Sokoto River</td>
<td>9.10</td>
<td>10.84</td>
</tr>
<tr>
<td>2.</td>
<td>Bobo River</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>Gora Tributary</td>
<td>2.2</td>
<td>3.05</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>11.30km</td>
<td>13.89km</td>
</tr>
</tbody>
</table>

Table 3.0: Bakolori Flood Dykes
3.2.8 The Jankarawa Irrigation Area

The Jankarawa Irrigation Area is made up of 5 pumping stations (JAS, JBS, JCS, JDS and JES) each of which has reservoirs with attached piezometric tower except JCS and JDS that share one tower and reservoir. JES is the last of the Pumping Stations in the area and does not have a piezometric tower. JAS pumping station has a dilapidated building and a functional reservoir with rusted pump-pipes some of which are perforated at different points. Sand deposit was visible at the sides of the reservoir, which may have been deposited from wind or human activity on the neck of the reservoir. This pumping station was initially meant to serve the sprinkler irrigation system in the Jankarawa irrigation area. However, members of the Maradun LGA obtain water for their domestic use from the JAS reservoir due to inadequate water supply. Water vendors also siphon water from this reservoir with Water tankers and plastic cans on hand push trucks. JBS – JES pumping stations are abandoned with dilapidated buildings, broken louvers and cracked reservoirs and are overgrown with weeds. Portions of the JBS reservoir are covered with rainwater and *algae* toads inhabit it, while the rest of the stations are highly silted.
There were no functional generators at the pumping stations and the electric power line running all the way down the length of the irrigation areas as well as the transformers have been vandalized. The flow pipes connecting the individual pumping stations were observed to be broken at some sections while some of the flow control points now serve as mosquitoes breeding sites especially after the rains.

The surroundings of these pumping stations have been covered by vegetation thereby limiting accessibility to the stations. These pumping stations lack sanitary facilities (toilets) and potable water. It was also observed that farmers were planting crops inside of the JBS reservoir since it has been abandoned.
Other pumping stations

These span the rest of the areas and covers mainly Talata Mafara and Bakura LGAs (Designated: G-Left & Right, F-Left, LS-Left, LS-20 & 21, AS, BS, DS). The pumping stations were all non-functional and some of the reservoirs were flooded. The flooded reservoirs were observed to be as a result of failed attached pumping stations, which were unable to pump out water sent in.

3.2.9 Buildings and Ancillary

Buildings in this area including the maintenance stations and staff quarters are all dilapidated.

3.3 Proposed Rehabilitation Works

Some of the proposed rehabilitation works that will be carried out for the Bakolori Irrigation Scheme are highlighted in the section below.

3.3.1 Proposed rehabilitation works for the Hydroelectric Power plant

The dam safety report prepared by the Feasibility Studies consultant has proposed the following works to be carried out for the Hydroelectric Power Plant:

- Replacement of the electrical components including the generators, 7 x 6.6kV switch gear panels and a remote control system with SCADA;
- Refurbishment of other components including transformers, 33kV indoor switchgear panel and 33kV outdoor switch yard;
- Refurbishment of the outlet works gates and valves.

Other remedial works recommended by the feasibility includes:

- The bats be excluded from all elements of the dam and associated equipment;
- The crest be cleared of vegetation;
- The ant and termite infestation be removed;
- The edge of the crest of the embankment sections be rebuilt and the stone protection be replaced where damaged;
- The crest of the dam repaired, particularly on the left hand side;
- The finger drain collection chambers be cleared of all debris and kept clear;
- The chambers be supplied with covers and safe access be provided;
- All gates, valves and penstocks be made to operate;
- All electrical controls and operating mechanisms be repaired/replaced;
- All seals will be replaced.
- Operation and maintenance manuals be written;
- All valves, penstocks and gates be operated over their full range at least at 6
monthly intervals and a record be made of their operation;
- A series of crest leveling points be installed into the core;
- All mechanical gates and valves and penstocks be inspected and repaired/repainted/refurbished as required;
- The gate and its operating facilities be examined, refurbished and made to operate;
- An appropriate instrumentation array be designed under the control of a dam engineer to include leakage, measurement, crest leveling, foundation pressures, inclination of the dam;
- The stop logs be cleaned and repainted.

3.3.2 Proposed rehabilitation works for the Irrigation Network (Main Canals, Secondary and Tertiary canals)

- De-siltation of canals
- The concrete panels of the canals be removed and replaced
- Minor canals on the panels be sealed
- Removal of grasses, weeds and shrubs from the canals
- The gates and some sections of the secondary canals to be rehabilitated.
- Repair of cracks, bulging, sliding and uplifting of the slabs for the lined secondary canals.
- Reinforcement of embankment for the tertiary canal carried out.

3.3.3 Proposed rehabilitation works for the Drainage Networks (main drain, secondary, tertiary and field drain)

- De-siltation of the entire drainage network.
- Repair of cracks on the entire drainage network.
- Construction of a new main drain within the sprinkler system irrigation area.
- Flood drains from farms.
- The drains to be cleared of silt, debris, vegetation, weeds, trees to avoid blockage.
- Construction of walls for the secondary and tertiary drains.
- All spoils to be conveyed to borrow pits.

3.3.4 Proposed rehabilitation works for the Road Networks

Access Road

- Removal of vegetation from the access roads.
- Removal of weak surface dressing on the roads.
- Grading and backfilling of the roads with laterite.
- Compacting and surface dressing of the access roads
• Construction of drainages along the access roads

**Service Road**
• Erosion management
• Road stabilization.

**Field Track**
• Weed management
• Drain management

### 3.3.5 Proposed rehabilitation works for the Flood dykes

The flood dykes will have to be rehabilitated to maintain a design height as well as to prevent the ingress of floodwater from the rivers within the project area.

Given the total length of the existing dykes and the low maintenance cost associated with them, it is suggested that options to rehabilitate the existing dyke network should be explored. At the three major breach locations the channel is highly mobile and can move by up to 18m per year. These dykes would require additional reinforcement with additional slope protection devices like rip rap, gabion, concrete lining, and stone pitching. However, the long term sustainability of the dyke location with regular maintenance and rebuild potentially required should be taken into account and set back locations considered. The prefeasibility studies inferred that a redesign of the breached areas would be carried out during the feasibility. Where necessary, based on the river modeling, it is envisaged that the river training works shall also include local riverbed excavation or dredging to improve the channel flow in order to facilitate high river flows and flood waters.

The existing dyke would be cut to a minimum of 0.3m in cases of extensive erosion or small gullies on the slopes the cuts would be to the extent of the erosion/gullies. The exposed soil would then be scarified and compacted before the placement of additional material to the final level of the dyke.

In areas near communities or villages, special passes with adequate protection will be provided to allow the passage of people and livestock. The slopes of the dykes at these passes shall be made shallower and lateritic material shall be used on the last 0.3m of the dyke to reduce erosion from people and livestock traffic.

The site-specific details that would be considered in the design of the dykes would include:
• Current foundation conditions;
• Dyke stability with respect to shear strength;
• Settlement, seepage, and erosion; and
• Slope stability.
**Slope Stability**
Slope stability analyses will be carried out on the various sections and in areas of changes of fill and foundation materials using analytical tools (slip circle and/or wedge analyses) available to the contractor. The slope stability analysis will take into consideration sub surface soil parameters, soil strength parameters and the slope that provides the optimum safety factor.

**Major Breaches**
Three distinct areas where there have been major breaches have been observed. These all appear to be taking place within or in close proximity to bends in the river. Groynes are required for protection and dykes will be rebuilt, the foundations strengthened and upstream protection provided.

3.3.6 **Proposed rehabilitation works for the Standard Structures**
These include the gates on the main canals, outlet structures, gates and weirs on the secondary canals, delivery structures, wastewater structures and crossing structures. The crossing structures include bridges, culverts and gates. Proposed rehabilitation works will include:

- Mechanical works
- Civil works

3.3.7 **Proposed rehabilitation works for the Irrigation Area**

- Rehabilitation of the existing gravity irrigation scheme.
- Conversion of the commendable sprinkler areas to gravity.
- Assessment of adjoining areas for expansion of the Bakolori Irrigation Scheme.
- Private sector development of certain areas.

3.3.8 **Proposed rehabilitation works for the Jankarawa**

- The pumping system needs to be rehabilitated and also the hydropower scheme in order to provide sufficient electricity supply for pumping.
- Rehabilitation of storage reservoirs and supply pipe and construction of canals from reservoirs.

3.4 **Workforce Recruitment and Accommodation**

3.4.1 **Recruitment**
Contractors should be recruited following the procurement procedures as prepared by the Bureau of Public Procurement (BPP), Federal Republic of Nigeria and the World Bank procedures for the selection of Contractors/Consultants. The selection option of choice should be Quality Cost Based Selection (QCBS).
Selected Contractors should integrate local skilled and unskilled labour as this will promote Cooperative Social Responsibility (CSR) and affirm goodwill among the project communities.

### 3.4.2 Accommodation

A gated camp-style option where the contractor installs prefabricated structures surrounded with perimeter fencing maybe most suitable. However, considering the availability of some abandoned and dilapidated structures within the Irrigation Scheme, Contractors could renovate these buildings (Talata Mafara Residential Complex, Staff quarters and Administrative buildings found within the farmlands). This will be cost effective to the Contractor, sustainable and beneficial to the timely realization of the Rehabilitation of the Bakolori Irrigation Scheme.
CHAPTER FOUR: DESCRIPTION OF THE STATE OF THE ENVIRONMENT AND BASELINE STUDIES

4.1 Overview of the Project State- Zamfara State

4.1.1 Introduction

Zamfara State is located in the northwestern part of Nigeria with its state capital in Gusau. The State covers an area of 35,711 square kilometers and lies at latitude 12° 10’ N and longitude 6° 15’ E. It shares an international border with Republic of Niger to the north and interstate boundaries with Katsina State to the east, Sokoto State to the west, and Kebbi and Niger states to the south. Its population is approximately 3,278,873 (2006 census) with a population density of 92 people per square kilometer. Zamfara State has 14 local government areas and they include Anka, Bakura, Bungudu, Bukkuyum, Gusau, Kaura Namoda, Talata Mafara, Tsafe, Zurmi, Gummi, Maru, Shinkafi and Birnin Magaji LGAs.

4.1.2 Physical Environment of Zamfara State

Climate: Zamfara state enjoys a tropical type of climate, largely controlled by two masses, namely, the Tropical Maritime from the Atlantic Ocean and the Tropical Continental from the Sahara Desert and the Middle East.

Temperature: The hottest months in Zamfara State are March and April, which is just before the onset of the first rains. The onset of the rains tends to bring a cooling effect with temperatures dropping below 36°C (90°F). The peak of the rainy season starts from July to September. Towards the end of October the temperature drops again to 17°C-20°C due to the tropical continental air masses from the Sahara.

Rainfall: The mean annual rainfall in the State varies slightly. For example, while Gumir records an average of 579mm of rainfall, Talata Mafara records 798mm, Kaura Namoda 990mm and Moriki 1,020mm. The onset of the rains, on the average, is between mid-March and May, lasting for about six months till the end of October.

Geology: Geologically, very old igneous and metamorphic rocks, formed during the Precambrian-Paleozoic era, characterize the State. Two rock types are found - granites, and meta-sediments. The granites (including un-differentiated granites), gneisses and migmatites are likely resistant to erosion, but when weathered, they result into poor soils. The meta-sediments, on the other hand, consist of phyllites, quartzites and meta-conglomerates. Although the meta-sediments are also resistant to erosion, weathered, they give rise to more fertile soils because the schists are rich in magnesium minerals.

The State's land surface consists of mainly the high plains. The only exception to this is the area extending north-eastwards from Talata Mafara and Moriki. Here can be found dissected
plateau crystalline rocks composed of a series of range hills around Maru, as well as the large, steep-sided smooth dome shaped hills called the inselbergs, exemplified by the Kotorkoshi Hill. Surrounding the inselbergs are plains, which are used for farming. The general elevation of the land ranges from 244m to 366m above sea level (Abdu and Swindel, 1982).

Soils: Two major soil types-ferruginous tropical soils and lithosols dominate Zamfara State. The ferruginous tropical soils can be found in the northern and central parts of the State, particularly around Gummi, Bukkuyum, Anka and Bakura. Other areas in which such soil occurs include Talata Mafara, Zurmi, Birnin Magaji, Shinkafi and Kaura Namoda. The soils are characterized by a sandy surface horizon, with clayey subsoil, both of which are fertile for agricultural production. The soil is prone to erosion, since the topsoil is easily washed off by rainwater, especially when the vegetation cover is removed.

On the other hand, lithosols, usually associated with ferruginous soils, can be found towards the eastern part of the State, particularly in such areas as Tsafe, Gusau, Maru and Bungudu. The soil is not only of low agricultural productivity but are also susceptible to erosion.

Mineral Resources: Minerals found in the state include: alluvial gold, mica, granite, silica, feldspar, gold, limestone, quartz, kaolin and sand.

The people of the state also engage in weaving, dying and designing materials and other kinds of woven products, usually made from date – palm raffia.

4.1.3 Biological Environment of Zamfara State

Vegetation: The vegetation of the State consists of Sudan and Northern Guinea Savannah. The Sudan Savanna occurs in the western, northern and eastern parts of the State and is characterized by woodlands, where grasses occur either totally or mixed with other herbaceous or shrubby plants. They are green in the rainy season with fresh leaves, but become dry during the dry season. Northern Guinea Savannah is found in the southern part of the state, which is typically found in Gusau and Anka LGAs.

Fauna: Livestock production is also a vibrant agricultural subsector in the state. Animals such as sheep, goats and cattle are reared on a large scale. The state can boast of nearly six million livestock comprising of over one million cattle; 857,000 sheep; over million goats; 1.7 million poultry; and about 18,000, 21,000 and 46,000 horses, camels and donkeys respectively.

Tourist Sites: Zamfara state has some sites of tourist attraction such as the Kalale Hippopotami pond, Kuyambana Game Reserve, Kwaratarkwash Rock/Water Spring, Kanoma Hill, the Danshi tunnel. All of these sites are located far off from the Bakolori Irrigation Scheme. Hence issues of interference with site of significance interest will not be impacted during project implementation.
Ecological Problems: Like most states in the northern most parts of the country, Zamfara State suffers from desertification, and environmental degradation arising from indiscriminate felling of trees for fuel wood. In addition to these, there is the problem of erosion as well as occasional floods—when heavy rains occur and rivers and dams over flow their banks.

4.1.4 Social Environment of Zamfara State

Economy: Agriculture is the core of the state’s economy. It employs about ninety per cent of the state population in various forms. Zamfara is blessed with variety of crops. Major crops grown in the state include maize, millet, cotton, rice, groundnut, guinea corn, tobacco and beans. Nearly four million hectares of land are cultivated which represents 30% of the total land area.

The existing industries in the state include The Zamfara Textile Mill, The Gusau Oil Mill and the Gusau Sweet Factory; all source their raw materials locally. The Gusau Oil Mill is based on the widespread groundnut farms, which can be found in virtually all the LGAs in the state.

While many open markets exist in the State, Talata Mafara within the Bakolori Irrigation Scheme Area is the largest market place in Zamfara, and it operates every Tuesday of the week.

Education: There is no university in the state. However, there are two polytechnics: the Federal Polytechnic Kaura Namoda and the Abdul Gusau Polytechnic in Talata Mafara. There is also the Zamfara College of Education in Maru.

4.2 Overview of the Project Environment

The Bakolori irrigation scheme is found in the northern Sudan Savannah zone and located about 100 km southeast of Sokoto in the Sokoto River Valley (Figure 4.0). The Federal Government of Nigeria has indicated the need to rehabilitate the Irrigation Project for higher agricultural productivity, drinking water supply and hydropower generation.
Figure 4.0: General Layout map of the Bakolori Irrigation Scheme
The construction work of the Bakolori Irrigation Project was started on 5th June 1975 and was substantially completed and commissioned on 19th April 1983. The scheme has been poorly managed and maintained over the decades and there is thus a critical need for the dam and irrigation structures to be investigated for integrity, reservoir siltation, certainty of the catchment areas to produce adequate run-off and other issues like poor drainage, problems of erosion along some access routes and canal, siltation of some segments of the canal, etc. within the command area.

The dam at its inception was built with a capacity of 450M m$^3$ for the irrigation of 23,000 ha (15,000 ha of sprinkler irrigation and 8,000 ha of gravity-fed irrigation). But since 2003 the sprinkler systems have been inoperative so the dam reservoir is being grossly underutilized.

4.2.1 Physical Environment of the Bakolori Irrigation Scheme

4.2.1.1 Climatic Characteristics of the Area

Analyses of rainfall data for thirty (30) years (1981-2010) shows a trend that is shown in figure 4.1. Rainfall is highly seasonal and controlled by the movement of the Inter-tropical Discontinuity (ITD). Most rainfall is experienced during the relatively short but intense localized thunderstorm covering small areas. Diurnal concentration of rain shows occurrence mainly in the afternoon and early morning. In some years rainfall is evenly dispersed throughout, in some other, it occurs irregularly but in large amount. This often affects runoff characteristics. Rainfall varies from 658mm in Gwadabawa to 1,115mm in Faskari.

![Figure 4.1: Annual rainfall for the zone (1981 – 2010)](image)

There is a prominent seasonal variation in temperature and diurnal range of temperature. A ten (10) year temperature data (2001-2010) was analyzed and plotted to show a trend of the annual average (Figure 4.2), and the trend of a monthly average from an annual data (Figure 4.3). Daily maximum temperature is about 36$^\circ$C. During the harmattan season, daily minimum temperature falls below 17$^\circ$C. Between February and April, which is the peak of heat, temperature reaches the highest of 44$^\circ$C. Range of temperature is generally high. Indeed, Sokoto basin is one of the few areas fingered for having the potential for more acute climate change impacts in Nigeria (Odjugo, 2010).
The evapotranspiration (Et) rates for the zone shows an increase from January and remains high through March, April and May and then reduces as the rainy season commences reaching a minimum mostly in August (Figure 4.3). The implication is that impounding water for irrigation should take into account the seasons when Et values are highest. The average monthly temperature patterns follow a similar pattern with the evapotranspiration from the zone. The highest temperatures are between March and May (Figure 4.4). Though the value is in line with general pattern of tropical temperatures, the annual range is smaller compared to evapotranspiration.
4.2.1.2 Geology

The Bakolori Irrigation Scheme is located to the west of the boundary between the sedimentary and Basement Complex. The irrigation area is located in the sedimentary zone, with the Basement Complex commencing to the west of Talata Mafara and running to the north-east. The eastern part of the supply canal, the dam and the reservoir are located in the Basement Complex. The supply canal transverses an area of broken metamorphic formations (Sir M. MacDonald & Partners, MRT Consulting Engineers, 1983) before reaching the sedimentary formations.

The sedimentary formation underlying the Bakolori Irrigation Scheme is known as the Gundumi Formation. The more geologically recent Gwandu Formation overlies parts of this formation although these are anticipated to be relatively thin deposits. The Gundumi Formation lies un-conformly on the Basement and consists of poorly cemented, false-bedded, basal conglomerates and gravels with sand and variegated clays increasing upwards. The maximum thickness of the unit is about 350m (Obaje, 2009) although it expected that it is thinner at Bakolori. The area consists of nearly level terrace plateau, which slopes gently in places towards the Sokoto River and its tributaries.

4.2.1.3 Topography

The project site is nearly gentle and undulating, lies at an elevation of 341m above mean sea level. There was no unusual topographic issues from Dam site to tertiary canals except in the 15 000 ha dedicated to sprinkler irrigation which seems to be at higher elevation compared to the gravity fed irrigation system; however due to the slightly varied slope of the canal resulting to sediment transport which will pose no significant impacts to topography if sediment are removed from the drains.

4.2.1.4 Soil

Sandy loam soils (terrace) are dominant on the slopes while the floodplains are dominated by black soils originally laterized, acidic, and with low level of available phosphorus, potassium and nitrogen (caused by high rate of leaching) with clayey texture developed from the river sediments but now because of accumulated effect of agro-chemicals applied Phosphorus and Potassium are now beyond the acceptable limits. Comprehensive soil evaluation is essential for successful management of irrigated areas. Soils found in the project area were observed to be mostly terrace soil and fadama soils, which are suitable for irrigation. The cultural practices and farming activities carried out by farmers in the project area has altered the physico-chemical properties of the soil, which may be due to the inappropriate application of organic and inorganic fertilizer to the soil. Salinity may occur as a result of the following in the project area:

- Salts carried in the irrigation water which are liable to build up in the soil profile,
- Solutes applied to the soil as a result of fertilizers, herbicides, pesticides, etc.,
• Salts already in the soil profile as a result of ground water associated with water logging which is very severe in arid areas,
• Humidity-salinity-bridge when a farmer transfers from rain-fed to irrigation.

Investigations of the topsoil physical and chemical properties are essential to establish the important factors of water retention in the study area. Soil samples in two layers 0-15cm for surface and 15-30cm for sub-surface were taken from several locations across the project area to ascertain the nutrient status of the soil in selected ditches and farmlands. pH, soil colour, organic carbon, exchangeable potassium and sodium, exchangeable calcium and magnesium, available phosphorus, chloride, boron, etc. were determined. FAO and Federal Ministry of Environment standards were employed in the interpretation of the analysis of the study parameters.

4.2.1.5 Geomorphology and Watershed Characteristics

Three physiographic units are found in the basin: the uplands or high plains of the east and southeast; the Sokoto plains of the north and the center; and lastly, the marine lowland of the Niger and lower Rima valley. The high plains are made up of dissected plateau of complex crystalline rock characterized by ranges of hills and massifs, smooth, dome shaped hills (inselberg). This has an average height of 700m.

The Sokoto plains form monotonous lowland derived from softer sedimentary rocks. The Basin is predominantly a gently undulating plain with an average elevation varying from 250 to 400 meters above sea-level (Figure 4.5). The flood plains are wide, sometimes about 8 km apart and they are complex in nature. Low mesas occasionally interrupt this plain. A low escarpment known, as the “Dange Scarp” is the most prominent feature in the basin and it is closely related to the geology of the area.
The Sokoto-Rima River Basin (SRRB) is both a trans-boundary river basin and a part of the Niger Basin. The total area of SRRB is 226,270 km² out of which only 93,129 km² lies in Nigeria. The Gagere, Bunsuru and Goulbin Maradi Rivers, which started within Nigeria, joined together and form the Rima River, which then joins with River Sokoto near Sokoto city. After the junction the name of the river becomes the Sokoto-Rima River. This river joins with the River Niger near Kende in Kebbi district of Kebbi State. The Goulbin Maradi River, though started in the mountains within Nigeria, travels through Niger Republic and joins with the River Rima within the Nigeria border.

The Nigeria Hydrological Services Agency (NIHSA) has divided the country into eight hydrological areas (HA) and the SRRB falls within the HA1 area (Fig 4.6). The outlet of HA1 is the Kainji dam, whereas the SRRB outlet is River Sokoto-Rima confluence with the Niger. The area of HA1 is 135,128km², whereas the area of SRRB is only 93,129 km². The SRRB covers six States: Sokoto, Kebbi, Zamfara, Katsina, Kano and Jigawa amongst which Kano and Jigawa have only a small area within the basin (Figure 4.7).
Figure 4.6: HA1 and SRRB
4.2.1.6 Hydrology

Drainage in the Sokoto-Rima Basin is somehow radial in nature. Main tributaries rise from the south-eastern part of the state and in neighboring Kaduna state. On the basement complex, drainage pattern is dendritic. Drainage density is high on metamorphic rocks. On the basement complex, gradients are steeper; on leaving the Precambrian they develop wide flood plains. On the upper part where deposition is greatest, rivers become wide and shallow. The width of the flood plain bears no relation to the present flow. Their size can be as a result of climatic changes that have taken place in the quaternary era, when the Pleistocene climate was wetter. Only rivers Niger and Rima are perennial. There is little groundwater recharge in the basement complex as rivers on them cease to flow after rainy season. Two hydrological regions are discernible; these are headwater part of the catchment overlying the basement complex and the lower part of the catchment overlying the sedimentary rocks. The upper part forms the headwaters of River Rima. It has a fast, rapid, high drainage density, steep gradient, low infiltration and high runoff coefficient. It also has a fast flood wave compared to the other half where the sedimentary rocks have caused higher infiltration and lower runoff coefficient.
4.2.1.7 Surface Water

Sokoto and Bobo River are the main natural surface water in the project area. Due to siltation over the years of operation of the dam the capacity have depreciated even though it acts only to store water in the reservoir and release water into the irrigation system and Sokoto River. The dam releases water at a rate of between 6 -10 m$^3$ per second to the irrigation canals, while 3 m$^3$ per second is released constantly to Sokoto river.

4.2.1.7.1 Stakeholder water uses, demand and needs

During field visits it was observed that the water meant for irrigation and other agro-related activities was also used for domestic purposes like drinking, washing clothes, washing motorcycles and bicycles; children swim inside the 15Km supply canal; downstream the water is further polluted by the activities of farmers - use of fertilizers, herbicides, pesticides and other farming activities that impact on the properties of the water. Procedures for handling and management of pesticides have been documented in the Pest Management Plan (PMP) for the TRIMING Project. Emphasis will be made from the PMP in addressing pest related issues.

4.2.1.7.2 Degree of siltation of Bakolori Reservoir

In addition to the main natural surface water in the Project Area (the Sokoto River and the Bobo River), there are seasonal tributaries that are found within the BIP, which feed these rivers. The Prefeasibility Studies revealed that the general observations of the soil erosion on the surrounding land and the turbidity of the reservoir water suggests that a significant quantity of silt has been deposited in the reservoir since it was commissioned. However, a bathymetric survey will be required to establish the current bed level.

4.2.1.7.3 Wastewater and drainage issues

In the Bakolori irrigation scheme a common feature is the water logging of farms, which is caused by insufficient drainage capacity in addition to improper water management. Rehabilitation and reconstruction of the drainage systems are needed.

4.2.1.7.4 Flooding and Water Logging

Due to long-term neglect of the drainage system at Bakolori a number of areas are experiencing regular flooding and waterlogging.

Over the years since dam construction, there have been cases of flood usually when the ‘dam gates’ have to be opened to curtail any damage to the dam structure. Lack of desilting of the dam reservoir since it was constructed in the late 1970s has led to the Bakolori Irrigation Project (BIP) management releasing water from time-to-time into farms within the scheme especially during the rainy season. Sediments have accumulated in the main and secondary
canals thus raising the level of water and have led to flooding of adjacent farms. The worst flooded areas are outside the Command area stretching from Bakura through Sokoto to Yelwa Yauri in Kebbi State especially during the rainy season. A period when water is least needed. The recommended solution is to de-silt the canals every year before the commencement of the rainy season.

In-field drains have broken down and the drainage pump stations that are supposed to drain the fields into Sokoto River have been vandalized and are not functional. Consequently many areas have become waterlogged and cannot be used for crop production.

4.2.1.7.5 Potential evapotranspiration and water balance of the project area

Figure 4.8 shows the trends of water balance and evapotranspiration in the project area. The curves for the project area show steep trends corresponding to the absolute dry months of the year. Mean annual actual evapotranspiration is more than 100% of mean annual rainfall.

In the absolute dry months when potential evapotranspiration is higher than actual evapotranspiration (ten months) soil moisture trends show that the project area never reaches full capacity at any time during the year. The length of time and the magnitude of soil water deficiency in the project area increase as mean monthly rainfall decreases. Thus the magnitude and length of the period of soil moisture deficiency at the project area cast a doubt on the effectiveness of the rainfall in recharging the soil even during periods of rains and this suggests less effective soil moisture recharge due to high moisture loss during the drought periods. The proportion of rainfall absorbed and retained at a site depends on the initial wetness of the soil.
One factor critical to the survival and growth of crops is not the mean annual rainfall but the net monthly rainfall. Mean annual rainfall figures ignore the periods of drought, which actually determine crop productivity. The protracted drought and high moisture stress may impose great limitation on arable crop yield in the project area. These facts justify the urgent need for rehabilitation of the irrigation facilities in the project area.

4.2.2  Socio-Economics of the Bakolori Irrigation Scheme Area

This section seeks to describe the existing socio-economic baseline condition of the project area. It encapsulates a spectrum of socioeconomic space including demographics, culture, traditional and formal administration, employment, occupation, literacy and land use. The TRIMING Project has prepared a Resettlement Policy Framework (RPF) to address resettlement, grievance and land related issues.

The baseline data obtained from this section will be relevant in subsequent sections during impact identification, characterization, and projection and in the formulation of mitigation measures.

4.2.2.1 Demographics

A projection of the population statistics of the project area (comprising of Talata Mafara, Bakura and Maradun) for 2013 was made, and is given as follows.

<table>
<thead>
<tr>
<th>Description</th>
<th>Population</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talata Mafara</td>
<td>260,937</td>
<td>130,094</td>
<td>130,842</td>
</tr>
<tr>
<td>Bakura</td>
<td>226,441</td>
<td>111,766</td>
<td>114,674</td>
</tr>
<tr>
<td>Maradun</td>
<td>251,151</td>
<td>128,748</td>
<td>122,404</td>
</tr>
<tr>
<td>Total</td>
<td>738,529</td>
<td>370,608</td>
<td>367,920</td>
</tr>
</tbody>
</table>

The above matrix result shows that the project area has a population of 738,529.

It is also important to state that the ratio of male to female within the project area is closely even. The proportion of males in the project area is 50.2% compared to 49.8% for females. Notably, policy formulation for sustainable development with regard to this project must be such that mainstreams reasonable gender inclusion and participation.

4.2.2.2 Culture and Administration

The cultural practices and belief system of the people of the project area is homogenous and similar across the 14 administrative Councils in the State. Survey for this ESIA reveals that the people of the area are predominantly of the Hausa and Fulani ethnic origins. The “Natu” Fishing Festival is a major cultural festival in the area. It takes place during dry season at
Gamji in Bakura. The Bakolori Dam and irrigation project is a major landscape that attracts tourists and adventurists to the area.

Two methods of socio-cultural and political administration exist in the project area: the local government (legal) administration and the traditional administrative system. The Local Government administrative system derives its powers and process from the Federal and State laws. However, the two systems have been so managed as to be definitive and complementary in roles and hierarchy as shown in the schematic drawing (figure 4.9).

![Administrative Reporting Commands](image)

The schematic administrative reporting line is also instructive for showing the local processes for inter and intra communal and household disputes resolutions over the area.

**4.2.2.3 Land Use/Tenure System in Bakolori (Zamfara State) Project area**

The land tenure systems in both the Bakolori Irrigation Scheme, covering an area 23,000 hectares and that of the greater community in general is of double ancestry. It is of communal as well as Islamic practices. These have later merged with British colonial influences beginning in the early 1900 and have continued to date despite the 1978/79 Nigerian Land Use Act. Land is said to belong to the community, where an individual by being a member of the community is entitled to own a piece of land to cultivate as long as he remains within the community. The farmer loses this right once he leaves the community.
With the advent of Islam in the 19th Century, individual rights to ownership began as the right to inheritance became institutionalized especially along patrilineal lineages. This individualization practice led to the emergence of a number of other rights to land i.e. hire, lease pledges, rent and gift. With the dawn of colonialism and the introduction of cash crops on one hand, and increase in population on the other, land sales began to feature, as commercial agriculture became entrenched. Competition for the best of land became severe, which led to the emergence of a landless class and subsequently led to a wave of rural to urban migration.

It is imperative to state that except in the Government Reservation Areas (GRAs) in the BIP that constitute less than 5% of total land holding within the Bakolori Irrigation Scheme; most if not all other land, is owned by the farmers prior to and after the development of the scheme.

4.2.2.3.1 Land Use and Irrigation Services and Management
Individuals or households own land transferred to them by inheritance. This is the reason why many of the project-affected persons during the construction of the dam reservoir were given land in the Jankarawa area for their land acquired by the project.

4.2.2.3.2 Land Types and Uses in Bakolori Project Areas
Traditionally, three land types are recognized in the Bakolori project area in terms of soil type and uses:

1. **Fadama**: being rich soils subject to seasonal flooding,
2. **Firkin**: being impermeable clay soils subject to water logging and cracking in the dry season (vertisols), and
3. **Fako**: upland, low fertility sandy soils.

While majority of the land use is for agricultural and grazing purposes others are for residential settlements, market places and public reserves for future development uses. A combination of traditional land ownership system and government ownership of land is observed in the area

4.2.2.3.3 Land Rights within the Bakolori Irrigation Scheme
Enplan and Afremede (2013) derived from studies by Mortimore and Wilson (1965), Hill (1972) andGoddard(1972) reveals many land tenure systems in the northern Nigeria, which are skewed towards the broad customary system. These include individual rights to ownership such as inheritance, purchase, hire, lease, pledge, gift and sharecropping.

Basically, there are two tenancy rights within the BIP covering the Command and Jankarawa areas. These are the owner-occupier and the user allocation. Associated with the owner-
occupier are a number of sub-rights such as inheritance (gado), purchase (sayo), pledge (jinga), hire or lease (aro), gift (kyaata) and share cropping (noma mu raba).

- **Inheritance**: This is farmland acquired after the death of a family head by a man or a woman, young or old. Inheritance is usually associated with controversies not so much over size, but the quality of land distributed. Such controversies are common amongst patrilineal relations, as each group will want the best of the farmland such as a fadama. Inheritance more often than not, results in fragmentation. It is estimated that 35% to 45% of all land holdings in the BIP excluding the Government Reservation Area GRA – (<5% of total land in the scheme) where it is completely absent, and up to 72% in the Jankarawa Area, were inherited.

- **Land Purchase**: Under most customary land tenure systems, land belongs to the community and as such members of the community have only a usufructuary right. However, with the advent of colonialism and the commercialization of agriculture, land transactions have emerged especially in cash crop producing areas and along river valleys where year round cropping is possible. Outside these areas, population pressure has led to land sales and purchases. Field studies show that land purchased account for about 34% outside the GRA, about 15% in the Jankarawa Area, and 97% within the GRA. There are strong indications to suggest that purchases are gradually increasing especially in the Command Area. On the other hand, it does not appear there would be any significant changes at the Jankarawa area in view of the expectation that the land would be developed. Most farmers are cautious not to dispose-off their land.

- **Hire**: In the BIP, hire refers to exchange of money for land but for a very short duration not exceeding one cropping season. Other variants of this type of land ownership include, pledge where land is given out in exchange of money and if the debtor is not able to pay back the amount collected, the creditor will continue to use the land until he or she is paid the amount pledged. Lease is similar to hire except that the person interested in using the land initiates the deal. These forms of land tenure account for 26% of all land owned outside the GRA and about 97% within the GRA except that in the latter area, the deal is between the prospective farmer and the management of the BIP. In the former case however, it is between the land owner and the prospective farmer. In the Jankarawa area, it was estimated that about 15% of farmland fall under these categories. The relatively small number is because land owners are anticipating development and as such farmers will rather go for hire, rent, pledge or lease rather than outright sale.

- **Gift**: This is a tenure system where the farmer transfers his rights of a portion or a whole of his farmland to a member of his family: son, daughter, any of his relations or a friend at no cost. Gifts have no time frame within which the land is expected to be returned. Gifts are not practiced in the GRA and less than 1.0% of farmers reported it. In the main Command Area however, a recent estimate shows that only...
about 5.0% of farmers gave out their land as gift. Total farmland given out as gift ranges from 4.5 to 6.3 % of the total farmland in the BIP. Most instances of gift were to female relations; wives, daughters, sisters and mothers.

- **Share Cropping:** This is a tenure arrangement between one or more farmers of different economic status coming together to cultivate a piece of land. A poor farmer with a piece of land but lacks the resource to hire labour and acquire the required inputs, could go into a farming arrangement with a well-to-do farmer. The poor farmer puts in his labour and supervises all farm work right from land preparation, planting, weeding to harvesting. In addition, the poor farmer keeps vigil over the farm from especially theft and pests (especially quella birds) given his proximity to the farm. A sharing formula based on percentage of total harvest is agreed at the initial stage of the deal. Field data collected during the preparation of this ESIA reveal no instances of share cropping in both the GRA and Jankarawa areas. Only about 2.5% of farmers were involved in this practice in the other parts of the scheme.

- **Absentee Farmers:** Field surveys of not only irrigation agriculture but also upland farms reveal a growing incidence of absentee farmers going into agriculture. Absentee farmers are of two types: relations of rural farmers resident in urban areas and retired and serving civil servants, technocrats, military personnel and most recently politicians who are not indigenes of the area. These are people with the resources and political connections to acquire large farmland, invest all that are needed in terms of labour and inputs and end up with better output per hectare compared to majority of farmers in the area. Almost all the farmers in the GRA belong to this category and about 21% of all farm holdings outside the GRA but within the Command area are owned by absentee farmers. Such farmers own some 2% of farmlands within the Jankarawa area. The figure could have been much higher if not for the reluctance of the people in the Jankarawa area to dispose of their farms in anticipation that the area will be developed just like the BIP. Outside the BIP, absentee farmers have not made any structural investments. The reason is that they only have an usufructuary right which is renewed seasonally or at most annually. As revealed by BIP management, absentee farmers have been soliciting that the land be sold to them to enable them invest in not just inputs, but also, infrastructures i.e. service roads, farm-houses and to introduce commercial livestock farming on some parts of their plots. In areas where these absentee farmers have acquired large farmland of about 15 to 20 hectares, they show seriousness or high level of commitment in participating in commercial agriculture. Some have proposals for industries such as rice milling, flour milling, Land Ownership in Bakolori Irrigation Scheme

In line with the discussion on land tenure above, land in the scheme is partly owned by households through inheritance (owner occupied) and partly by government (Bakolori...
Project). Individuals or households own land transferred to them by inheritance. In the BIP owner occupier accounts for about 95% of the 26,000 ha of irrigable land while about 5% is under a user allocation system on what is referred to as Government Reservation Area (GRA).

### 4.2.2.3.4 Land holding

Survey conducted in the project area as shown in Figure 4.10 below supports previous one undertaken by Enplan (2013) and shows that the project area is characterized largely by small land holding structure.

![Figure 4.10 Trend in Landholding Structure (in hectare) in the Project Area](image)

Figure 4.10 reveals that landholding is less in the command area compared to outside the command area and that few commercial investors exist in the project area. About 55 percent of farmers hold between 1-5 hectares of land in the command area as against 40 percent that hold between 6-10 hectares. Also, the survey shows that no farmer holds up to 11 hectares of land. Outside the command area however, landholding trend is about 70 percent of the people holding 1-5 hectares, about 20 percent holding 6-10 hectares and 10 percent for 11-15 hectares. Albeit, small land holding (1-5 hectares) is predominant in the project area, it was informed that cost of land (rent) is higher in the command area than in Jankarawa and other undeveloped areas because of the availability of irrigable water in the command area which supports dry season farming.

### 4.2.2.3.5 Land value

Cost of land in the Jankarawa and other non-irrigable area is as low as ₦4,000 to ₦6,000 Per hectare.
The annual cost for land lease per hectare in the command area is N17,000 (about $107). The Bakolori Irrigation Scheme charges N22,500 ($140) per annum per hectare to cover irrigation services (water charges). The Bakolori Irrigation Scheme also renders extension services to farmers on lands not belonging to the project for an annual service charge of N5,000 ($30) per hectare.

4.2.2.3.6 Land Documentation
This is one item missing within the BIP. Except for the initial air photomaps given to individual farmers in the early 1980’s when farmlands were developed and returned to their owners, there are no documents to show changes in land ownership over a period of 30 years. Many initial allocations changed hands; many have been sub-divided into several small plots, with some as small as 0.1 ha and there are a few instances of land consolidation not recorded. Furthermore, the various tenure rights discussed above have neither been monitored nor documented especially outside the GRA. Proper land documentation is no doubt required for effective monitoring and subsequent development of the entire Command area and in the proposed Jankarawa area.

4.2.2.3.7 Land Disputes
Disputes in the BIP are of three types. (i) Land ownership, (ii) Water usage, and (iii) Farmer-herders.

Land ownership disputes are more of intra i.e. between members of the same family and are mostly along matrilineral divide. It is usually over the allocation of ‘juicy’ farmlands not so much about the proportion shared, as the Sharia Law, which is strictly practiced in the area, is clear about this. Disputes over land ownership accounts for only about 13-15% of all reported cases.

Disputes over water usage arise in instances of damages to water canals thus affecting steady flow and where there is evidence of wastage thus limiting access for other water users. This type accounts for about 33% of all reported disputes. The most serious disputes are those between farmers and herders - especially where farmers have encroached on herders’ routes or refuse grazing on fields already harvested. Farmer-herder conflicts account for about 50% of all reported disputes.

There were few cases of disputes reported in the Jankarawa area as it is yet to be developed. Disputes were more in the GRA, which initially was a “no man’s” land where herders were able to graze freely but have now been completely denied access.

In summary, most disputes are intra-family and over water usage. Except for farmers-herders disputes that are often volatile sometimes resulting in loss of lives and the destruction of properties (five of such cases in the last 20 years), most other forms of
disputes were settled by family members and community heads. Less than 5% were resolved in courts and these were those between farmers and herders.

4.2.2.3.8 Procedure for Allocating Land within the Scheme

There are two methods through which lands were or are allocated in the BIP. In the GRA, a prospective farmer files in an application to the management of the BIP indicating the number of hectares he or she is interested in and based on total demand and land available, an applicant is allocated some hectares. The applicant pays the prescribed amount of N12,500 per hectare plus water charges of N5,000 per hectare per season totaling N17,500 per season. Outside the GRA, the farmers had already been reallocated their initial land, less 5% taken for infrastructure and services. Under this system, farmers are not charged any amount except a flat rate of N5,000 per season as water charges. The unofficial rates for land in the GRA could be up to and above 400% per season excluding water charges.

In addition to the 1980s disputes when farmers lost a season and were about to lose another season, there have been no reported cases of disputes between farmers and BIP management over land allocation. It is only in the Jankarawa area that farmers are still aggrieved because the sprinkler irrigation system broke down after a short-while of their installation; this, after their original farmlands were submerged by the dam reservoirs and being moved to the Jankarawa area. In the new area (Jankarawa) were they are resettled, they complain that the land is not suitable (fako) both in terms of soil texture and land configuration. It is only by providing irrigation facilities that these farmers’ ill-feelings towards the whole irrigation scheme can be assuaged.

There exists no communal landholding anymore in the BIP area. All land either belongs to individuals who owned them by inheritance or by resettlement and government who acquired part of the land (command area) for the Bakolori irrigation scheme.

4.2.2.3.9 Incidence of Landlessness

Within the BIP excluding the Jankarawa area, there is no incidence of landlessness. Farmers have tried at all cost to at least have 0.1-0.3 Ha on which they cultivate. Some have given out portions of their initial allocation as rent, hire, lease among others. The big question is whether what they now cultivate, plus the proceeds from other land transactions are enough for their sustenance. This is an area that requires a full study by an agricultural economist.

In the Jankarawa area, there are a large number of people without land for no fault of theirs, but by the initial project implementation mechanisms, which did not make adequate compensations, or alternative land for them. The most vulnerable among the Jankarawa people are the small farm holders and women. Others such as the well-to-do and traditional rulers have ended up with land in the Command Area either through purchase or allocation by the BIP authorities for their support especially during the 1980 crisis when they had clashes with the Federal Government authorities.
4.2.2.4 Agriculture

The construction work of the project started on the 5th June 1975 and was completed on the 9th of April 1993; though suffering from years of neglect and lack of maintenance, which has led to a failed dyke close to G-Rice area, and the silting of the drainage ditches across the gravity fed areas. Bringing more land under irrigated agriculture will contribute to improving the sustainable food security of Nigeria. The construction of the Bakolori Irrigation Scheme contributed to the significant increases in irrigated hectares for crop farming, livestock and of recent fish farming within the project area. The impacts on farmers even with the shortcoming of the project are overwhelmingly beneficial especially due to the gravity fed irrigation system. However, social tension between livestock farmers and crop farmers is gradually becoming a consistent trend, which has generated countless number of conflicts and court cases.

4.2.2.4.1 Agronomy and Patterns

Rain-fed agriculture is being practiced in the section originally developed for sprinkler irrigation system and during the dry season some sections of the secondary channel is destroy intentionally by farmers to convey water to their farms; also as a result of siltation of drainage ditches over the years without maintenance, the drainage ditches have been converted by farmers for growing crops in the surface irrigated area.

Rice is the major crop grown mostly in the fadama area; about seven varieties are available to farmers. Rice cropping is achieved by transplanting (after raising a nursery) and/or by laying seeds directly on designated holes with respect to farmers discretion; the farmers reported that transplanting rice is more economical and reliable. 0.5ha when managed with their traditional way of farming could generate 35-40 bags of rice. However, crop density is not considered by farmers in the project area (that is row-row and plant-plant spacing) for optimum performance; the farmers have little knowledge of appropriate fertilizers for particular crops and soil types and application of recommended doses of fertilizers at the proper stage of cropping is not followed by farmers; they however, complain of the scarcity of fertilizer when it is most needed and if available may be beyond their reach because of economic hardship. Quella birds, rodents and insects constantly pose great threats to crops and farmers spend a lot of valuable time and in some cases are forced to withdraw their kids from schools to pursue quella birds away from the farms; it was gathered that at the early stage of the project the government used to conduct aerial spraying of the farms with insecticides and bird repellants, but unfortunately, this is rarely done now.

Other commonly grown crops are maize, cowpea, sweet potato, groundnut, wheat, vegetables and sugar cane during the dry season while during the wet season millet, guinea corn, cowpea, groundnut, rice, cassava, vegetables and sweet potatoes are grown. The yield per hectare of some of the crops grown in the project area is as follows: Rice 5.7ton/ha,
Maize 2ton/ha, Cowpea 1.2ton/ha. Sweet-potato 18ton/ha Ground nut 1ton/ha, wheat 2tons/ha, vegetables 45ton/ha and sugar cane 100 ton/ha.

4.2.2.4.2 Constraints to Agricultural optimization in Bakolori Irrigation Scheme

The main constraints to the optimization of agriculture in the Irrigation Scheme include:

- Lack of irrigation in area dependent on rain fed crop production.
- Poor drainage and waterlogging of the farms.
- Shortage of farm machinery.
- Poor storage and processing facilities.
- Lack of market.
- Unreliable supply of irrigation water for some section of the existing irrigation network.
- Incidence of Pest and disease.

4.2.2.5 Farmers/Water Users Association (WUA)

Field visit revealed that most farmers in the BIP are members of the Water Users Association (WUA). The WUA is registered with the Corporate Affairs Commission in Abuja. The subsidiary groups under the apex umbrella are registered under section 5 of the Nigerian Cooperative Societies Act and Regulations No 90 of 1993 with Zamfara State Ministry of Commerce, Industry and Cooperatives. According to the byelaws, the aim of the WUA is to raise the level of agricultural productivity, farm economy, employment and income of members and act as growth center in the area of its operations.

The primary objective of the WUA is to help sustain the BIP by providing a range of services to the farmers; however, the range of services is not entirely clear. Some of the objectives of the WUA are to undertake the following functions:

- Identify farmers interested in irrigation farming within Bakolori Irrigation Project
- Serve as a single contact point for services within the project.
- Assist in collection of land lease charges, water rates and other services and remittance of the funds to the BIPO.
- Mobilization of members for community works and maintenance of irrigation infrastructure such as tertiary canals, drains, farm roads, culverts and storage facilities.
- Organization and mobilization of farmers during fertilizer distribution and sales.
- Ensure the sustainable use of project water resources.

From further questionings it was evident that the WUAs’ management presently carries out only the following functions and responsibilities:
• Organization and mobilization of farmers during fertilizer distribution and sales.
• Mobilization of members for community work on the tertiary irrigation facilities especially in relation to de-silting.
• Ensuring sustainable use of project water resources.
• Collection of water charges for land leases, water rates and other services and remittance of funds to the project office.

A membership fee of ₦20 is charged to join the association, followed by monthly fees of ₦50. When asked to comment on the proposed rehabilitation works to be carried out on the project all of those interviewed were happy and enthusiastic about it and that it was very important; in general, most stated that the rehabilitation of the dyke in the G-Rice area was the most important task that needs to be carried out.

4.2.2.5.1 Existing Water User Associations in Bakolori Irrigation Scheme

The three Water Users Associations that exist within the 3 local government areas are:
1) Dan Kadu-Daji Group Water Users Association, Talata Mafara
2) L20 Group Water Users Association, Maradun, and,
3) Yar Kofogi Water Users Association, Bakura.

4.2.2.6 Livestock Headers

This is an uncoordinated and unregistered body in the area. There appears to be a plan to have a formal registered association in the near future. Livestock herders were interviewed in the field; there is a distinction between two types of herders that should be made. First there are herders who manage cattle within the irrigation system for other cattle owners (Farmers owning livestock), then there are the Fulani, nomadic cattle herders who do not have any affiliation with the BIP; they graze their cattle outside of the irrigation system during the wet season and then move into the BIP during the dry season due to the availability of water there. The cattle farmers use the drainage ditches as grazing areas. When informed of the intention to rehabilitate the drainage ditches they commented that this might disrupt the cattle grazing patterns.

During the consultation forum involving the farmers, herders, BIP and WUA, it was agreed that there is a need to establish a committee of farmers and herders to regulate the activities of the parties and ensure compliance to agreed terms in the common interest of all parties.

4.3 Baseline Data

Baseline data were acquired during field trips made to the project area and associated communities.
4.3.1 Sampling Design & Studies

A total of Twenty-seven (27) air quality-sampling points were established within defined sections in the project area.

Seven (7) soil-sampling points were selected. Two (2) samples (topsoil and sub-soil) were taken at each point. The list of sampling points and their GPS coordinates are presented in Table 4.1.

Surface water samples were collected from different locations within the irrigation canals, reservoirs and pumping stations located within the project area. A total of Fourteen (14) surface water samples were collected from the points.

Groundwater samples were collected from boreholes in different locations within the project area. A total of Three (3) groundwater samples were collected.

Flora and fauna studies were also conducted.
### Table 4.1 GPS Coordinates for Sample Collection Points

<table>
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<tr>
<th>COORDINATES</th>
<th>NAME</th>
<th>SOIL/ SEDIMENT SAMPLE</th>
<th>SURFACE WATER</th>
<th>GROUND WATER</th>
<th>AIR/NOISE SAMPLING</th>
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<td>SS5 &amp; SS6</td>
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<td>AQ7</td>
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<td>SS8</td>
<td>SW4, SWT1</td>
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<td>AQ9</td>
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</table>
ESIA Report for the Bakolori Irrigation Scheme

N12.59164  E06.08656  Main Canal 15km  SS9  SW5  AQ10
N12.60731  E06.09316  Pipe Bridge-Cross Regulator  AQ11
N12.59463  E06.08423  Irrigation Canal left  SS11  AQ12

Key

SS – Soil sample
SW - Surface Water
AQ - Air Quality
GW - Ground Water
SWT – Surface Water at turbulence
SD - Soil Sediment
Figure 4.11 Map showing Air/Noise Level sample points
4.3.1.1 Soil Sample Collection

Soil samples were collected within pumping and lifting stations, and from the irrigation areas. Samples were collected using a manual soil auger. Surface soil samples were collected within a soil depth of 0-15cm; while sub-soil samples were collected within a soil depth of 15-30cm. Samples for physico-chemical analysis were collected into coded plastic bags after being wrapped in aluminium foil. Soil samples were placed into containers made of high UV (Ultra Violet) resistant material. A total of fourteen (14) soil samples were collected comprising topsoil (7 samples) and sub-soil (7 samples).

4.3.1.2 Surface Water Sample Collection

Water samples were collected using sterile 100ml bijou bottles (made of high UV resistant material). Fast changing physico-chemical parameters such as Temperature, pH, DO, Conductivity and TDS were measured in-situ using an in-situ water analyser. Samples for heavy metals and BTEX studies were preserved with nitric acid (HNO₃). Samples for physico-chemical studies were stored in cooler boxes with ice and later transferred to the laboratory and preserved in refrigerators at 4°C prior to analyses. A total of sixteen (16) surface water samples were collected for laboratory analyses of various parameters. Hanna HI 991300 PH/EC/TDS Meter was used for water sample analysis (In-situ).

4.3.1.3 Air Quality Sample Collection

Air samples were collected using a Testo 350 XL. Measurements were taken at different locations around the project area with their geographical coordinates noted.

4.3.1.4 Noise Level Measurement

Noise levels were measured using a Testo 815 Noise meter. Noise samples were collected at the same locations as the above-mentioned parameters.
4.3.1.5 Groundwater Studies

Groundwater samples were collected from Three (3) boreholes in the project areas. The water samples were collected in new sterile plastic bottles. After each collection the bottle lids were replaced immediately to avoid oxygen enrichment. The samples were stored in an ice-packed cooler and transported to base for refrigeration then later transferred to the laboratory for analysis within 24hrs.

These boreholes could also serve as monitoring boreholes during the ESMP Implementation.

4.3.1.6 Fauna Studies

The animal life studies concentrated on the identification of the species of existing domestic and wild animal life in the study areas. A systematic random sampling approach was adopted to select on-site domestic animals and these were physically examined.

Two methods were adopted to assess the fauna resources of the area;

1. An Extensive literature search was conducted on the fauna and conservation activities of the locations to obtain background information.

2. Field observations and oral guided interviews were conducted on natives and residents within and around the project area (domestic and wild).

The sampling stations used were designed to coincide with those of the vegetation study. A species classification matrix was designed to impute relevant fauna data. Identified and existing animal species in the project area were grouped as domestic and wild and documented according to taxonomical classifications.
4.3.1.7 Vegetation Studies

Vegetation studies were carried out in order to understand the existing nature of the vegetation and crops, including the species composition, diversity and population of plant species as well as pathology.

Sampling for vegetation was done as follows:

- Sampling stations were erected based on transects and quadrant systems within the field. At each sampling point, transects of 100m in four directions: East – West, North – South were used to demarcate the project area coverage for the assessment of the vegetation.
- Visual assessment was used to determine the health status of the vegetation.
- Sample collections were made at every 20m intervals. In each quadrant, all plants within each species were carefully counted and recorded against the name of the specie (where it was identified on the spot) or a coded name indicating also the quadrant and site of occurrence. The Raunkaerian classification of the vegetation was also employed for this vegetation study.
- Species that could not be immediately identified in the field were collected in polythene bags and later determined at selected herbarium of choice using aids such as the Flora of Tropical Africa.
- Other parameters such as abundance, height and diversity were also appropriately assessed.

4.3.1.8 Socio-economic Studies

The following approaches were undertaken:

- Description and review of the existing baseline socio-economic variables and conditions in the project area. These include the variables enlisted in the ToR for examination under socio-economics;
- Consultation with stakeholders within the project area. This includes the communities, farmers, Water Users Associations, Women, Vulnerable people (disable groups), project office, potential investors and institutions;
- Primary data and techniques for data acquisition and analysis- attention is given to scientific determination of sampling population, sampling technique, instrument for data collection and analysis as well as assessment of captured data (primary data) from the field.

Detailed consultation with stakeholders is presented in Chapter 8 of this report, while socioeconomic baseline description and presentation of technique for data acquisition and analysis are presented in section 4.9.
### Table 4.2 Noise Levels and Air Quality Data

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<th>Parameter</th>
<th>Admin</th>
<th>SS1</th>
<th>SS2</th>
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<th>SS7</th>
<th>New Maradun</th>
<th>M/C 7Km</th>
<th>M/C 15Km</th>
<th>M/C 12Km</th>
<th>Pipe/Reg</th>
<th>H2C/Left</th>
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Bakolori Irrigation/dam Project, Zamfara State.

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Map Showing Surface Water Sample Points

**Legend**
- Surface Water Sample
- Piezometric Towers
- Drainage Station
- Pumping Station
- Major Road
- Minor Roads
- Bridge
- Dam
- Mains Canals
- Secondary Roads
- Built Up Areas
- Water Body
- Surface Irrigation
- Rice Surface Irrigation
- Sprinkler Irrigation
- Wet Land
- Farm Land

*Figure 4.12 Map Showing Surface Water and Ground Water Sample Points*
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Hospitalia Consultaire
2, Masaka Close, Off Olusegun Obasanjo Way, Zone 7, Abuja, FCT, Nigeria;
www.hospitaliaconsultaire.com
The following sections provide in-situ and laboratory analysis for air, noise, surface water, groundwater and soil samples. Due to the large number of samples analyzed for water, the graphs were split into physico-chemical, heavy metals, other physico-chemicals, and water hardness.

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Figure 4.13 Physico-chemical analysis from Surface Water

FME Limit
Temp. <40
pH: 6-9
Dissolved Oxygen: 7.5
Conductivity: 1000
Salinity: 0.1
Turbidity: 100
Total Dissolved Solid: 1000
Figure 4.14: Heavy metals analyzed from Surface water
Figure 4.15 Other Physicochemical analysis from Surface water

- **NITRATE**
- **SULPHATE**
- **PHOSPHATE**
- **AMMONIUM**
- **POTASSEIUM**
- **SODIUM**
- **CHLORIDE**

FME Limits:
- Nitrate: 20
- Sulphate: 500
- Phosphate: 5
- Ammonium: <1
- Potassium: <1
- Sodium: 200
- Chloride: 250
Figure 4.16 Analysis of surface water hardness

FME Limits
Total Hardness: 200
Calcium: 150
Magnesium: 50
Carbonates: 200
Bicarbonate: 200
Table 4.4 Result of Groundwater analyses

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<td>Feacal Coliform/100ml</td>
<td>3 X 10²</td>
<td>1.1 X 10²</td>
<td>1.2 X 10²</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.4 Discussion of Results of Water Quality Analysis

Temperature
The temperatures of all the sampling locations were all within the FMEnv range.

PH
The normal range of pH for use in irrigation water is 6.5 to 8.4. A pH value above or below this is a warning than an abnormal situation exists and needs either further evaluation or immediate remedial measures. The pH ranged from 6.04 – 7.44 for the surface and 6.26 – 6.97 for the groundwater.

Dissolved Oxygen (DO)
Dissolved oxygen is the oxygen molecule present in water. Very low levels ranging from 0-2mg/l do not support life (aquatic flora and fauna); however, studies show that aquatic organisms survive in a DO range of 2-4mg. The samples collected had a range from 2.6mg/l – 3.6mg/l.

Turbidity
Turbidity is a measure of water clarity and an indicator of the quantity of suspended solids in the water. Turbidity is the scattering and adsorption of light within water, caused mainly by suspended sediment, dissolved organic matter and plankton. Anthropogenic activities and natural occurrences (such as rainfall) can lead to the suspension of sediments, which increases
turbidity levels. Clay, silt and other sediment end up in the reservoir and canals after rainstorm events. The measured turbidity value for the surface water ranged from 8.0 to 94 NTU and 0.2 to 0.3 NTU for groundwater. It should be noted that turbidity for the surface is very high, almost at the FMEnv permissible boundary limit of 100NTU. The turbidity levels in Irrigation Left (SW6) were quite high, about 94 NTU. However, the groundwater value is below the WHO permissible limit of 5 NTU for drinking water.

**Conductivity**

The high level of conductivity values of the waters is a reflection of the chemical richness of the water body of the study areas. The conductivity values of the underground water samples were high; however, they were not above the FMEnv limits. This may be attributed to the mineral richness of the substratum of the project area and Zamfara State at large. The conductivity values of the surface water body ranged from 62μS/cm – 195μS/cm. The highest level was recorded at the Bakolori Mono Pump (GW21).

**Salinity**

The salinity values were low and within range in all the sampling points for surface water, however, the values were high for groundwater. The salinity levels of the groundwater levels ranged from 0.2 – 0.3%.

**Colour**

The sample points that had the highest values for colour were MC 15KM (SW5) and I/L (SW6); this can be attributed to the human activities ongoing in the canal during field visit as people were seen bathing in the canal, washing clothes and motorcycles and even collecting water for other domestic uses. The values were 66 and 68 TCU respectively though within the 100TCU limits prescribed by FMEnv the values for the groundwater were all within limits.

**Total Dissolved Solids (TDS)**

The Total Dissolved Solids (TDS) content is a measure of turbidity and general polluting potentials in water. It is an index of the amount of dissolved substances in water. The TDS concentration of both the surface and groundwater were found to be below the FMEnv limit of 1,000mg/l. A TDS concentration over the recommended limit of 1,000mg/l may cause gastrointestinal problems in humans and animals. Dissolved solids in water may include organic matter and inorganic salts, calcium and magnesium carbonates, bicarbonates, chlorides, sulphates, with traces of iron, manganese and other substances. If TDS concentrations are high, it is wise to have further tests to determine specific contaminants.

**Nitrate, Sulphate, Phosphate and Iron**

These parameters were found within limits prescribed by the FMEnv for groundwater. However, they varied for surface water.

**Nitrate**: Concentration of Nitrate is within the acceptable limit for all samples collected except the Nitrate level (99.5mg/l) for SW 19 at (MS-11) which is above the permissible level (20 mg/l) as shown in Table 4.3a. The MS-11 was flooded as a result of blockage of the drainage and canals. Numerous domestic activities were seen ongoing in the area during field observation.
This may have attributed to the high level of nitrate in the area. Nitrates can encourage the growth of algal blooms and aquatic weeds.

The levels for Iron were high for the surface water samples and ranged from 0.92-1.86 (FMEnv limit is 1.5 mg/l). The highest value was observed in SW4 (Main Canal-12). The iron concentration in Irrigation Left (SW6) and FS 10-1 (SW7) were beyond the permissible level which may be due to the fact that members of the community use the water from the canal to wash their motorcycles and bicycle, also some throw metallic objects into the channel; it is therefore recommended that the channel should be cleaned and protected from being used by constructing a barricade to prevent members of the community from encroaching.

The levels for Phosphate and Potassium were mostly above the FMEnv limits. The elevated levels of these parameters may be attributed to the cumulative residual application of wrong dosages of agrochemicals and level of use of pesticides in farmlands during crop production over the last 30 years, which drained into the ditches. Runoff from fertilizer could have also infiltrated the water body.

The level for phosphorus is within FMEnv limit. Phosphorous can encourage the growth of algal blooms and aquatic weeds. This has to be monitored closely to avoid eutrophication.

**Calcium and Magnesium**

Ca$^{2+}$ and Mg$^{2+}$ ions in high concentrations cause water hardness. Their levels were all within limit for all the surface water samples. However, they were extremely highly for GW 1 and Bakolori Mono Pump groundwater samples. The most common source of calcium and magnesium in groundwater is through the erosion of rocks, such as limestone and dolomite, and minerals, such as calcite and magnetite. This can be attributed to the presence of minerals in the State. Calcium salts can form white encrustation of lime on irrigation equipment.

**Bicarbonates and Carbonates**

The bicarbonate and carbonates levels were within limits. High bicarbonates and carbonates in water can cause calcium to precipitate.

**Sodium and Chloride**

The values for sodium and chloride for both the surface and ground water levels were within FMEnv limits.

**Biochemical Oxygen Demand, (BOD$_5$)**

Biochemical Oxygen Demand is a measure of the amount of oxygen utilized during a specific incubation (usually for 5 days) for the biochemical degradation of organic materials and also the oxygen utilized to oxidize inorganic material such as sulphate and ferrous ion. The BOD$_5$ values for the surface water were all within the FMEnv range of 30mg/l. The groundwater samples ranged from 0.1-0.3mg/l and were also within range.
**Chemical Oxygen Demand (COD)**

The COD measures the amount of organic compounds present in a water sample. The COD values of the surface water were very high ranging from 53 – 93 mg/l at the surface. This can be attributed to the increase in human activities such as washing, and possible movement of fertilizer into the water. It was within range for groundwater.

**Microorganisms**

The types and number of microorganisms present determine the quality of drinking water. Water is considered bacteriologically potable if it does not contain any pathogenic microorganism. Pathogenic organisms get into the water through contamination by sewage or human and animal excretion. Coliform bacteria are the indicator organisms most commonly used to determine the purity of water. The coliform group of bacteria that were present in the water samples include *Escherichia coli*, *Enterobacter*, *(Salmonella, Shigella)*, and *Enterobacter aerogenes (Enterococcus)* They are facultative aerobic, gram-negative, non-sporing, rod shaped bacteria that ferment lactose with gas formation within 48 hours at 35 °C. Incidentally, the coliforms include a wide range of bacteria whose primary source may not be the intestinal tract. The coliform group particularly *Escherichia coli* are most commonly used as indicators of fecal pollution. The presence of enteric bacteria among the species list suggest that the area is used for human or livestock fecal disposal. Such water requires conventional methods of treatment before drinking.

Feecal microbes like cholera, hepatitis, and *Salmonella spp.* enter water supply through untreated wastewater. These are derived from the intestine of warm-blooded animals, which can grow at the more restrictive temperature of 44.5°C. The presence of feecal pollution indicator organisms (*Escherichia coli* and *Streptococcus spp.*) in surface water samples analyzed suggests recent feecal pollution. This can further give rise to typhoid, dysentery when consumed by man.
<table>
<thead>
<tr>
<th>S/N</th>
<th>PARAMETERS (units in mg/kg)</th>
<th>I/L SS10 (0-15cm)</th>
<th>I/L SS11 (0-15cm)</th>
<th>M/C 15KM SS9 (0-15cm)</th>
<th>M/C 15KM SS9 (15-30cm)</th>
<th>GIS 30 SS21 (0-15cm)</th>
<th>GIS 30 SS21 (15-30cm)</th>
<th>KM 12 SS9 (0-15cm)</th>
<th>KM 12 SS9 (15-30cm)</th>
<th>SS1 ADU SS2 (0-15cm)</th>
<th>JAS SS2 (0-15cm)</th>
<th>JAS SS2 (15-30cm)</th>
<th>SSD1 FME LIMIT</th>
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<td>1</td>
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<td>27.3</td>
<td>27.3</td>
<td>27.4</td>
<td>27.5</td>
<td>27.4</td>
<td>27.2</td>
<td>27.3</td>
<td>27.2</td>
<td>27.4</td>
<td>27.6</td>
<td>27.3 &lt;40</td>
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<tr>
<td>2</td>
<td>pH</td>
<td>5.7</td>
<td>5.5</td>
<td>5.5</td>
<td>5.6</td>
<td>6.3</td>
<td>5.8</td>
<td>5.7</td>
<td>5.6</td>
<td>5.5</td>
<td>5.6</td>
<td>5.6</td>
<td>5.5 6.2</td>
</tr>
<tr>
<td>3</td>
<td>CONDUCTIVITY (µS/cm)</td>
<td>19</td>
<td>6</td>
<td>17</td>
<td>8</td>
<td>37</td>
<td>36</td>
<td>22</td>
<td>10</td>
<td>3</td>
<td>8</td>
<td>36</td>
<td>24 9</td>
</tr>
<tr>
<td>4</td>
<td>SULPHATE</td>
<td>55.1</td>
<td>20.4</td>
<td>18.1</td>
<td>23.3</td>
<td>23.5</td>
<td>24.4</td>
<td>94.4</td>
<td>34.1</td>
<td>17.7</td>
<td>14.4</td>
<td>18.1</td>
<td>18.4 14.2 500</td>
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<td>5</td>
<td>CHLORIDE</td>
<td>5.49</td>
<td>40.8</td>
<td>11.4</td>
<td>15</td>
<td>1.2</td>
<td>1.32</td>
<td>13.13</td>
<td>2.61</td>
<td>11.7</td>
<td>7.3</td>
<td>9.7</td>
<td>10.8 6.8 254.3</td>
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<tr>
<td>6</td>
<td>PHOSPHORUS</td>
<td>0.4</td>
<td>0.6</td>
<td>0.7</td>
<td>1.0</td>
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<td>0.6</td>
<td>0.5</td>
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<td>0.5</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5 0.1</td>
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<tr>
<td>7</td>
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<td>2.8</td>
<td>3.2</td>
<td>0.7</td>
<td>1.3</td>
<td>1.0</td>
<td>0.96</td>
<td>4.62</td>
<td>1.57</td>
<td>0.56</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5 8.32 20</td>
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<tr>
<td>8</td>
<td>CYANIDE</td>
<td>0.11</td>
<td>0.422</td>
<td>0.039</td>
<td>0.045</td>
<td>0.043</td>
<td>0.048</td>
<td>0.163</td>
<td>0.063</td>
<td>0.038</td>
<td>0.044</td>
<td>0.031</td>
<td>0.036 0.027 0.091</td>
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<tr>
<td>9</td>
<td>CHROMIUM</td>
<td>0.048</td>
<td>0.07</td>
<td>0.071</td>
<td>0.086</td>
<td>0.084</td>
<td>0.096</td>
<td>0.035</td>
<td>0.042</td>
<td>0.07</td>
<td>0.071</td>
<td>0.048</td>
<td>0.062 0.041 0.042</td>
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<tr>
<td>10</td>
<td>IRON</td>
<td>0.183</td>
<td>0.165</td>
<td>0.197</td>
<td>0.123</td>
<td>0.126</td>
<td>0.151</td>
<td>0.122</td>
<td>0.106</td>
<td>0.192</td>
<td>0.16</td>
<td>0.156</td>
<td>0.18 0.142 1.196</td>
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<tr>
<td>11</td>
<td>COPPER</td>
<td>0.72</td>
<td>0.28</td>
<td>0.21</td>
<td>0.25</td>
<td>0.24</td>
<td>0.31</td>
<td>0.18</td>
<td>0.39</td>
<td>0.19</td>
<td>0.35</td>
<td>0.18</td>
<td>0.13 0.18 0.9</td>
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<tr>
<td>12</td>
<td>TOTAL</td>
<td>0.5</td>
<td>2.1</td>
<td>9.6</td>
<td>12.7</td>
<td>13.7</td>
<td>14.2</td>
<td>21.9</td>
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<td>6.1</td>
<td>9.7</td>
<td>9.7</td>
<td>6.3 1.42 &lt;1</td>
</tr>
<tr>
<td>16</td>
<td>SODIUM</td>
<td>1.3</td>
<td>1.8</td>
<td>2.4</td>
<td>1.3</td>
<td>1.0</td>
<td>1.3</td>
<td>1.2</td>
<td>1.6</td>
<td>1.7</td>
<td>1.8</td>
<td>1.9</td>
<td>1.2 1.5 1.7</td>
</tr>
<tr>
<td>17</td>
<td>POTASSIUM</td>
<td>0.051</td>
<td>0.071</td>
<td>0.019</td>
<td>0.045</td>
<td>0.054</td>
<td>0.068</td>
<td>0.041</td>
<td>0.061</td>
<td>0.113</td>
<td>0.068</td>
<td>0.099</td>
<td>0.11 0.069 1.18</td>
</tr>
<tr>
<td>18</td>
<td>CADMIUM</td>
<td>1.8</td>
<td>1.9</td>
<td>1.6</td>
<td>1.5</td>
<td>1.3</td>
<td>1.9</td>
<td>1.7</td>
<td>1.0</td>
<td>1.1</td>
<td>1.8</td>
<td>1.3</td>
<td>1.1 1.8 1.2 10</td>
</tr>
</tbody>
</table>
Figure 4.18: Map showing soil sample points
Figure 4.19: Physico-chemical analyses of soil samples

- **TEMPERATURE (°C)**
- **pH**
- **CONDUCTIVITY (µS/cm)**
- **TOTAL NITROGEN**

**FME LMMI**
- Temp: <40
- pH: 6-9
- Conductivity: 1000
- Total Nitrogen: <1
- THC: 10
Figure 4.20: Other Physicochemical analysis of soil samples

SULPHATE
CHLORIDE
PHOSPHORUS
NITRATE
CALCIUM
SODIUM
POTASSIUM

FME Limit
Sulphate: 500
Chloride: 250
Phosphorous: 0.1
Nitrate: 20
Calcium: 100
Sodium: 200
Potassium:
Figure 4.21: Heavy metal analysis for soil

- Cadmium
- Cyanide
- Chromium
- Iron
- Copper

FME Limit
Iron: 1.5
Copper: <1
Chromium: <1
Cadmium: 0.01
Cyanide
4.5 Soil Analysis

4.5.1 Physico-chemical properties of soil samples

The physico-chemical properties of soils from the sample locations shown in table 4.5 indicate that the pH of the soil, which depends on soil water ratio, ranged between 5.5-6.3. The lowest pH value of 5.5 was found at irrigation left Farmland and also at 12th km of main canal and the maximum pH of 6.3 was found in subsoil (15-30cm) of farmland close to the main canal.

Colour of the soil sample range from grey to brown; majority of the soils observed were of different shades of brown.

Electrical conductivity (EC) is a measure of the amount of soluble salts present in the soil; The EC varied from 3-80 µS/cm, which is within acceptable limit. The lowest EC was found at farmland at 12km (main canal) at the topsoil (0-15cm) and highest was noticed in the soil of the reservoir.

The level of Sulphate, chloride, nitrate, calcium and sodium were all with the FMEnv prescribed limits. Phosphorus and Total Nitrogen were higher than the limits and this can be attributed to the use of agrochemicals and could be associated with the use of pesticide in the farms, which could have been drained into ditches depending on their solubility in water. Fixation reactions in the soils may allow only a small fraction (10 to 15%) of the phosphorus in fertilizers and manures to be taken up by plants in the year of application. Consequently, most farmers apply two to four times the amount of phosphorus as is removed in the crop harvest. Repeated over many years, such practices may have saturated the phosphorus fixation capacity and built up the level of available phosphorus in the soil, hence the high concentration. Hence excavated soil from any region in the project area should not be used as amendment for soils in the farm plots, rather the excavated soils may be used to fill borrow pits.

4.5.2 Heavy metal properties of soil samples

The heavy metals concentrations in soils from sampling locations were also assessed. The values of some of the heavy metals (Copper and Cadmium) were high and above the FMEnv limits. Chromium and Iron were within limits. The presence of these parameters in excess can result to health concerns in humans and animals. Sources of cadmium pollution are mining and industrial discharges. A lot of mining activities are being undertaken within the watershed of the Bakolori Dam. These could be the possible sources of the high concentration recorded.
### 4.5.3 Microbiology of soil samples

#### Table 4.6 Result of microbial study from soil samples

<table>
<thead>
<tr>
<th>S/N</th>
<th>SPECIE</th>
<th>1/L</th>
<th>1/L</th>
<th>1/L</th>
<th>M/C</th>
<th>M/C</th>
<th>GIS</th>
<th>GIS</th>
<th>KM</th>
<th>SS1</th>
<th>SS1</th>
<th>JAS</th>
<th>JAS</th>
<th>JAS</th>
<th>SSD1</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>SS10</td>
<td>SS10</td>
<td>SS11</td>
<td>15KM</td>
<td>15KM</td>
<td>30</td>
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<td>12</td>
<td>9</td>
<td>9</td>
<td>ADU</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
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<td>(0-15cm)</td>
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<td>(15-30cm)</td>
<td>(0-15cm)</td>
<td>(15-30cm)</td>
<td>(15-30cm)</td>
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<td>Ent. aerogenes</td>
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<td>+</td>
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<td>+</td>
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<td>+</td>
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<td>Salmonella</td>
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<td>+</td>
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<tr>
<td>4</td>
<td>Shigella sp</td>
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<tr>
<td>5</td>
<td>Cfu/100ml</td>
<td>2.5 x 10^4</td>
<td>1.7 x 10^4</td>
<td>1.4 x 10^4</td>
<td>2.7 x 10^4</td>
<td>2.1 x 10^4</td>
<td>2.3 x 10^4</td>
<td>2 x 10^4</td>
<td>2.4 x 10^4</td>
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<td>2.5 x 10^4</td>
<td>2.2 x 10^4</td>
<td>4.5 x 10^4</td>
</tr>
<tr>
<td>6</td>
<td>Feecal Coliform/100ml</td>
<td>2.2 X 10^3</td>
<td>1.1 X 10^3</td>
<td>2 X 10^3</td>
<td>1.4 X 10^3</td>
<td>2.9 X 10^3</td>
<td>1.6 X 10^3</td>
<td>2.8 X 10^3</td>
<td>1.6 X 10^3</td>
<td>1 X 10^3</td>
<td>1.8 X 10^3</td>
<td>1.9 X 10^3</td>
<td>1.7 X 10^3</td>
<td>1.3 X 10^3</td>
<td>4.2 X 10^3</td>
</tr>
</tbody>
</table>
There is a uniform pattern of bacteria distribution in the soils. The distribution is however, closely linked with the occurrence of organic matter. At 0-15 cm depth, soil is rich in organic matter and this layer accordingly harbors the maximum bacterial population. The bacterial counts were higher than the fungal counts. Depending on soil structure and the various physico-chemical parameters, the types of bacteria vary in different soils.

4.6 Vegetation and Flora Studies

The project area lies in the open Sudan Savanna woodland vegetation (plate 8). The irrigation project area is intensively and extensively cultivated for various arable crop productions. The density of the solitary and isolated trees on the irrigated croplands was ≤ 1 per hectare. The trees are non-species specific and are located in inter and intra-boundary positions. This is understandable in that land preparation for crop planting in the area is mechanized and the less there are trees, the better for tractor easy and unobstructed movement. The farmers also remove trees from their croplands because the trees provide hiding and roosting places for grain-destroying birds. The farmers also claimed that planting under the trees did not encourage good crop yield.

Plate 8: Trees in irrigated croplands

In riparian areas along the dry Sokoto River valley and marginal land areas, the tree density and distribution did not vary much as these areas are intensively used for livestock grazing. However *Acacia sp* and *Azadirachta indica* appear to be the most abundant.
Field assessment confirms that the natural vegetation of the project area has been eliminated by arable crop cultivation. Evidence from residual trees and shrubs sparingly located at the croplands suggest that they are fire and drought resistant species. The following are some common plant species of the irrigation project area (Table 4.7).
Table 4.7: List of common plant species of the project area

<table>
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<tr>
<th>S/N</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Structure</th>
<th>Local Uses</th>
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<td>Acacia nilotica</td>
<td>Acacia</td>
<td>Shrub</td>
<td>Source of Gum and Tannin</td>
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<tr>
<td>2</td>
<td>Acacia senegal</td>
<td>Acacia</td>
<td>Tree</td>
<td>Source of Gum Arabic</td>
</tr>
<tr>
<td>3</td>
<td>Adansonia digitata</td>
<td>Baobab</td>
<td>Tree</td>
<td>Edible leaves and fruits</td>
</tr>
<tr>
<td>4</td>
<td>Afrotisica raciflora</td>
<td>Makerfo (Hausa)</td>
<td>Tree</td>
<td>Fuel wood</td>
</tr>
<tr>
<td>5</td>
<td>Afzelia africana</td>
<td>Kawo (Hausa)</td>
<td>Tree</td>
<td>Fodder for livestock</td>
</tr>
<tr>
<td>6</td>
<td>Angiessa leicarpa</td>
<td>Marke (Hausa)</td>
<td>Tree</td>
<td>Chewing stick, medicinal</td>
</tr>
<tr>
<td>7</td>
<td>Azadirachta indica</td>
<td>Neem</td>
<td>Tree</td>
<td>Fuel wood, medicinal</td>
</tr>
<tr>
<td>8</td>
<td>Bauhinia rejeascens</td>
<td></td>
<td>Tree</td>
<td>Livestock feed</td>
</tr>
<tr>
<td>9</td>
<td>Bombax costatum</td>
<td>Red silk cotton</td>
<td>Tree</td>
<td>Edible leaves and fruits</td>
</tr>
<tr>
<td>10</td>
<td>Borassus cathipum</td>
<td>Ron palm</td>
<td>Tree</td>
<td>Edible fruits</td>
</tr>
<tr>
<td>11</td>
<td>Burkea africana</td>
<td>Barkin makarfo (Hausa)</td>
<td>Tree</td>
<td>Source of Tannin, fish poison</td>
</tr>
<tr>
<td>12</td>
<td>Ceiba pentandra</td>
<td>Silk cotton</td>
<td>Tree</td>
<td>Edible leaf, Timber</td>
</tr>
<tr>
<td>13</td>
<td>Cochlospernum</td>
<td></td>
<td>Shrub</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Daniellia olivari</td>
<td>Maje (Hausa)</td>
<td>Tree</td>
<td>Fuel wood</td>
</tr>
<tr>
<td>15</td>
<td>Hymenocarida acidia</td>
<td>Janyaro (Hausa)</td>
<td>Tree</td>
<td>Fuel wood</td>
</tr>
<tr>
<td>16</td>
<td>Hyphaene thebaica</td>
<td>Dum palm</td>
<td>Tree</td>
<td>Fruit for livestock feed</td>
</tr>
<tr>
<td>17</td>
<td>Isobertinia doka</td>
<td>Doka (Hausa)</td>
<td>Tree</td>
<td>Fuel wood</td>
</tr>
<tr>
<td>18</td>
<td>Mangifera indica</td>
<td>Mango</td>
<td>Tree</td>
<td>Fruit edible</td>
</tr>
<tr>
<td>19</td>
<td>Parkia biglobosa</td>
<td>Locust bean</td>
<td>Tree</td>
<td>Fruit eaten</td>
</tr>
<tr>
<td>20</td>
<td>Pilostigia reticulatum</td>
<td>Kalgo (Hausa)</td>
<td>Tree</td>
<td>Fuel wood</td>
</tr>
<tr>
<td>21</td>
<td>Senna occidentialis</td>
<td>Coffee senna</td>
<td>Herb</td>
<td>Leaves edible</td>
</tr>
<tr>
<td>22</td>
<td>Tsamandias indica</td>
<td>Isamiya (Hausa)</td>
<td>Tree</td>
<td>Fruits eaten by cattle</td>
</tr>
<tr>
<td>23</td>
<td>Vitellaria paradoxa</td>
<td>Shea butter tree</td>
<td>Tree</td>
<td>Edible fruit and vegetable oil</td>
</tr>
</tbody>
</table>

GRASSES

<table>
<thead>
<tr>
<th>S/N</th>
<th>Scientific Name</th>
<th>Structure</th>
<th>Local Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aristodo sp</td>
<td>Grass</td>
<td>Livestock feed</td>
</tr>
<tr>
<td>2</td>
<td>Brachiaria sp</td>
<td>Grass</td>
<td>Cattle feed</td>
</tr>
<tr>
<td>3</td>
<td>Digitaria sp</td>
<td>Grass</td>
<td>Cattle feed</td>
</tr>
</tbody>
</table>

4.7 Aquatic Vegetation

At the project area in Bakura LGA, which is a major rice producing area, unlined secondary and tertiary canals and pipes were seen broken and collapsed. Consequently the low-lying fadama area has become flooded and impounded beyond arable cultivation. This has changed the ecology of the fadama area to a semi-aquatic environment.

At Talata Mafara project area a major canal was observed to have silted enough to encourage luxuriant growth of Typha spp. grass. *Typha spp.* is a tall grass of permanent aquatic environments not expected in the irrigation project area. During interactions with the project area Water Users Association, it was learnt that the *Typha* grass provides breeding, hiding, and roosting sites for the Quella birds that are a major pest of cereals, the major arable crops of the area. Table 4.8 shows identified Aquatic Plants in the project area.
Table 4.8: Common Aquatic Plants of the project area

<table>
<thead>
<tr>
<th>S/N</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ludwigia abyssinica</td>
<td>Water primerose</td>
<td>Woody herb</td>
</tr>
<tr>
<td>2</td>
<td>Ludwigia decurrens</td>
<td>Water primrose</td>
<td>Woody herb</td>
</tr>
<tr>
<td>3</td>
<td>Nymphaea lotus</td>
<td>Water lily</td>
<td>Herb</td>
</tr>
<tr>
<td>4</td>
<td>Typha australis</td>
<td>Cattail</td>
<td>Woody herb</td>
</tr>
<tr>
<td>5</td>
<td>Hydrilla palustris</td>
<td>Swamp morning</td>
<td>Herb</td>
</tr>
<tr>
<td>6</td>
<td>Ipomoea aquatica</td>
<td>Swamp cyperus</td>
<td>Herb</td>
</tr>
<tr>
<td>7</td>
<td>Nymphaea lotus</td>
<td>Wild rice</td>
<td>Woody herb</td>
</tr>
<tr>
<td>8</td>
<td>Clappertonia ficifolia</td>
<td>Swamp cyperus</td>
<td>Herb</td>
</tr>
<tr>
<td>9</td>
<td>Mimosa bige</td>
<td>Giant sensitive plant</td>
<td>Woody herb</td>
</tr>
</tbody>
</table>

4.8 Fauna
No game mammals were sighted in the project area. Interviews with hunters led by Alhaji Amadu (Sarikin baka galadima) indicated that all the game mammals in the area disappeared due to habitat loss which can be attributed to intensive and extensive land clearing for arable crop cultivation. However, before the commencement of the project, the animal population of the area included the following (Table 4.9).

Table 4.9: Some animals of the project area

<table>
<thead>
<tr>
<th>S/N</th>
<th>Common Name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cane Rat</td>
<td>Tryonomys swinderianus</td>
</tr>
<tr>
<td>2</td>
<td>Striped ground squirrel</td>
<td>Euxerus errythropus</td>
</tr>
<tr>
<td>3</td>
<td>Giant Rat</td>
<td>Cricetomys gambianus</td>
</tr>
<tr>
<td>4</td>
<td>Puff adder (sighted)</td>
<td>Bitis ariens</td>
</tr>
<tr>
<td>5</td>
<td>Termites</td>
<td>Trinervitermes spp</td>
</tr>
<tr>
<td>6</td>
<td>Bats</td>
<td>Chiroptera spp</td>
</tr>
</tbody>
</table>

4.8.1 Birds
No game bird of conservation interest was sighted within the investigation period in the project area. However, birds sighted include:
1. Cattle Egret (*Bubulcus ibis*)
2. Grey Heron (*Ardea cineria*)
3. White-faced whistling duck (*Deridrocynga viduata*)
4. Hooded vulture (*Nicrocytes monachus*)
5. Black kite (*Milvus migrans*)
6. Speckled pigeon (*Columbia guinea*)
7. Black billed dove (*Streptopelia abysinicus*)
8. African morning dove (*Streptopelia decipiens*)
9. Village indigobird (*vidua chalybeate*)
10. Red-headed quelea (*Quelea quelea*)
11. Abyssinian roller (*Coracias abyssinicus*)
12. Little swift (*Apus affinis*)
13. Pied king fisher (*Ceryle rudis*)
14. Common garden bulbul (*Pycnonotus barbatus*)
4.8.2 Termites

During the field assessment for data collection, a lot of Termite mounds and tunnels were observed at the Dam site at Maradun and on some trees in that area. According to Ohiagu (1980) termites are the predominant members of the soil fauna in tropical, subtropical and semi-arid regions of the world. They feed on all forms of plant materials from living tissues to humus. In the Nigerian Savanna various grass and wood eating termites are abundant notably Trinervitermes spp. and some members of the Macrotermiteinae spp. There are five species of grass and litter feeding Trinervitermes associated with mounds, which are often so abundant that they are characteristic features of the landscape. These mounds are used both for storing grass and for breeding purposes. The activities of the grass-eating termites not only cause damage to grass and pasture legumes but also lead to denudation and accelerated erosion of the grasslands.

In addition to grass-eating termites the Nigerian Savanna abound in dead wood- and litter-feeding termites, the majority of which belong to the Macrotermiteinae. They construct runways (channels) and sheets of soil over trunks and branches of trees and feed under their protective cover. The Macrotermiteinae have been implicated with the removal of 35.5% of the annual litter in the Savanna area. These termites are also responsible for the termite damages of wooden materials in structures and houses.

4.8.3 Bats

Bats were observed at the Dam building. There are about 12 species of bats (Chiroptera) in the Nigerian Savanna (Ayeni et al 1982). These bats naturally live on trees and feed on their fruits in the vegetation. The vegetation of the project area and beyond has been cleared for arable crop cultivations so the bats lost their habitats; none was sighted during the field fauna assessment. Consequently, the bats found the abandoned Dam buildings a good undisturbed shelter. There are no data on the effect of bats on the environment. However their fecal droppings and offensive odour degrade the quality of the environment.

4.9 Aquatic Fauna

4.9.1 Fish

Previous studies done by USAID (2010) indicated that fishing within the scheme was considered a secondary occupation within the river flood plains of the project area. It however has the potential to serve as a major supply of animal protein for the local community.

During field visits, fishermen were identified who harvested fishes within the reservoir. The harvested fishes are sold as either live fishes or smoked for consumption by the consumers. The fishermen indicated that they have been fishing for over 20 years. They also indicated that their fishing activities thrive well even in the dry season due to the availability of water in the reservoir. Some of the species encountered during the fieldworks include Alestes spp., Clarias spp., tilapias, Synodontis spp. and Labeo spp. Alestes, tilapias.
Fish farmers around the dam reservoir reported a 200% increase in catch and between 120 to 150% in the rivers within the Command area since the construction of the dam. On the contrary, fishermen further downstream, outside the Command area reported drastic loss of over 200% compared to catches before the dam was constructed. This has affected their basis of livelihood.
4.10 Habitat Types Summary

During the exercise the following habitat already discussed in the sections above and table on the ESMP where encountered in the project area:

a. The Natural Sudan Habitat: with its characteristics floristic composition already described and the impacts of the project on which are described on the text as habitat fragmentation, vegetation loss, soil erosion and paucity/lack of fauna population.

b. Aquatic habitat: created in hitherto arable crop production seasonally flooded fadama area by continuous discharge from unlined canals thereby altering the ecology and utility of the area.

c. Riparian habitat: a forest type lining the Sokoto River. The diversion and exclusion of the Sokoto River drainage in the Irrigation main canals altered the habitat and domestic value

d. Invasive Typha grass habitat: observed on some primary canals where water flow is impeded. This provides roosting and breeding habitat for the destructive Quella birds.

4.11 Socio-economic Assessment

4.11.1 Primary data Analysis and Technique for Data Acquisition

Primary data acquisition depended on multi-level communication and consultations with the affected project communities. Scientific process for sampling determination was engaged. Since the aggregate population of the three (3) LGAs of project influence amount to 738,529 the sample population was established at 384 using the Decision Analyst STAT 2.0. Means of data acquisition included structured questionnaire, interviews, public consultations and focus group discussions. Stratified random sampling was the preferred technique in the circumstance that there are many groups and variables of interest (such as women, Water Users Association, Farmers, Livestock owners/herdsmen, traders, households, etc.) that needed to be included and well represented. This technique involves dividing the overall sample population (384) into the strata, and then choose a simple random sample from each stratum whose aggregation feeds into the overall population sample.

4.11.2 Composition of Respondents

Out of the 384 respondents, the proportion of male to female respondents was 65 percent and 35 percent respectively. The skewed gender outcome of respondents did not pose a problem in the validity of the data because the female population was stratified as a group, consulted and administered questionnaires. The main reason for inequality in the gender representation is caused by a culture in which men/husbands are favoured to represent their household in matters involving interview and questionnaires at household levels.
4.11.3 Age of Respondents

The respondents consist of men and women of full productive age as presented in table 4.10:

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-19</td>
<td>5</td>
</tr>
<tr>
<td>20-24</td>
<td>12</td>
</tr>
<tr>
<td>25-29</td>
<td>34</td>
</tr>
<tr>
<td>30-34</td>
<td>58</td>
</tr>
<tr>
<td>35-39</td>
<td>56</td>
</tr>
<tr>
<td>40-44</td>
<td>65</td>
</tr>
<tr>
<td>45-49</td>
<td>54</td>
</tr>
<tr>
<td>50-54</td>
<td>35</td>
</tr>
<tr>
<td>55-59</td>
<td>32</td>
</tr>
<tr>
<td>60-64</td>
<td>23</td>
</tr>
<tr>
<td>65 and above</td>
<td>10</td>
</tr>
</tbody>
</table>

The survey shows that the highest number of respondents (65) falls within 40-44 years old while the least number of respondents (5) are between 16-19 years old. Figure 4.23 shows that respondents were predominantly from ages 30 to 49 years. This is typically representative of active workforce age range, and lays credence to the validity of the survey.
Figure 4.23 shows that the survey targeted a reasonable number of household-head respondents, as evident by the proportion of household heads (48.9%) that participated in the response. The general implication of the result from the two variables analyzed so far is that the numbers of females as well as household head respondents are significant enough in giving validity to the outcome of the survey on the position of events in the households, and the opinions of women in the project area.

4.11.4 Marital Status

About 88 percent of the respondents are married while 12 percent are not married. Among the married ones, 60 percent among the males are married to at least two (2) wives, 40 percent have one wife each. Number of widows among the female respondents are 75 percent, divorcees are about 15 percent while those in marriage constitute about 10 percent of the female respondents.

4.11.5 Religion

Majority of the respondents (about 95 percent) stated that they are Moslems while 5 percent are Christians.

4.11.6 Number of Children in Household

The survey identifies and compares the number of children within households along 4 various scenarios including:

1) All households (general)
2) Households headed by females (widows)
3) Households with one wife (monogamous homes)
4) Households with more than one wife (polygamous homes)
Figure 4.24 generally indicates that large household size is predominant in the project area. It also shows that polygamy accounts for large household size in the project area as about 75% of the households involving more than one wife have a minimum of 10 persons/children in their households. The survey also shows that one out of every 10 households in the project area is headed by a widow/female. About 20 percent of the widow/female headed households are populated with about 7 children while about 5 percent of the widow headed households have about 10 children or more.

4.11.7 Gender Issues

Muslim Hausa/Fulani males dominate the project area as seen in the ratio of 65: 35 amongst male and female respondents. The women are restricted mostly within their houses and appear to have less contribution to decision making processes at the community level. Traditionally the decision-making is the responsibility of the family head, which usually is a man. Men carry out most of the farming activities such as tilling, seeding, weeding and harvesting.

4.11.7.1 Women within the Bakolori Irrigation Scheme

Data on women participation in agriculture in the BIP were obtained through Focus Group Discussions (FGD). This is because most women cannot be easily captured using any quantitative method of data collection. Interviews were mostly off-farm and at home. It was not easy for women to talk freely when their husbands are around. There are a number of women visibly outside on farms not just as farm labourers but farm owners. They engage in all farm activities from land preparation, planting, weeding, watering, harvesting and processing. Women have come to own land through all the tenure systems identified: inheritance, gift, purchase, hire, lease and pledge among others. Most men fear engaging in disputes over land with women that are not their wives or relations. Furthermore not a single woman has land in the GRA and there is no evidence to suggest that
this would change. The only way out is to allocate a certain proportion to women especially in
the GRA and the proposed “improved” Jankarawa area. At the Talata Mafara market, women were also seen selling foodstuff and other daily needs. At
the farms, the women were seen providing refreshment such as Akara (bean-cake), dried fish, Kwaidakwa (made from soybeans) and Kosai (made form cassava) to the men working in the field and passers-by.

**4.11.7.1 Women in Management**

Field investigations and Focus Group Discussions show that women are members of Water User Associations and Farming Cooperatives dealing with credit, and farm inputs. Data analysis revealed that there are at least two women in the executive cadre of the Federated WUA and other WUAs. However, two in a membership of 30 to 50 members is too small. Secondly, their roles in the entire executive cadres is no more than vice or assistant. There are no women Chairperson, Secretary, Treasure and Publicity Secretary. These will have to be addressed. The argument by most men for non-inclusion of women is that they are not literate and that they cannot satisfactorily combine domestic work, childbearing and still be active members of the executive committee. This argument is not plausible given the fact that a number of women within some associations have gone beyond secondary school, and they have children who assist them with domestic work whenever they are away from home.

**4.11.7.2 Category of Women who own Farms**

Irrespective of age and level of literacy, women own farms in the Bakolori Irrigation Scheme. There are women as young as 25 years and those over 50 years with plots in the project. The only deciding factor is whether or not they have all the resources to acquire inputs, pay for their water bills and hire the required farm labour. Many women farmers, farm by proxy through their children and hire labour to execute some difficult tasks.

**4.11.8 Vulnerability Issues**

Survey data and outcome of consultation in Bakolori are reinforcing on the issue of vulnerability in the project area. About 35 farmers of the 22,000 registered farmers are physically disabled and are associated under the Vulnerable User Association. No disabled person is found among the women farmers. Although female headed households exist in the project area this group may not be regarded as being vulnerable in their present social and economic representation and status. It is not however inconceivable that the activities and programme of the rehabilitation and transformation of the scheme may trigger vulnerability in women if gender sensitivities are not mainstreamed into the policies and operations of the scheme.

**4.11.9 Analysis of Welfare/Livelihood in the Project Area**

Three major variables were singled out as indicators of welfare in the project area for the purpose of this study. They include occupation, income and dependence measured by number of children served by a scenario income grade. Figure 4.25 provides the concise scenario.
4.11.9.1 Occupation

There are three occupations identified within the Bakolori Project area. They are farming, trading and civil service employment. The survey shows that the predominant occupation of the people of the project area is farming (engaged by about 90 percent) which includes livestock rearing. About 8 percent of the communities are into trading while only 2 percent are civil servants. Although some women are involved in farming, majority of them are satisfied with home activities.

4.11.9.2 Income

The graph listed income categories associated with respondents in the project area. At World Bank 2008 income threshold of $1.25 per person, an average household of 5 persons in the project area would require a minimum of $6.25 or ₦1,000 per day which translates to about ₦365,000 per annum for the provision of basic necessities such as food, clothing, shelter and transportation. In view of this benchmark the income category of poverty threshold for this study may be from ₦300,000 to ₦399,000 and above.

Figure 4.25 therefore shows that in general not more than 5 percent of the farmers live above poverty line. In contrast, 50 percent of the civil servants live above poverty threshold just as 10 percent of traders also live above poverty line. This result however dwelled only on income earning of the people and did not capture the contribution of subsistence food production to welfare, which is very prevalent in the project area.

4.11.9.3 Dependence Factor (Average Number of Children to Income Category)

The study shows that households with lowest income earning have the highest average number of children. As shown in the graph, (figure 4.25) households on income of less than ₦100,000 per annum have on the average 9 children while those on income of ₦100,000 to ₦199,000 have 8 children on the average. Interestingly, households on income level above ₦300,000 have 7 children and less on the average.
4.11.9.4 Linking Poverty/Livelihood Analysis to Education Level and Household Size

Efforts made to link the result of the livelihood measurement to the educational status of respondents and household size yielded interesting results. In terms of the highest level of educational qualification, the survey identified that 30 percent of the male respondents have no formal education compared to 85 percent for the females. Respondents with primary school attempted (dropped out) are 24 percent for males and 10 percent for females just as those that completed Primary school education are 20 percent for males and 5 percent for females. Secondary School Attempted was 15 percent for males and 1 percent for females just as 3 percent of the respondents among males are said to have attained tertiary or higher education, while no female respondent had higher education attainment. This situation implies that the project community is largely uneducated and the females are more educationally disadvantaged.

It was found that the respondents (males) with 5 to 7 children are largely those that had secondary and tertiary education while those with 8 and more number of children had little or no formal education. Exceptions to this result are a few households from among those with good livelihoods (income above ₦300,000) that are married to more than one wife. It is therefore, inferred that poverty, large household size and illiteracy are correlated in the project area.

4.11.10 Pest and weed management

A Pest Management Plan (PMP) has been prepared for the TRIMING Project and has been disclosed as a separate document in Nigeria and in the World Bank InfoShop.

One of the problems observed from field visits and questionnaire administration (see annex 9) to the farmers was the issue of pests and weeds on farmlands. The most problematic of the pests
were quella birds, rodents and locusts that attack cereal farms. To take care of this, the farmers use some pesticides and herbicides. These include products containing mainly one or more of the following agents;

1. Lambda-Cyhalothrin
2. Paraquat dichloride
3. Cypamethrin
4. Propanil
5. 2, 4- D
6. Butachlor

Major Pesticides used by Rice farmers include Dromana A, Red Star and Oregon.

Run-offs from farmland into surface water from these farms may be a source of toxicity and dermatitis for the project community and those living downstream of the irrigation scheme. Manual and mechanical weeding is also applied for weeds management.

4.11.10.1 Fertilizers
Field visits revealed that the most common fertilizers applied to farmlands include Urea and NPK. These fertilizers are applied in order to improve crop and agricultural yields. Information gathered also indicates that there is an increasing salinity of the farms and farmers confirmed this by stating that they had observed reddish appearances on some of the crops, stunted growth, and inability to observe any improvement even with the application of fertilizers. This situation is not uncommon with large-scale irrigation systems.

4.11.11 Social Infrastructure

4.11.11.1 Educational Facility
Apart from Islamic schools, there are many primary and secondary schools across the project area. Also, Talata Mafara in the project area is widely known in the State as “Centre for Education” because of the existence of various higher educational institutions including Abdul-Gusau Polytechnic and the School of Agriculture. In terms of the highest level of education achieved by respondents, the survey identified 6 categories (figure 4.27) including persons with no education (30%), respondents with primary school attempt (PSA)(24%), Primary school completed (PSC) (20%), Secondary School Attempted (SSA) (15%), Secondary School Completed (SSC)(8%) and those with Tertiary education (TIC) (3%).
Figure 4.27 shows that the population without any formal education has the highest figure (30%) and that only 3% of the population has any form of tertiary education. The implication of this is that there is a strong correlation between poverty and literacy rate in the project area. Poverty may be a major factor for people not attending or going far in academic attainment; similarly, the high illiteracy level in the area may continue to perpetuate poverty in the project communities.

4.11.1.2 Water and Electricity Supply

Portable water supply continues to be a chronic problem in the project area. Whereas the Bakolori Irrigation Scheme was envisaged to alleviate this problem as well as to provide irrigation services for dry season farming, the scheme has failed to live up to expectation due to poor management and maintenance which has led to the dilapidated state of the facility.

Socio-economic survey administered to households as a part of this ESIA reveals that all the respondents consider lack of water as a major problem affecting both productivity and household welfare in the area.

The project area is connected to the national electricity grid. About 70% of respondents are satisfied with power supply in the area. This group said that on the average they are serviced with electric power supply for an average of 10 hours in a day. However, 30% of the respondents are not satisfied with the electric power supply, stating that the power supply to the area is not enough to support sustainable businesses.

4.11.1.3 Housing and Settlements

The settlement patterns in the project area consist of clustered settlements in the rural areas and linear settlements in the urban and semi-urban areas. Housing types range from traditional thatched mud houses, to mud-brick houses with corrugated roof, to modern cement block houses. Modern housing features mostly in the urban and semi-urban centers and partly in the rural areas. Figure 4.28 shows the trend in types of housings occupied by respondents.
4.11.1.4 Markets

The largest market within the project areas is located in Talata Mafara. The market operates daily though the major market day is on Tuesday - indeed the name of the town is derived from the weekday (Tuesday is Talata in Hausa). Merchants from various parts in the country including Sokoto, Kebbi, Katsina, Kano States and even as far as Abuja in the Federal Capital Territory come to make bulk purchases of products such as rice, cowpea, millet, guinea corn, maize, potato and vegetables (tomato, onion, lettuce etc.). The average distance of the main market from the farm area is about 3 kilometers. The availability of the market is a major source of encouragement for continued farm production in the Bakolori Irrigation Scheme. Farmers travel by themselves or transfer farm produce to middlemen who transport the products to the market. Secondary data revealed that price of products fluctuates as determined by the market.

4.11.1.4.1 Storage facilities

The common storage facility available is the rhombus (traditional, mud constructed stores) while the majority of the markets only have basic open sheds, which have many limitations in terms of security, pest infestation and produce deterioration. The vast majority of farmers who sell produce store quantities ranging from 40kg to 200kg. In addition most traders store their produce for a period of up to 30 days. Cereals (i.e. rice, maize, sorghum and millet) are the main crops sold in the project areas but other crops such as cowpea, cassava, potato, sugarcane and vegetables are also marketed.

4.11.1.4.2 Processing

Only limited processing and packaging such as drying, sieving and bagging are done on the products before they are sold. Interviews with farmers from Maradun indicated that the Flour mill located in Kaduna State in the past bought produce from the farmers.
About 95% of the farmers do not possess any processing units and so over 90% sell their crops in an unprocessed form. The value and quality of the produce is restricted which, in turn, reduces from crop production (Atkins-Enplan Pre-feasibility Report, 2013).

The processing activities, which add value to crop production, are very limited in the project areas the most common processing facility is small, village mills (driven by a petrol engine) which are used for the de-husking of rice and the milling of crops, such as maize, sorghum and millet, into flour mainly for family consumption. There are two (2) types of rice sold in the market - processed rice (de-husked rice) and unprocessed rice. A bag of the unprocessed rice (50kg) goes for ₦5, 500 – 6, 000 while a 100kg bag for processed rice goes for ₦14, 000 – 16, 000.

In addition groundnuts are also milled into pulp for further processing into groundnut oil and groundnut cake.

4.11.11.5 Transportation

The project area has reasonable motor-able access roads across its transverse. There are also ongoing access roads constructions particularly in the Maradun project area. However, roads in the irrigation areas are either dilapidated or inaccessible. Modes of transporting goods from the farms include the use of Lorries, camels, horses and donkeys. Use of Lorries is the preferred economical option but this virtually not possible presently because of the inaccessible roads. Due to the inability of the farmers to get their products easily to the market, middlemen come to the farm gates to purchase crops from the farmers at unfair low prices.

4.11.11.6 Health and Sanitation

Health Care Facilities (HCFs) in the project area include three General hospitals (one in each of the three LGAs in the project area), 120 Primary Health Centers (PHCs) and some private health care facilities. Services provided at these HCFs include but are not limited to child health and antenatal services, anti-malarial treatment, HIV testing, counseling and antiretroviral treatment and antibacterial intervention services. Zamfara state shows a commitment to the health of the citizens through the provision of free drugs and medical services particularly in the area of malaria intervention and antenatal services. Similarly, there is a drug-revolving scheme by the local governments in which drugs not supplied by the State Ministry of Health are provided by the local government. Table 4.11 provides a number of HCFs located within the three LGAs.

<table>
<thead>
<tr>
<th>LGAs</th>
<th>Number of Wards</th>
<th>Number of Secondary HCFs</th>
<th>Number of Primary HCFs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakura</td>
<td>10</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Maradun</td>
<td>10</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>Talata Mafara</td>
<td>11</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>TOTAL</td>
<td>31</td>
<td>3</td>
<td>120</td>
</tr>
</tbody>
</table>

Table 4.12 shows responses received from households on awareness and use of healthcare facilities.

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>RESPONSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness / existence of HCFs</td>
<td>Yes (%)</td>
</tr>
<tr>
<td>Satisfaction with proximity of HCF to household</td>
<td>80</td>
</tr>
<tr>
<td>Adequacy of HCF personnel</td>
<td>35</td>
</tr>
<tr>
<td>Availability of drugs</td>
<td>30</td>
</tr>
<tr>
<td>Affordability of drugs</td>
<td>20</td>
</tr>
<tr>
<td>Households that attend antenatal</td>
<td>15</td>
</tr>
<tr>
<td>Households that delivered children in the HCFs</td>
<td>10</td>
</tr>
<tr>
<td>Households that prefer to deliver children at home</td>
<td>3</td>
</tr>
</tbody>
</table>

The outcome of Table 4.12 is that majority of the households (80%) are aware of the availability of HCFs in their community, although far distance to the facilities may be a challenge to many. The survey principally indicates the need for improving awareness on the benefits of the use of HCFs; presently, there is a general apathy to the use of HCFs especially for antenatal care and delivery services.

Malaria is highly prevalent in the area. Hematuria was reported as one of the common clinical signs observed by medical practitioners suggesting a high incidence of Schistosomiasis. Hematuria occurs mostly among youths between the ages of 10-20 years. This may be due to the fact that they are the ones that go to the water bodies to fetch water for domestic use. However, the people’s perception was that hematuria is a sign of sexual maturity and therefore seldom reported in the clinics. Other diseases reported include Guinea worm, Cholera, Dysentery and Fascioliasis. Professor Tukur Adamu, a professor of parasitology in Ahmadu Bello University Zaria, an indigene of Talata Mafara LGA, confirmed the above as he had conducted a survey on the prevalence of Schistosomiasis in the community. It was also observed that there is evidence of Hepatic Fascioliasis, Schistosomiasis and Foot and Mouth Disease among Livestock within the community. Water snails that serve as vector for some of these zoonotic diseases were visible within the project area.

4.11.1.7 Borrow pits

Borrow pits from where sand was gotten during construction of infrastructure such as the embankments of the main canals and roads were observed in several places in the project area. These borrow pits are presently filled with weeds, debris and water from rainfall. Those filled with water serve as breeding grounds for mosquitoes during the rainy season, death traps to pedestrians during the dry season, and community members confirm that there have been incidences of children drowning in them as they use them as swimming ponds. Members of the community were also observed collecting water from these “man-made lakes” and therefore maybe exposed to some waterborne diseases. However, these borrow pits may be put to good use during the rehabilitation of the irrigation scheme as the silt from the canals can be used in filling them.
CHAPTER FIVE  PROJECT ALTERNATIVES

Alternative approaches to major aspects of the Bakolori project were evaluated. The power supply requirements and the rehabilitation options for the sprinkler served irrigation areas are aspects that are critical to a full operation of the scheme.

5.1 Alternatives for Power Supply

Water supply for the Bakolori irrigation system was originally designed to be powered by the generation of electricity from the diesel generators and the hydro-power turbine installed at the dam house. The turbines and generators are presently non-functional due to major breakdowns. A number of alternatives are available for consideration, taking into account the geographic coverage of the scheme, the load requirements of the project and the environmental, socio-economic and health implications of the options. They include the following:

- Solar Energy
- Wind Energy
- Decentralizing power generation using multiple diesel generation units
- Construction of a dedicated electricity distribution station connected to the nation grid
- The Do-Nothing approach

A. Solar Energy

Solar provides an environmentally safe means of generating electrical energy for a variety of purposes including irrigation and other water supply facilities. Gaseous pollution emission from solar is extremely minimal and this will help to preserve the quality of the air in the project area, thereby providing a suitable ecosystem for the growth of crops in the farms. This will ultimately reduce negative effects of the project on global warming and climate change over its lifespan. Zamfara State experiences a relatively high sunshine intensity with a potential of about 6.5 to 7KWh/m² (Habib, S.L. Et Al, 2012). By implementing the solar power option the scheme will have the potential to qualify as a CDM (Kyoto Protocols Clean Development Mechanism) project eligible for carbon credits, and in effect earn income on it. Each pumping station or sub-station can be powered by its own solar electricity generating installations.

This option even though environmentally desirable, will entail a lot of costs and time for its execution. Also, the technology for solar power generation is currently, not very viable for a nation like Nigeria due given the technological capacity available for its running and maintenance. This option is therefore, not acceptable.

B. Wind Energy

Studies have shown that the North-West region of the country experiences relatively high wind speeds across most months of the year. Most wind turbine manufacturers provide a required speed, typically a minimum of 10 miles per hour, for turbines to generate at their stated capacity.
Wind power can be utilized for powering the pumping stations and other facilities. Wind power provides a low-carbon source of electricity generation and is thus an environmentally friendly solution. A number of optional configurations for the wind turbine may be adopted. Each pumping station may have its own dedicated wind turbine powering the water pumps and other electrical devices. Another option will be to group a number of pumping stations within close proximity to depend on one wind turbine with an output capacity that is capable of supporting their combined electrical load requirements.

The reasons that make the solar power option unacceptable equally apply in this case. It is therefore, unacceptable.

C. Decentralizing Power Generation using multiple diesel generation units

The current power network design of the irrigation scheme was for electricity to be generated at the dam house using hydropower turbines and diesel generators, and then distributed via power lines to the pumping stations and other facilities which are distributed all over the irrigation area. Decentralizing electricity generation in this context implies that diesel generators can be installed at each of the pumping stations or at strategic locations that can serve groups of facilities within close proximity. The problem with this option will be that of running costs, and security issues (to prevent vandalization of the generators and ancillary equipment); the maintenance culture in the country is rather poor, and if this option is chosen, may lead to a situation in which the generators will probably be out of operation in a few years. This option is therefore, unacceptable.

D. Construction of a dedicated electricity distribution station connected to the nation grid

The existence of PHCN’s Talata Mafara transmission 132/33KV substation is an advantage to the irrigation scheme. For a large irrigation project such as Bakolori, establishing a dedicated distribution station will enable a reliable and steady supply of electricity from the national grid. A distribution station if established can thus be easily linked to the Talata Mafara transmission station as its source.

This option can be combined with a repair of the hydropower turbines already installed at the dam site. The generated power can then be sold to the national bulk electricity buyer. Given the present critical electric power shortfall situation in the country, and the ever increasing demand for more electricity power as the country industrializes, this option will improve the electricity supply state in the project command area, generate income for the scheme from the electricity sold, ensure speedy development and industrialization of the area, and improve the socio-economic potentials and quality of life for the people and the communities in the Bakolori Irrigation Scheme area, Zamfara State, and the country in general.

E. The Do-Nothing Approach

This option considers the scenario where the power situation is left unaltered during the rehabilitation project. The irrigation area in Bakolori covers a geographic span of 23,000 hectares
of land that requires electricity to power the devise that pump the water to overcome the undulating terrains and to maintain the required pressure for adequate reticulation. The system also makes use of electrical pumps to facilitate the drainage of storm and irrigation water from the farms to prevent flooding crop damage. Thus, the rehabilitation of the power supply system is a critical aspect of the project that cannot be ignored.

**Chosen Option:**

Option “D” above is chosen due to the stated socio-economic benefits as stated. In addition, the option entails minimal environmental consequences, and in terms of time factor, will not delay the rehabilitation works at all.

### 5.2 Alternatives Irrigation System for the Sprinkler Irrigation Areas

At the commissioning of the Bakolori irrigation scheme the Jankarawa area had sprinkler irrigation network installed with five pumping stations and peizometric towers located strategically within the land. Due to lack of proper maintenance and poor power supply, the sprinklers were abandoned and ultimately vandalized over the years. Farming in this area has since been dependent on rainfall and other individual alternative measures the farmers have adopted such as the provision and use of tube-wells. The rehabilitation project seeks to revitalize access to irrigation water through an efficient and sustainable means. A variety of alternative approaches to this objective are available for consideration, and the option of leaving the area as it is has also been evaluated by this study. They include:

F. Rehabilitation of the Sprinkler Irrigation Infrastructure  
G. Conversion of the whole project scheme to gravity fed surface irrigation method  
H. Do-Nothing Approach

**F. Rehabilitation of the Sprinkler Irrigation Infrastructure**

A sprinkler system applies water to farmland in a rain-simulated pattern, thus providing a very suitable method of irrigating crops and optimizing water management. However, the intricate nature of sprinkler system infrastructure makes it challenging to operate and maintain without the required skilled manpower. Rehabilitating the sprinkler system in Jankarawa will entail procuring and installing new piping and sprinklers across the area since almost all those initially installed have been vandalized. Installation of sprinklers system is generally known to be a cost intensive option as compared to other methods of irrigation that take advantage of natural features such as gravitational force as with surface irrigation. The farmers in the sprinkler irrigated areas of the scheme which is presently broken down have indeed specifically requested that the areas be converted to surface fed gravity irrigation system. This they feel will be more amenable to maintenance by the BIP management and them. This option is therefore not recommended.
G. Conversion of the Whole Scheme to Surface Irrigation

Surface irrigation requires a suitable topography for the water in the canals to flow naturally by means of gravitational force. The Jankarawa area is characterized by an undulating terrain which is an impediment to applying this method. Thus, a major preconstruction activity to achieving this alternative will be to level the terrain and give it a suitable gradient for adequate water distribution and flow. The existing pumping stations and their associated elevated towers can easily be repaired and linked up to the canal network, while some of the reservoirs of the pumping stations will require excavation to modify them to suite the new topography of the area. In order to optimize the supplied irrigation water, the system can be designed to reuse drained water from the farms by pumping it back to the reservoirs of the pumping stations. However, this may require continuous quality monitoring of tail water at the drainage termination areas.

H. Do-Nothing Approach

This alternative considers the scenario whereby the as-is situation of the irrigation infrastructure of the irrigation areas that were initially served with the sprinkler systems is not modified or rehabilitated and the gravity fed areas of the scheme would be left to continue deteriorating. This implies that the pumping stations, their surface reservoirs and elevated storage tanks are left unrehabilitated. It also means that access to water for irrigation from the Bakolori dam will remain restricted due to lack of functional distribution infrastructure. Crop yield for the area will be low and the settlers at Jankarawa who originally inhabited the dam area will remain disgruntled toward the Bakolori irrigation scheme.

Farmers in areas poorly served with irrigation water will need to go to the other areas of the scheme where there is access to water to rent farmlands for cropping. The “Do Nothing” alternative would therefore, severely impede the national and community economic improvement potentials of the scheme. All the noted positive impacts of the proposed rehabilitation would be foregone. The relatively minor, less than significant environmental impacts (such as noise and short-term air quality impacts due to rehabilitation activities) and inconveniences would be avoided in the short-run. In the long-run however, the steadily declining state of the irrigation system and the farmlands would severely hamper the farming practices in the project area. In light of these considerations, the "Do Nothing" Alternative is deemed to be neither prudent nor in the best interest of all stakeholders, Bakolori area, Zamfara State and the country as a whole.

Preferred Option:

Option “G” above is the preferred option and therefore recommended. It will bring significant socio-economic benefits to the farmers in the project area, Zamfara State, and improve food security in the country. The environmental and social risks identified for Option G, can be avoided or mitigated with measures proposed in this ESIA/ESMP.
CHAPTER SIX: POTENTIAL IMPACTS AND MITIGATION MEASURES

6.1 Introduction

The proposed project will lead to several impacts on the environmental, occupational health and safety, and socio-economic status of the project area. Whilst this development will bring about a good number of beneficial impacts, especially improved performance and functionality of the Bakolori Irrigation Scheme, there is need to prevent unfavorable impacts so as to enhance the sustainability of the project. Irrigation related projects have the potential to generate a wide range of physical, biological and socio-economic changes to the project area with possible consequences to the environment. This chapter presents a summary of the identified potential beneficial and adverse impacts associated with the proposed rehabilitation works for the Bakolori Irrigation Scheme.

6.2 Associated and Potential Environmental Impacts

For the identification and rating of key issues and impacts that are likely to occur during the phases of this rehabilitation project and the significance of the associated impacts, a “5-Step Tool” was used.

6.2.1 Rating of Impacts

Five steps were followed sequentially in order to rate the impacts of the various activities of the projects as shown below:
Step 1: Identification of Potential Impacts

Expected impacts were determined based on anticipated interactions between project activities and major environmental and social sensitivities. The environmental and social sensitivities likely to be affected by project activities include the following:

Environmental Components
- Air (physical and chemical properties)
- Noise - vibrations, sound waves etc.
- Surface Water
- Ground Water and Hydro-geology
- Soil
- Topography and Landscape
- Climate Change
- Terrestrial Habitats

Social Components
- Air (odour)
- Noise – nuisance
- Visual Sensitivity
- Economic Activities
- Employment
- Public Health
- Occupational Health and Safety
- Education
- Land Use
- Property Rights
- Transport and Traffic
- Religious Activities
- Leisure and social activities
- Community Affairs and Grievance Redress
- Power (electricity)

Step 2 and 3: Qualification of Impacts

Qualification of impacts was based two assessment characteristics:

Step 2: Likelihood of occurrence – This is an assessment of the probability of the effect occurring.
Step 3: Potential consequence – This is the actual result and scale that an effect might have. The application of each of the two characteristics is described below.

Table 6.0: Likelihood of Occurrence of Impact

<table>
<thead>
<tr>
<th>Impact Probability</th>
<th>Likelihood</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>High probability (80-100%)</td>
<td>A very likely impact</td>
<td>Very frequent impacts</td>
</tr>
<tr>
<td>Medium high probability (60-80%)</td>
<td>A likely impact</td>
<td>Frequent impacts</td>
</tr>
<tr>
<td>Medium probability (40-60%)</td>
<td>A possible impact</td>
<td>Occasional impacts</td>
</tr>
<tr>
<td>Medium low probability (20-40%)</td>
<td>An unlikely impact</td>
<td>Few impacts</td>
</tr>
<tr>
<td>Low probability (0-20%)</td>
<td>A very unlikely impact</td>
<td>Rare impacts</td>
</tr>
</tbody>
</table>

The magnitude of the potential changes to the physical and social environment caused by the impact of an activity or hazard, and the level of sensitivity of the receiving environment determine the potential impact of the activity. This is shown below:
### Table 6.1: Potential Consequences Classification Matrix

<table>
<thead>
<tr>
<th>Receptor Sensitivity</th>
<th>Low change</th>
<th>Medium change</th>
<th>High change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low receptor sensitivity</td>
<td>Trivial effect</td>
<td>Slight effect</td>
<td>Substantial effect</td>
</tr>
<tr>
<td>Medium receptor sensitivity</td>
<td>Slight effect</td>
<td>Substantial effect</td>
<td>Big effect</td>
</tr>
<tr>
<td>High receptor sensitivity</td>
<td>Substantial effect</td>
<td>Big effect</td>
<td>Massive effect</td>
</tr>
</tbody>
</table>

The rating of the potential consequences of an impact and its effects are shown below:

### Table 6.2: Potential Consequences

<table>
<thead>
<tr>
<th>Potential Consequence</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme consequence</td>
<td>A massive effect</td>
</tr>
<tr>
<td>Great consequence</td>
<td>A big effect</td>
</tr>
<tr>
<td>Considerable consequence</td>
<td>A substantial effect</td>
</tr>
<tr>
<td>Little consequence</td>
<td>A slight effect</td>
</tr>
<tr>
<td>Hardly any consequence</td>
<td>A trivial effect</td>
</tr>
</tbody>
</table>

### Step 4: Degree of Significance

The table below shows the impact significance with associated impact ratings.

### Table 6.3: Degree of Impact Significance

<table>
<thead>
<tr>
<th>Impact Significance</th>
<th>Impact Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major significance</td>
<td>Major Impact</td>
</tr>
<tr>
<td>Moderate Significance</td>
<td>Moderate Impact</td>
</tr>
<tr>
<td>Minor Significance</td>
<td>Minor Impact</td>
</tr>
<tr>
<td>Negligible Significance</td>
<td>Negligible Impact</td>
</tr>
</tbody>
</table>

### Step 5: Impact Assessment Matrix

### Table 6.4: Impact Assessment Matrixes

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hardly any</td>
<td>Little</td>
</tr>
<tr>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Medium high</td>
<td>Minor</td>
<td>Moderate</td>
</tr>
<tr>
<td>Medium</td>
<td>Minor</td>
<td>Minor</td>
</tr>
<tr>
<td>Medium low</td>
<td>Negligible</td>
<td>Minor</td>
</tr>
<tr>
<td>Low</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
</tbody>
</table>
After the rating of each impact, the determination of mitigation measures followed (refer to section on ESMP). Only moderate and major impacts were considered for impact mitigation. Continuous improvement practices will address low impacts. The positive impacts shall be monitored and enhanced when expedient.

6.2.2 Associated and Potential Impacts Determination

The results of the evaluation of the interactions between the proposed rehabilitation activities and their impacts on environmental and social sensitivities are shown in subsequent pages of this chapter. The identified negative impacts were rated as minor, moderate and major. Beneficial impacts arising from the project were rated as positive. Hence, no further classifications were made on the beneficial impacts.

6.2.3 Methodology for Assessing and Analyzing the Social Impacts

The socio-economic impacts were identified through:
1) technical identification of the scope and nature of rehabilitation works required,
2) previous experience on similar jobs,
3) concerns raised by stakeholders during focused group discussions and public and stakeholder consultations,
4) interactions with professionals and experts in the field by the ESIA team,

The impacts and discussions on them are presented in this section with regard to the various project phases:

6.3 Broad Beneficial Impacts of the Proposed Rehabilitation of Bakolori Irrigation Scheme

The implementation of the rehabilitation of Bakolori dam and irrigation scheme is envisaged to largely impart positively to the people of the community and stakeholders at large. The potential positive impacts will depend on the proper implementation of the project components and sub-components.

The beneficial environmental and social impacts will include:

6.3.1 Beneficial Impacts

- Improved performance of irrigation and water resources for the Bakolori Irrigation Scheme.
- Optimization of the irrigation scheme in Bakolori
- Improved infrastructure in the dam, which would improve dam operations.
- Enhancement of the capacity of the Bakolori Irrigation Scheme in the supply of water within the 3 local governments (Maradun, Bakura & Talata Mafara).
- Removal of pests breeding sites and weeds.
- De-silting of the ditches which is expected to reduce flooding in the farm lands, and which in turn will reduce potential salinity problems
• The irrigation rehabilitation project will improve and increase access to water for farming and irrigation activities in the Bakolori Scheme Area – Bakura, Talata Mafara and Maradun LGAs

• It will ensure sustainability of irrigation water services provision in the long term, meeting the needs of present population in the Bakolori scheme area.

• It will serve as a positive benchmark for future developments and rehabilitation of irrigation dams under the TRIMING Project.

• Improvements of public goodwill and satisfaction towards governance in Zamfara State

• Increased opportunity to develop agriculture, livestock farming and other businesses in the Bakolori scheme area and surrounding communities.

• Increase opportunities for job creation and employment

• Encourage behavioral changes in hygiene and sanitation amongst the peoples of Bakura, Talata Mafara and Maradun

• Encourage training and capacity building for the Bakolori irrigation scheme and the Bakolori Project Office

• Increase public awareness on irrigation services.

• The rehabilitation of the access roads within the Bakolori Irrigation Scheme will ultimately lead to opening up of the farms to markets. There have been challenges that arise out of the dilapidated roads especially in transportation of farm produce; with the rehabilitation of these roads, accessibility shall be made easy. Consequently, the improved revenue growth will precipitate the development of other social amenities.

• Create potential for private sector involvement and participation in the scheme especially in the areas of Public Private Partnerships (PPP), facilities maintenance, and sub-contracting to companies to manage the Bakolori Dam and some irrigation infrastructures.

• During the construction phase, some construction materials will be sourced from local businesses and stores. This will inject income into the local economy benefitting local businesses.

• Reduce time, expenditure and stress of water collection from wells for farming and domestic purposes.

• Reduce health risks.

• Improve water resources management and sustainable dam operation

• Increased income to households, farmers and investors

• Increased internally generated revenue to state and federal government

• Improved households capacity to support children education and welfare

• Restoration and augmentation of the productivity of farming in the area

• Strengthen the Water User Associations (WUAs) and help them fulfill their intended functions

• Improved market access for agricultural goods and services

• Improved physical development of the area through infrastructural upgrade and investments
The anticipated positive impacts notwithstanding, the envisaged rehabilitation and expansion works required for the rehabilitation of the Bakolori irrigation scheme and dam would have some associated negative impacts on the environment and socio-economics of the project command area. These environmental and socio-economic impacts could adversely affect the project sustainability and the community; it thus necessary that they are identified early in the project life starting from the design stage, and mitigation measures proffered for them. It is also necessary to ensure the enhancement of all identified positive impacts of the project. Those impacts if not identified early and mitigated may offset the potential positive impacts of the project.

6.4 Identified Potential Impacts (by Project Phases)

6.4.1 Pre-construction Phase

A. Environmental Impacts

Positive

a. Assessments and Studies

- Prior to the commencement of rehabilitation works, a feasibility study and environmental assessment are required to describe the proposed project needs, aid project design, and ensure environmental and socio-economic sustainability of the project and the project community.

- The project will undertake a stakeholders/public consultation exercise to sensitize the stakeholders in the project command area and beyond on the environmental safeguards components of the project. The public consultation process is seen to be a positive impact, as it will form a basis for project design and implementation decisions making.

Negative

a. Air Quality

- The pre-construction phase will give rise to fugitive dusts and frequent exhaust emissions into the atmosphere as equipment is delivered to the Bakolori Irrigation Scheme and along access roads where the proposed rehabilitation works will take place.

b. Soil

- Leakages may occur from stacked equipment containing oil such as engine oil (especially dam site). This could result in the seeping-through of oil into the soil, thereby leading to possible contamination of soil, surface water and ground water.

- Soil compaction and soil structure changes may occur due to influx and stationary positioning of heavy-duty equipment and vehicles.
c. Noise
   • The project area is within an expanse of farmlands and few settlements. During the pre-construction activities the WHO/FMEnv permissible noise level (90dB) may be exceeded due to mobilization of heavy machinery to the rehabilitation areas.

d. Vegetation
   • During the pre-construction phase there will be increased de-vegetation activities.

B. Social Impacts

   Positive
   a. Participation
      • The project will undertake a stakeholders/public consultation exercise to sensitize stakeholders in the project command area and beyond on the social safeguards to ensure project sustainability. The public consultation process is seen to be a positive impact, as it will form a basis for project concept decision-making and implementation.
      • The implementing agency (FMWR) may also help establish project supervision committees at the Local Government and community levels to enable participation, monitoring and evaluation when rehabilitation works commence.

   Negative
   a. Movement
      • Possible disruptions of movement of inhabitants to farmlands, as a result of movement of equipment and materials along access roads, resulting in loss of man-hours and negative perception of the project amongst road users and residents.
      • Properties particularly farmlands may be accidentally damaged or destroyed during the movement of heavy-duty vehicles and equipment.
      • Accidents involving vehicles or pedestrians may occur during vehicle and equipment movements to dam site and other rehabilitation work areas.

   b. Noise
      • Noise from heavy-duty project vehicles and equipment may exceed the WHO/FMEnv acceptable noise level limits, resulting in nuisance.

   c. Conflict
      • Albeit no new land will be acquired in this project, there is the tendency for the dam rehabilitation and irrigation project to trigger conflict. This may occur during rehabilitation activities as new canals maybe constructed across farms land in the sprinkler irrigation area. Conflicts may also arise during the movement of construction materials, vehicles, deposition of debris and construction waste, and other civil works.
A Grievance Redress Mechanism already prepared in the RPF for the TRIMING project will be the suitable instrument or tool for addressing conflicts and grievance issues that may arise.

- Possible conflicts between PAPs and different project implementing bodies (FMWR, Bakolori Irrigation Project Office, SRBDA, Contractors, etc.)

d. Insecurity
- Insecurity challenges in some northern parts of the country may affect contractors interest to bid for job and this may lead to selection of less qualified contractors. Similarly, insecurity and the misguided knowledge of “Sharia Practice” in the state may have an adverse impact on construction workers willingness to work in the area especially if these workers are not familiar with the local terrain.

e. Public Private Partnership (PPP)
- This component if implemented as part of the project may be resisted by some stakeholders because of inadequate information and wrong perception that PPP is synonymous with monopoly and/or putting the WUA/farmers out of work.

C. Occupational Health & Safety

Positive
- During the pre-construction phase, Occupational Health and Safety (OHS) awareness programs will be conducted. Awareness programs and interactive sessions will benefit primarily the contractors’ personnel, Bakolori Irrigation Project Office and SRBDA staff, schools, residents and businesses. Guidelines on safe practices and safe behaviours will be made available to these groups in order to minimize the occurrence of occupational incidents or accidents in the course of implementing project activities.

Negative
- During the pre-construction phase air pollution from exhaust fumes of vehicles and equipment moving to the work areas may occur. This will pose an occupational health risk (respiratory infections and diseases), especially for people living in and carrying out activities around the project rehabilitation areas and also, contractor personnel, and personnel conveying equipment.
- Exposure to noise pollution, injuries and accidents during movement of equipment to the work areas. Visual impacts will also occur.

6.4.2 Construction Phase

A. Environmental Impacts

Positive
a. Performance
- The de-silting of the Primary, Secondary and Tertiary channels will help address water quality issues and enhance flow.
- This phase will also allow for rehabilitation of the distribution canals (particularly secondary and tertiary) where feasible.
- Repairs of cracks in the main canal walls will allow easy flow of water, and prevent possible collapse of the walls.
- Retrofitting/replacement/procurement of new and functional electrical equipment: This will improve the performance and functionality of the dam and help improve electricity supply to the project area and the country.
- The phase will allow for the decommissioning of dilapidated structures and equipment, construction of new and stronger structures and provision of new and more efficient equipment in the Bakolori Irrigation Scheme
- Construction of walls/Lining of secondary, tertiary and field drains will allow easy flow of water and prevent possible gully erosion.
- The de-silting of the drainage canals in the farms will reduce the problem of waterlogging of the farms, and improve farm yields
- Access roads into the farms will be created/re-created thereby, improving farm access to the farmers and improve access to markets for farm produce.

b. Aesthetic
- The removal of weeds from the canals and the surrounding areas will improve the aesthetic of the project area
- The de-silting of the canals and drainage systems will have a positive impact on the general aesthetics of the project scheme area.

Negative

a. Climate Change
- Climate change impacts need to be assessed from two perspectives. Firstly the impact of the project on climate change and secondly the impact of climatic change on the project scheme and its infrastructure.
- Green House Gas (GHG) emissions from vehicular and construction equipment would be generated during the pre-construction, construction and subsequently, operational phases of the project. These emissions would be the primary impact of the project on climate change. GHG emissions are considered based on three “scopes” – Scope 1 (direct emissions), Scope 2 (indirect emissions) from the consumption of purchased energy [Purified Motor Spirit {PMS}, diesel] and Scope 3 (other indirect emissions).

b. Air Quality
- Increase in fugitive dusts and vehicular emissions during operation of vehicles.
- Civil works will cause changes in the air and atmospheric conditions of the project area and surrounding environment. Fugitive dusts, machinery exhaust fumes [nitrogen oxides (NOx), carbon monoxide (CO), sulphur oxides (SOx), hydrocarbons and suspended particulates], and dusts from rehabilitation/construction activities will impact negatively on air quality. Air pollution from machineries will be short term, moderate and localized.
Air pollution in the vicinity of the rehabilitation works areas will be generated by activities involving de-silting, trench diggings, excavations, running of hydrocarbon powered machinery and demolitions.

During the rehabilitation, demolition and construction exposed paints and other hazardous substances may result in volatile vapour release into the atmosphere causing environmental and health risks.

Release of pungent odour as a result of decaying matter from silt material removed from the canals. This may pose nuisance.

c. Water Quality and Hydrology

i. Pollution of Water Bodies

During the rehabilitation works, there may be potential for sediment/contaminant laden water runoff to impact on water quality. The contaminants in water runoff may have the potential to enter existing drainage channels and into local watercourses, affecting downstream users and aquatic life.

Accidental spillage of chemicals and fuels from the operation and maintenance of construction vehicles and equipment will pose negative impacts to surface and future groundwater quality.

Flood draining activities may introduce agricultural chemicals (herbicides, fertilizers, etc.) into water bodies (surface water and groundwater) leading to possible pollution and eutrophication in surface waters.

ii. Health Risks

Many households in the area depend presently on water discharge from the dam for drinking and domestic uses. During rehabilitation works water from the canal will be polluted beyond existing conditions and may likely cause or exacerbate water borne and water related diseases to consumers.

iii. Shortage of Water

Conceivably, irrigation gate valves in the areas to be rehabilitated may be locked during the rehabilitation period; this will have attendant economic and social consequences on water users who are served with water from the canals. The vulnerable persons will be worse off if the little channel of water being depended upon is completely short down.

d. Soil/Geology

i. Soil Structure

Stationary heavy duty vehicles and heavy equipment (positioned over a long period) in and off rehabilitation work areas may lead to surface soil compaction. Surface soil will also be compacted during frequent movement of vehicles and heavy equipment; this can induce ground motion (vibrations), which can affect structures with weak foundations. Soil compaction can further lead to reduced capacity of water to infiltrate into the soil thereby affecting soil-water balance and the hydrological cycle largely.
Implementation of some aspects of the project will include major earthworks such as excavation with the movement of excavators, tippers and other equipment, road works, cut and fill works during the grading of the sprinkler irrigated and Jankarawa areas which are proposed to be converted to gravity fed irrigation system. This will affect the surface natural flow regime of water especially when the sub-soils have been destabilized by construction activities.

- Loss and exposure of topsoil (soil erosion) during de-vegetation activities.
- Increased water runoff and erosion from various sections where rehabilitation work is carried out could potentially cause and result in siltation and sedimentation of downstream waters, canals and drainage systems.

ii. Contamination/Pollution

- Oil and chemical leakages from work vehicles and equipment may lead to soil contamination and death of beneficial soil flora and fauna, particularly farm crops.
- During the rehabilitation of the pumping stations, there may be potential PCB contamination during the handling of transformers since some of the transformers presently located/stored in the project scheme were manufactured prior to 1980 when PCB use as a dielectric in transformers was banned.
- The construction of a proposed new main drain within the sprinkler system irrigation area may destabilize the soil structure in the area.
- Soil contamination from construction wastes such as oil (fuel, lubricants), cement, and paint may occur. This impact will be localized, minor and short term.
- Increase in the accumulation of heavy metals from concrete (used for repair of cracks in canal walls and construction of canal walls in secondary and tertiary canals) in soil.

e. Noise

- The rehabilitation works and the extension of irrigation scheme will involve the use of heavy machinery for land clearing, leveling and excavation of soil for construction of canals and drains. The noise level may be high, probably exceeding WHO/FMEnv (90 dB) permissible limits and may cause hearing impairment to workers and the public.

f. Sanitary Concerns

- The management of human faecal waste may be an issue. Contractor workers that will be at the sites at the peak of construction works will need good, hygienic gender specific toilet facilities. Some rehabilitation work areas are in remote locations, thus sanitary facilities may not be available. This could increase spread of infections such as dysentery, typhoid and may even lead to conflicts between the farmers and contractor personnel.

g. Waste

- Construction activities will lead to the production of solid wastes - soil excavated debris, metal scraps, plastics, wood, waste concrete, papers and cartons, etc.
- Increased generation of liquid waste – concrete washings, canal watering, etc.
h. Fauna and Flora

- During the construction phase, loss of economical trees/fauna may occur
- Civil work activities during this phase may disrupt the fauna and flora within the project areas, including aquatic life (if surface water is contaminated by contaminant sources from rehabilitation activities).

B. Social Impacts

Positive

a) Employment

- Employment of skilled and unskilled labour will be promoted. Artisans and professionals from the Talata Mafara, Bakura and Maradun LGAs will be provided contractual employment (even if only temporary) during this phase. This will help promote community goodwill.

b) Security

- Construction activities may bring about illumination (lighting) at night. This will help secure the work premises and may reduce the occurrence of social vices within the rehabilitation work areas and surrounding neighbourhoods at night
- As a result of project implementation activities, there may be an improvement in security within the LGAs. This improvement in security will positively affect the surrounding neighbourhoods, schools, businesses and offices

c) Economic Benefits

- This phase will encourage economic activities within and around work areas. Petty traders, food vendors and other small businesses will benefit immensely from the demands at work sites.

d) Waste Management

- The construction phase will see to the implementation of a viable waste management plan for project activities.

e) Occupational, Health and Safety

- Occupational health and safety efforts will be intensified during the construction phase as traffic signs, warning and hazard signs will be put up to inform residential communities and others, about the on-going rehabilitation works in sensitive areas.
- The phase will encourage the conduct of Occupational Health Risk Assessment (OHRA), Job Hazard Analysis (JHA), Hazard Communication Program (HAZCOM), OHS trainings and other proactive safety strategies (fulfilling the social and fiscal imperatives) which will help reduce the occurrence of on-site incidents/accidents and the resultant burden of direct or indirect compensation costs.

Negative
a) Agricultural Activities
- Disruptions to farming activities and access to water for domestic uses may occur during repair works. This will/may occur especially during the following rehabilitation activities – rehabilitation of the spill-ways and by-pass gates; repairs of cracks on canal walls and main drains, lining of secondary and tertiary canal walls; de-silting activities; construction of main drain.
- Rehabilitation/Construction activities may reduce access to owned farmlands thus disrupting farming activities.

b) Livelihood
- Inconvenient search for alternative sources of water by women and children for domestic use may occur during water flow regulation. This may pose safety risks.

c) Shortage of Water
- Regulation of water during repair works will reduce access to water for domestic use and business reliant activities especially water vendors (mai rawa), thus hindering sources of livelihood.
- Canal closure as a result of rehabilitation activities such as de-silting activities and repair of cracks may cause “Row Delay”. This is the delay and reduced access to water for plants in specific farm rows, leading to poor plant growth and consequently economic loss.

d) Traffic
- There may be occurrences of traffic congestion on access roads as a result of intermittent movement of equipment and materials into the dam site and other rehabilitation workstations. This will impact on travel time, and may result in negative perception about the project amongst road users, residents and commercial establishments.
- Road rehabilitation activities may disrupt use of access roads by other users including farmers.

e) Social Vices
- The project will attract a significant workforce. Associations between workers and local residents may lead to casual sexual relationships, thereby increasing the risks of sexually transmitted infections (STIs) and HIV. The sub-components requiring rehabilitation are many (access road, canal gates, irrigation system, dam rehabilitation, pumping stations, etc.). While the contractor is encouraged to employ local labour, this might be more in terms of unskilled labour. The need for skilled labour remains key and may inform the use of migrant labour. Nature of change in the community will not be about conflict in labour camp but about complete social exchange and introduction of new ways of life considering the relatively long months of rehabilitation period.
- Vices such as excessive alcohol (this is quite an issue in the project area since the State is a Sharia implementing State and thus the drinking of alcohol is banned) and
drug use, casual sex, small scale gambling, etc., may arise due to the influx of project workforce into the area.

f) **Health and Safety**
   - Incidences of respiratory conditions and respiratory diseases (silicosis, asthma, bronchitis, upper respiratory infections may occur due to air contamination by exhaust fumes and dust resulting from civil works.
   - Possible spread of water borne diseases may occur during flood draining activities from farmlands.
   - Stacked silt materials removed from the canal could become a breeding site for disease vectors e.g. flies and mosquitoes.
   - The deposition of silted matter on adjacent roads and/or farmlands may cause blockage of access roads and routes to farms.

g) **Noise**
   - This phase may also cause noise disturbance and nuisance.

h) **Waste**
   - The construction phase will lead to increase in on and off site quantities of generated construction wastes.

i) **Grievance**
   - Farm areas may be damaged or destroyed during excavations and repair works on the lining of canals.
   - Complaints may arise as a result of unintentional dumping of weeds or transplanting of weeds on farmlands during weed removal/handling activities.

j) **Conflict**
   - If project implementation will require the procurement of more than one contractor, the possibility of conflicts and workplace violence occurring may arise. This may hinder or slow down project implementation activities. Impediment to the work schedule will pose a negative social impact as successful project management and monitoring will be compromised.

k) **Power Outage**
   - Power outages from the mains may be necessary during the rehabilitation of the pumping stations and electrical infrastructures thus affecting socio-economic activities in the area.

C. **Occupational Health and Safety**

*Negative*

In the course of rehabilitation works, there would be a moderate to severe likelihood of the occurrence of workplace hazards. Activities such as well drilling, removal and replacement of pipes, trench digging, mechanical works, structural works and electrical installations could predispose personnel to hazards. “Unsafe behaviours” and “unsafe conditions” will pose serious
occupational health and safety risks. Hazardous conditions or practices likely to impact on occupational health and safety will include:

- Works involving repairs of cracks in canals and drainage networks
- Works involving de-silting of canals (primary, secondary and tertiary)
- Works involving de-silting of drainage systems
- Conveying and lifting of heavy equipment (transformers, generators, sprinkler pipes, etc.)
- Works at heights (such as the rehabilitation of pumping stations)
- Use and exposure to hazardous energy sources
- Water treatment upgrades
- Electrical installations, etc.
- Trench digging
- Vegetation clearing

The rehabilitation of the flood dykes is required to maintain a design height as well as to prevent the ingress of floodwater from the rivers within the project area. However, human errors during construction may cause water flooding the farms and adjoining settlements. The flooding of a settlement may be a potential risk to life, especially children. Similarly, siltation and broken linings of the dam may induce erosion leading to flooding in the farms and the adjacent settlements.

6.4.3 Operation Phase
A. Environmental Impacts

Positive Impacts

a. Performance
- Improved technology in farming and production methods will have significant positive impact on the environment through introducing energy efficient, water conservation technologies and waste minimization methods.
- Improved efficiency and effectiveness of the Bakolori irrigation scheme particularly the supply of water services for irrigation.
- Improved agricultural production, thus, improved economy for the farmers, and improved food security.

b. Water Supply
- Increased supply of water for agricultural and domestic use. This will hugely impact positively on the health statistic in the communities around the project.

c. Air
- Vehicular emissions generated during the operations are expected to be minimal.
- Aesthetic modifications will promote good ambience within and around the dam and pumping stations, during the operational phase.

Negative Impacts
a. **Water Quality and Hydrology**

- Intensified use and improper disposal of agrochemicals (*pesticides and fertilizers*), surface water and ground water pollution, and also eutrophication of surface water may occur.
- There may be further pollution and probable poisoning of aquatic life and pollution of water bodies.

b. **Soil/ Geology**

- Soil nutrient depletion due to prolonged cultivation and crop uptake leading to decline in productivity.
- The continuous introduction of large volumes of water into the soil profile through irrigation may likely change the soil physico-chemical attributes.
- Inadequate drainages in the farms will lead to water logging and leaching of water-soluble nutrients to levels where they are no longer available for use by plants.
- The uncontrolled use of agro-chemical additives in irrigation agriculture can lead to a build-up of salts through the soil profile.
- If proper land drainage is not practiced, irrigation activities may increase soil salinity through a raised water table and accumulation of soluble salts from the water.

- **Air**
  
  - Air quality impacts that would arise during the operation of the Bakolori dam and pumping stations would include emissions from generators and vehicular emissions. Regular servicing of equipment can minimize this.

- **Noise**
  
  - The operation of pumping stations will not pose any significant adverse impacts on baseline noise conditions. As noise or vibrations will be only site specific and expected to be below WHO/FMEnv acceptable limits (90 dB).

- **Pests**
  
  - Mono cropping of large areas for long periods may lead to new strains of pests and weeds.
  - The rehabilitation of the Irrigation Scheme will increase crop production thereby attracting higher density of pests; consequently farmers may incur greater production losses or may need to spend more for achieving adequate levels of pest control.
  - Increase in crop diseases as a result of infestation by pests.
  - Pests such as nematodes often constitute an important biotic constraint to irrigated crop productions.
  - Soil borne pathogens may also result in disease (damping off, foot rot, wilts, blast blight, rust, stem rot, sheath rot, black rot and foot rot).
B. Social Impacts

*Positive Impacts*

a. Water Supply and Irrigation
   - Improvement in overall water supply and irrigation services for the Bakolori Irrigation Project Scheme.

b. Agriculture and Economy
   - Increased agricultural activities due to availability of irrigation water.
   - The improved operation of the Bakolori Irrigation Scheme will ensure increased yield and reduction of crop loss. This increased production capacity will boost the economic gains through the sale of farm produce thus boosting the state and consequently the national economy.
   - Improved food security with increase in the quantity of food produced. Food security will be achieved at individual household level and at the national level due to the increase in food production.
   - The growth and expansion of local markets is envisaged with the increased farming of and markets for various crops.

c. Health
   - Improved agricultural production will ultimately lead to improved nutrition for the local populations and thereby leading to improved health in the long run.
   - Improved standard of living; personal and infrastructural hygiene is envisaged

d. Employment
   - There will be job creation and employment. For instance, more workers may be employed in Bakolori Irrigation Project Office and SRBDA. Also the project will create direct employment for community members in farming.

e. Education
   - During operation phase, there will be opportunities for skills acquisition such as training of farmers by extension officers e.g. on farm water management, crop husbandry, mechanical equipment repairs, etc.
   - The rehabilitation and upgrades in the Bakolori Irrigation Scheme area will lead to educational and social tourism to the project (for example university students studying various the fields of water resources management and irrigation engineering, picnickers, etc.), and Industrial Training and those requiring hands-on experience.

f. Infrastructures
   - The improved operation of the Bakolori Irrigation Scheme will bring about other infrastructural developments such as market expansion and expansion of roads.
• Services delivered by commercial establishments (*restaurants*), hospitals, businesses etc. will be enhanced directly and indirectly

g. Public – Private Partnerships
• Increased interest from private sector institutions and Public – Private Partnerships.

### Negative Impacts

a. **BIP may be faced with incapacity to implement project**
• BIP may be incapacitated to operate and manage the rehabilitated dam and irrigation scheme, and particularly to implement environmental and social management plan due to lack of skills, shortage of manpower and lack of funding.
• There may be malfunctioning of the entire system which could affect livelihood and raise negative reactions from inhabitants of the project area.

b. **Funding Gap may affect Project Implementation**
• The success or otherwise of any project depends to a large extent on funding of the implementation and monitoring programmes. As lofty as this project is, there is likely to be failure arising from lack of proper funding arrangement, timely approval and implementation. Failure in the implementation of environmental and socio-economic safeguards may impact on the project and communities negatively. is an essential part of this project because it is time scheduled; failure of which may dampen the success of the project.

c. **PPP Related Impacts**
• Poor project preparation for PPP characterized by risk-under-identification and misallocation to parties that best bear them may lead to project failure.
• PPP may be resisted by farmers because of the speculation that its practice may increase cost and also deprive the low-income farmers of the opportunity to participate in farming activities in the command area.
• Inability to reach a financial close in the PPP arrangement on time may result to project abandonment. The likelihood of this occurrence is high because of the inherent time it takes to reach a financial close in PPP, and this may be made worse with change in political administration.

d. **Impact of Limited Market and Lack of Storage System**
• Low output prices and loss of capital: Even small scale rural farmers in the area share the opinion that there is lack of market for their farm produce which affects their output prices and income. This scenario is likely to be made worse when the scheme is rehabilitated and more farming land and dry season farming restored.
Discouragement of investment and large scale farming: The lack of market and storage facilities is likely to cause disincentives to private investors and large scale farmers.

e. Temporary Unemployment

- Contractors, sub-contractors and personnel engaged during the construction phase will be relieved of their duties at the commencement of the operational phase. These may be temporarily unemployed.

f. Water

- The improved irrigation water services may lead to inappropriate management of water (water wastage and water logging of farms).

Health

- Some communities within the Bakolori irrigation project area do not have access to water. Residents may be tempted to use the irrigation water for domestic consumption and livestock uses which may endanger their health as the canal water may be contaminated with agrochemicals and so may threaten community public health. Chemicals “Contact dermatitis” as a result of bathing in irrigation canals was observed among the populace during field visits. This situation may even get worse with irrigation water available to more areas.
- Probable increase in water borne diseases such as malaria, typhoid, schistosomiasis and cholera. The availability of more water will provide more breeding grounds for mosquitoes and many other vectors of waterborne infections thus leading to more incidences of malaria in particular and other water-borne diseases.
- If the waste management plan implemented during the construction phase is not followed through into the operational phase, the issues of poor waste management may arise, posing social and health concerns to the facility management and other affected groups.

h. Livestock

- Increased farmers-herdsmen conflicts: Livestock (cattle, goats, sheep, etc.) may stray into the farms and damage farm crops through illegal grazing. Already, this is a problem within the project scheme and may get worse with increased farming activities that are envisaged with improved irrigation.

C. Occupational Health and Safety

Positive Impacts

- Implementation of site-specific occupational health and safety management plans (OHSMPs)
- Monitoring for occupational health and safety risk assessment (OHSRA) report data.
c. Continuous job hazard analysis and process hazard analysis (JHA and PHA)
d. Implementation of a hazard communication program (HazCom)
e. Institution of the facility safety committee.
f. Reduced direct and indirect costs as a result of pro-active safety strategies.
g. Availability of a fire safety and emergency plan.
h. Availability of dam safety plan
i. Availability of electric safety plan
j. OHS Training
k. PPE availability

Negatives Impacts

a. There may be flood risk associated with operation error. This is likely to occur when the impoundment level of the dam exceeds the safety level.
### Table 6.5: Identified Potential Impacts and Rating - Pre Construction Phase

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Component</th>
<th>Sub-component</th>
<th>Potential Impact</th>
<th>Description</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-construction Phase</td>
<td>Environment</td>
<td>Air</td>
<td>Fugitive dust and exhaust fumes from vehicles</td>
<td>Direct Negative short-term/local/widespread Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil</td>
<td>Soil compaction and soil structure changes due to influx and stationary positioning of heavy duty equipment and vehicles</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium Low</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leakages from stacked equipment and subsequent seeping through of contaminated oil and chemicals</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noise</td>
<td>Increase above permissible noise level, (90dB) due to movement of vehicles, equipment and machines to the pumping stations</td>
<td>Direct Negative short-term Local/widespread Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetation</td>
<td>De-vegetation – Loss of flora and fauna</td>
<td>Direct Negative short-term Local/widespread Reversible/Irreversible</td>
<td>Medium</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td>Project Phase</td>
<td>Component</td>
<td>Sub-component</td>
<td>Potential Impact</td>
<td>Description</td>
<td>Likelihood</td>
<td>Consequence</td>
<td>Rating</td>
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<tr>
<td>Pre-construction Phase</td>
<td>Social</td>
<td>Traffic</td>
<td>Traffic congestion/travel delay</td>
<td>Direct Negative short-term/Long-term Local/widespread Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noise</td>
<td>Nuisance to surrounding communities/settlements</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Others</td>
<td>Accidental destruction of property particularly farmland/crops</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium low</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grievances</td>
<td></td>
<td>Direct/Indirect Negative short-term Local Reversible</td>
<td>Low</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accidents involving vehicles or pedestrians</td>
<td></td>
<td>Direct/Indirect Negative short-term Local Reversible</td>
<td>Medium low</td>
<td>Considerable</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blocked access route to farmlands</td>
<td></td>
<td>Direct/Indirect Negative short-term Local Reversible</td>
<td>Medium Low</td>
<td>Considerable</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Occupational Health and Safety</td>
<td>Air</td>
<td>Exposure to respiratory disease risks from dusts, exhaust fumes of equipment and vehicles could lead to death</td>
<td>Direct Negative short-term /long-term Local/wide spread Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Major</td>
</tr>
<tr>
<td>Project Phase</td>
<td>Component</td>
<td>Sub-component</td>
<td>Potential Impact</td>
<td>Description</td>
<td>Likelihood</td>
<td>Consequence</td>
<td>Rating</td>
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</tr>
<tr>
<td>Pre-construction Phase</td>
<td>Social</td>
<td></td>
<td>Collapse of heavy equipment being conveyed by vehicles/injury to unsuspecting persons</td>
<td>Direct / indirect negative; Short-term/Long-term local reversible</td>
<td>Medium high</td>
<td>Great</td>
<td>Major</td>
</tr>
<tr>
<td>Pre-construction Phase</td>
<td>Noise</td>
<td></td>
<td>Noise pollution</td>
<td>Direct negative; Short-term local/widespread reversible</td>
<td>Medium</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Health</td>
<td></td>
<td>Exposure to carbon monoxide emissions (CO)</td>
<td>Direct negative; Short-term local reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
**Table 6.6: Identified Potential Impacts and Ratings - Construction Phase**

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Component</th>
<th>Sub-component</th>
<th>Potential Impact</th>
<th>Description</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Environment</td>
<td>Climate Change</td>
<td>GHG Emissions</td>
<td>Direct /indirect Negative short-term/Long-term Local/widespread Irreversible</td>
<td>Medium low</td>
<td>Considerable</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction</td>
<td>Environment</td>
<td>Air</td>
<td>Cement dust, fugitive dust, exhaust fumes, hazardous gases (NOx, CO, SOx, PM2.5, PM10)</td>
<td>Direct Negative short-term/Long-term Local/widespread Irreversible</td>
<td>Medium high</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Release of pungent smell as a result of decaying matter from silted material removed from canal</td>
<td>Direct Negative short-term/Long-term Local/widespread Irreversible</td>
<td>Medium</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Volatile vapour release from exposed paints and hazardous chemicals into the atmosphere</td>
<td>Direct Negative short-term/Long-term Local/widespread Irreversible</td>
<td>Medium</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Water quality/hydrology</td>
<td>Discharge of sediment laden run-off into water bodies</td>
<td>Direct/Indirect Negative Short-term/Long-term Local/Widespread Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Project Phase</td>
<td>Component</td>
<td>Sub-component</td>
<td>Potential Impact</td>
<td>Description</td>
<td>Likelihood</td>
<td>Consequence</td>
<td>Rating</td>
</tr>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contamination from (oils, fuel, agrochemicals, chemical substances etc.)</td>
<td>Direct/indirect Negative short-term/long-term Local/widespread Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Project Phase</td>
<td>Component</td>
<td>Sub-component</td>
<td>Potential Impact</td>
<td>Description</td>
<td>Likelihood</td>
<td>Consequence</td>
<td>Rating</td>
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<td>---------------</td>
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</tr>
<tr>
<td>Construction Phase</td>
<td>Environment</td>
<td>Water quality/hydrology</td>
<td>Contamination by human faecal wastes</td>
<td>Direct/indirect Negative short-term/long-term Local/widespread Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Construction Phase</td>
<td>Environment</td>
<td>Soil/Geology</td>
<td>Loss or compaction of top soil due to movement of heavy vehicles and equipment</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium-high</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Construction Phase</td>
<td>Environment</td>
<td>Soil/Geology</td>
<td>Contamination of soil by oil spills, fuel, PCB etc.</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium-low</td>
<td>Considerable</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction Phase</td>
<td>Environment</td>
<td>Soil/Geology</td>
<td>Destabilization of soil structure/ Creation of erosion sites</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Construction Phase</td>
<td>Environment</td>
<td>Noise</td>
<td>Extensive noise pollution as a result of on-going rehabilitation works.</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium-high</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Project Phase</td>
<td>Component</td>
<td>Sub-component</td>
<td>Potential Impact</td>
<td>Description</td>
<td>Likelihood</td>
<td>Consequence</td>
<td>Rating</td>
</tr>
<tr>
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<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
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<td>----------</td>
</tr>
</tbody>
</table>
| Construction  | Environment  | Waste         | Increased generation of solid and liquid wastes | Direct Negative  
short-term  
Local Reversible | Medium     | Considerable  | Moderate |
|               |              | Biodiversity  | Loss of flora and fauna | Direct Negative  
short-term /Long term  
Local Reversible/irreversible | Medium High | Little        | Minor    |
| Social        | Farming Activities | Disruptions to farming activities due to reduced access to water during rehabilitation works | Direct Negative  
short-term  
Local Reversible | Medium     | Great         | Major    |
|               |              | Block access route to farmlands | Direct Negative  
short-term  
Local Reversible | Medium     | Considerable  | Moderate |
|               | Grievance    | Hindrance to sources of livelihood e.g. unavailability of water for domestic use and business reliant activities (ma ruwa) | Indirect Negative  
short-term  
Local Reversible | Medium     | Considerable  | Moderate |
|               |              | Inconvenient search for alternative sources of water by women and children | Indirect Negative  
short-term  
Local Reversible | Medium     | Considerable  | Moderate |
|               |              | Damage to farm areas and crops | Direct Negative  
short-term  
Local Reversible | Medium     | Considerable  | Moderate |
### Construction Phase

#### Social

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Component</th>
<th>Sub-component</th>
<th>Potential Impact</th>
<th>Description</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Public</td>
<td>Negative perception among residents and commercial establishments etc. about the project.</td>
<td>Direct</td>
<td>Medium</td>
<td>Little</td>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Traffic</td>
<td>Traffic</td>
<td>Delay in travel time</td>
<td>Direct</td>
<td>Medium</td>
<td>Little</td>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Education</td>
<td>Noise disturbances to the serene learning environments.</td>
<td>Direct</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>Health</td>
<td>Increase in sexual activities leading to possible spread of STIs</td>
<td>Indirect</td>
<td>Medium high</td>
<td>Great</td>
<td>Maj</td>
<td></td>
</tr>
<tr>
<td>Incidence of respiratory diseases due to air contamination by fugitive dusts and exhaust fumes</td>
<td>Direct</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence of water borne diseases</td>
<td>Direct</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Phase</td>
<td>Component</td>
<td>Sub-component</td>
<td>Potential Impact</td>
<td>Description</td>
<td>Likelihood</td>
<td>Consequence</td>
<td>Rating</td>
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</tr>
<tr>
<td>Construction Phase</td>
<td>Social</td>
<td>Environmental hygiene and aesthetics</td>
<td>Complaints</td>
<td>Direct Negative short-term Local Reversible</td>
<td>High</td>
<td>Considerable</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td>Behaviour</td>
<td></td>
<td>Occurrence of on-site social vices</td>
<td>Indirect Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Noise</td>
<td></td>
<td>Nuisance due to increase in noise levels</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td></td>
<td>Row Delay – delay or reduced access to water for plants in specific farm rows</td>
<td>Direct /Indirect Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Power Outage</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td>Project Phase</td>
<td>Component</td>
<td>Sub-component</td>
<td>Potential Impact</td>
<td>Description</td>
<td>Likelihood</td>
<td>Consequence</td>
<td>Rating</td>
</tr>
<tr>
<td>---------------</td>
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</tr>
<tr>
<td>Construction Phase</td>
<td>Social</td>
<td>Project performance</td>
<td>Conflicts between contractors may disrupt completion of tasks on or before the proposed project end date.</td>
<td>Direct Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Direct/Indirect Negative Short-term/long-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Occupational Health and Safety</td>
<td>Personnel safety</td>
<td>Injuries, falls, collapse of structures on personnel during demolition, bursts, accidents, electric shocks, electrocution, explosions, flashovers, fires, leakages, release of hazardous (electric, electromagnetic) energy, accidents etc.</td>
<td>Direct/Indirect Negative Short-term/Long-term Local/widespread Reversible</td>
<td>Medium high</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
### Table 6.7 Identified Impacts and Ratings - Operational Phase

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Component</th>
<th>Sub-component</th>
<th>Potential Impact</th>
<th>Description</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational Phase</td>
<td>Environment</td>
<td>Air</td>
<td>Exhaust fumes from equipment</td>
<td>Direct Negative Short-term/long-term Local/widespread Irreversible</td>
<td>Medium low</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil/Geology</td>
<td>Groundwater contamination from accidental spills and increased use of agrochemicals</td>
<td>Indirect Negative Short-term/Long-term Local Irreversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Changes in soil physical and chemical attributes</td>
<td>Indirect Negative Short-term/Long-term Local Irreversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leaching of water soluble nutrients</td>
<td>Indirect Negative Short-term/Long-term Local Irreversible</td>
<td>Medium Low</td>
<td>Little</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Build-up of salts from excess agrochemicals</td>
<td>Indirect Negative Short-term/Long-term Local Irreversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noise</td>
<td>Nuisance due to increase in noise levels</td>
<td>Direct Negative Short-term/long-term Local Reversible</td>
<td>Low</td>
<td>Little</td>
<td>Negligible</td>
</tr>
</tbody>
</table>
## Project Phase

### Component

<table>
<thead>
<tr>
<th>Sub-component</th>
<th>Potential Impact</th>
<th>Description</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water quality and hydrology</td>
<td>Contaminated (with agrochemicals and human waste) water run-off into surface water etc.</td>
<td>Indirect Negative Short-term/long-term Local/widespread Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Employment</td>
<td>Loss of employment (engaged contract staff on the project)</td>
<td>Indirect Negative short-term Local Reversible</td>
<td>High</td>
<td>Little</td>
<td>Moderate</td>
</tr>
<tr>
<td>Behaviour</td>
<td>Poor water management practices</td>
<td>Indirect Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Health</td>
<td>Increase in water borne diseases (malaria, typhoid, cholera)</td>
<td>Indirect Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
<tr>
<td>Conflict</td>
<td>Human-livestock-wildlife conflict</td>
<td>Indirect Negative short-term Local Reversible</td>
<td>Medium</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

### Occupational Health and Safety

<table>
<thead>
<tr>
<th>Component</th>
<th>Potential Impact</th>
<th>Description</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel safety</td>
<td>Mechanical injuries, electric shocks, electrocution, explosions, flashovers, fires, leakages, falls, release of hazardous (electric, electromagnetic) energy, accidents etc</td>
<td>Direct Negative short-term/Long-term Local/widespread Reversible</td>
<td>Medium high</td>
<td>Considerable</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 Overview

The range of environmental, social and occupational health and safety issues associated with the rehabilitation works for the Bakolori Irrigation Scheme Project will be described in a matrix table format for the Environmental and Social Management Plan (ESMP). The table also includes a column for Monitoring Indicators and Monitoring Frequencies.

It outlines the corresponding mitigation measures for potential environmental and social impacts; and occupational health and safety risks that are envisaged to occur during activities (See annex 6 for the outlined OHS Plan). Since the project consists of civil, electrical and mechanical rehabilitation works basically, majority of the environmental and social impacts and occupational hazards will be expected to arise during the construction phase of the project. The ESMP also covers potential impacts as perceived during the pre-construction and operation phases.

7.2 Institutional Arrangement for ESMP and Monitoring Plan

It is planned that the environmental and social impacts and their designed enhancement and mitigation measures shall be monitored during implementation of the construction/rehabilitation works and operation phases. The roles and responsibilities for monitoring the environmental and social impacts and the implementation of the ESMP are as follows:

Overall project coordination will be housed in FMWR, which hosts the Project Coordination Unit (PCU). The PCU will be in charge of the daily coordination, supervision and implementation of the project’s components. The Zamfara State Ministry of Water Resources, Sokoto-Rima Basin Development Authority (SRBDA) and the Bakolori Irrigation Project Management Office (BIPMO) will oversee the day-day project management and ensure that environmental and socio-economic concerns and management as elucidated in the ESIA are integrated into all aspects of project implementation. The State Ministry of Environment (SME), National Environmental Standards Regulatory Enforcement Agency (NESREA), and Zamfara State Environmental Protection Agency (ZSEPA) will monitor, evaluate and audit the implementation of the ESMP to ensure that the rehabilitation works and project operations meet “best environmental practices”. BIPMO will also, be responsible for the development of project specific management plans as described in the ESMP (e.g. monitoring program, site-specific safety management plans, site-specific waste management plans, health, safety and environmental management plans, etc.)
The SME/ZSEPA will undertake compliance monitoring and periodic inspection of pumping stations and other work areas. The FMWR through the PCU and SRBDA will also be involved in monitoring in of ESMP implementation.

The ESMP shall be included in the contract documents for successful project implementation contractors. Awareness creation exercises on HIV/AIDS, environmental protection and personal hygiene and sanitation shall also be undertaken for contactors personnel and all stakeholders involved in project implementation.

7.2.1 Environmental and Social Management Plan Budget

The total cost for the ESMP for the Bakolori Irrigation Scheme Project Rehabilitation Works is estimated at USD 1,649,512.15 *(One Million, Six Hundred and Forty Nine Thousand, Five Hundred and Twelve US Dollars, Fifteen Cents)*. Table 7.0 gives a breakdown of the estimated costs.

*Table 7.0 Budget and Responsibilities for ESMP Implementation*

<table>
<thead>
<tr>
<th>Item</th>
<th>Responsibility</th>
<th>Cost Breakdown</th>
<th>Cost Estimate in Nigerian Naira (₦)</th>
<th>Cost Estimate in Us Dollars (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhancement of +ve impacts and Mitigation of –ve impacts</td>
<td>Contractor, PCU, SRBDA, BIPMO</td>
<td>184,560,800</td>
<td>1,153,505</td>
<td></td>
</tr>
<tr>
<td>Management of ESMP Implementation</td>
<td>PCU, SRBDA, BIPMO</td>
<td>5% of Mitigation Cost</td>
<td>9,228,040</td>
<td>57,675.25</td>
</tr>
<tr>
<td>Monitoring, Evaluation &amp; Audit</td>
<td>FMWR, SRRBDA, BIPMO</td>
<td>25% of Mitigation Cost</td>
<td>46,140,200</td>
<td>288,376.25</td>
</tr>
<tr>
<td><strong>SUB- TOTAL</strong></td>
<td></td>
<td><strong>239,929,040</strong></td>
<td><strong>1,499,556.5</strong></td>
<td></td>
</tr>
<tr>
<td>Contingency</td>
<td>10% of Sub-Total</td>
<td>23,992,904</td>
<td>149,955.65</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>263,921,944</strong></td>
<td><strong>1,649,512.15</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Table 7.1: ESMP - PRE-CONSTRUCTION PHASE  
**Bakolori Irrigation Scheme Project Rehabilitation**

<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Monitoring Indicators</th>
<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air</strong></td>
<td>Mobilization of workers, equipment and other materials into Bakolori Irrigation Scheme work areas</td>
<td>Mobilization of workers, equipment and other materials into Bakolori Irrigation Scheme work areas</td>
<td>Increase in amounts of fugitive dusts and exhaust fumes from movement of heavy-duty vehicles and equipment into work areas.</td>
<td>Sprinkling of water via spraying devices to limit dusts.</td>
<td>Air quality parameters are within permissible Limits</td>
<td>Twice monthly</td>
<td>Mitigation: SRBDA, BIPMO and Contractors</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
<td>Mobilization of workers, equipment and other materials into Bakolori Irrigation Scheme work areas</td>
<td>Loss of top soil and soil compaction due to movement of vehicles to site and stacking of heavy-duty equipment</td>
<td>Limit zone of vehicle and equipment weight impacts (designate an area for parking and stacking equipment)</td>
<td>Visible demarcation of vehicles and equipment limit zone</td>
<td>Weekly</td>
<td>Mitigation: PCU, SRBDA, BIPMO and Contractors</td>
<td>8,500</td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Mobilization of workers, equipment and other materials into Bakolori Irrigation Scheme work areas</td>
<td>Leakages from stacked equipment and subsequent intrusion of oil and chemical substances into soil.</td>
<td>Ensure fastening of loose parts (bolts, nuts); Install impermeable surface at the limit zone to contain potential leakages</td>
<td>Installation of impermeable platform at limit zone.</td>
<td>Weekly</td>
<td>Monitoring: SME, ZSEPA, PCU, BIPMO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Environment

#### Noise

<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Monitoring Indicators</th>
<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
</table>
| Environment | Noise | Mobilization of workers, equipment and other materials into Bakolori Irrigation Scheme work areas | Increase above permissible noise level, (90dB) during movement of vehicles, equipment and machines (site-specific and widespread) | The effective control of noise from vehicles and equipment during this phase may be achieved by considering the following techniques:  
- Alternative design options;  
- Mitigation at the source;  
- Mitigation along the path; and  
- Mitigation at the receiver  
For minimal disturbance it will be advised that equipment is transported in the evening or night hours when traffic is less.  
Work should be performed during normal working hours (suggested 6am to 6pm) | Options for noise impact mitigation are being implemented | Weekly | PCU, BIPMO, SRBDA, Contractors | Mitigation: PCU, BIPMO, SRBDA, Contractors  
Monitoring: SME, ZSEPA | 1,500 |
| Environment | Vegetation | Vegetation clearing in preparation for lining of unlined secondary and tertiary canals | Displacement of soil fauna and damage to flora. | Contractors should limit vegetation clearing to minimum areas required particularly areas with indigenous vegetation | Vegetation clearing is limited to precise areas | Monthly | Contractors | 1,800 |
| Environment | Vegetation | Predisposing of soils to erosion | Cleared areas should be re-vegetated with beneficial local species known to mitigate against erosion | Re-vegetation is ongoing where appropriate. | Monthly | PCU | - |

**SUB-TOTAL** | - | 16,800
<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Monitoring Indicators</th>
<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>Traffic</td>
<td>Mobilization of workers, equipment and other materials into BIP</td>
<td>Traffic congestion/travel delay along some major roads (Gasau–Sokoto road).</td>
<td>Apply lane configuration changes to affected roads and streets.</td>
<td>Lane configuration changes are being made where applicable.</td>
<td>Daily</td>
<td>Mitigation: Contractors, FRSC (Federal Road Safety Corps) Monitoring: FRSC</td>
<td>2,500</td>
</tr>
<tr>
<td></td>
<td>Noise</td>
<td>Mobilization of workers, equipment and other materials into BIP areas</td>
<td>Nuisance to nearby residential areas</td>
<td>Retrofit with suitable cost effective vehicle sound proofing materials/technologies.</td>
<td>Retrofitting with vehicle sound proof materials is being performed</td>
<td>Daily</td>
<td>Mitigation: Contractors Monitoring: SME, ZSEPA</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td>Air</td>
<td>Mobilization of workers, equipment and other materials into Bakolori Irrigation Scheme work areas</td>
<td>Exposure to health risks from fugitive dusts and exhausts fumes.</td>
<td>Provision of facemasks to residents and project personnel.</td>
<td>Provision of face masks and appropriate PPEs are being provided.</td>
<td>Weekly</td>
<td>Mitigation: SME, PCU, BIP, Public Health depts. of Talata Mafara, Bakura and Maradun LGAs Monitoring: ZSEPA</td>
<td>1,050</td>
</tr>
<tr>
<td>Social</td>
<td>Land use</td>
<td>Land use</td>
<td>Conflict owing to speculation about involuntary displacement during the construction</td>
<td>BIPMO will carry out an extensive enlightenment program to inform farmers and communities on the aim, scope and nature of the work</td>
<td>Documented evidence of enlightenment carried out showing method, coverage and dates of programs</td>
<td>Monthly for 6 months before and during construction/rehabilitation phase</td>
<td>BIPMO</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conflict between farmers and herdsmen</td>
<td>BIPMO will ensure availability of potable water and irrigation water services to affected community in Jankarawa in line with agreed terms</td>
<td>Evidence of portable water points</td>
<td>Evidence of irrigation water to farmers</td>
<td></td>
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</tbody>
</table>
### Procurement

<table>
<thead>
<tr>
<th>Committee from among the parties</th>
<th>Minutes of meeting held by committee</th>
<th>Number of issues resolved by committee</th>
</tr>
</thead>
</table>

### Grazing Areas

- A grazing route and grazing area should be dedicated to herdsmen.

### Minutes of Meeting

- BIPMO should seek assistance from Zamfara State Government in providing adequate security.
- Use of media adverts and correspondences that establish a peaceful and workable environment of the project area.
- BIPMO will carry out an extensive advertisement and will ensure that selected contractor have experience of working in the northern Nigeria.

### Evidence of Advertisements
- Evidence of advert;
- Evidence of selection criteria;
- Evidence of similar job done in same circumstance;
- Once before final approval of engagement of contractor.

### Procurement

- Perceived insecurity which may influence best practicing contractors from not bidding.
- Procurement

### Perceived Insecurity

- Which may influence best practicing contractors from not bidding.
- Use of media adverts and correspondences that establish a peaceful and workable environment of the project area.
- BIPMO will carry out an extensive advertisement and will ensure that selected contractor have experience of working in the northern Nigeria.

### BIPMO

- BIPMO should seek assistance from Zamfara State Government in providing adequate security.
- Use of media adverts and correspondences that establish a peaceful and workable environment of the project area.
- BIPMO will carry out an extensive advertisement and will ensure that selected contractor have experience of working in the northern Nigeria.

### Use of Media

- Use of media adverts and correspondences that establish a peaceful and workable environment of the project area.
- BIPMO will carry out an extensive advertisement and will ensure that selected contractor have experience of working in the northern Nigeria.

### Public Safety

- Transportation of heavy equipment will be carried out during off peak hours when it will not disturb public movement.
- Where movement cannot be avoided during work hour, the contractor must attach a warning signal.

### Transportation

- Transportation of heavy equipment will be carried out during off peak hours when it will not disturb public movement.
- Where movement cannot be avoided during work hour, the contractor must attach a warning signal.

### Log Record

- Weekly during pre-construction phase.

### Resistance to PPP

- Lack of enlightenment about PPP project failure.

### BIPMO

- BIPMO will carry out enlightenment/sensitization campaign in the project communities.

### Evidence of Campaigns

- Schedule of campaigns
- Evidence of campaigns

### Schedule of Campaigns

- Twice in each of the 3 LGAs

### Contractor PCU

- 10,000
<table>
<thead>
<tr>
<th>Others</th>
<th>Mobilization of workers, equipment and other materials into Bakolori Irrigation Scheme work areas.</th>
<th>Disruption of vehicle and pedestrian access to surrounding farmlands and part of the roads where rehabilitation works will be conducted</th>
<th>Adequate and timely sensitization of PAPs; Lane configuration</th>
<th>Adequate and timely sensitization program is being conducted Lane configuration change have been made</th>
<th>Monthly</th>
<th>Mitigation: PCU, BIPMO, MO</th>
<th>2,500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Grievances and negative community perception about the project.</td>
<td>Adequate and timely sensitization of PAPs</td>
<td>Sensitization exercise are conducted</td>
<td></td>
<td>PCU, Independent Consultant Contractors, Independent Consultant</td>
<td>8,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Destruction of properties (public/private) during vehicle and equipment movement</td>
<td>Training and sensitization of personnel (drivers) in road safety and traffic regulations; Ensure class “H” accreditation for heavy duty vehicle drivers, and Mental status screening for drivers.</td>
<td>Evidence of training in road safety and traffic regulations; Evidence of class “H” accreditation and mental screening for drivers</td>
<td>Monthly</td>
<td>PCU, Independent Consultant Contractors, Independent Consultant</td>
<td>17,000</td>
</tr>
<tr>
<td><strong>SUB-TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>47,750</strong></td>
</tr>
<tr>
<td>Component</td>
<td>Sub-component</td>
<td>Activities</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
<td>Monitoring Frequency</td>
<td>Institutional Responsibility</td>
</tr>
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</tr>
<tr>
<td>Air</td>
<td>Occupational Health and Safety</td>
<td>Mobilization of workers, equipment and other materials into pumping stations and work areas</td>
<td>Respiratory disease risks from exposure to exhaust fumes of equipment and vehicles</td>
<td>Institute workers respiratory protection program (WRPP)</td>
<td>Institution of WRPP</td>
<td>Weekly</td>
<td>Mitigation: Independent Consultant, Contractors Monitoring: ZSEPA, PCU, SRBDA, BIPMO</td>
</tr>
<tr>
<td>Noise</td>
<td>Occupational Health and Safety</td>
<td>Mobilization of workers, equipment and other materials into pumping stations and work areas</td>
<td>Noise pollution</td>
<td>Institute noise control plan</td>
<td>Institution of noise control plan</td>
<td>Weekly</td>
<td>Mitigation: Independent Consultant, Contractors Monitoring: ZSEPA, PCU, SRBDA, BIPMO</td>
</tr>
<tr>
<td>Accidents</td>
<td>Occupational Health and Safety</td>
<td>Mobilization of workers, equipment and other materials into pumping stations and work areas</td>
<td>Accidents involving pedestrians</td>
<td>Contractor(s) education and training on pedestrian safety</td>
<td>Training has been conducted</td>
<td>One-off</td>
<td>PCU, BIPMO, SRBDA, Independent Consultant</td>
</tr>
<tr>
<td>Personnel Safety</td>
<td></td>
<td>Collapse of pipes, heavy equipment etc. being conveyed to rehabilitation work areas</td>
<td>Conduct haulage safety training</td>
<td>Training has been conducted</td>
<td>One-off</td>
<td>Contractor</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Enhanced fastening of equipment to carriage section of vehicles</td>
<td>Contractor(s) Compliance</td>
<td>Weekly</td>
<td>Contractor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Attack from dangerous animals during de-vegetation activities</td>
<td>Conduct safety and first aid training</td>
<td>Training has been conducted</td>
<td>One-off</td>
<td>Contractor</td>
</tr>
</tbody>
</table>

SUB-TOTAL = 34,100

PRE-CONSTRUCTION PHASE TOTAL = 98,750
<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Monitoring Indicators</th>
<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Climate Change</td>
<td>Operation of equipment used during the construction phase</td>
<td>GHG Emissions</td>
<td><strong>Fuel switching</strong>: Fuel switching from high- to low-carbon content fuels (where available) can be a relatively cost effective means to mitigate GHG emissions during this phase. Transition to renewable energy sources i.e. solar energy (where applicable) <strong>Energy efficiency</strong>: Machines e.g. generator plants could be turned off when not in use, in order to reduce carbon emissions. <strong>Multiple trips reduction</strong>: In order to reduce vehicular movement and subsequent increased carbon emissions. Hire vehicles, plants and equipment that are in good condition (current models) generally less than 3 yrs. old.</td>
<td>Compliance to proffered mitigation measures.</td>
<td>Weekly</td>
<td>Mitigation: PCU, BIPMO, SRBDA Contractors</td>
<td>5,000</td>
</tr>
<tr>
<td>Component</td>
<td>Sub-component</td>
<td>Activities</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
<td>Monitoring Frequency</td>
<td>Institutional Responsibility</td>
<td>Costs (USD)</td>
</tr>
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</tr>
<tr>
<td>Environment</td>
<td>Air</td>
<td>Operation of equipment used during the construction phase</td>
<td>Fugitive and cement dusts</td>
<td>Routine watering of the rehabilitation sites</td>
<td>Contractors Compliance</td>
<td>Daily</td>
<td>Mitigation: Contractors</td>
<td>Costs may not apply as water is available in the project area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rehabilitation works</td>
<td>Fugitive and cement dusts</td>
<td>Routine watering of the rehabilitation sites</td>
<td>Contractors Compliance</td>
<td>Daily</td>
<td>Mitigation: Contractors</td>
<td>Costs may not apply as water is available in the project area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>De-silting</td>
<td>Release of pungent odour as a result of decaying matter from removed silt</td>
<td>Covering of removed silt</td>
<td>Contractors Compliance</td>
<td>Daily</td>
<td>Mitigation: Contractors</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy equipment operations during construction, welding and galvanizing works</td>
<td>Exhaust fumes, hazardous gases (NOx, CO, SOx, SPM), Oxides from welding activities.</td>
<td>Wet Right-of-Way to reduce dust production</td>
<td>QC and QA are in practice</td>
<td>Monthly</td>
<td>Mitigation: PCU, BIPMO, SRBDA Contractors</td>
<td>1,800</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Test Procedures – Routine measuring of HC and CO concentrations during rehabilitation works should be employed for PMS powered vehicles. Diesel (AGO) vehicles should be tested for exhaust opacity during unloaded engine free acceleration periods.</td>
<td>Contractors Compliance</td>
<td>Monthly</td>
<td>Monitoring: PCU, SRBDA, BIPMO Contractors</td>
<td>10,250</td>
<td></td>
</tr>
<tr>
<td>Component</td>
<td>Sub-component</td>
<td>Activities</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
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<td>Monitoring Frequency</td>
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</tr>
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</tr>
</tbody>
</table>
| Environment | Air | Mechanical installations and fittings (pumps, valves etc.) | Release of possible hazardous welding fumes during minor welding works | **Quality Control** – Routine equipment efficiency audits  
**Quality Assurance** – Continuous training of contractor(s) personnel on air quality management  
**Welding design consideration** – Use of properly designed welds and best practices in welding operations to ensure lowest amount of welding fumes | Contractor(s) Compliance | Monthly | Mitigation: Contractors  
Monitoring: PCU, BIPMO | 4,500 |
<p>| | | Painting and wood treatment works | Volatile vapour release from exposed paints and hazardous chemicals into the atmosphere | <strong>Welding design consideration</strong> – Use of properly designed welds and best practices in welding operations to ensure lowest amount of welding fumes | Contractor(s) Compliance | Weekly | Mitigation: Contractors | 4,500 |
| | Water quality/Hydrology | All rehabilitation works | Contamination of surface water (discharge of sediment laden run-off into drainages, waterways etc.) | Attempts to dispose of sediment-laden run-off into surface water should be discouraged and prevented. Implement site-specific waste management plans | Contractor(s) Compliance | Daily | Mitigation: BIPMO, SRBDA, Contractors | 5,250 |
| | | Rehabilitation of existing drainages, canals | Interruption of surface water flows during construction | Do not hamper drainage of surface water (e.g. to Sokoto and Bobo rivers). Plan for restoration measures after construction if hampered. | Contractor(s) Compliance | Daily | Contractors Monitoring: ZSEPA | 1,000 |
| Environment | Water quality/Hydrology | Defecation into | Increase in | Device feasible alternatives to collect sediment laden water run-off | Contractor(s) Compliance | Daily | Contractors Monitoring: ZSEPA | 1,125 |</p>
<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Monitoring Indicators</th>
<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Water quality/Hydrology</td>
<td>Dredging activities</td>
<td>Increase in water turbidity, TDS, including possible introduction of some minerals that may be harmful to crops in solution</td>
<td>Drainage during this operation should be properly channeled to avoid any harm to the crops Regular sampling to ascertain water quality</td>
<td>PCU, BIPMO and Contractor Compliance</td>
<td>Daily – for the duration of dredging activities</td>
<td>Contractor, BIPMO</td>
<td>10,000</td>
</tr>
<tr>
<td>Environment</td>
<td>Water quality/Hydrology</td>
<td>Flood Draining</td>
<td>Release of agrochemicals into water bodies</td>
<td>Device alternative means for flood draining for farmlands such as creation of temporary channels and use of pump machines and tankers.</td>
<td>Contractor's Compliance</td>
<td>Monthly</td>
<td>Contractor</td>
<td>3000</td>
</tr>
<tr>
<td>Environment</td>
<td>Water quality/Hydrology</td>
<td>Generation of sewage overtime (from use of temporary mobile toilets by personnel involved in civil works)</td>
<td>Pathogenic water coliform bacteria facilities in the Bakolori Irrigation Project Scheme area; Provide sanitary mobile toilets around the project work areas as temporary support during rehabilitation of existing ones.</td>
<td>Liaise with the municipal sewage collection authorities for collection and treatment of waste with ZSEPA</td>
<td>PCU/BIPMO Compliance</td>
<td>Monthly</td>
<td>Mitigation: PCU, BIPMO Monitoring: SME, ZSEPA</td>
<td>6,000</td>
</tr>
<tr>
<td>Environment</td>
<td>Water quality/Hydrology</td>
<td>Water Impoundment along the channel to allow for certain rehabilitation/construction works</td>
<td>Upwelling capable of flooding some areas upstream</td>
<td>Shorten the duration of every impoundment Installation of gauge for flood stage monitoring</td>
<td>PCU, BIPMO, Contractor Compliance</td>
<td>Daily</td>
<td>Mitigation: Contractor, BIPMO Monitoring: PCU, BIPMO, SRBDA, NIHSA</td>
<td>4,000</td>
</tr>
</tbody>
</table>

**Note:**
- **Compliance** indicates the level of responsibility and monitoring frequency.
- **Contractors** are responsible for implementing the mitigation measures, and monitoring is handled by the responsible authority.
- **Costs** are in USD and reflect the estimated expenses associated with each activity.
## Environmental Impact Assessment (ESIA) Report for the Bakolori Irrigation Scheme

### Soil/Geology

<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
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<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil/Geology</td>
<td>Movement of heavy vehicles/Stationary vehicles and equipment</td>
<td>Surface soil compaction thus affecting soil-water balance</td>
<td>Creation of limit zones</td>
<td>PCU, BIPMO and Contractor's Compliance</td>
<td>Monthly</td>
<td>PCU, Contractors</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Soil/Geology</td>
<td>Contamination by oil spills, lubricants and other chemicals</td>
<td>Pollution of soil and groundwater</td>
<td>All oil and lubricants should be sited on an impervious base and should have drip pans. The storage area should be far from water course. All containers should be clearly labeled</td>
<td>Contractor Compliance</td>
<td>Periodically</td>
<td>Mitigation: Contractor Monitoring: BIPMO</td>
<td>7,000</td>
<td></td>
</tr>
</tbody>
</table>

### Environment

<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
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<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Installation and decommissioning of transformers in pumping stations</td>
<td>Contamination of surface waters and groundwater by PCBs</td>
<td>Implement site-specific PCBs management plan</td>
<td>BIPMO Compliance</td>
<td>Bi-Monthly</td>
<td>MWR, BIPMO, Independent Consultant Monitoring: PCU, SME, ZSEPA</td>
<td>Implement site-specific PCBs management plan</td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>Excavations for trench digging</td>
<td>Loss of top soil; possible minor to moderate soil instability</td>
<td>Ensure excavation is limited to desired areas for trenches</td>
<td>MWR/BIPMO Compliance</td>
<td>Monthly</td>
<td>BIPMO, SRBDA Contractors</td>
<td>1,200</td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>De-silting of lined and unlined canals</td>
<td>Creation of erosion prone sites; Stockpile of silted material will be generated</td>
<td>Demarcation of erosion prone zones; Deposited materials should be surrounded by a perimeter; Creation of limit zone – use of burrow pits</td>
<td>Contractor Compliance</td>
<td>One-off</td>
<td>Mitigation: Contractor, BIPMO Monitoring: BIPMO, Farmers Association</td>
<td>15,500</td>
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</tr>
<tr>
<td>Environment</td>
<td>Excavation of soil</td>
<td>Exposure of soil to gully erosion</td>
<td>Excavated to be minimized and filled to ground level</td>
<td>Contractors Compliance</td>
<td>Weekly</td>
<td>BIPMO, Contractors, Independent</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>Extension of unlined canal</td>
<td>Ensure all canals are lined</td>
<td>Contractors</td>
<td>One-off</td>
<td>BIPMO,</td>
<td>50,000</td>
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</table>
## ESIA Report for the Bakolori Irrigation Scheme

<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
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<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Noise</td>
<td>Rehabilitation and construction of irrigation network</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Rehabilitation of drainage structures</td>
<td>Extensive noise site-specific pollution as a result of on-going construction works.</td>
<td>Mitigation at source (for all activities)</td>
<td></td>
<td></td>
<td>Contractor, BIPMO, PCU, SME, ZSEPA</td>
<td>23,250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rehabilitation of standard structures</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Rehabilitation of road networks</td>
<td></td>
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<td></td>
<td></td>
<td>Mechanical work</td>
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<td></td>
<td></td>
<td>Electrical works</td>
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<tr>
<td></td>
<td></td>
<td>Equipment off-loading, installations and test running.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Waste</td>
<td></td>
<td>All rehabilitation/costruction works</td>
<td>Increase in waste generated</td>
<td>Implement site-specific waste management plan</td>
<td></td>
<td></td>
<td>Contractor</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Liaise with ZSEPA for effective waste management</td>
<td></td>
<td></td>
<td>Contractor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>De-silting</td>
<td>Removal of silt material from canals</td>
<td>Implement site-specific waste management plan</td>
<td></td>
<td></td>
<td>Contractor</td>
<td>10,000</td>
</tr>
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<td></td>
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</table>
## Component

<table>
<thead>
<tr>
<th>Sub-component</th>
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<th>Potential Impact</th>
<th>Mitigation Measures</th>
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<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Weed removal and handling</td>
<td>Increase in waste generated Dispersion of pollens, unintentional transplanting of weeds</td>
<td>Implement site-specific waste management plan Anti-weed treatment during aesthetic works Use of weeds for mulching to be applied on farmlands</td>
<td>BIPMO and Contractor's Compliance</td>
<td>Monthly</td>
<td>BIPMO, Contractors</td>
<td>3,800</td>
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<tr>
<td>Sanitary Concerns</td>
<td>Increased human faecal waste</td>
<td>Increased human faecal waste</td>
<td>Provision of on-site sanitary facilities</td>
<td>Contractors Compliance</td>
<td>One-off</td>
<td>Mitigation: Contractors, BIPMO</td>
<td>4,000</td>
</tr>
</tbody>
</table>

### SUB-TOTAL – 21,155

<table>
<thead>
<tr>
<th>Social</th>
<th>Livelihood</th>
<th>Rehabilitation of all canals, drainage network, standard structures, road networks</th>
<th>Temporary regulation of water whereby access is reduced; thus disrupting water dependent economic activities (farming, water vendors).</th>
<th>Inform farmers of water supply/disruption schedule Provision of alternative source of water particularly for farming activities Routine for water regulation</th>
<th>Independent Consultants Compliance</th>
<th>One-off</th>
<th>Mitigation: PCU, BIPMO, Independent Consultant Monitoring: SMWR, SMI, PCU, WUA</th>
<th>20,250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>Livelihood</td>
<td>Construction of Main drain</td>
<td>Disruptions to farming activities – (e.g. blocked access to farmlands)</td>
<td>Conduct survey to identify best alternatives to prevent disruptions to livelihood within on &amp; off-site work areas before commencement of rehabilitation works.</td>
<td>Independent Consultants Compliance</td>
<td>One-off</td>
<td>Mitigation: PCU, BIPMO, Independent Consultant Monitoring: SMWR, SMI, PCU, WUA</td>
<td>16,000</td>
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<tr>
<td>Social</td>
<td>Livelihood</td>
<td>Water regulation during rehabilitation works on canals and drains</td>
<td>Disruptions to irrigation activities</td>
<td>Alternative source of water BIPMO Compliance</td>
<td>Weekly</td>
<td>Contractor, MWR, BIPMO</td>
<td>25,000</td>
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</tr>
<tr>
<td>Social</td>
<td>Livelihood</td>
<td>Row Delay – reduced access to water in specific farm rows, possibly leading to poor plant</td>
<td>Alternative channel for water Contractors Compliance</td>
<td>Monthly</td>
<td>Contractor, MWR, BIPMO</td>
<td>25,000</td>
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<tr>
<td>Component</td>
<td>Sub-component</td>
<td>Activities</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
<td>Monitoring Frequency</td>
<td>Institutional Responsibility</td>
<td>Costs (USD)</td>
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<tr>
<td>Social</td>
<td>Traffic</td>
<td>Mobilization of equipment and other materials</td>
<td>Loss of travel time due to heavy concentration of construction/project vehicles on and off the rehabilitation work areas</td>
<td>Lane configuration changes</td>
<td>Contractors Compliance</td>
<td>Weekly</td>
<td>Mitigation: FRSC, Monitoring: PCU, BIPMO</td>
<td>28,500</td>
</tr>
<tr>
<td>Social</td>
<td>Education</td>
<td>Extensive civil work/rehabilitation activities</td>
<td>Grievances and negative perception among residents and commercial establishments about the project</td>
<td>Involve PAPs at certain levels of decision making and implementation of activities</td>
<td>PCU/BIPMO Compliance</td>
<td>Monthly</td>
<td>PCU, BIPMO, WUAs, Monitoring: MWR</td>
<td>13,000</td>
</tr>
<tr>
<td>Social</td>
<td>Health</td>
<td>Continuous civil work activities and steady influx of workforce</td>
<td>Increase in sexual activities leading to possible spread of STIs</td>
<td>Awareness campaign on sexual diseases, and distribution of male and female condoms. Conduct of awareness campaigns</td>
<td>Mitigation: MWR, BIPMO, Public Health dept. of the Talata Mafara, Bakura and Maradun LGAs, Monitoring: SMH</td>
<td>Quarterly</td>
<td>3,750</td>
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<td></td>
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<td>Incidence of respiratory diseases due to air contamination by fugitive dusts and exhaust fumes</td>
<td>Distribute facemasks to residents as a means to reduce allergic reactions and respiratory disease occurrence. Regular sprinkling of water in during construction works. Facemasks are being distributed</td>
<td>Mitigation: MWR, BIPMO, Public Health dept. of the Talata Mafara, Bakura and Maradun LGAs, Contractors Monitoring: SMH</td>
<td>MWR, BIPMO, Public Health dept. of the Talata Mafara, Bakura and Maradun LGAs. Contractors Monitoring: SMH</td>
<td>Monthly</td>
<td>1,050 1,000</td>
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<td>Component Sub-component</td>
<td>Activities</td>
<td>Potential Impact</td>
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<td>Monitoring Frequency</td>
<td>Institutional Responsibility</td>
<td>Costs (USD)</td>
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<tr>
<td>Flood draining</td>
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<td></td>
<td></td>
<td></td>
<td>Creation of temporary channels to collect flood water  Use of pumps and tankers</td>
<td>Compliance</td>
<td></td>
<td>Monitoring: BIPMO</td>
<td>2,000</td>
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</tr>
<tr>
<td>Environmental hygiene and aesthetics</td>
<td>Waste management</td>
<td>Increase in waste generated from construction works</td>
<td>Ensure that all construction wastes are gathered on-site and disposed off according to the available waste disposal operation in the project area.</td>
<td>Contractors Compliance</td>
<td>Weekly</td>
<td>Contractors Monitoring: SME, BIPMO, ZSEPA, FMW</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waste from desilting activities</td>
<td>Stacked silt materials removed from the canal could become breeding site for disease vectors  Deposition of silt matter on adjacent roads and/or farmlands – blocking access to roads and farmlands</td>
<td>Use of silt material to fill gully erosion sites  Proper disposal of silted materials</td>
<td>Contractors Complaints</td>
<td>One-off</td>
<td>Contractors -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behaviour</td>
<td>Implementation of civil works and Rest periods</td>
<td>Occurrence of on-site/off-site social vices (Fights, rape, harassments, theft, vandalism, drug use etc.)</td>
<td>Enforce and ensure proper orientation on acceptable behaviours for construction personnel on/off-site.  Maximize utilization of local workforce.  Regular monitoring of migrant workers.  Awareness campaigns on safe behaviors for local and migrant workers and adjacent communities</td>
<td>Compliance</td>
<td>Monthly</td>
<td>MWR, BIPMO, Contractors Monitoring: SME, ZSEPA, FMW</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>Project performance</td>
<td>Implementation of all construction phase activities</td>
<td>Conflicts between contractors, communities etc. may disrupt completion of tasks.</td>
<td>Good work enforcement program  Conflict resolution, use of grievance redress mechanism (described in the Project RPF)  Regular stakeholders meetings</td>
<td>Compliance</td>
<td>Monthly</td>
<td>MWR, BIPMO, Contractors Monitoring: SME, ZSEPA, FMW</td>
<td>500</td>
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<td>Component</td>
<td>Sub-component</td>
<td>Activities</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
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<td>Monitoring Frequency</td>
<td>Institutional Responsibility</td>
<td>Costs (USD)</td>
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<tr>
<td>Noise</td>
<td></td>
<td>Massive use of heavy machinery for land clearing, leveling and excavation of soil</td>
<td>Hearing impairment for machinery operators</td>
<td>Operators of heavy duty machines must wear ear muffs&lt;br&gt;They must not exceed 8 working hours per day</td>
<td>Evidence of procurement of ear muffs&lt;br&gt;Evidence of use of the PPE&lt;br&gt;Record of signing out time</td>
<td>Daily</td>
<td>Contractor</td>
<td>1,000</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td>Locking of gate valves</td>
<td>Shortage of water and increased suffering to the vulnerable</td>
<td>Shortage of gate valve will be temporal and only when it is necessary to allow for work. This will not pose significant inconvenience</td>
<td>-&lt;br&gt;daily</td>
<td>-</td>
<td>Mitigation: Contractor&lt;br&gt;Monitoring: BIPMO</td>
<td>--</td>
</tr>
<tr>
<td>Dam safety</td>
<td></td>
<td>Rehabilitation of flood dikes and canals</td>
<td>Human/constructon error may cause water over flooding into the farms and adjoining settlement</td>
<td>The control gate must be locked during rehabilitation of dike</td>
<td>-&lt;br&gt;-</td>
<td>-</td>
<td>Mitigation: Contractor&lt;br&gt;Monitoring: BIPMO</td>
<td>-</td>
</tr>
<tr>
<td>Loss of occupation</td>
<td>Leveling of the virgin Jankarawa area and conversion to irrigation system</td>
<td>Disincentive to pastoralists</td>
<td>The pastoralist must be carried along all through</td>
<td>Minutes of meetings with pastoralist</td>
<td>monthly</td>
<td>Mitigation: Contractor&lt;br&gt;Monitoring: BIPMO</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Occupationa l Health and Safety</td>
<td></td>
<td>Personnel safety</td>
<td>Electrical works</td>
<td>Injuries, electric shocks, electrocution, explosions, flashovers, fires, leakages, falls, release of hazardous (electric, electromagnetic) energy, accidents, death etc.</td>
<td>Institute and implement an electrical safety plan&lt;br&gt;Conduct electrical safety trainings</td>
<td>Contractors Compliance&lt;br&gt;Monthly</td>
<td>Independent Consultant, Contractors&lt;br&gt;Monitoring: PCU</td>
<td>240,000</td>
</tr>
<tr>
<td>Component</td>
<td>Sub-component</td>
<td>Activities</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
<td>Monitoring Frequency</td>
<td>Institutional Responsibility</td>
<td>Costs (USD)</td>
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<tr>
<td><strong>Occupational Health and Safety</strong></td>
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<tr>
<td></td>
<td>Personnel safety</td>
<td>All construction activities</td>
<td>Fugitive dust and fumes from grinding, welding, cutting, or brazing surfaces coated with lead-based paint; Silica dust from cutting concrete; solvent vapours from adhesives, paints, strippers, cleaning solvents, and spray coatings; and isocyanate vapours from spray foam insulation and certain spray paints or coatings.</td>
<td>Develop and implement on-site occupational health and safety management plan; Routine OHS training and education; Conduct routine JHA/PHA; Use of PPE; Establish electrical safety program; Establish fall protection program; Establish fleet safety management program; Establish and implement HazCom; Conduct hazard identification, control and analysis; Establish fire prevention program; Use material safety data sheets (MSDS); Employ hierarchy of controls procedure; Conduct OHSRA, Cost Benefit Analysis (CBA), Return on Investment (ROI) / pay-back period analysis</td>
<td>Independent Consultants/Contractors Compliance</td>
<td>Monthly</td>
<td>Independent Consultant, Contractors</td>
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<td></td>
<td>Monitoring: PCU</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Contractors should prepare and implement a Community Affairs, Safety, Health, Environment and Security (CASHES) manual, to coordinate OHS issues during the construction phase.</td>
<td></td>
<td>Monthly</td>
<td>Contractors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mechanical works</td>
<td>Mechanical/Machine Accidents, Lead fumes and particles, welding fumes, Musculoskeletal Disorders (MSDs)</td>
<td></td>
<td></td>
<td></td>
<td>Monitoring: PCU</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Trench digging and earthworks</td>
<td>Silica dust, histoplasmosis, whole-body vibration, heat stress, noise, MSDs</td>
<td>Develop and implement on-site occupational health and safety management plan; Routine OHS training and education; Conduct routine JHA/PHA; Use of PPE; Establish electrical safety program; Establish fall protection program; Establish ergonomics program; Establish and implement HazCom; Conduct hazard identification, control and analysis; Establish fire prevention program; Use material safety data sheets</td>
<td>Independent Consultants/Contractors Compliance</td>
<td>Monthly</td>
<td>Independent Consultants, Contractors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Removal and replacement of pipes</td>
<td>Collapse, injuries, death, exposure to dust MSDs.</td>
<td></td>
<td></td>
<td>Monthly</td>
<td>Monitoring: PCU</td>
<td></td>
</tr>
</tbody>
</table>

Hospitapia Consultaire
2, Masaka Close, Off Olusegun Obasanjo Way, Zone 7, Abuja, FCT, Nigeria;
www.hospitaliaconsultaire.com
<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Monitoring Indicators</th>
<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupational Health and Safety</td>
<td>Personnel safety</td>
<td>Rehabilitation of elevated tanks and construction of new ones</td>
<td>MSDS, Falls, fractures, death</td>
<td>(MSDS); Employ hierarchy of controls procedure; Conduct OHSRA, Cost Benefit Analysis (CBA), Return on Investment (ROI)/pay-back period analysis</td>
<td>Independent Consultants/Contractors Compliance</td>
<td>Monthly</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Exposure to potentially PCBs contaminated transformer oil</td>
<td></td>
<td></td>
<td>Independent Consultants/Contractors Compliance</td>
<td>Monthly</td>
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</table>

**SUB-TOTAL -** 240,000
Table 7.3: ESMP - OPERATION PHASE – (Bakolori Irrigation Scheme Rehabilitation)

<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-component</th>
<th>Activities</th>
<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Monitoring Indicators</th>
<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Air</td>
<td>Use of equipment and generator plants to power pumping stations</td>
<td>Exhaust fumes from equipment and diesel generator plants.</td>
<td>Machines could be turned off when not in use, in order to reduce emissions into the atmosphere.</td>
<td>BIPMO Compliance</td>
<td>Daily</td>
<td>Mitigation: PCU, SRBDA, BIPMO Monitoring: SME, NESREA (state), ZSEPA</td>
<td>500</td>
</tr>
<tr>
<td>Environment</td>
<td>Air</td>
<td>Vehicle movement</td>
<td></td>
<td>Establish and enforce emissions management controls</td>
<td></td>
<td>Monthly</td>
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<tr>
<td>Environment</td>
<td>Soil</td>
<td>Increased irrigation activities</td>
<td>Change in soil profile</td>
<td>Training on Sustainable Land Management (SLM) practices</td>
<td>Trainings are conducted</td>
<td>Monthly</td>
<td>Mitigation: PCU, SRBDA, BIPMO Monitoring: SME, NESREA (state), ZSEPA</td>
<td>10,000</td>
</tr>
<tr>
<td>Environment</td>
<td>Soil</td>
<td>Dislodging of diesel and oil used for operation</td>
<td>Soil and Groundwater contamination by oil, PCBs and diesel</td>
<td>Ensure environmentally sound and safe storage and containment of oil and diesel</td>
<td>BIPMO Compliance</td>
<td>Daily</td>
<td>Mitigation: PCU, BIPMO Monitoring: SME, NESREA (state), ZSEPA</td>
<td>8,250</td>
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<td>Component</td>
<td>Sub-component</td>
<td>Activities</td>
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<td>Mitigation Measures</td>
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<td>Institutional Responsibility</td>
<td>Costs (USD)</td>
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</tr>
<tr>
<td>Environment</td>
<td>Noise</td>
<td>Use of equipment and generator plants to power the pumping stations</td>
<td>Noise nuisance</td>
<td>Procure diesel generators with soundproofing.</td>
<td>Administrative controls to minimize noise levels BIPMO Compliance</td>
<td>One-off</td>
<td>PCU, Monitoring: SME, NESREA (state), ZSEPA,</td>
<td>7,000</td>
</tr>
<tr>
<td>Water quality and hydrology</td>
<td>Noise</td>
<td>Dislodging of diesel and oil from tankers into drums.</td>
<td>Water run-off (containing oil and diesel) into surface and groundwater</td>
<td>Ensure that water run-off is channeled properly (Treat before disposal into the environment)</td>
<td>BIPMO Compliance</td>
<td>Monthly</td>
<td>PCU, BIPMO Monitoring: SME, NESREA (state), ZSEPA</td>
<td>1,000</td>
</tr>
<tr>
<td>Environment</td>
<td>Waste</td>
<td>Waste generation</td>
<td>Social and health concerns arising due to poor waste management practices</td>
<td>Training on proper agrochemical use and application, Extension worker trainings Water sampling and monitoring</td>
<td>Trainings conducted</td>
<td>Bi-Annual</td>
<td>Mitigation: PCU, SRBDA, BIPMO Monitoring: SME, NESREA (state), ZSEPA</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>Waste</td>
<td>Waste generation</td>
<td>Social and health concerns arising due to poor waste management practices</td>
<td>Dispose waste streams through the municipal waste management system in the project area.</td>
<td>BIPMO Compliance</td>
<td>Monthly</td>
<td>PCU, BIPMO</td>
<td>3,500</td>
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<tr>
<td></td>
<td></td>
<td>Pumping station/ Dam operations</td>
<td>Shut-down due to equipment failure (or other reasons), and subsequent disruption of socio-economic activities</td>
<td>Ensure routine maintenance practices; Inform Water Users and Local Communities beforehand when sudden shut down occurs or is envisaged.</td>
<td>BIPMO Compliance</td>
<td>Quarterly</td>
<td>PCU, BIPMO</td>
<td>3,000</td>
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<td>Component</td>
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<td>Potential Impact</td>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
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<td>Institutional Responsibility</td>
<td>Costs (USD)</td>
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</tr>
<tr>
<td>Environment</td>
<td>Others</td>
<td>Negligence of Bakolori facility environment</td>
<td>Increased presence of termite mounds, Bat infestation, Typha grass invasion of project area including canals</td>
<td>Use of herbicides, aerial and ground spraying with insecticides, rodenticides and anti-bird sprays, Manual removal of grasses, Physical disturbance of bats, Regular cleaning and dredging of sediments in canals</td>
<td>BIPMO Compliance</td>
<td>Monthly, Weekly, Monthly</td>
<td>BIPMO</td>
<td>7000</td>
</tr>
<tr>
<td>Social</td>
<td>Performance</td>
<td>Pumping station operations</td>
<td>Shut-down due to equipment failure (or other reasons), and subsequent disruption of socio-economic activities</td>
<td>Ensure routine maintenance practices;</td>
<td>BIPMO Compliance</td>
<td>One-off</td>
<td>PCU, BIPMO</td>
<td>5,000</td>
</tr>
<tr>
<td>Social</td>
<td>Performance</td>
<td>Arable Crop production</td>
<td>Quelea bird invasion, locusts and grasshoppers invasion</td>
<td>Scarecrow mounts. Physical disturbance of birds, Farmers training on pest management strategies - Use of agrochemicals, Aerial spraying of project area, Manual removal of (bird nesting sites – Typha grass), Procedures for handling and management of pesticides have been documented in the Pest Management Plan (PMP) for the TRIMING Project.</td>
<td>BIPMO Compliance</td>
<td>Annually for aerial spraying, Continuous for others</td>
<td>Mitigation: Farmers, BIPMO</td>
<td>10,000</td>
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<tr>
<td>Employment</td>
<td>Employment</td>
<td>Closure of civil works</td>
<td>Loss of employment</td>
<td>Inform personnel that employment is short-term prior to their engagement.</td>
<td>Proper engagement of service documentation</td>
<td>One-off</td>
<td>Contractors Monitoring: MWR, BIPMO</td>
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**SUB-TOTAL – 50,350**
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<th>Potential Impact</th>
<th>Mitigation Measures</th>
<th>Monitoring Indicators</th>
<th>Monitoring Frequency</th>
<th>Institutional Responsibility</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>Employment</td>
<td>Lack of capacity to implement safeguards</td>
<td>Social crises and environmental degradation will cause project failure</td>
<td>Employ additional staff</td>
<td>Number of new staff employed and date Documentation of safeguard training and number of staff trained</td>
<td>Annually</td>
<td>BIPMO</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Poor funding arrangement for mitigation measures</td>
<td>failure arising from lack of proper funding arrangement</td>
<td>Define funding arrangement, source, schedule for fund release and responsibilities</td>
<td>Evidence of the action Plan</td>
<td></td>
<td>One-off</td>
<td>BIPMO, World Bank</td>
<td>-</td>
</tr>
<tr>
<td>Social</td>
<td>PPP Program</td>
<td>Poor project preparation</td>
<td>risk-under-identification and mis-allocation and overall project failure</td>
<td>Engaged expert transaction advisor (TA) with experience in dam and irrigation project for PPP project development</td>
<td>Evidence of Advert Selection criteria, Profile of preferred TA</td>
<td>One-off</td>
<td>BIPMO, World Bank</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td>Resistance to PPP due to speculations</td>
<td>Project failure</td>
<td>BIPMO will carry out enlightenment / sensitization campaign in the project communities</td>
<td>Schedule of campaigns</td>
<td>Evidence of campaigns</td>
<td>Twice in each of the 3 LGAs</td>
<td>BIPMO</td>
<td>cost covered under rehabilitation phase</td>
</tr>
<tr>
<td></td>
<td>Delay in reaching a financial close by parties</td>
<td>Project abandonment</td>
<td>Project preparation time must be duly followed, and financial guarantee of bidders must be accessed early</td>
<td>Evidence of bond from bank/letter of financial commitment to finance transaction</td>
<td>During procurement</td>
<td>BIP</td>
<td>World Bank</td>
<td>-</td>
</tr>
<tr>
<td>Social</td>
<td>Market and storage</td>
<td>lack of market for farm produce &amp; storage</td>
<td>Low output prices and loss of income</td>
<td>BIP to liaise with stakeholders to create market, Private investors should be wooed to make use of Silo complex constructed by State government</td>
<td>Aid memoirs MOUs</td>
<td>-</td>
<td>BIP, World Bank</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lack of market for farm produce &amp; storage</td>
<td>Discouragement of agro investment and large scale farming</td>
<td>As in above</td>
<td>As in above</td>
<td>-</td>
<td>BIP, World Bank</td>
<td>-</td>
</tr>
<tr>
<td>Component</td>
<td>Sub-component</td>
<td>Activities</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
<td>Monitoring Frequency</td>
<td>Institutional Responsibility</td>
<td>Costs (USD)</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------</td>
<td>----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>----------------------</td>
<td>--------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Social</td>
<td>Public safety</td>
<td>Rise in water above impoundment safe limit</td>
<td>Over flooding and risk to life and property</td>
<td>The control gate must be manned by an officer to monitor/detect impoundment</td>
<td>Name of officer on duty pasted</td>
<td>Daily</td>
<td>BIP</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Revenue</td>
<td>WUA and BIP may be inefficient in the collection of users fees</td>
<td>Operation and maintenance of the scheme may be jeopardized</td>
<td>WUA and BIP coordination will be strengthened through capacity building</td>
<td>Evidence of meetings/training</td>
<td>Annually</td>
<td>BIP</td>
<td>150,000</td>
</tr>
<tr>
<td></td>
<td>collection</td>
<td></td>
<td>The scheme operation may close up leading to the poor case scenario of the pre-rehabilitation period, and ultimately loss of public fund</td>
<td>Private operators with prerequisite experience may be engaged to manage the operation of the scheme to ensure optimal collection of revenue</td>
<td>Evidence of meetings/training</td>
<td>Annually</td>
<td>BIP</td>
<td>150,000</td>
</tr>
<tr>
<td>Population change</td>
<td>Population change</td>
<td>Population density upsurge</td>
<td>Increase in HIV/AIDS rates and other STDs, safety risks to local population, especially women.</td>
<td>Regular monitoring and training of migrant workers/Awareness campaigns among local population</td>
<td>Evidence of sensitization programs</td>
<td>Bi-Annually</td>
<td>BIP</td>
<td>10,000</td>
</tr>
<tr>
<td>Health</td>
<td>Water use for domestic use</td>
<td></td>
<td>Increase waterborne diseases such as malaria, typhoid, cholera</td>
<td>Education of residents on public health risks</td>
<td>BIPMO, SRBDA Compliance</td>
<td>Bi-annually</td>
<td>Mitigation: BIPMO, SRBDA Monitoring: Ministry of health (state)</td>
<td>15,000</td>
</tr>
<tr>
<td>Component</td>
<td>Sub-component</td>
<td>Activities</td>
<td>Potential Impact</td>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
<td>Monitoring Frequency</td>
<td>Institutional Responsibility</td>
<td>Costs (USD)</td>
</tr>
<tr>
<td>-------------------------------</td>
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<td>-------------------------------------------------</td>
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<td>-------------------------------------------------------------------------------------</td>
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<td>--------------</td>
</tr>
<tr>
<td>Social</td>
<td>Behaviour</td>
<td>Inappropriate management of water</td>
<td>Inappropriate management of water</td>
<td>Enlightenment of farmers and residents on irrigation water management</td>
<td>BIPMO, SRBDA Compliance</td>
<td>Bi-annually</td>
<td>Mitigation: BIPMO, SRBDA Monitoring: MWR (state), PCU</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Extension workers/ Training of Trainers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Functioning irrigation services</td>
<td>Waterlogging</td>
<td>Loss of crops, farm lands inundated</td>
<td>Enlightenment of farmers and residents on irrigation water management</td>
<td>BIPMO, SRBDA Compliance</td>
<td>Bi-annually</td>
<td>Mitigation: BIPMO, SRBDA Monitoring: MWR (state), PCU</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Extension workers/ Training of Trainers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational Health and Safety</td>
<td>Personnel safety</td>
<td>Tasks implementation</td>
<td>Injuries, accidents, deaths</td>
<td>Implement on-site occupational health and safety management plan; Routine OHS training and education; Conduct routine JHA/PHA; Use of PPE; Establish electrical safety program; Implement fall protection program; fleet safety management program; Implement HazCom; Conduct hazard identification, control and analysis; Implement fire prevention program; Use material safety data sheets (MSDS); Implement hierarchy of controls procedure; Conduct OHSRA; Cost Benefit Analysis(CBA), Return on Investment (ROI)/pay-back period analysis</td>
<td>BIPMO Compliance Independent Consultants, Contractors Compliance.</td>
<td>Monthly</td>
<td>MWR, BIPMO, SRBDA</td>
<td>225,000</td>
</tr>
</tbody>
</table>

**SUB-TOTAL – 210,700**

**OPERATIONAL PHASE TOTAL – 486,050**
Some interventions highlighted in the pre-feasibility study that will improve the realization of the Rehabilitation of the Bakolori Irrigation Scheme are highlighted in the subsections below.

7.3 Improved crop marketing
This could be achieved by mitigating the existing constraint to crop marketing through the construction of storage and processing facilities as well as the provisions of credit. Furthermore, farmers and traders could be trained in improved handling, transport and storage techniques. It is therefore expected that the following tentative proposal and recommendations will improve crop marketing and add value to agricultural produce:

- Upgrading and improvement of service roads and village market infrastructure within the project area
- Standardize unit weights and measures for agricultural commodities to mitigate fraudulent activities.
- Provision of credit to both farmers and traders through participating banks to facilitate local supply.
- Training of farmers and trader in improved handling, transport and storage techniques
- Establishment of a market information system to provide regular and timely information to farmers and traders.
- Provision of crop storage facilities through private companies, farmers’ co-operatives and/or the project office.
- Facilitate and support private investment in crop processing facilities, e.g. Rice mill, flour mills.

7.4 PPP Principles for the TRIMING Project Schemes
The Pre-feasibility designed established some mechanisms that maybe adapted for the eventual PPP structures:

- Try to work with structures, which already ‘work’ in Nigeria that is, avoid large organizations. Avoid agents’ problems, which are particularly acute. Avoid the need for regulation, which supposes effective and accountable government. Attempt to use market-based mechanisms, which clearly do work in Nigeria. Leverage demonstrated willingness of people to pay in “proximate” transaction, which is open to competition (Moto pumps, threshing, milling, taxis, mobile phones, water porters, roadside food sellers, market stalls, etc.).
- Do not take a supply/input driven approach. Try to implement a flexible approach that responds to demand, even if this is ‘less efficient’. Supply driven approaches (“built it and they will come”) have historically failed completely in both schemes. Services which work in Nigeria is inefficient weakness of effective government and large scale, centralized organization means “invincible” market based mechanism are to be preferred.
These principles, and the fact that both the farmers and the SRRBDA were unconvinced about the use of a large-scale contractor, suggest appropriate PPPs for the schemes will be “small scale” and open to competition. The only possible exception to this is the possible hydropower refurbishment (which cannot be “small scale”).

Furthermore, the Pre-feasibility Report for the Sokoto Rima advises on PPP possibilities for the Irrigation Assets Operation and Maintenance. Figure 7.0 shows procedure by which the assets (arranged from upstream to downstream) could be managed by different parties.

![Diagram](image)

**Figure 7.0** PPP Opportunities by Irrigation Assets/Function (Source Atkins-Enplane Prefeasibility Report, 2013)
7.5 River Training

A River training assessment was also carried out by the Atkins-Enplan Consortium for the Pre-feasibility report, the outcome is highlighted in this section. This section sets out an initial assessment of managing flood risk by the reinstatement/construction of embankment downstream of Bakolori dam. Although the history of embankment failure in Sokoto catchment triggered by lateral movement of the river strongly indicates that embankment immediately adjacent to channels are not always a sustainable means of managing flood risk, embankments are still likely to be a significant component of the flood risk management package in both catchments. The assessment below therefore provides an initial context for decisions on flood risk management by setting costs and risks associated with reinstating and constructing embankments.

Sokoto and Karaduwa River Conditions

The rapid assessment has made use of readily available information to draw on the key geomorphological characteristics of the rivers downstream of the dams.

Introduction and objectives

The primary areas of interest for river training are the reaches immediately downstream of both dams within the command areas. Structural measures such as the dykes (for example rehabilitation of the dyke downstream of Bakolori) have been examined, restoration of functional floodplain (e.g. through improvement to floodplain conveyance and transmission, development of set-back dykes to allow the river to more within its natural floodplain and consequence delineation of areas set aside for this), provision of flood storage through appropriate operation of the dams (i.e. revision of reservoir control rules). Non-structural measures have also been considered, such as catchment management and spatial planning to zone future development and economic activity away from high-risk areas. The baseline modeling was used to identify and assess the feasibility of a number of outline options for river training and control of flooding, erosion and sedimentation. Technically, feasible and economically viable solutions are needed to the following common problems downstream of the dams.

- Loss of crops due to flooding from the river overtopping its banks (and the lack of predictability of when and where flooding will occur due to the constant changing of the river course);
- River bank and bed erosion;
- Lateral movement of the river resulting from bank and bed erosion and deposition; and
- Loss of agricultural lands due to erosion.
The problems listed above are most noticeable in the reaches immediately downstream of the dams impacts generally decay with distance downstream. The strategy set out below recognizes that, although traditional engineering controls may offer solutions to these problems where higher value assets are at threat, alternative strategic and non-structural approaches may sometimes be the only technically feasible or economically viable solutions, particularly where erosion risk is extreme or only lower value assets at risk.

**High Level Options**

High level options currently under consideration includes structural measures such as embankments and bank protection as well as a wide range of non-structural measures that look to manage down risk through strategic planning of land uses, flood warning, preparedness and resilience measures. Some high level options developed are outlined in the text below is suggested.

1. **Continue the initial assessment** of flood and geomorphological risk carried out to date. The key objectives of these two streams of work is to better understand:
   - the spatial distribution of current flood risk (both the frequency at which areas flood and the consequence of that inundation in terms of flood damage), and
   - the rate and trajectory of channel migration in order to define the areas of floodplain that are likely to be subject to extreme erosion risk over the lifetime of the project.

2. **Avoid future flood and erosion risk**, wherever possible, by directing development of intensively irrigated agriculture, key infrastructure and higher density settlements towards lower risk areas. The opportunity for implementing such measures as part of this project may be limited, but the approach is the most effective means for managing flood and erosion risk.

3. Where appropriate, **adapt land uses and agricultural practices** so that they are resilient to inundation and potential erosion. In areas where it is not economically viable to provide formal flood or erosion protection appropriate agricultural system (e.g. dry season usage) possibly combined with low ‘submersible’ banks may still keep the land productive.

4. Where technically feasible and economically viable **control flood and geomorphological risks through structural measures** such as maintaining and rehabilitating existing embankments, construction of new embankments, bank protection and river training. Such measures are only likely to be viable in areas where the consequence of flooding and erosion are highest (for instance existing settlements or where key infrastructure crosses the floodplain) or the risk of erosion or flooding is relatively low (areas not susceptible to erosion risk from river migration or relatively infrequently inundated).
5. **Mitigation against residual risks of flooding.** Measures are likely to include development of robust, simple flood forecasting tools to warn of inundation; promotion of flood resilient agricultural systems and infrastructure in areas most vulnerable to flooding (for instance land between the channel and set back embankments) and structural provisions for extreme events in the form of controlled spillways.
CHAPTER EIGHT: PUBLIC CONSULTATIONS

8.1 Introduction

The Bank has recognized that Public Consultation is essential in the achievement to the overarching objectives of project implementation and sustainable development. Participatory approaches have been shown to enhance project policy, ownership and sustainability and to empower targeted beneficiaries in particular, women, children and other vulnerable groups.

8.2 Consultation Objectives

Considering the uniqueness of the Bakolori Rehabilitation Scheme, consultation objectives were identified as follows:

- Informing stakeholders
- Gaining their views, concerns and values
- Taking account of public inputs in decision making
- Influencing project design
- Obtaining local knowledge
- Increasing public confidence
- Improving transparency and accountability in decision-making
- Reducing conflict

8.3 Envisaged Benefits

The envisaged benefits of the Public Consultation exercises were as follows:

- Provision of opportunities to foresee and/or resolve potential obstacles, constraints and conflicts;
- Means to identify and address potential negative social and environmental impacts as envisaged by stakeholders;
- Opportunities to generate social learning and innovations based on local field experiences;
- Means of ensuring that project benefits are distributed equitably, and;
8.4 Stakeholder Engagement/Consultation Plan

Following the review of the ESIA ToR and other relevant documents by the team of Consultants/staff of Hospitalia Consultaire and the project staff at Bakolori Irrigation Project, existing and efficient channels of public consultation in the local area were explored. This involved the BIP consultation network media that uses phone contacts of the existing network chain, mail dispatch and organized visits. The team of BIP management unit facilitated this. Quite a number of stakeholders were identified and consulted. Approach to consultation therefore, began with stakeholder identification. In doing that our team identified primary and secondary stakeholders of the project. Primary stakeholders constitute of direct potential beneficiaries of the proposed programme or those potentially adversely affected by the proposed rehabilitation works.

8.4.1 Stakeholders Identification

Stakeholders were identified based on the following categories:

- Direct project targeted beneficiaries:

  These include:

  ✓ SRRBDA
  ✓ Bakolori Irrigation Project Talata Mafara Water Users Association Unit WUA's
  ✓ Water Users Association Intake WUA's
  ✓ Water Users Association Federated
  ✓ Water Users Association Special Women Group
  ✓ Women Associations,
  ✓ Farmers Groups
  ✓ Talata Mafara, Bakura Water Workers and Maradun Water Workers
  ✓ Fishermen
  ✓ Cattle Rears Association of Talata Mafara, Maradun and Bakura Local Government

- Adversely Impacted groups

  During the civil works the following groups may be impacted:

  ✓ Farmers Groups
  ✓ Water Users Association
  ✓ Women and children (for domestic purposes)
  ✓ Water Vendors

- Vulnerable Groups

  ✓ Disabled groups in the Project areas.
• Project supporters and opponents
  ✓ No opponent was identified during the consultation exercises.
  ✓ All identified groups were in support of the project.

• Responsibilities for carrying out planned activities:
  ✓ Project Coordination Unit (PCU);
  ✓ The Zamfara State Ministry of Water Resources,
  ✓ Sokoto-Rima Basin Development Authority (SRBDA);
  ✓ Bakolori Irrigation Project Management Office (BIPMO);
  ✓ Zamfara State Ministry of Environment (ZSMEnv),
  ✓ National Environmental Standards Regulatory Enforcement Agency (NESREA),
  ✓ Zamfara State Environmental Protection Agency (ZSEPA)
  ✓ Federal Road Safety Corps

• Responsibility to provide financial and technical resources contributors
  Financial: These include;
  ✓ Federal Ministry of Water Resources, PCU
  ✓ Financial Institutions (Bank of Agricultural, Commercial Banks)
  Technical:
  ✓ PCU, ESMF, RPF and Feasibility & Engineering Design Consultants.

Critical concerns raised include:
  ✓ Failed sprinkler system;
  ✓ Water sharing issues for farmer;
  ✓ Inoperative pumping stations, gates, and other infrastructures;
  ✓ Canal conditions;
  ✓ Availability of agricultural services and resources;
  ✓ Improved market economy;
  ✓ Persistence of *Typha* grass; and
  ✓ Infestation by quella birds that attack farm crops.

### 8.5 Methodology for the Stakeholder Consultation

The stakeholder consultations for this ESIA were conducted in 3 phases.

This chapter is presented in 3 sections. Section A provides an insight to the consultation exercise carried out with Focal Groups held during field surveys for data gathering. Section B provides a matrix table summary of Consultation with Bakolori Irrigation Project Office, relevant Zamfara State Ministries and Sokoto-Rima River Basin Development Authority, and stakeholders from the 3 LGAs’ held during the field survey for data gathering. Section C
provides a summary of the major stakeholder consultations held at the Bakolori Irrigation Management Project Office following newspaper advertisements in the “Legacy Newspaper” - a local tabloid in Zamfara State and “Weekly Trust Newspaper” – a nationally circulating newspaper.

The General Public Consultations for the ESIA were conducted on the 7th of November, 2013 and 10th of December, 2013 within the premises of the Bakolori Irrigation Project Office, following public notifications via newspaper advertisement, notices in local government headquarters and relevant government ministries and agencies, letters and oral communications.

8.5.1 Section A

8.5.1.1 The Focal Groups Consultation

The focal group consultation was carried out over a 10-day period (28th October - 6th November, 2013).

The groups consulted include the farmers group, Women Farmers Groups, Water Users Association (WUA), Women Water Users Association and the disable under the aegis of the Vulnerable User Group. Most farmers in the Bakolori Irrigation Project are members of the WUA. Meetings were held with 3 groups of WUA from the 3 local government areas of project influence including a separate meeting with the leaderships of the Women Association of Water Users.

Considering the social structure of the project area, women groups were consulted separately. BIPMO officials were requested to assemble the Women Groups.

The three WUA consulted are as follows:

1. Dan Kadu-Daji Group Water Users Association, Talata Mafara -
2. L20 Group Water Users Association, Maradun, and
3. Yar Kofogi Water Users Association, Bakura
### Consultation with the Women Association of Water Users

Hospitalia Consultaire worked in collaboration with the BIP consultative network to identify and consult with the women farmers within the WUA in BIP. During the public consultation meeting held at the BIP compound a private consultation was held with the women in order to prevent interferences from the male counterparts that may affect their right of expression and concerns.

Issues, concerns and the general outcome of the consultation with the women is indicated in the matrix below:

<table>
<thead>
<tr>
<th>Issues and Concerns</th>
<th>How they were addressed/Resolved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right to farm land, farm inputs and irrigation service</td>
<td>The women attested to the fact that they have equal right to BIP land lease. However, poor income and poor irrigation services is a limitation to their desire to operate large farms. On distribution of fertilizer, the women stated that they were being marginalized and wants an improved distribution management.</td>
</tr>
<tr>
<td>Right to input, decision making and representation in the community</td>
<td>The women are customarily and religiously not granted representation or leadership roles within the community as long as it has to do with men. But in terms of affairs that concern women society they make their decisions. As for involvement in BIP, the women are considered as a reputable entity and consulted in all matters to ensure they are carried along</td>
</tr>
<tr>
<td>Constraints to women farming in the community</td>
<td>Poor irrigation service, lack of sufficient farm inputs (fertilizer, herbicides, agricultural extension services), activities of herdsmen, lack of credit, poor access and service roads and poor pricing of produce due to absence of storage facilities, etc.</td>
</tr>
<tr>
<td>Women commitment to BIP improvement</td>
<td>The women stated that they have been committed to payment of users fees, and promised to do even more if the operation and management of the scheme is enhanced</td>
</tr>
<tr>
<td>General concerns and suggestions</td>
<td>The women are happy with the planned rehabilitation work, as they are optimistic that it will improve their farming potentials. However, they want the government to complete the work on time and also intervene</td>
</tr>
</tbody>
</table>
with the provisions of farm inputs at affordable cost. They also, want
government to help them in tackling the quella bird that usually infest
on their crops. They also want the authority to regularly clear the
grasses/shrubs along drains which they claim induces the presence of
birds (quella) into the farms

Similarly, consultation was held with the representatives of the Vulnerable User Group in the
new Maradun settlement area. The group was formed under the BIP scheme for easy
coordination and attention in terms of government livelihood enhancement programmes.
The concerns and perceptions of the Vulnerable User Group are documented in the matrix
below:

**8.5.1.1.2 Consultation with Vulnerable User Group**

<table>
<thead>
<tr>
<th>Issues and Concerns</th>
<th>How they were addressed/Resolved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right to farm land, farm inputs and irrigation service</td>
<td>The group chaired by Alhaji Sani attested to the fact that they have equal right to BIP land lease. They thanked the BIP for being supportive, and for the establishment of their union which has reduced marginalization in getting inputs and services. They however, stated that only 1 bag of the federally subsidized fertilizer is made available to each farmer, a situation described as far below requirement.</td>
</tr>
<tr>
<td>Right to input, decision making and representation in the community</td>
<td>The group are well and equally represented in community decision making and leadership</td>
</tr>
<tr>
<td>Constraints to farming in the community</td>
<td>Constraint to farming includes lack of irrigation services, inadequate farm inputs and capacity building on modern farm techniques and crop improvement. The group also complained of spending so much money on hiring labour not only for farming services but to chase away quella birds in the farms.</td>
</tr>
</tbody>
</table>

The comments and concerns received from the three groups and women associations
indicate a trend. All comments raised by the Women groups were collectively presented by a
spokesperson representing the Women Water Association and the Women Farmers
Associations (see Annex 3 for all other concerns raised).

Some key data from the farmers included the following:

- The farmers were both landowners and leasers of government land. Many of
  those farmers leasing government land also owned land.
- Farm sizes ranged from 0.15 hectares to 2.56 hectares and some farmers owned
  multiple plots.
- Rice is the dominant crop in the BIP with at least 4 varieties of rice (Biginbira,
  farrow 44, CP and Jamila 1) farmed in large quantities.
- Farmers pay N100 for rice threshing per bag/sack
- Yields of rice were around 75 bags (75kg per bag) per hectare, or 5,600 kg per
  hectare. Farmers sold the rice for between 4,000 and 5,000 naira per sack during
  harvest time and around N6000 during post-harvest season
• 50 ridges (0.5 hectares) of rice farm yields about 35-40 bags of rice

• Most farmers only crop once a year, blaming poor water management from the irrigation system for their inability to crop more than once.

• Fertilizer and pesticides were applied, although there was very little knowledge of the pesticide types or how to apply it correctly. Stem Borer and Quella Birds were acknowledged as the main pests.

• Although the Ministry of Agricultural and Natural Resources stated during consultation that the State Government has in employment approximately 1000 Agriculture extension workers, most are idle as a result of low rate of farming activities; the field surveys show that many of the farmers lacked farming skills including knowledge of fertilizer application. Many of them also claimed that, they have not been in touch with the agricultural extension officers.

• Women are not only involved in winnowing activities but have equal stake in farm ownership participation of the BIP.

• Most farmers complained about livestock herders who often graze on their farms; this invariably, leads to clashes.

• They also commented that cattle often caused destruction of embankments around the canals while feeding.

When informed about the potential environmental and socio-economic effects of the proposed project, majority of the farmers preferred to suffer any form of inconvenience during project rehabilitation for the sake of overall improvement of the irrigation system. Even farmers who are currently cropping in the silted drains expressed satisfaction to see their crops affected by the work so long as the affected drains and canals would be desilted.

8.5.2 Section B

8.5.2.1 Consultations with relevant line Ministries and offices

Consultation was carried out with the following groups:

• Zamfara State Ministry of Agriculture,
• Zamfara State Ministry of Water Resources
• Zamfara State Ministry of Environment
• Sokoto Rima River Basin Development Authority
• Bakolori Irrigation Project Management Office
• Bakura LGA
• Water Users Association
• Women Group Farmers Group
- General Hospital, Maradun

Others are Emirs and district heads, Health care facilities including PHCs and financial institutions including Bank of Agriculture, Unity Bank Plc., First Bank Plc., Zenith Bank Plc., Access Bank Plc. and Eco Bank Plc. These are financial institutions present in the project area.

The above institutions in many ways will play key roles in the overall project implementation and also in the ESMP implementation during the implementation of works for the proposed Bakolori Dam and Irrigation Project rehabilitation and expansion project.

The institutions and groups were informed about the proposed project and the intention of the proponent to carry out an Environmental and Social Impact Assessment to ensure the environmental and socio-economic sustainability of the project, and to explore windows for capacity development and market expansion.

Summarized contents of the public consultations are presented Table 8.0.
Introduction

The Managing Director of Bakolori Irrigation Project welcomed all in attendance. He informed the participants that the meeting was convened to inform them of the plan to rehabilitate the Bakolori Dam and irrigation scheme with loan from World Bank. He stated that the failure of the Dam to function optimally has caused a set back to the farmers, Communities and the state, and hopes that this time, the project shall be revitalized to be of immense benefits to the stakeholders. He pointed out that such large rehabilitation works is likely to have some adverse effects and may elicit public perceptions, which need to be identified, addressed or mitigated. This he said was the reason for engaging Hospitalia Consultaire to carry out the ESIA study. He urged all to express their concerns freely and make their inputs, which will enrich the planning, and implementation of the project.

Remarks

The Managing Consultant of Hospitalia Consultaire reiterated the statements of the first speaker. He added that the consultation was necessary to inform the stakeholders, particularly farmers, Water Users Association, Women and vulnerable groups about the nature of civil works and expected impacts. No new land acquisition is anticipated but dam rehabilitation may impact on the water/river by causing pollution during implementation phase. It may alter or reduce irrigation services for the period among other things. He told them it is their right to be informed, to explain their concerns including alternatives to avoid or reduce impacts as well as related matters they would want government to know.

Other Remarks

Representatives of the Commissioners for Ministry of Water Resources, Ministry of Agriculture and the Royal Fathers spoke differently on their satisfaction with the project, their readiness to partner with BIP and to support the successful implementation and operation of the project in the interest of the State. The Ministry of Agriculture also said they have distributed free seedlings and fertilizers, and is collaborating with the Bakolori Irrigation Scheme to train two people on improved farming techniques from each of the local governments in the state.

Responses, Inputs and concerns

Responses and concerns came from various groups and persons including the Bakolori Water Users Association (WUA), Bakolori Consultative Forum, Association of Women Farmers and the Fishermen Association. Alhaji Sani Iadan spoke for the Bakolori WUA. He stated that the WUA are in 100% support of the project and are ready to give their support where necessary, praying that they will start and finish the work in peace. He said that their problem is that the canals in their farms are seriously in bad conditions. He said that they also need tractors, fertilizers, chemicals and other things.

Lastly, he said that they are also having the problem of market for their produce.

Alhaji Shehu spoke for the Bakolori Consultative Forum. He stated that the Bakolori Consultative Forum was established four (4) years ago reason for its establishment was to bring peace between the farmers, the SRRBDA, the police force, market people and everybody else. He said forum has resolved many conflicts involving farmers and interest groups in the area. He cited lack of market, portable water and functional Hospitals as their challenges. He also added that they needed a large rice-processing machine.

Hadjiah Ladi spoke on behalf of the Association of Women Farmers. She said that the canals in their farms were in bad conditions and expressed support and satisfaction with government intention to repair them.
The representative of the fishermen association added that their problem is that they lack fishing materials and there are a lot of fishes in the dam. They will require help to secure fishing nets. Secondly, he informed that some fishermen employ the use chemicals such as gamalin for fish catching, which can affect water quality and the aquatic system. He asked that something should be done such situation.

**How comments were addressed**

The PM of BIP and the Managing Consultant of Hospitalia Consultaire thanked all the speakers and participants for the concerns raised. They assured the stakeholders that the concerns will be reflected in the report and also be factored into the project design and plan. The people were assured that issues on hospitals, market, fishing nets, etc. will be reported to the appropriate authorities for their action. The communities were assured that best practices will be employed to minimize negative impacts, and that the affected people/communities will continually be carried along during project implementation phase.
8.5.3 Section C

Some of the stakeholders that participated in the General Public Consultations included the following:

- Ministry of Agriculture and Natural Resources, Zamfara State
- Ministry of Water Resources, Zamfara State
- Ministry of Environment, Zamfara State
- The Emirs of Bakura, Talata Mafara and Maradun Emirate Councils
- Local Government Chairmen of Talata Mafara, Bakura, and Maradun
- Councilors of Agriculture for Maradun, Talata Mafara and Bakura Local Governments
- Talata Mafara, Bakura, and Maradun LGs’ Water Workers
- The Principal Medical Officer, General Hospital, Talata Mafara, Bakura, and Maradun Local Government
- Rice Sellers Association, Talata Mafara Local Government
- The Head of Fishermen
- The Head of Threshed Rice Association
- Vegetable Sellers/Marketers
- Cattle Rearing Association of Talata Mafara, Maradun and Bakura Local Governments
- SRRBDA, Sokoto
- Management of Bakolori Irrigation Project, Talata Mafara
- Water Users Association Unit WUA’s
- Water Users Association Intake WUA’s
- Federated Water Users Association
- Water Users Association (Special Women Group)
- District Heads of Irrigation Areas, Talata Mafara, Bakura, and Maradun
- Health Care Centers, Rini, Gora, D/Kaiwa, Yarkofoji, D/Kado, Moddoci, Matusgi, Ware
- Mafara Development Association
- Mafara Elders Association
- Maradun Development Association
- Rini Development Association, Yarkofoji, Gora etc.
- National Union of Road Transport Workers, Talata Mafara, Bakura, Maradun Local Governments
- Road Safety Commission, Talata Mafara
- First Bank of Nigeria, Talata Mafara
The summarized content of the public consultations is presented Table 8.1

<table>
<thead>
<tr>
<th>Table 8.1</th>
<th>Documentation of the Public Consultation held on December 10, 2013 at Meeting Hall, Talata Mafara, Zamfara State</th>
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</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>The Project Manager of Bakolori Irrigation Project welcomed all in attendance. He specifically thanked the Emir of Bakolori, Commissioner of Agriculture, Zamfara State and the staff of the Ministry of Water Resources for their support of the Bakolori project. He urged all present to make free contributions that will aid in strengthening key decision areas in the interest of their people.</td>
</tr>
<tr>
<td><strong>Remarks</strong></td>
<td>The Managing Consultant of Hospitalia Consultaire stated that ESIA is a requirement of the Federal Ministry of Environment and the World Bank for the rehabilitation of the Bakolori Irrigation Scheme. He stated that environmental and social impact associated with the rehabilitation of the scheme must be assessed. He informed the audience that their opinions, concerns and inputs are required as people with knowledge of the local area and as beneficiaries of the project. He urged all to contribute and identify any problem that may arise during the pre-construction, construction and the operational phase of the project. Other areas of concern mentioned by the consultant include: issues that will lead to improving agriculture, modalities for strengthening the water users association, how the silted waste can be best used/disposed, issues of access to farms, issues of conflict among users of the land areas such as herdsmen, fishermen, water users association. He also mentioned the issue of optimal water sharing between, people downstream and those upstream.</td>
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<tr>
<td><strong>Responses, Concerns and Inputs</strong></td>
<td>Many of the stakeholders spoke in response to the address by the consultant. They all promised to give all the necessary support to see the success of the project. Concerns raised were as follows:</td>
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<td>• the need to rehabilitate power/electricity around the irrigation area</td>
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<td>• the design for the project should ensure that project option for the irrigation is such that will not have an easy maintenance system and not lead to failure of the scheme as the sprinkler system had failed in the past</td>
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<td>• the need to put in place an arrangement for eradicating birds in their farms</td>
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<td>• the need to assist farmers with fertilizers.</td>
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<td><strong>How Concerns were Addressed</strong></td>
<td>The Consultant thanked stakeholders for their support and for the concerns raised. It was pointed out that in line with their observations, the ESIA team will recommend practicable project alternatives that will consider cost of installation, maintenance and sustainability. The stakeholders were also assured that the electric power issue is part of the rehabilitation plan. Stakeholders were assured that issues of fertilizer, birds and other obstacles that militate against farming will be handled by government in collaboration with the farmers associations.</td>
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</table>

Future Stakeholder consultations are required throughout the rehabilitation of the Bakolori Irrigation Scheme. These consultations maybe conducted during the various project phases (Planning phase, Pre-construction, Construction and Operation).
**Figure 8.0 Consultation process for project phases**

**Affected Parties** - Those directly affected by the project

**Table 8.2 Summary of benefits of project by stakeholders and key indicators**

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<thead>
<tr>
<th>S/No</th>
<th>Perceived benefits of project by stakeholders</th>
<th>Key indicators of support for the project</th>
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<tbody>
<tr>
<td>1.</td>
<td>Training and provision of material resources for farmers, agricultural extension workers and BIPMO personnel.</td>
<td>Verbal expression of project support by the State Ministry of Agriculture, Zamfara State.</td>
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<tr>
<td>2.</td>
<td>Reactivation of multi-seasonal rice and wheat farming.</td>
<td>Assurance and support by the SRRBDA</td>
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<td>4.</td>
<td>Fostering unity amongst communities, different LGAs, Emirates, MDAs and all groups within the scheme.</td>
<td>Observed communal participation towards project success.</td>
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<td>5.</td>
<td>Freedom to execute contractual services</td>
<td>Expressed willingness by communities to permit Contractors to carry out all civil works within farmland</td>
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<td>6.</td>
<td>Improved access roads and service roads and Improved and availability of irrigation services that will support dry season farming</td>
<td>Perseverance of the community on BIP land conflict. The community has put behind them grievances that resulted from poor handling of resettlement in the area</td>
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<td>7.</td>
<td>Increased market and credit that will help to expand agricultural activities</td>
<td>There is commitment to support the project by rallying support to the WUA, and ensuring that community members/farmers pay for irrigation services</td>
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<td>Job creation for the teeming youths</td>
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www.hospitaliaconsultaire.com
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<th>Key indicators of support for the project</th>
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<td>8.</td>
<td>Improvement in water supply in the Jankarawa area and extension of the scheme to other undeveloped areas</td>
<td>The community welcomed suggestions to set up committee of WUA and herdsmen to ensure that conflicts between the two group are avoided or resolved</td>
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<td>9.</td>
<td>Provision of agricultural incentives and good distribution and allocation of Fertilizers and pesticides to farmers, and assistance to contain the incidences of quella birds and other pests</td>
<td>Community showed willingness to work with BIP by providing security to protect government installation during rehabilitation and operation phases</td>
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<td>10.</td>
<td>Repair of dyke and de-siltation of canals</td>
<td>There was commitment by the community to collaborate with BIP in sensitization and enlightenment campaigns that will promote, impact knowledge and responsibilities of the WUA and the entire community members</td>
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</table>
CHAPTER 9 RECOMMENDATIONS

The following recommendations are for the consideration of the TRIMING project towards ensuring the improvement of decisions and filling of gaps identified by the ESIA study.

Improving the Capacity for Sustainable Management of the Scheme

(i) Bakolori Irrigation Project Management Office:
- There is a dire need to improve the staffing capacity of the Bakolori Irrigation Project Management Office particularly at the Dam site and key areas within the Bakolori Irrigation Scheme
- There is a need to have regular training programmes for the staff of BIP on dam management, irrigation operations and safeguards

(ii) Farm Level-Water Users Association Intervention

In view of the apparent weakness and poor organization of the Water Users Association, there is need to strengthen the association to better discharge its responsibilities and commitment to the scheme. Going forward, the capacity of the WUA can be enhanced via the use of extension farming professionals (in this regard, the Zamfara State Government stated that it has over 1000 trained extension farming professionals in its employ and would be willing to deploy some of them to assist with the raining of the farmers in the Bakolori Irrigation Scheme), trainings including improved produce preservation techniques, food processing, assets preservation, communication strategies, conflicts management, and improved field level implementation techniques.

Resolution of legacy/land related Issues

- BIPMO should ensure availability of potable water and irrigation water services to the Jankarawa communities in line with agreed terms during the public consultations
- BIPMO should ensure early interventions and resolutions of conflicts between the farmers and pastoralist, and those between water users by setting up a conflict resolution committees from among the various associations within the scheme.
- A grazing route and grazing area should be dedicated to herdsmen preferably carved out from the GRA of the scheme

Synergy with Existing Institutions:

- The institute of Agriculture of the Ahmadu Bello University, Zaria, already has a well-established and running research facility located within the Bakolori Irrigation Project. There is a need for the project management to synergize with the institute to
utilize its abundant technical knowledge, research findings and capabilities in the provision of improved yield seedlings and pest resistant plant species, growing of fodder, animal husbandry, and also, in assisting with the training of farmers in improved farming techniques and assets maintenance and preservation.

- Improved agricultural practices such as improved water management practices and sequestering of carbon above and below ground can be achieved through training of farmers by the Institute for Agricultural Research within the project scheme, and by extension farming professionals from the Zamfara State Ministry of Agriculture, and the Bakolori Irrigation Project Office personnel. As stated above, the Zamfara State Government has confirmed the availability of one thousand (1000) trained extension farming professionals in its employ that it is willing to deploy into the training of farmers in the Bakolori irrigation scheme.

**Increased water use efficiency**

Conveyance, distribution and application of the irrigation water will be improved through well maintained, lined canals and piping systems – and above all, avoiding leakages. These can be achieved through the development of a well-managed public-private partnership arrangement (especially for the primary and secondary canals) for the water distribution system within the scheme.

**Enhancing and improving soil fertility through sustainable land management (SLM)**

There is a need to train the farmers on SLM practices that will maintain or improve a balanced soil organic material-nutrient cycle.

- Improving soil fertility: The deliberate planting of fast-growing species - usually leguminous - for rapid replenishment of soil fertility. Nutrient fixing plants may be planted either in sequence, intercropped or in rotation with regular crops.

- Improved residue management: by encouraging soil surface cover with crop residues after harvest. It requires residue from the previous crop as the main resource (thus burning is discouraged) – this will also help reduce erosion, improve water infiltration and therefore moisture conservation.

- Application of improved compost and manure: Compost (mainly from plant residues) and manure (from livestock) help to close the nutrient cycle by ensuring that these do not become losses to the system. By building up soil organic material, they help maintain soil structure and health, as well as fertility.

- Integrated crop-livestock systems which combine crops, grazing lands and trees;
• Encouraging Agro-forestry: this will benefit the cropping system by tapping nutrients through the roots of trees and other perennial plants when mixed with annual crops. Trees act as nutrient pumps: that is, they take up nutrients from the deep subsoil below the rooting depth of annual crops and return them to the topsoil in the form of mulch and litter. This enhances the availability of nutrients for annual crops.

• Application of inorganic fertilizer: Without a combination of organic matter application and inorganic fertilizer, soil fertility is unlikely to meet production demands: thus the concept of ‘Integrated Soil Fertility Management’ should be supported.

• Minimum soil disturbance: Tillage systems with minimum soil disturbance such as reduced or zero tillage systems leave more biological surface residues, provide environments for enhanced soil biotic activity, and maintain more intact and interconnected pores and better soil aggregates. Water can infiltrate more readily and rapidly into the soil with reduced tillage, and this also helps protect the soil from erosion. In addition, organic matter decomposes less rapidly under these systems. Carbon dioxide emissions are thus reduced. No tillage has proven especially useful for maintaining and increasing soil organic matter.

• Agro-forestry practices (especially the introduction of indigenous leguminous trees into farming practices)

• Improved management of pastures and grazing practices, including optimizing stock numbers and utilizing rotational grazing to maintain ground cover and plant biodiversity;

• Improved tillage practices – such as conservation agriculture – to increase soil organic carbon (SOC) content through permanent soil cover with crops and mulch, minimum soil disturbance, fallows, green manures, and crop rotations; and

• Micro-dosing with fertilizer to increase biomass production, yields and soil organic carbon.

Minimization of disputes between farmers and herdsmen, could be squarely addressed by providing pastoralists them with designated grazing and “watering” areas within the BIP and in the proposed improved Jankarawa area. The introduction of a fodder production area in the BIP scheme will provide a ready source of feeds for the herders’ animals and also, provide a new stream of income for the farmers. This can be achieved through the use of a private firm in partnership with the farmers and the BIPMO with a designated hectarage probably in the GRA for the production of fodder.
The Ahmadu Bello University Agricultural Research Centre which presently, has a demonstration farm and animal husbandry scheme within the Bakolori Irrigation Scheme will be very useful in achieving this goal.
CHAPTER TEN: REFERENCES


FAO (2000). Nigerian Irrigation Sub-Sector Study


Punch News Paper, 18th Sept., 2010: Sokoto Environmental Relief Agency, Sokoto


USAID, 2010. Irrigation Rehabilitation Program. Environmental Assessment. USAID


## ANNEXES

### Annex 1: Attendance List from Public Consultation

<table>
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<tr>
<th>S/N</th>
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### ESIA for the Bakolori Irrigation Project

#### Attendance for Public Consultation

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# ESIA for the Bakolori Irrigation Project

**Attendance for Public Consultation**  
**Location:** Bako, Jigawa State, Nigeria  
**Date:** 10/11/2023

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### ESIA for the Bakolori Irrigation Project

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**District Heads of Irrigation Areas**

ESIA Report for the Bakolori Irrigation Scheme
ESIA for the Bakolori Irrigation Project

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## ESIA for the Bakolori Irrigation Project

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**Location**

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Annex 2: Newspaper Adverts
Physically challenged protest ban on street begging in Kano

Kaduna NUJ commences LG assessment tour

Federal Ministry of Water Resources
PUBLIC NOTICE

Tender Notice

The Federal Ministry of Water Resources invites tenders from reputable security service providers for the provision of a reliable security service at Bongay Hydroelectric Power Station, Benue State. The objective of the contract is to provide security to the facility.

Tender documents cost N10,000 and can be obtained at the Ministry’s head office in Abuja. The closing date for the submission of tenders is November 30, 2021.
Annex 3: Stakeholder Consultation held on 10th December, 2013 at BIPO

List of participants at the consultation and summaries of contributions

Welcome Address

The under-listed were recognized by the Master of Ceremony:

- The Emir of Bakura, The Emir of Talata Mafara, and The Emir of Maradun who were highly represented
- Representatives from FMWR
- The Zamfara State Commissioner of Water Resources
- The Commissioner of Health
- The Commissioner of Agriculture
- The Commander, Federal Road Safety Corp
- The Commander, Nigeria Security and Civil Defense Corp
- The D.P.O, Nigeria Police Force, Talata Mafara
- The Chairmen, Talata Mafara and Maradun Local Government Area Councils
- The District heads
- The Managing Director, Sokoto Rima River Basin Development Authority
- The Project Manager, Bakolori Irrigation Project
- The Bank Managers of Unity Bank, Access Bank, First Bank, and Agric. Bank
- The Director of Hospitalia Consultant Limited and World Bank
- The Chairmen, Water Users Association
- The Users of Bakolori Water
- The Farmers’ Association
- The Fishermen Association
- The Association of Livestock Owners
- After the welcome address, Mallam Sani Ladan then opened the occasion with a prayer.

Opening Remark

The Project Manager, Bakolori Irrigation Project, rendered the opening remark. He started by informing the participants that the project is for their benefit and that several people and groups were invited, some of them already there, some of them represented and some, on their way to the program. He continued by introducing Hospitalia Consultaire as the organizer of the consultation meeting, for the purpose of the Bakolori Irrigation Project mandated by the Federal Government and assisted by the World Bank. In order to prevent
negative impacts on the community and the environment, they have appointed Hospitalia Consultaire to carry out on-site investigations, identify environmental problems and preventive measures. He further stated that the key reason for this meeting was so that Hospitalia Consultaire will get first-hand information from the local people (particularly farmers) and current conditions of the Irrigation scheme. The Project Manager called on the people to contribute information on the present situation so that a lasting solution could be found. Upon conclusion of his opening remark, the consultants from Hospitalia Consultaire explained the essence of the stakeholders’ forum and the project scope to the participants;

The next phase was the interactive sessions between the various groups that were visited, starting with the Zamfara State Ministry of Agriculture.

**Ministry of Agriculture**

The Zamfara State Ministry of Agriculture was represented by their Director of Irrigation Services. The Director started by requesting permission to speak in Hausa as most of the people present were Hausas and he was there because of them. He then said that he was representing the Commissioner of Agriculture for Zamfara State, Dr. Dodo, who he said wanted to be a part of the on-going blessed meeting but had to travel with the state governor to Abuja.

He continued by saying the Ministry of Agriculture and Bakolori are just like mother and child that everyone knows the effort that they (Zamfara State Ministry of Agriculture) have put for the progress of Bakolori in the last five years. They provided and will continue to provide farm equipment like tractors, fertilizers and training to the farmers.

He stated that with the recent partnership of state and federal government to support weed farmers in the project area, the local farmers complained of lack of market for farm produce, of which they intervened. It was also agreed that the State Government, the Federal Government and the Sokoto Rima River Basin Development Authority will train weed farmers from Sokoto, Kebbi and Zamfara on the 15th of this month (December) and that they will continue to give their full support for Bakolori. He further said that they (Zamfara State Ministry of Agriculture) have distributed free siblings, fertilizers and trained their farmers so as to encourage tree planting and also collaborated with the Bakolori Irrigation Scheme to train two people from all the Local Governments in the state. He concluded by saying that they are ready to give their full support to the Bakolori Irrigation Scheme.

**Managing Director SRRBDA**

The next speaker was the Managing Director, Sokoto Rima River Basin Development Authority (SRRBDA), Alhaji Hassan Kambari. After acknowledging the guests, he said that this is the day that God has given them. In those days when Bakolori was fully active, it was
well-known around the country and even till now, there has never been any project like the Bakolori Irrigation Project. He said that the Bakolori Irrigation Scheme has 23,000 ha for farming but now, the primary, secondary and tertiary structures are in a bad state. He said that due to some problems caused by them (the farmers) and some other problems caused by the Federal Government, the production of rice and wheat were terminated but have now been reviewed by the Federal Government and have recognized the benefits reactivating the project it will provide particularly to the people.

He commended the project as a welcome development and he encouraged the people to open up at this forum, speak out on problems currently faced, as withholding information will not be of any benefit. Furthermore, he said that project Consultants are coming from all over the world with their knowledge for them to learn from, so they should give them their full support to ensure that the project purpose is achieved. He also called on Hospitalia Consultaire to tolerate the people in terms of culture and religion and they would also tell the people to do likewise and make sure that they do not interfere with Hospitalia Consultaire’s activities. He reminded the people of the recent visit of the Minister of the Federal Ministry of Water Resources to the Bakolori Dam. The Minister went round the Bakolori Irrigation Scheme and made assurance that rehabilitation and for this reason, the people should give their visitors the necessary support demanded of them. The MD further informed the stakeholders to state their specific need concerning the irrigation systems “If they want the sprinkler system, they should state so”. To conclude he also advised them not to harass the visitors and thanked them.

Project Manager, BIP

The representative of the Project Manager, Bakolori Irrigation Project in his speech first acknowledged the special guests. He stated the importance of the Bakolori Irrigation Project in providing water during dry season and in wet seasons when the rains are not sufficient, and in providing electricity and promoting fish and livestock farming. He also added that the Bakolori Irrigation Project involves different people and that there is need to harmonize them to avoid issues. He referred to farmers as the backbone of the Bakolori irrigation project but that a lot is still needed to be done for them to reach their full potential.

In the past, the government used to provide everything the farmers needed but now, things have changed. He said that the people should keep doing their best by doing what the government has not done. He said that even though it will be difficult, that they should keep doing it because maybe the government does not have the resources to carry out the responsibilities alone. The reactivation this project by the Government is a welcome development. With the support of the State Ministry of Agriculture, Water Resources and others working with them, he encouraged collaboration with one another in order to ensure the success of the project. He assured them that the Bakolori project authority is in
complete support of the project because its success will bring about a change in their living standards. Everybody was urged to give their support and contribute towards the success of the rehabilitation works.

**The State Ministry of Water Resources, Zamfara State**

Engineer Salamu Hassan, the director of water resources represented the Commissioner of Water Resources. He started by saying that Bakolori dam was being used to provide water for domestic and other uses to Talata Mafara, Bakura and Maradun LGAs’ after it had been processed, so they are in full support of the rehabilitations because they wouldn’t exist without the dam. Furthermore, he reminded Hospitalia Consultaire that some of the water channels that linked Talata Mafara, Bakura and Maradun LGAs were also having problems. He said that it is general knowledge that the country is currently facing water issues, but if adequate measures are taken, such issues will be resolved for drinking and irrigational purposes. He also added that the commissioner wanted him to remind everyone about the issue of hydro-electricity, that the turbines should be replaced so that it will continue working and rice processing can also take place. Lastly, he used the opportunity to appreciate the Federal Government for initiating activities towards the repair works and thanked Hospitalia Consultaire for inviting them as stakeholders to this great occasion.

**The Royal Fathers (Emirs)**

Alhaji Ahmed Mohammadu represented the royal fathers. He started his speech by thanking all for coming. He also added that they are ready to give their 100% support to any company that is willing to carry out the rehabilitation works. He assured that there will be no disturbance and that the royal fathers are ready to provide for any project needs required and that their people and local government chairmen are also ready to give their full support as well. They also assured that they will give Hospitalia Consultaire a peaceful working environment.
Bakolori Water Users Association
Alhaji Sani Iadan represented the Bakolori Water Users Association. He started by saying that they (the Federated Bakolori Water users Association) are in 100% support of the project and are ready to give their support where necessary, and prayed that the project works start and finish in peace. He said that their main problem is that the canals in their farms are in dire conditions; therefore they are calling on Hospitalia Consultaire to take their plea to the government for the canals to be repaired. He said that they also need tractors, fertilizers, chemicals and other farming equipment. Lastly, he complained of their market, and pleaded that the government should be informed so that a good market where they can market their farm products is made available.

The Bakolori Consultative Forum
Alhaji Shehu represented the Bakolori Consultative Forum. He began by saying that the Bakolori Consultative Forum was established four (4) years ago and the reason for its establishment was to bring peace between the farmers, the SRRBDA, the police force, market people and others. The purpose was achieved because he said that in the past years, many conflicts have been resolved through this forum. They are calling on the State Government and the Local Government to provide assistance during the Bakolori rehabilitation work. He said that current complains in their forum is the lack of market (customers) because no matter how much they farm and with no market in place, the farming is just a waste of time. So he said that they are using this medium to call on Hospitalia Consultaire to come to their aid and take their plea to the government, and also help them with drinking water and a hospital because they are suffering from cholera and other diseases. He also added that they needed a large rice-processing machine.

The Women Groups
Hadjiah Ladi represented the Women Groups.
She said that the canals in their farms are in bad conditions and need to be repaired urgently. Secondly, she said that they need fertilizers, pesticides, herbicides and chemicals for birds so that
they will have good produce. She also added that they were having problems marketing their produce.

The Fishermen Association
The representative of the fishermen association started his speech by assuring that there will be no problems during the rehabilitation works. He added that their (The Fishermen Association) problem is that they do not have fishing materials and there are a lot of fishes in the dam. They asked that the government should help in the provision of fishing nets. Secondly, he said that there are some people that use chemicals (gamalin) that are not good for the aquatic environment and animals. He pleaded for an intervention on the matter. He concluded by saying that the dam should be well rehabilitated for better fishing benefits.
Audience
A man from Jankarawa stood up and said that some of the dam sprinklers were missing, so Hospitalia Consultaire should help by replacing them. He also added that God should help them.

The second person said that there will be no problem in terms of the dress code of their visitors because some of them were opportune to go to school, so they are aware of the different types of dressing. He also added that they are going to give their full support towards the project and also added that the company should help them resolve the canal problems in their farms.

The last person said that they want the conflict between the Fulani people and their farmers to be resolved because the Fulani people do enter their farms to destroy their canals and farm products.
Annex 4: Minutes from the General Public Consultation (Third)

Participants were seated at 10am; registration marked the start of official activities for the day at about 10:30am. Opening Prayers was led by Alhaji Sani Ladan which was followed by the introduction of guests by the Master of ceremony. A welcome speech was delivered on behalf of Engr. Khalid U. Yusuf, MD/CE, Sokoto Rima River Basin Development Authority (who was attending an annual National Council of Water Resources meeting including the Minister of Water Resources and other leaders of River Basin Development Authorities in Kaduna), by the project manager Bakolori Irrigation Project.

Formal recognition of dignitaries present was made. His Royal Highness, the Emir of Bakura, Engr. Bello Sani was present. Other Royal fathers were represented. Other dignitaries in attendance were Special Advisers to the Governor of Zamfara State on Agriculture and Water Resources, respectively, Commissioners for Environment, Water Resources and Agriculture, Women leaders, Youth leaders, Representatives of LGAs, Development Associations, Representative of Power Holding Company of Nigeria (PHCN), Representatives of the Police Force, Civil Defense Corps, and Federal Road Safety Corp, Representatives of Medical Institutions, Representatives of Banks, the Press, etc.

Opening Remarks:
The opening remark was made by Alhaji Muhammed Lawal Maidoki, the Project Manager, BIP; he pointed out that the essence of the public consultation was to educate and enlighten the people who are stakeholders of the project on the likely project impacts as well as plans to enhance positive impacts and mitigate adverse impacts of the project before and during implementation.

Full Speech by the Project Manager, Bakolori Irrigation Project Management Office

His royal highness, the Emir of Bakura, Engineer Bello Sani and other royal fathers; the representative of Emir of Talata Mafara, Alhaji Maman Wada; the representative of the Commissioner of Agriculture, Zamfara State; the representative of the Commissioner of Water Resources, Zamfara State, who is the Permanent Secretary; the representatives from the law enforcement agencies; the farmers and all other invited guests; you are all welcome. The Hospitalia Consultaire team who are the main organizers of this occasion; the leaders of the Water Users Associations; the secretary of the Bakolori Consultative Forum; the Director of Irrigation Services, Zamfara State; the District Heads; the leaders of the fisherman and the herdsmen; our partners the Security Agencies here present; the leadership of the Power Holding Company of Nigeria; the Road Safety Commanders; and all other distinguished invited guests here present, I wish to acknowledge your presence and on behalf of the Sokoto Rima River Basin Development Authority, the management as well as the management staff of the Bakolori Irrigation Project here in Talata Mafara, I want to seize
this opportunity to welcome each and every one of you to this very important public consultation. My Managing Director, Engineer Yusuf is unavoidably absent; he is currently attending an annual National Council of Water Resources meeting including the Minister of Water Resources and other leaders of River Basin Development Authorities in Kaduna, Kaduna State.

We want to say that we are fully in support of this rehabilitation works and that God should give us all the blessing to achieve this endeavor. I want use this opportunity to thank the Emir of Bakura for his advice and support towards this project, the Commissioner of Agriculture, Zamfara State and the staff of the Ministry of Water Resources; we all thank you for your support in this work. And I want Hospitalia Consultaire to know that I have been working hand-in-hand with the Federal and the State Governments including His Excellency, the Executive Governor of Zamfara State who has been very supportive; in fact, less than two weeks ago he constituted a committee of three Commissioners associated with water issues to advice and liaise with the Federal Government, SRRBDA, BIPO, and the World Bank to intimate him on how he can come in to assist with the rehabilitation of the Bakolori irrigation project and what he can also do as a short term intervention before the rehabilitation works begin fully. This is a right step in the right direction.

Consultant:
After greeting all the invited guests He said basically what we are here to do today, which we have done before, is to intimate stakeholders on the activities that will be involved in the rehabilitation works for the Bakolori Irrigation Scheme rehabilitation; inform stakeholders on what the ESIA is all about; Collect and collate their views on the proposed rehabilitations works and integrate this in the ESIA; the ESIA and their views will be used in project design and implementation. Any project that is funded by an international agency such as the World Bank, the funding agency wants to know of anything that might have any negative impact or beneficial impact on the community and the environment; these must be assessed and taken into cognizance and an environmental management plan developed for implementation during the course of project implementation. Basically what this means is that we want to look at the whole project from conception through design, construction, operations and even up to project closure. Take an example of this Bakolori project, we know that there will be many beneficial aspects and impacts that will come out from it, but there might be small problems and impacts during project implementations. We want to ensure that all identified negatives are ameliorated or mitigated where possible, and all identified positives are fully enhanced for maximum benefits to all from the project. Please we want to assure everybody here before I go on, that as good Nigerians we all want the success of this project.

So let’s all contribute during discussions in this stakeholders’ forum and please identify any problem that you feel may occur whether during construction or when we are preparing for construction or even during the operation of the project or maintenance of the project; the
main reason for us being here, is for you to come and talk to us not us talk to you; tell us what you think are the things that might hold this project back; be assured that we are not here to look for reasons to stop the rehabilitation, but to ensure that it is done properly in a sustainable manner and to guaranty maximum benefits to you, the beneficiary communities, and the Nigerians in general. For instance, we have invited the representatives of the Road Safety Commission because during rehabilitation there will be issues that have to do with transportation, there will be traffic hold ups, we want the drivers that will come into the place to be managed properly, we want the Federal Road Safety Corp to understand that this project is going to come and heavy vehicles are going to be part of the project so we need their cooperation.

The same thing with the police force there will be people coming from outside; technicians’, specialist people from outside Nigeria; people from other parts of Nigeria; there might be criminal activities; we want to minimize there might be people who will drink and want to fight; we want to avoid all these things from the beginning; so when we talk about environmental and social impact assessment we look at both the environmental and social issues; we want to eliminate and take care of these problems from the beginning of the project and make sure that those things that could have resulted in problems in the project are taken care of from the beginning when the project is still in its infancy; so let us not look at it as if some investigators want to come and do something that may stop the project; it is purely for the benefit of the project that the ESIA is being conducted; our concern with Bakolori project and its rehabilitation is how do we make it even better than it was originally; such that all through the implementation of this project there will be no accident; there will be no deaths; and at the end of the day we have maximum benefits from it. Some of the things to be looked at are things that we have concerns about and things to improve agriculture, to improve production, to improve health, to improve standards of living and hygiene, etc. You people will tell us what are the things you think that we will do currently on the project design to improve the project outcome. The water users associations, how do you think we can strengthen the water users association? We are not the persons on ground; you understand the system better than anybody from outside; you are the inheritors of the project; you are the owners of the project even though we are all beneficiaries of the project.

We must know how to improve on some things so that the water user associations will function very well; so that the canal will work well; so that the dam does not get unduly silted. We know that there is some silt in the primary, secondary and tertiary canals; we are going to remove these silts that are there; where are we going to put them? If we are putting them somewhere will there be problem? Will people complain? Will they pollute the water that people will drink? These are issues we want to look at. The vehicle that will carry these silts to disposal sites are we sure that when carrying it there will not be pollution of the air thus creating hazard to our people. We don’t want where people remove silts from the canals and drainages and dump them in places where they constitute fresh nuisance; those are the problems we want to look at. Other issues we want to look at are how to increase production; but equally, there are problems with increased production without access to
markets; when a farmer farms for one year under the sun and under the rain and at end of the day he produces plenty sells a basket of say tomatoes for N500 is it fair? the middlemen come to the farm gates to buy produce and they are making more money than the farmers; So what are the factors that had been hindering our farmers from benefiting equitably from what they are doing; we want to know these problems; we want to identify them and then take them into consideration during project design; what is access to the markets like for the farmers; Another thing is access into the farms; how do we improve on this so that the farmers can access their farms more easily; even when they have harvested their crops they can’t bring them out; this is a critical problem; these are issues we need to look at and improve on, as part of the rehabilitation. It is not just about improving production; we have mango and tomato but there are no food processing facilities in the project area; a lot of the food stuff produced by farmers are wasted; this is a disincentive to improve production; how do we resolve these socio-economic issues? Another issue we will look at is the soil fertility issue; how can we improve on it? Is it to use manure or fertilizer? We know the adverse impacts of excess use of fertilizer; how can we integrate farming practices here such that we can use natural manure for increased production instead of pumping in more fertilizer. There are conflict issues that are already in existence; the conflicts between the herdsmen and the farmers are an example; how do we assure that they can co-habit because they are beneficial to each other. The farmer needs the manure of the herdsman, and the herdsman needs the fodder from the farmer; this is the way of doing things.

If you go to Niger republic there are beneficial agricultural practices that they are operating; Southern Niger is presently, greener than the Northern-most parts Nigeria of which Katsina, Zamfara and Sokoto States are part of; can’t we integrate some of these their beneficial practices into our own system, such as agro-forestry where you plant crops and trees together; these are some of the things we want to look at, so we want you to tell us what we will do to improve on the project sustainability. We would also look at the issues of water sharing; people up stream, people downstream; how do we use the water so that everybody gets enough water on a regular basis; we will also look at the people doing Fadama farming. So these are all issues; as you know, we were here last month and we are here again; this is to show how important this project is to government. They want us to give this report by the end of this year because it is part of the requirement of the Federal Government of Nigeria for a big project like this, and for organizations like the World Bank - that before they fund a project such as this the environmental and social impact assessment must be done. We will also look at the women; our mothers - we want to look their situations; we want to look at the gender issues are their families. We would also look at the health system; if you look here we have the Head of the General Hospital in Maradun here with us; you are welcome, Sir. Why we have invited people like him is because the health issues are critical to the success of this project. If the farmer breaks down with malaria we cannot be talking of producing more. How do we ensure that we reduce the un-sanitary practices which encourage the prevalence of malaria? How do we ensure that there are enough drugs in the hospitals to treat our
people? These are all areas we intend to look at. Also we know that there are maintenance issues; how do we ensure that after these repairs we will not go back to where we had started. How will we ensure that the money collected from the water users associations are applied effectively for the project? We want to also look at the water users associations - are they registered with the Corporate Affairs Commission? Are they registered with the Zamfara State government Ministry of Commerce? The issues of birds that do attack our crops; what is the best way to manage this problem. These are things we want to find out and make our recommendation on. We welcome all the fishers men, we want to know if they are catching more fish, or if they were catching more before; what is the problem now if any? We would also look at the issue of the herdsmen; what problems are they facing? There are problems with Bakolori Implementation Management Office; we know that they have the problem of staffing. What can be done so that the project management will be more effective? We will also look at the electricity issues and get advice from you the stakeholders on it; how do we improve the electricity supply to the area? Is it better to repair the turbines, use generators, or depend on the national grid? The essence of the environmental and social assessment is to know and identify the beneficial things that will come out of this project and how can we enhance them. We will also identify all the negative environmental and socio-economic impacts, and see how we can mitigate them or if not possible, ameliorate them. It is only with your speaking out and letting us know what the present and anticipated problems (in your view) are that we will have a good report, which will ensure the sustainability of this project. So please, feel free and speak on all issues of concern to you with regards to this project. Nobody will be harassed or penalized. It is for the good of your community and the greater society at large. May God give us the grace to have a successful forum. Thank you.

Audience:
After the Consultants presentation the people said that they welcome this project and that they will give all necessary support to see to its success. A member of the audience stated that “when the project was started, we had about 26,000 hectares of land irrigated, but because there wasn’t much maintenance of the scheme this figure kept reducing till it reached as low as 4,000 hectares under cultivation last year. We also want the government to intervene on the issue of electricity so that people around the irrigation area can have light. Also the design for the project should ensure that minimal maintenance is required as the sprinkler system did not function properly because it required high maintenance”.

THE EMIR OF BAKURA
After greeting all the guests present, he said first of all we want to thank the Federal Government for the wonderful idea of rehabilitating the Bakolori irrigation project. He prayed that all due diligence and care are taken to ensure that project implementation goes smoothly, and that the set project target goals are met or even surpassed.
THE REPRESENTATIVE OF EMIR OF MAFARA
I greet the entire invited guests here. I don't have much to say but his Highness is wishing everyone well concerning this project and he prays that the work will be done successfully.

THE REPRESENTATIVE OF THE COMMISSIONER OF AGRICULTURE ZAMFARA STATE
The emir of Mafara, the Hospitalia Consultaire team and all other invited guests here, I am very happy that the Ministry of Agriculture is being invited for the rehabilitation works of the Bakolori irrigation project; the Federal Ministry of Water Resources and Environment respectively, have seen the need for this work that is why they say they should bring consultants to come and hear our opinion; so the Zamfara State Ministry of agriculture is fully in support of the rehabilitation works and are also partners with the Federal Government. Also we have our royal fathers; we know that they will give us the right advice. The commissioner of agriculture is in agreement with the rehabilitation works as the dam is almost 30 years old and suffers serious siltation. If the sand in the canals is removed the Dam will give us enough water for irrigation farming and we will have enough food such as wheat, tomato, rice, etc.; with this, our youth that are not employed will be employed, also with this people will come from different places to learn our farming methods. We advise that for the successful rehabilitation of the Bakolori Dam, facilities especially pumping stations should be repaired and de-silting of the canals should be carried out. Thank you.

THE REPRESENTATIVE OF TALATA MAFARA LOCAL GOVERNMENT CHAIRMAN
After greeting the entire invited guests he said the government should help in the management of the pest - Quella birds which do great damage to crops in their farms; they don't want a situation where some of their children are withdrawn from school while others will leave other important activities in the farms just to be chasing birds. He further said the government should help them with free fertilizer so as to boost their productivity.

THE REPRESENTATIVE OF CHAIRMAN, BAKURA LOCAL GOVERNMENT
After greeting all the invited guests he said he thanked the authority and also the royal fathers for their speech in which he knows will benefit us all for the success of this work.

THE LEADER, BATOLOPU WATER USERS ASSOCIATION
After greeting guests he said the advice he has is let the tertiary canal be repaired and be well maintained. Secondly, he stated the issue of shortage of staff on the BIPMO and for this to be rectified. Thirdly, he said the problem of birds is a big problem to their farming activities and lastly, he said the issue of trespassing grazing cattle into their farms as no access route has been made for their use. To conclude he made known the dire need of access roads so that lorries can ply to their farms for the evacuation of produce.
THE REPRESENTATIVE OF THE LEADER MAFARA DEVELOPMENT COMMITTEE
After greeting the entire invited guests he said this committee had been waiting for long for this great opportunity of rehabilitation. We thank God it has come. In the last 8 years, this committee took the responsibility of writing recommendations and suggestions to the Federal Ministry of Water Resources and forwarded it to them and the Minister of Water Resources then said they will do something about it. We also presented a copy to the royal fathers and Sokoto Rima River Basin Development authority. So we are hoping that this present set of recommendation will be well implemented. By God’s grace we will benefit from these our recommendations and will assist the proposed rehabilitation works. We have our recommendations written (both hard and soft copy), and will be made available on request. Thank you.

THE REPRESENTATIVE OF HERDSMEN
After greeting the entire invited guest he said we and the farmers are brothers and sisters the government should find a way for them to graze peacefully.

THE REPRESENTATIVE OF FISHERMEN
Upon greeting the invited guests, he said their problem is they are lacking fishing material (tool) and asked for assistance.

THE REPRESENTATIVE OF WOMEN WATER USERS ASSOCIATION
After acknowledging the invited guests, she requested that the sand deposited in the canals and drainage systems be removed. Lastly, she said they are in support of the rehabilitation works 100%.

THE REPRESENTATIVE OF BAKOLORI CONSULTATIVE FORUM
Upon greeting the invited guests he continued by saying this forum was established last 4 years between the herdsmen and farmers with the help of the royal fathers and the security agents. The forum is happy for the coming of Hospitalia Consultaire and the Federal Government and World Bank intervention. He further said Hospitalia Consultaire should help them as part of their recommendation in stating the need for more health centers (Hospital) and also the provision of drinking water by constructing boreholes within the irrigation area. He further said government should assist them with access to a good market so that their effort will not be wasted again; they should help them with a rice processing facility. Lastly, he said they should be provided with farm machineries such as tractors, harvesters, etc.

THE REPRESENTATIVE OF SECURITY AGENTS
After greeting all the invited guests he said security agents are not angels that they are normal people, that the local people should endeavor to willingly provide all information on any
offence and they will give their support 100%. He further stated information sources will be kept private and due process will be followed in prosecuting the offender. Even among workers he said that there might be offenders, and the local peoples support is important.

**THE REPRESENTATIVE OF THE FEDERAL ROAD SAFETY COMMISSION**

He started by greeting the entire guests, and explained that the commission was established to reduce road traffic accidents and if possible to eliminate road traffic accidents on our highways. Secondly I want to advice that during the construction works, the vehicles that will be carrying silt/sand should be well covered.

**AUDIENCE**

The first person said the government should repair the roads within the irrigation scheme. The second person said the company Hospitalia Consultaire should advice the government to come and repair the silted and broken canals. Another member of the audience said they need storage facilities to be storing their farm produce before selling.
## Annex 5: Site-specific PCB Management Plan

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Environmental impact</th>
<th>Health impact</th>
<th>Mitigation Measure</th>
<th>Institutional Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformer Oil spills unto the ground</td>
<td>Alteration of natural soil geo-physical properties. Surface and ground water contamination. Persistence of PCBs in contaminated soil and land area.</td>
<td>Exposure to disused oils could lead to cancers of the digestive tract. Neurologic effects Liver damage Epigenetic diseases, etc.</td>
<td>Tightly seal all storage drums and tanks Immediate cleaning of spills. Place storage drums on permeable platform</td>
<td>BIPMO, PCU</td>
</tr>
<tr>
<td>Oil leaks from disused transformers</td>
<td>Soil, Surface and ground water contamination</td>
<td>Chloracne if personnel have skin contact with PCB contaminated oil during housekeeping. Various neurologic, liver, endocrine, reproductive and congenital/neonatal diseases, cancers. Death</td>
<td>Proper equipment maintenance Regular equipment inspection Good House keeping</td>
<td>BIPMO, PCU</td>
</tr>
<tr>
<td>Draining of used oils into creeks, streams and other natural water bodies</td>
<td>Intake by marine organisms and bio-magnification up the food chain Destruction of animal and plant marine habitats</td>
<td>Consumption of marine food containing PCBs could cause: Elevated liver enzyme levels Bioaccumulation in adipose tissues Neurologic effects Liver damage Epigenetic diseases Cancers, etc.</td>
<td>Use of proper drainage methods for oils in Pumping Station Good House Keeping Provision of good storage facilities for oil and disused equipment</td>
<td>BIPMO, PCU</td>
</tr>
<tr>
<td>Enclosed containment of stored oils</td>
<td>Increased concentration of PCBs within storage area because of restriction of sunlight</td>
<td>Inhalation of PCB contaminated air</td>
<td>Store disused oils in sunlight to allow break down of chlorine molecules into less hazardous quantities</td>
<td>BIPMO, PCU</td>
</tr>
<tr>
<td>Using transformer Oil as weed kill</td>
<td>Absorption of quantities of PCBs into plant Parenchyma tissue. Possible destruction of important plant species Bioaccumulation</td>
<td>Consumption of PCB containing plants could cause: Neurologic effects, Epithelial Bronchial ulceration.</td>
<td>Manual or mechanical weeding practices</td>
<td>BIPMO, PCU</td>
</tr>
<tr>
<td>Lack of PPEs</td>
<td>N/A</td>
<td>Loss of skin pigmentation with continuous handling of PCB oils</td>
<td>Use of adequate PPEs</td>
<td>BIPMO, PCU</td>
</tr>
<tr>
<td>Burner Fuels</td>
<td>Release by-products such as hydrogen chloride and PCDF during combustion</td>
<td>Nasal ulceration, Epithelial Bronchial ulceration, Reactive Airway Dysfunction Syndrome</td>
<td>Prohibit sale of disused oils to unauthorized end users</td>
<td>BIPMO, PCU</td>
</tr>
</tbody>
</table>
Annex 6  Occupational Health and Safety (OHS) Considerations for Proposed Rehabilitation Works

Considering the potential for rehabilitation works to require medium to large scale labour, and the peculiarity of the works (Hydro-electric, electric, civil, mechanical, social etc.) the project will require a Project Occupational Health and Safety Management Plan. The plan will focus on workers’ health and safety during the major rehabilitation activities.

Rehabilitation works for the Hydroelectric Power plant

### Bakolori Irrigation Project (BIP) OHS Responsibilities

The BIP has a responsibility to ensure the health and safety of all persons working on the dam and irrigation sites including, their own employees, Contractors, Subcontractors and agency employees.

In this regard, the BIP shall:

- Define systems of work and requirements for Contractors and Subcontractors to ensure their health and safety on the site. This means that BIP will require Contractors and Subcontractors to follow safe systems of work, meet statutory and other requirements (Nigerian and International), and audit their capability to safely manage work performed by their own employees. A periodic audit by BIP of the Contractor’s work performance and systems including OHS should be required as partial basis for payment.
- Provide information needed by the Contractors to document and carry out work in a safe manner.

BIP should provide information on hazards and their associated risks while working on any specific part of the Hydroelectric power plant. This will enable Contractors document their procedures for managing work around hazardous conditions, and to ensure they are aware of these hazards. BIP will do this by providing a set of requirements and safe work procedures through the Terms of Reference (TOR) in the Contractors contract document. It should also highlight Risk and Control Assessments, Work Control Permits etc.

- Review Contractors Safe Work Method Statements to ensure they comply with the Bank’s Environmental and Social safeguards and statutory HSE Requirements.
- Any Safe Work Method Statements submitted at tender should be reviewed to ensure safety and environmental requirements have been fully met.
- Ensure that Contractors follow all safety and environmental requirements.

BIP should monitor health and safety during rehabilitation works. Pre start checks, inspections and audits will be conducted while on-site. These checks will look at work practices and methods, equipment conditions and suitability, and competency of people through checking the permits, licenses etc. Individuals are not permitted to bring, use or be under the influence of alcohol or non-prescribed drugs on site.

### Contractor’s Responsibilities

Contractors are responsible for ensuring that their work methods consider and incorporate best practice and Hydro safety requirements.

Contractors are responsible for ensuring that safety and health hazards associated with the work they are performing, are satisfactorily controlled and do not pose a risk. In the process of carrying out their work a Contractor may introduce other hazards. The identification and control of these hazards is the responsibility of the Contractor. These hazards and controls identified by the Contractor must be considered in the Work Method Statements.

Contractors are responsible for ensuring the health and safety of their employees including Sub-contractors. This means that the Contractor is responsible for ensuring that: a) their employees and sub-contractors are adequately trained and competent in performing their tasks, and in basic safety procedures. b) are provided information about processes and materials which are hazardous. c) are issued with appropriate safety equipment and have appropriate instruction in its use. d) have safe work methods and are adequately supervised to ensure safe work. e) workplace safety inspections are regularly carried out. f) there is access to first aid equipment and trained persons.
Contractors are responsible for ensuring their plant and equipment is safe. This means that Contractors’ plant and equipment whether their own or hired is:

- in a serviceable condition with regular maintenance and inspections.
- suitable for the task it is to perform and
- meets TRIMING PROJECT/SRDB/BIP requirements.

The primary concerns of plants are that:

- All guards are in place and secure
- Relevant safety equipment is fitted and working
- Operating controls (indicators, brakes, steering etc.) are working properly
- possible safety or environmental risk items are satisfactory. (hydraulic hoses, mufflers, exhaust emissions, fluid leaks etc.).

Rehabilitation works for the Irrigation System (Primary Canals, Secondary and Tertiary Canals)

**Bakolori Irrigation Project (BIP) OHS Responsibilities**

The BIP has a responsibility to ensure that all farmers, by-passers, visitors and locals are informed about the rehabilitation works, especially at the primary canals.

BIP should provide information on hazards and their associated risks while working along the primary canal, and ensure that contractors place safety signage at work sites/sections.

Review Contractors Safe Work Method Statements.

BIP should monitor health and safety during rehabilitation works. Pre start checks, inspections and audits will be conducted while on-site.

**Contractor's Responsibilities**

Contractors should be responsible for ensuring that their work methods consider and incorporate best practice and project-safety requirements.

Contractors should ensure that life jackets are worn by personnel when working in/along the primary canal. Environmentally safe snake repellents could be applied in areas where work is carried out along the primary, secondary and tertiary canals. Findings during baseline data gathering have shown that viparine species of snakes exist within the irrigation area. Contractors should also have on-site medical personnel to administer anti-vermin in the case of snake bites during work.

Proposed rehabilitation works for the Road Networks Access Road

**Bakolori Irrigation Project (BIP) OHS Responsibilities**

The BIP has a responsibility to ensure that all farmers, by-passers, visitors and locals are informed about road rehabilitation works.

**Contractor's Responsibilities**

Contractors should be responsible for ensuring that:

- Caution signs are in place.
- Dust reduction methods
- Noise reduction
Annex 7: Waste Management Plan

This section provides an overview of the integral components of a waste management plan for the Bakolori Irrigation Scheme Rehabilitation Project. Considering that waste generation will be a major issue during the rehabilitation/construction phase, emphasis is therefore laid on this subject matter.

Objectives of the Waste Management Plan

- Ensure reduction of wastes
- Meet the environmental requirements of FME, State Ministry of Environment (SME), Zamfara State Environmental Protection Agency (ZSEPA) and other national and international waste management guidelines.
- Establish, implement and maintain waste segregation aimed at enhancing recycling.
- Ensure that PCU and Contractors are responsible for effective waste handling and disposal process, which shall be monitored by relevant waste disposal authorities.

The ESMP will provide detailed information on waste management including the amount and type of waste to be generated, the sources, and the existing waste management practices and proffer mitigation measures, which will involve:

- Sensitization amongst the Contractors, workers, labourers on the need for effective waste management in and around the pumping stations throughout the project activities.
- Community sensitization and mobilization on the adverse consequences of poor waste management.

Waste types

The rehabilitation works will produce vast amount of waste from the construction activities. The following are some of the materials that can be expected to be generated during construction: vegetation stripping, concrete forms, packing materials, containers for various construction materials, asbestos, plastics, waste oil, filters, lubricants and hydraulic fluids, food, sewage, etc.

It is necessary to ensure that wastes generated during construction are handled in a way that protects human, animal and environment health and complies with applicable regulations.

Recommended Measures for Waste Management

The ESMP details how wastes that will be generated at the project sites will be managed in an environmentally sustainable and socially acceptable manner. To be practical and effective in handling of wastes, (Solid, liquid and hazardous) the ESMP follows the fundamental principles of waste management:

- Minimize the production of waste that must be treated or eliminated
- Identify and classify the type of waste generated. If hazardous wastes are generated, proper procedures must be taken regarding their storage, collection, transportation and disposal.
• Identify and demarcate disposal areas clearly indicating the specific materials that can be deposited in each.

• Control placement of all construction waste to approved disposal sites (>300 m from rivers, streams, lakes, or wetlands). Dispose all wastes in authorized areas, metals, used oils, and excess material generated during construction, incorporating recycling systems and the separation of materials.

• Identify and demarcate equipment maintenance areas (>15m from rivers, streams, lakes or wetlands).

• Identify, demarcate and enforce the use of within-site access routes to limit impact to site vegetation.

• Install and maintain an adequate drainage system to prevent erosion on the site during and after construction.

• Erect erosion control barriers around perimeter of cuts, disposal pits, and roadways.

• Spray water on dirt roads and stockpiled soil to reduce wind-induced erosion and particulates dispersal, as needed.

• Identify and demarcate locations for stockpiles and borrow pits, ensuring that they are 15 meters away from critical areas such as steep slopes, erosion-prone soils, and areas that drain directly into sensitive water bodies.

• Establish and enforce daily site clean-up procedures, including maintenance of adequate disposal facilities for construction debris.

The management of other kinds of waste that will be generated is highlighted below

**General Waste**

• There should be adequate number of garbage bins and containers made available at strategic areas of the site. The use of plastic bin liners should be encouraged.

• All organic and inorganic materials will be placed and/or disposed of so as not to directly or indirectly impact any watercourse or groundwater. The placement and disposal of all such products and materials will be done in an environmentally acceptable manner.

• Solids, sludge and other pollutants generated as a result of construction or those removed during the course of treatment or control of wastewaters will be disposed of in a manner that prevents their direct or indirect re-entry into any watercourse or ground waters.

• Any waste material that is inadvertently disposed in or adjacent to watercourses will be removed immediately in a manner that minimizes adverse impacts, and the original drainage pattern should be restored.

• All wastes that are not designated, as combustible waste on-site will be recycled, disposed of in any of the Zamfara State’s approved dumpsites, landfills or waste treatment facilities (where they exist).
Waste materials should be placed and stored in suitable containers. Storage areas and containers will be maintained in a sanitary condition and shall be covered to prevent spreading of wastes by water, wind or animals.

All food wastes should be collected and stored in containers at appropriate locations and should be emptied at regular intervals and the collected waste should be transported to Government designated waste management facilities.

Oil waste

- Ensure that all equipment maintenance activities, including oil changes, are conducted within demarcated maintenance areas designated for such.
- Ensure that oil or other lubricants are never dumped on the ground, in designated areas.

Material waste (concrete, stones, mixtures, cement)

- There will be a designated site for washing of containers or trucks that contain cement wastes.
- Control placement of all construction waste to approved disposal sites (>300 m from rivers, streams, lakes, or wetlands).
- Concrete waste, including wastewaters from batching or cleaning, will only be disposed of at approved and designated disposal sites with containment facilities.
- All cement-contaminated wastewater from cleaning or mixing is to be considered toxic, and must be prevented from entering any watercourse or drainage channel for at least 48 hours to allow the water to reach neutral pH level.

Sewage Disposal

- It is highly imperative to channel sewage facilities to avoid getting into the ground water, soil or even resulting to other types of nuisance to the environment.
- Suitable sanitary waste collection and disposal facilities or systems should be made available at the pumping stations, camps, work areas, workshops, stores, and offices.
- All temporary toilets will be placed in environmentally acceptable areas, and will be equipped with approved septic tanks having safe drainage that are emptied only into approved treatment plants or sewage tanker truck.
- The temporary toilet facility will be secured to avoid or minimize damage from animals or vandalism.

Vegetative waste

- The typha grasses when cleared from the canals, drainages and the other areas where they thrive, can be used as fodder for livestock feeding.
Annex 8: General Environmental and Social Management Conditions for Construction Contracts

General

1. In addition to these general conditions, the Contractor shall comply with any specific Environmental Management Plan (EMP) or Environmental and Social Management Plan (ESMP) for the works he is responsible for. The Contractor shall inform himself about such an EMP, and prepare his work strategy and plan to fully take into account relevant provisions of that EMP. If the Contractor fails to implement the approved EMP after written instruction by the Supervising Engineer (SE) to fulfill his obligation within the requested time, the Owner reserves the right to arrange through the SE for execution of the missing action by a third party on account of the Contractor.

2. Notwithstanding the Contractor's obligation under the above clause, the Contractor shall implement all measures necessary to avoid undesirable adverse environmental and social impacts wherever possible, restore work sites to acceptable standards, and abide by any environmental performance requirements specified in an EMP. In general these measures shall include but not be limited to:

   (a) Minimize the effect of dust on the surrounding environment resulting from earth mixing sites, vibrating equipment, temporary access roads, etc. to ensure safety, health and the protection of workers and communities living in the vicinity dust producing activities.

   (b) Ensure that noise levels emanating from machinery, vehicles and noisy construction activities (e.g. excavation, blasting) are kept at a minimum for the safety, health and protection of workers within the vicinity of high noise levels and nearby communities.

   (c) Ensure that existing water flow regimes in rivers, streams and other natural or irrigation channels is maintained and/or re-established where they are disrupted due to works being carried out.

   (d) Prevent oils, lubricants and waste water used or produced during the execution of works from entering into rivers, streams, irrigation channels and other natural water bodies/reservoirs, and also ensure that stagnant water in uncovered borrow pits is treated in the best way to avoid creating possible breeding grounds for mosquitoes.

   (e) Prevent and minimize the impacts of quarrying, earth borrowing, piling and building of temporary construction camps and access roads on the biophysical environment including protected areas and arable lands; local communities and their settlements. In as much as possible restore/rehabilitate all sites to acceptable standards.
(f) Upon discovery of ancient heritage, relics or anything that might or believed to be of archeological or historical importance during the execution of works, immediately report such findings to the SE so that the appropriate authorities may be expeditiously contacted for fulfillment of the measures aimed at protecting such historical or archaeological resources.

(g) Discourage construction workers from engaging in the exploitation of natural resources such as hunting, fishing, and collection of forest products or any other activity that might have a negative impact on the social and economic welfare of the local communities.

(h) Implement soil erosion control measures in order to avoid surface run off and prevents siltation, etc.

(i) Ensure that garbage, sanitation and drinking water facilities are provided in construction workers camps.

(j) Ensure that, in as much as possible, local materials are used to avoid importation of foreign material and long distance transportation.

(k) Ensure public safety, and meet traffic safety requirements for the operation of work to avoid accidents.

3. The Contractor shall indicate the period within which he/she shall maintain status on site after completion of civil works to ensure that significant adverse impacts arising from such works have been appropriately addressed.

4. The Contractor shall adhere to the proposed activity implementation schedule and the monitoring plan / strategy to ensure effective feedback of monitoring information to project management so that impact management can be implemented properly, and if necessary, adapt to changing and unforeseen conditions.

5. Besides the regular inspection of the sites by the SE for adherence to the contract conditions and specifications, the Owner may appoint an Inspector to oversee the compliance with these environmental conditions and any proposed mitigation measures. State environmental authorities may carry out similar inspection duties. In all cases, as directed by the SE, the Contractor shall comply with directives from such inspectors to implement measures required to ensure the adequacy rehabilitation measures carried out on the bio-physical environment and compensation for socio-economic disruption resulting from implementation of any works.

Worksite/Campsite Waste Management

6. All vessels (drums, containers, bags, etc.) containing oil/fuel/construction materials and other hazardous chemicals shall be bunded in order to contain spillage. All waste containers, litter and any other waste generated during the construction shall be collected and disposed-off at designated disposal sites in line...
with applicable government waste management regulations.

7. All drainage and effluent from storage areas, workshops and camp sites shall be captured and treated before being discharged into the drainage system in line with applicable government water pollution control regulations.

8. Used oil from maintenance shall be collected and disposed-off appropriately at designated sites or be re-used or sold for re-use locally.

9. Entry of runoff to the site shall be restricted by constructing diversion channels or holding structures such as banks, drains, dams, etc. to reduce the potential of soil erosion and water pollution.

10. Construction waste shall not be left in stockpiles along the road, but removed and reused or disposed of on a daily basis.

11. If disposal sites for clean spoil are necessary, they shall be located in areas, approved by the SE, of low land use value and where they will not result in material being easily washed into drainage channels. Whenever possible, spoil materials should be placed in low-lying areas and should be compacted and planted with species indigenous to the locality.

**Material Excavation and Deposit**

12. The Contractor shall obtain appropriate licenses/permits from relevant authorities to operate quarries or borrow areas.

13. The location of quarries and borrow areas shall be subject to approval by relevant local and national authorities, including traditional authorities if the land on which the quarry or borrow areas fall in traditional land.

14. New extraction sites:
   a) Shall not be located in the vicinity of settlement areas, cultural sites, wetlands or any other valued ecosystem component, or on high or steep ground or in areas of high scenic value, and shall not be located less than 1km from such areas.
   b) Shall not be located adjacent to stream channels wherever possible to avoid siltation of river channels. Where they are located near water sources, borrow pits and perimeter drains shall surround quarry sites.
   c) Shall not be located in archaeological areas. Excavations in the vicinity of such areas shall proceed with great care and shall be done in the presence of government authorities having a mandate for their protection.
   d) Shall not be located in forest reserves. However, where there are no other alternatives, permission shall be obtained from the appropriate authorities and an environmental impact study shall be conducted.
   e) Shall be easily rehabilitated. Areas with minimal vegetation cover such as flat and bare ground, or areas covered with grass only or covered with shrubs less than 1.5m in height, are preferred.
   f) Shall have clearly demarcated and marked boundaries to minimize vegetation
15. Vegetation clearing shall be restricted to the area required for safe operation of construction work. Vegetation clearing shall not be done more than two months in advance of operations.

16. Stockpile areas shall be located in areas where trees can act as buffers to prevent dust pollution. Perimeter drains shall be built around stockpile areas. Sediment and other pollutant traps shall be located at drainage exits from workings.

17. The Contractor shall deposit any excess material in accordance with the principles of these general conditions, and any applicable EMP, in areas approved by local authorities and/or the SE.

18. Areas for depositing hazardous materials such as contaminated liquid and solid materials shall be approved by the SE and appropriate local and/or national authorities before the commencement of work. Use of existing, approved sites shall be preferred over the establishment of new sites.

Rehabilitation and Soil Erosion Prevention

19. To the extent practicable, the Contractor shall rehabilitate the site progressively so that the rate of rehabilitation is similar to the rate of construction.

20. Always remove and retain topsoil for subsequent rehabilitation. Soils shall not be stripped when they are wet as this can lead to soil compaction and loss of structure.

21. Topsoil shall not be stored in large heaps. Low mounds of no more than 1 to 2m high are recommended.

22. Re-vegetate stockpiles to protect the soil from erosion, discourage weeds and maintain an active population of beneficial soil microbes.

23. Locate stockpiles where they will not be disturbed by future construction activities.

24. To the extent practicable, reinstate natural drainage patterns where they have been altered or impaired.

25. Remove toxic materials and dispose of them in designated sites. Backfill excavated areas with soils or overburden that is free of foreign material that could pollute groundwater and soil.

26. Identify potentially toxic overburden and screen with suitable material to prevent mobilization of toxins.

27. Ensure reshaped land is formed so as to be inherently stable, adequately drained and suitable for the desired long-term land use, and allow natural regeneration of vegetation.

28. Minimize the long-term visual impact by creating landforms that are compatible with the adjacent landscape.

29. Minimize erosion by wind and water both during and after the process of reinstatement.
30. Compact surfaces shall be deep ripped to relieve compaction unless subsurface conditions dictate otherwise.
31. Re-vegetate with plant species that will control erosion, provide vegetative diversity and, through succession, contribute to a resilient ecosystem. The choice of plant species for rehabilitation shall be done in consultation with local research institutions, forest department and the local people.

**Water Resources Management**

32. The Contractor shall at all costs avoid conflicting with water demands of local communities.
33. Abstraction of both surface and underground water shall only be done with the consultation of the local community and after obtaining a permit from the relevant Water Authority.
34. Abstraction of water from wetlands shall be avoided. Where necessary, authority has to be obtained from relevant authorities.
35. Temporary damming of streams and rivers shall be done in such a way avoids disrupting water supplies to communities downstream, and maintains the ecological balance of the river system.
36. No construction water containing spoils or site effluent, especially cement and oil, shall be allowed to flow into natural water drainage courses.
37. Wash water from washing out of equipment shall not be discharged into water courses or road drains.
38. Site spoils and temporary stockpiles shall be located away from the drainage system, and surface run off shall be directed away from stockpiles to prevent erosion.

**Traffic Management**

39. Location of access roads/detours shall be done in consultation with the local community especially in important or sensitive environments. Access roads shall not traverse wetland areas.
40. Upon the completion of civil works, all access roads shall be ripped and rehabilitated.
41. Access roads shall be sprinkled with water at least five times a day in settled areas, and three times in unsettled areas, to suppress dust emissions.

**Blasting**

42. Blasting activities shall not take place less than 2km from settlement areas, cultural sites, or wetlands without the permission of the SE.
43. Blasting activities shall be done during working hours, and local communities shall be consulted on the proposed blasting times.
44. Noise levels reaching the communities from blasting activities shall not exceed 90 decibels.

**Disposal of Unusable Elements**

45. Unusable materials and construction elements such as electro-mechanical equipment, pipes, accessories and demolished structures will be disposed of in a manner approved by the SE. The Contractor has to agree with the SE which elements are to be surrendered to the Client’s premises, which will be recycled or reused, and which will be disposed of at approved landfill sites.

46. As far as possible, abandoned pipelines shall remain in place. Where for any reason no alternative alignment for the new pipeline is possible, the old pipes shall be safely removed and stored at a safe place to be agreed upon with the SE and the local authorities concerned.

47. AC-pipes as well as broken parts thereof have to be treated as hazardous material and disposed of as specified above.

48. Unsuitable and demolished elements shall be dismantled to a size fitting on ordinary trucks for transport.

**Health and Safety**

49. In advance of the construction work, the Contractor shall mount an awareness and hygiene campaign. Workers and local residents shall be sensitized on health risks particularly of AIDS.

50. Adequate road signs to warn pedestrians and motorists of construction activities, diversions, etc. shall be provided at appropriate points.

51. Construction vehicles shall not exceed maximum speed limit of 40km per hour.

**Repair of Private Property**

52. Should the Contractor, deliberately or accidentally, damage private property, he shall repair the property to the owner’s satisfaction and at his own cost. For each repair, the Contractor shall obtain from the owner a certificate that the damage has been made good satisfactorily in order to indemnify the Client from subsequent claims.

53. In cases where compensation for inconveniences, damage of assets etc. are claimed by the owner, the Client has to be informed by the Contractor through the SE. This compensation is in general settled under the responsibility of the Client before signing the Contract. In unforeseeable cases, the respective administrative entities of the Client will take care of compensation.

**Contractor’s Health, Safety and Environment Management Plan (HSE-MP)**

54. Within 6 weeks of signing the Contract, the Contractor shall prepare an EHS-MP
to ensure the adequate management of the health, safety, environmental and social aspects of the works, including implementation of the requirements of these general conditions and any specific requirements of an EMP for the works. The Contractor’s EHS-MP will serve two main purposes:

• For the Contractor, for internal purposes, to ensure that all measures are in place for adequate HSE management, and as an operational manual for his staff.
• For the Client, supported where necessary by a SE, to ensure that the Contractor is fully prepared for the adequate management of the HSE aspects of the project, and as a basis for monitoring of the Contractor’s HSE performance.

55. The Contractor’s EHS-MP shall provide at least:

• a description of procedures and methods for complying with these general environmental management conditions, and any specific conditions specified in an EMP;
• a description of specific mitigation measures that will be implemented in order to minimize adverse impacts;
• a description of all planned monitoring activities (e.g. sediment discharges from borrow areas) and the reporting thereof; and
• the internal organizational, management and reporting mechanisms put in place for such.

56. The Contractor’s EHS-MP will be reviewed and approved by the Client before start of the works. This review should demonstrate if the Contractor’s EHS-MP covers all of the identified impacts, and has defined appropriate measures to counteract any potential impacts.

HSE Reporting

57. The Contractor shall prepare bi-weekly progress reports to the SE on compliance with these general conditions, the project EMP if any, and his own EHS-MP. An example format for a Contractor HSE report is given below. It is expected that the Contractor’s reports will include information on:

• HSE management actions/measures taken, including approvals sought from local or national authorities;
• Problems encountered in relation to HSE aspects (incidents, including delays, cost consequences, etc. as a result thereof);
• Lack of compliance with contract requirements on the part of the Contractor;
• Changes of assumptions, conditions, measures, designs and actual works in relation to HSE aspects; and
• Observations, concerns raised and/or decisions taken with regard to HSE management during site meetings.

58. It is advisable that reporting of significant HSE incidents be done “as soon as practicable”. Such incident reporting shall therefore be done individually. Also, it is advisable that the Contractor keeps his own records on health, safety and welfare of persons, and damage to property. It is advisable to include such records, as well as copies of incident reports, as appendixes to the bi-weekly reports. Example formats for an incident notification and detailed report are given below. Details of HSE performance will be reported to the Client through the SE’s reports to the Client.

Training of Contractor’s Personnel

59. The Contractor shall provide sufficient training to his own personnel to ensure that they are all aware of the relevant aspects of these general conditions, any project EMP, and his own EHS-MP, and are able to fulfill their expected roles and functions. Specific training should be provided to those employees that have particular responsibilities associated with the implementation of the EHS-MP. General topics should be:

• HSE in general (working procedures); emergency procedures; and social and cultural aspects (awareness raising on social issues).

Cost of Compliance

60. It is expected that compliance with these conditions is already part of standard good workmanship and state of art as generally required under this Contract. The item “Compliance with Environmental Management Conditions” in the Bill of Quantities covers these costs. No other payments will be made to the Contractor for compliance with any request to avoid and/or mitigate an avoidable HSE impact.

Example Format: HSE Report

Contract: Period of reporting: HSE management actions/measures: Summarize HSE management actions/measures taken during period of reporting, including planning and management activities (e.g. risk and impact assessments), HSE training, specific design and work measures taken, etc.

HSE incidents:
Report on any problems encountered in relation to HSE aspects, including its consequences (delays, costs) and corrective measures taken. Include relevant incident reports.
**HSE compliance:**
Report on compliance with Contract HSE conditions, including any cases of non-compliance.

**Changes:**
Report on any changes of assumptions, conditions, measures, designs and actual works in relation to HSE aspects.

**Concerns and observations:**
Report on any observations, concerns raised and/or decisions taken with regard to HSE management during site meetings and visits.

**Signature (Name, Title Date):**
Contractor Representative

**Example Format: HSE Incident Notification**
Provide within 24 hrs. to the Supervising Engineer

**Originators Reference No: Date of Incident:**
**Time:**
**Location of incident: Name of Person(s) involved:**
**Employing Company:**
**Type of Incident:**

**Description of Incident:**
Where, when, what, how, who, operation in progress at the time (only factual)

**Immediate Action:**
Immediate remedial action and actions taken to prevent reoccurrence or escalation

**Signature (Name, Title, Date):**
Contractor Representative
Annex 9  
Questionnaire for Socio-Economic Data Collection for the ESIA Study for the Bakolori Irrigation Project Rehabilitation

SECTION A: DEMOGRAPHIC DATA

1) Name of Respondent .................................................................
2) Are you a household head (bread winner)? i) Yes… ii) No….(Please Tick One)
3) GPS Coordinates of household
4) Sex (M)…… (F)……
5) Age (last birthday)…………………………
6) Religion (Christian)…… (Moslem)…… (Traditional)…… (Others)….. (Please Tick One)
7) Language Spoken: .................................................................
8) Marital Status (Single)…… (Married)…… (Divorced)……
   (Widow/Widower)……(Separated)……(Please Tick One)
9) Number of wives ..............................
10) Number of children.................................
11) How long have you lived in this community ............................... 
12) Household composition, education and occupation (please filling the codes given after the table)

<table>
<thead>
<tr>
<th>S/N</th>
<th>Name</th>
<th>Sex</th>
<th>Age</th>
<th>Marital Status</th>
<th>Relationship to HH-head</th>
<th>Educational level</th>
<th>Major occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sex: Male (M), Female (F); Marital status: Single(S), Married(M), Divorced(D), Widowed(W) Relationship to HH-Head: Self(Sf), Husband(H), Wife(W), Daughter(D), Son(Sn), Sister(St), Brother(Br), Grandchild(GC), Parent(Pr), Laborer(Lb), Educational qualification: Illiterate(IL), Primary-completed(PriC), Primary-attending(PriA), Secondary-completed (SecC), Secondary-attending(SecA), Tertiary-completed(TerC), Tertiary-attending(TerA), (Post graduate(PG), Islamic education(IsEd) Occupation: Farmer(Fmr), Trader(Trd), Housewife(Hw), Herding(Hrd), Carpentry(Cpt), Servant(Svt), Other(Specify)
14) Number of buildings owned by household

<table>
<thead>
<tr>
<th>Building No</th>
<th>Type of roof</th>
<th>Type of floor</th>
<th>Initial cost</th>
<th>Year of construction</th>
<th>Present Value</th>
</tr>
</thead>
</table>

15) Assets and investments

<table>
<thead>
<tr>
<th>Asset</th>
<th>Do you or any of your household members own any of these? (Yes/No)</th>
<th>How many</th>
<th>Value as at today(N)</th>
<th>Value at time of purchase(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plough</td>
<td>Harrows</td>
<td>Shovels</td>
<td>Hoe</td>
<td>Spike</td>
</tr>
</tbody>
</table>

16) Land owned (allocated to household)

<table>
<thead>
<tr>
<th>S/N</th>
<th>Land Use</th>
<th>Area(ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Homestead</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Rain fed cultivation</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Irrigable cultivated</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Fallow</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Private pasture</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Private tree planting</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Others(specify)</td>
<td></td>
</tr>
</tbody>
</table>

17) Livestock owned (number and value)

<table>
<thead>
<tr>
<th>Type of animal</th>
<th>Number</th>
<th>Value(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young bull</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heifer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft oxen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
18) If you are a farmer, state what you produce, and specify if it is for your household only or for market

<table>
<thead>
<tr>
<th>Produce</th>
<th>Household consumption only</th>
<th>Household and Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundnut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle rearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

19) What is your income per:

(Fill the space applicable to you)

- Annum
- Quarter
- Month
- Week

20) Did you produce enough for your household consumption from 2011 and 2012? Yes……………… No…………….  (Please Tick one)

21) If no, how much of your household food requirement was met in 2011/2012 produce (in %) ………………….

22) How many plots do you have? Irrigated plots………………. Non-irrigated plots……………….

23) Have you ever faced flooding? Yes……………….. No……………..  (Please Tick as one)

24) Does your access to water limit the area you cultivate? Yes………………. No……………..  (Please Tick as one)

25) If yes indicate the reasons.

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

26) Does the water amount determine your choice of irrigation crops? Yes……………….. No……………..  (Please Tick as one)

27) If yes, which crops do you give priority to grow with irrigation when water is short?

(Rank)

1st………………………………………………….

2nd………………………………………………….

3rd…………………………………………………..
SECTION B: AMENITIES AND GENERAL

28) **Tick** based on your own perception of the following social goods in this community

<table>
<thead>
<tr>
<th>Amenities</th>
<th>Not available</th>
<th>Not good/functional</th>
<th>Not enough</th>
<th>Good and enough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access road</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market</td>
<td></td>
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</tr>
<tr>
<td>Farm</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>inputs/fertilizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water for irrigation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop market</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock market</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Grain mill</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safe drinking water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage facility for crops</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>School</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Hospital</td>
<td></td>
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</tbody>
</table>

29) Which three (3) out of the following would you want government to provide first?

<table>
<thead>
<tr>
<th>Tick</th>
<th>Most critical</th>
<th>2nd critical</th>
<th>3rd critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access road</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Market</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm inputs/fertilizer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water for irrigation</td>
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<td></td>
<td></td>
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<tr>
<td>Crop market</td>
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<td></td>
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<tr>
<td>Livestock market</td>
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<tr>
<td>Grain mill</td>
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<tr>
<td>Safe drinking water</td>
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<tr>
<td>Storage facility for crops</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Electricity</td>
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<td></td>
</tr>
<tr>
<td>School</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

30) What is the major source of water available to your household for domestic use during wet and dry seasons?

<table>
<thead>
<tr>
<th>Use</th>
<th>Season</th>
<th>Main source (River=R, Stream=S, Pond=P, Borehole=B, Pipe borne=Pb)</th>
<th>How long is the water available (months)</th>
<th>Quality of water (Good=G, Bad=B, Average=A)</th>
<th>Distance to source of water (km)</th>
<th>How much time does it take to collect water from this source (one way)</th>
<th>How many times in a day do you go to collect water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>Dry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Wet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal</td>
<td>Dry</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
31) How much do you spend/pay in a month for water bill? (i) ₦………… (ii) No fee………

32) What is the main source of electricity/ light to your household? **(The most regularly used)**
   i) Hurricane Lamp ………. (ii) Private Generators………..
   iii) Community Generators……… (iv) PHCN (National Grid)……
   v) Company Operating in your community……

33) If you use generator as source of power how much do you spend/pay in a week on fuel?

34) Do you think that improvement of the Dam facility will be beneficial to your socio-economic wellbeing?
   i) Yes……. ii) No………… iii) No idea…………

35) Would you like to pay bill for improved Dam and/or electricity supply? i) Yes….. ii) No……

36) If no, what are your reasons?
   (i)………………………………………………………………………………
   (ii)…………………………………………………………………………………………

37) What is the main fuel you use for cooking? **(Please Tick One)**
   i) Firewood …………… (ii) Charcoal…………
   iii) Kerosene/ Oil …….. iv) Gas…………
   v) Electricity ……….. vi) Crop residue/ Saw dust…………

38) What is the popular means of transportation to this community/town
   i) Bus…… ii) Car…….. iii) Keke NAPEP…… iv) Bike…… v) Horse……

39) Have you ever faced conflict with neighbouring farmers because of using irrigation?
   Yes………….. No………

40) If Yes, what were the problems or source of the conflict? (Rank)
   1st………………………………………………………………………………
   2nd………………………………………………………………………………
   3rd………………………………………………………………………………

41) If yes, what measures were taken to resolve the conflict?
………………………………………………………………………………
………………………………………………………………………………
………………………………………………………………………………
42) If no measure was taken so far, what solutions do you suggest to resolve such conflicts?

…………………………………………………………………………………………
…………………………………………………………………………………………
…………………………………………………………………………………………

SECTION C: HEALTH AND SANITATION

43) What type of toilet facility do you use? (Please Tick One)
   i) Pit latrine .......... ii) Bush ............
   iii) Water closet ...... iv) VIP latrine .......... 
   v) River ..... vi) Others (Specify) ....

44) How do you dispose of your household refuse? (Please Tick one)
   i) Open Dump ..... ii) Burrow pit 
   iii) Municipal Waste Vendor iv) Burning
   v) Bush ...... vi) Burying

45) Do you use any of these for crop protection? (Tick as Appropriate)
   Pesticides ................. Herbicides ................... Insecticides ......................
   Fungicides .................. Fertilizer .....................

46) If yes how do you store them?

………………………………………………………………………………

47) Which of these products do you use? (Tick)

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endosulphan 35% EC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endosulphan 3% granular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cypermethrin 1% granular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Murshal 25% EC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper fungicides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimethoate 40% EC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trzine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glyposel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dalapan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others(specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

48) Which of these types of fertilizer do you use?
   NPK ............... Urea ........... Others(Specify) ............... None ............... (Please Tick as appropriate)

49) Do you have protective clothing when spraying pesticides? Yes ..............
   No ............... (Please Tick one)

42) If Yes
describe .........................................................................................

…..
50) Have you ever faced any animal disease problem due to using irrigation?
Yes…………… No………….(Please Tick one)

51) If Yes list the diseases
encountered………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………

52) Which of these disease conditions/symptoms have you experienced? ..(Please Tick as appropriate)

<table>
<thead>
<tr>
<th>Symptoms/conditions</th>
<th>Regular</th>
<th>Not regular</th>
<th>Don’t have</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscle cramp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea/vomiting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blurred vision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest pain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cough</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tremor/seizures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye irritation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin irritation/ itching</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stomach pain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anaemia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Night blindness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pruritis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin rashes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyspnea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haematuria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of appetite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloat(excess gas)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

53) Which of these diseases have you or any member of your household been diagnosed of?

<table>
<thead>
<tr>
<th>Disease/infestation/infection</th>
<th>You</th>
<th>Household member</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filariasis / Elephantiasis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onchocerciasis /River blindness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typhoid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow fever</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoebiasis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giardiasis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholera</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guinea worm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helminthiasis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dysentery</td>
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</tr>
</tbody>
</table>
Annex 10 WUA Structure and Interventions

It is significant that despite the absence of specific enabling legislative instruments for Water Users Association (WUA) establishment, substantive progress has been driven in the last 7 years prompted by the WUA structure envisaged in the National Irrigation Policy. Schemes included in the NiTIP have to some extent embraced the concept of PIM and on initiative from the FMWR, the RBDAs and the scheme management (employed by the RBDAs) have established WUAs at various levels using the flexibility of the Cooperatives Act. While the effectiveness of these WUAs has been weak in ensuring equitable and reliable water management per se, there have been gains made in introducing the concept of farmer-managed WUA principles to both farmers and Government personnel. The planned project interventions will build on these positive aspects already in place and focus on transforming functions and institutional arrangements, which have not been effective.

1. The current scheme level WUA structure in the draft policy has 3 tiers:
   - Federated Water User Association is intended to have an oversight role over the Intake and Unit WUAs and provide a conflict resolution platform as well as provide representation in relations with project management.
   - Intake Water User Associations are supposed to be responsible for OMM of secondary canals, and water distribution to tertiary level while representing the unit WUAs at Federated level.
   - Unit WUAs shall be responsible for operation, maintenance and management of tertiary and field channel and drainage systems while representing the farmers at intake WUA level.

Practice to date using the above institutional structure, as well as gaps in the available legislation have exposed a disjuncture between the proposed 3-tier institutional arrangement and their operational experiences.

2. Absence of financial self-determination: The WUAs remit all O&M (water-service) fees to the RBDA for onward payment to the Federal Treasury. Treasury in return allocates budget within the overall RBDA budget for the irrigation schemes, always considerably less than what the scheme believe is required. The WUAs retain no fees to finance their designated responsibilities but must negotiate and lobby with the scheme management and the RBDA for maintenance as needed. The RBDAs budget from the Federal treasury is unreliable in its timing and amount and maintenance responses are therefore inconsistent and ad-hoc. The related transactional costs and inherent risks to the farmers result in unreliable at best, or at worst water supply failure. Going forward it is therefore essential that a portion of collected water-user fees are retained by the WUA in a systematic way to allow them to maintain the appropriate elements of the irrigation system delegated to them for maintenance, themselves.

3. Excessive transaction costs for the INTAKE WUA: The mid-tier INTAKE WUA has a key and unavoidable function in coordinating water apportionment from the secondary canals, through the 'intakes', to the tertiary canals. The tertiary canals and field
canals are maintained by the UNIT WUAs and two representatives from each, presently comprise the INTAKE WUA membership. The coordination role has two aspects in practice: (i) first is discussion and agreement on the routine scheduling of water releases into the different tertiary canals leading from the 'intake' structure (located on the secondary canal). This schedule of releases (typically rotational) can be planned ahead of time for the dry season and the wet season (days and hours/day etc.) in negotiations at the APEX WUA. If water shortages occur, then this would need to be systematically revised. The water schedule is then an issue addressed bi-annually and has limited transaction cost; (ii) physical water releases according to the monitoring of water releases in accordance with the above rotational schedules. This is a weekly or bi-weekly action currently exercised by RBDA-paid water-bailiffs under the authority of the scheme management. The existing WUA structure envisages that the INTAKE WUA will in future either pay for or take on this role voluntarily. While the first task has limited transaction costs, the second has significant implications in that either the INTAKE WUA must operate a bank account and employ bailiffs, or some farmers must volunteer to take on this task, which is likely to be unrealistic in the time-commitment that is required. Further there will be inherent bias and this will require further transaction costs from those on adjacent tertiary intakes who will need to cross-check releases routinely. To date on the schemes, the INTAKE WUAs have not functioned in their envisaged O&M roles and it seems prudent that apart from the role of coordinating and monitoring water-release schedules (i.e. point (i) above), the other responsibilities, being secondary canal maintenance and water-bailiff responsibilities, are delegated to the higher level of the APEX WUA and contracted out to employees.

4. **Unrealistic maintenance expectation for the INTAKE WUA:** The mid-level 'Intake WUA' has responsibility for maintenance and operations of the secondary canals. The size of maintenance tasks on secondary canals is typically sizeable civil works, either earthwork, concrete works, or mechanical works (in the form of maintenance or replacement of gates). It is not reasonable that the farmers undertake these large repairs by themselves and they therefore currently rely on scheme management to respond to emergency breaches or flood-damage. In the absence of the RBDA carrying out these functions as envisaged in the draft policy and in a PIM framework in future, it seems unavoidable that these kind of larger works be contracted out by the APEX WUA using their own funds, with the contracting process supported by the RBDA staff. The ad hoc construction repair activities and routine canal cleaning task (bi-annual or annual) is in fact a 'commons' responsibility and therefore better achieved at the APEX WUA and not the INTAKE WUA. This would leave the INTAKE WUA with no need for a bank account and it would remain with the important role of coordination of irrigation water at intake level and representation of their UNIT constituents at the APEX WUA.

5. **UNIT WUA self-determination and financing:** The UNIT WUAs typically comprise between 30 and 100 farmers who share a tertiary canal and through the UNIT WUA collaborate around a number of critical activities. These include: maintenance and cleaning of the tertiary canals and drains; water scheduling and monitoring of distribution; fee collection and conflict resolution among other. It is necessary that the UNIT WUA is enabled to conduct these activities by holding some of the fees collected from water-uses in their own bank account, for their discretionary use to maintain the tertiary canal and inlet gates.
6. From the above discussion it is apparent that a bank account, and related administration and organizational systems, are needed at the UNIT WUA (tertiary canal level) as well as at the APEX WUA but not at the intermediate INTAKE WUA. While the organizational development tasks of supporting many hundreds of the UNIT WUAs (tertiary level) to be established with financial competency and effectively maintain bank accounts, this must be balanced with the risks of all funds going into a central WUA account with resultant drastic consequences for scheme operation should mismanagement occur. A highly decentralized financial management system is well proven in other developing countries and any mismanagement is highly localized and immediately in the realm of response by individual farmers who have elected their representatives at the UNIT WUA (with 30 to 100 farmer members only). In addition, financial management training is both relatively simple and would be done alongside the extensive organizational development that would anyway be required for the other numerous key functions needed for effective PIM at this tertiary level. Consultations during project preparation show this is preferred by present scheme management, the Department of Irrigation, and by the existing UNIT WUAs.

7. While the exact detail of roles and responsibilities of the three-tiered WUA institution is necessarily subject to final consultations with farmers during implementation it is evident that for the UNIT and APEX WUAs to function they must be able to collect and have executive responsibility for an appropriate portion of the fees.

8. The absence of a regulatory mechanism to achieve fee-retention for own use by the WUA requires an immediate reform using existing legislation as new legislation is unlikely to be promulgated in time for project commencement. This enabling action is in fact possible using the existing Cooperatives Act to constitute a legal entity with WUA responsibilities as is currently the case (e.g. 86 constituted at Bakolori Scheme), and by the formulation and passing of a new regulation by the Minister of Water Resources as provided for in the Water Resources Act (1993, Act 101. This new regulation would specifically define the 3-tier WUA structure in outline, and enable fee retention by the WUA in principle. The drafting and passing of this regulation is further explained below and due the critical function in achieving project objectives is required to be a trigger for project effectiveness.

Legislative Basis to Facilitate WUA Financial Autonomy (Trigger Activity)

9. The National Water Resources Act (1993, 101) makes provision for the following:
   • Clause 14: The Secretary may by regulation or otherwise, and subject to such terms and conditions as he may prescribe, authorize any authority to impose charges in connection with the provisions of any service prescribed pursuant to this Decree or regulations made thereunder including any charge by way of contribution to the costs of any works associated with the provision of such services paid for from public funds.
   • Clause 15: The Secretary may, by regulation or otherwise, fix the maximum rates which may be levied in connection with the abstraction and use of water and may authorize any authority to assess, levy and recover any rate so prescribed.
• Clause 19: The Secretary may make regulations generally for the due administration of the provisions of this decree.

10. A regulation using the above provisions therefore allows for the Minister to set terms and conditions in relation to water services (i.e. provision of water to the APEX WUA, the legal entity using the water) and authorize the RBDA (i.e. the authority) to levy and recover fees for water supplied (i.e. abstraction and use). The regulation terms and conditions need to elaborate the following conditions:

- The RBDA will maintain the dams and the main canal on specified schemes and provide water to farmers in accordance with a performance agreement, including specific 'dry-periods' for main canal maintenance.
- Farmers through the APEX WUA will pay for bulk irrigation water supplied by the RBDA on a volumetric basis that will be measured at the end of the main canal using both GSM telemetry and physical flow measurement for backup.
- Farmers will organize themselves into a 3 tier WUA structure (to be elaborated in the regulation) so as to collect fees from farmers and remit these to the APEX WUA for onward payment to the RBDA.
- The APEX WUA will retain any amount agreed with the RBDA up to a maximum of x% (need regulating entity - independent consultant every 2 years ??) of the fee and be responsible for maintenance, directly or indirectly, of the secondary and tertiary canals.

11. The Nigerian Co-operatives Societies Act (1993, 90) and Co-operative Societies Regulations have been used to constitute the current WUAs and this will be used for future WUAs given the absence of more specific legislative instruments. Each UNIT WUA so constituted will pass a bye-law to enable them to open a bank account and collect fees which will be retained in part, and remitted in part to the APEX WUA with reference to fee setting which will be defined in a Memorandum of Agreement with the APEX WUA. This 'internal' fee arrangement will be modified from time to time as agreed by both WUAs facilitated by the (regulating entity).

12. A Memorandum of Agreement (MoA) is the final instrument to be used between the APEX WUA and the UNIT WUA. This will define the commitment to pay Irrigation Service Charges, signed by the APEX WUA and each of the UNIT WUAs. This MoA will set out the fees to be paid (or refer to a schedule to be revised from time to time) and define responsibilities and performance requirements for supply of water to the inlets of the tertiary canals by the APEX WUA and define processes for the agreement of 'dry-periods' for secondary canal maintenance.

Institutional Arrangements of WUAs for Effective Irrigation Water Management

13. The fundamental principles for the transformative interventions at the Water User Association level guide both the envisaged structure and the functions of the WUA. These principles are:
• Fairness and Equity: An association shall be operated in a fair and equitable manner in terms of decision making and the allocation of irrigation water.

• Rational Use of Resources: An association shall manage the canal network within its Service Area in a rational manner so as to prevent waste, over-watering, erosion, salinization and pollution, as well as to promote the protection of the environment.

• Compulsory Membership: Membership in WUA is compulsory to all of the resource users, both land and water, land-owners and those leasing, borrowing, or using land through any other accepted mechanism of land access, where land is within the accepted boundary of the association.

• Voluntary and open membership: Membership in the WUA is voluntary and open to all others within the accepted boundary of the association (i.e. where the boundary extends beyond the irrigation fields themselves) that can make use of its services and are willing to accept the corresponding responsibilities.

• Democratic control: WUA members enjoy equal right to vote (one member one vote) and participate in decisions affecting the WUA without regarding to the amount of water or land or the volume of the business. The WUAs are autonomous, within the framework of law and regulations, serving and controlled by its members.

• Non-Discrimination: WUAs are non-discriminatory and a member of an association shall not suffer discrimination on any basis, in relation to gender, race, nationality, sex, religion and politics.

• Transparency and Participation: An association shall operate in a transparent manner and shall promote effective participation in its management bodies.

• Education and Training: WUAs actively promote the education of their members, committee members, employees if any and others, along with the public in general, in the economic, social, democratic and mutual self-help principles of WUAs.

• Cooperation among other WUAs in the WUA Federation: WUAs within their capability will actively cooperate with other WUAs in order to best serve the interest of their irrigation water user members and their needs.

14. The WUA structure is based on existing WUA institutions in place on some of the project schemes, and on extensive discussions with the Department of Irrigation and farmers during project preparation.
The WUA structure is more decentralized than is sometimes the case, but with substantive rationale based on local experiences as expanded in the earlier discussion. The institutional transformation process requires a number of important changes from the current arrangements, and the intention is to build on the capabilities and practices in place with a focused effort on those elements where change is really necessary.

Table 6: Functions of key institutions in irrigation scheme operations and management in NiPIT

<table>
<thead>
<tr>
<th>Institution</th>
<th>Main Functions</th>
<th>Funding Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBDA</td>
<td>Maintain and operate dam and drainage pump stations.</td>
<td>Federal funding for dam maintenance and capital investments.</td>
</tr>
<tr>
<td></td>
<td>Maintain main canal and flow measurement structures including desilting, weed clearance and routine and emergency repair of lining.</td>
<td>Federal funding for capital investment for main canal repairs and reconstruction.</td>
</tr>
<tr>
<td></td>
<td>Strive to comply with service-agreement in terms of quantity, quality and reliability of water delivered to the end of the main canal.</td>
<td>16. WUA fees to cover routine operational costs of water management, main canal maintenance personnel and equipment and drainage pump stations.</td>
</tr>
<tr>
<td>Role</td>
<td>Tasks</td>
<td></td>
</tr>
<tr>
<td>------</td>
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<td></td>
</tr>
<tr>
<td><strong>APEX WUA</strong></td>
<td>Collect Irrigation Service Charges (ISC) from UNIT WUAs and remit to the RBDA. Coordinate preparation of water-allocation schedules with INTAKE WUAs. Maintain secondary canals including gates and structures, ensuring bi-annual 'dry-period' for desilting and weeding. Contract out routine canal maintenance (weeds and desilting) and civil repair works including earthworks, bank protection and concrete to local contractors assisted by the RDBA. Employ a technical manager for coordinating water operations, and a team of bicycle water-bailiffs to operate gates at tertiary canal inlet structures and maintain these. Enforce non-payment of tertiary hydraulic units by locking gates at tertiary canal inlets and policing these as necessary. Oversee the financial functioning of the UNIT WUAs and assist in conflict resolution within UNIT WUA.</td>
<td></td>
</tr>
<tr>
<td><strong>INTAKE WUA</strong></td>
<td>Coordinate irrigation schedules at intakes (i.e. tertiary canal intakes) and monitor bailiff operations. Report and coordinate around water distribution issues to the APEX WUA on behalf of UNIT WUAs. Represent the UNIT WUAs at routine APEX WUA meetings and routine fee-setting negotiations as appropriate.</td>
<td></td>
</tr>
<tr>
<td><strong>UNIT WUA</strong></td>
<td>Collect fees from farmers and enforce penalties for non-payment of fees given that the whole tertiary unit will be cut off from water should fees not be paid. Remit appropriate proportion of fees to APEX WUA. Administer bank account and routine record-keeping from monthly meetings. Undertake routine O&amp;M such as desilting, bank protection, and weeding at tertiary and field</td>
<td></td>
</tr>
<tr>
<td>Fees collected from UNIT WUAs. Portion retained for own operations and maintenance and portion remitted to RBDA for bulk water services. Sliding scale of fee recovery over the project period with 100% initial subsidy from project reducing 20% per year, with full self-sufficiency by end of Year 6 of project. Voluntary</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fees collected from farmers**

**Portion retained for own maintenance operations, and portion remitted to APEX WUA.**

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Willingness and Ability to Pay

17. Currently irrigation scheme management charges between USD18 and USD30 per season for irrigation water services which is too low for sustained O&M. Collection rates are highly variable and unreliably reported, but typically between 25% and 50% on Bakolori IS, though 100% was reported on a section of Kano IS, but not verified. Willingness and ability to pay investigations have shown that substantially higher fees are justified both in terms of willingness and ability. Willingness to pay at Bakolori averaged USD 86/ha/annum (2013), and ability to pay calculated on 7-10% of gross margins (a reasonable international benchmark) arrived at a figure of USD 169-241/ha/annum. Key to fee-collection is reliable water supply and the role of the WUAs in allocation and delivery of water is therefore central. Explicit rules of delivery (schedules of days and times) and monitoring thereof will be addressed in the WUA training process, tailored for each WUA. Agreements for billing and water supplies will be made between the UNIT WUA and the APEX WUA and if the delivery to the tertiary canal inlet (on the secondary canal) by the APEX WUA is not in accordance with the allocation, the farmers must be able to seek redress through the WUA.

18. A key challenge to be addressed at the UNIT WUA level will be the definition of appropriate responses to those farmers unable, or unwilling to pay, which will need to be explicitly addressed in the WUA training process and the final agreements made with the APEX WUA.

Intervention Activities

19. The investments would support the development of a detailed training strategy with associated learning materials to re-align existing WUAs and establish new WUAs to achieve a transformed institutional structure for effective water management. The engagement process with existing WUAs and new farmers groups would take place in an intensive series of training and information exchange sessions at UNIT WUA (tertiary level) as well as at the APEX WUA level (scheme level). To achieve this there are two main activities would be supported, the first being the design of the training process and associated learning materials and media, and the second being the implementation of the WUA training process at field level over an extended timeline.

20. **Activity (1): Design and Production of a WUA Training Process and Multi-Media Toolkit.** This activity comprises specialist technical assistance to design in detail a WUA training programme and related manuals and media, down to the level of a curricula and a series of daily learning sessions for WUA members. It also involves the design and production of a communication strategy and resultant multi-media outputs that are needed by the facilitators who will be working with the WUAs.
• Technical support for the detailed design of and intensive WUA training programme. The WUA training programme has two levels, the first being the training of the facilitators who will go into the field and work with WUAs at field level. The first level would require a detailed design of lesson plans to be used in an intensive 'training-of-trainers' course, prior to the outreach work in the field. The WUA facilitators would need to be taken through a learning process in relation to how irrigation schemes operate, the legal basis for WUA establishment, operational, financial and administrative processes and required skills for key WUA positions. They would need hands-on exposure to irrigation water-management practices in the field and engage with engineers, scheme management and farmers to fully appreciate the scope of work and functioning of the scheme, to be able to support the WUA establishment process. In the course of the WUA-facilitator training process, the facilitators would need to become WUA training experts in their own right, equipped with materials, lesson-plans and supported by high-quality media. The second level of training programme design is the development of specific daily lesson-plans to be used by the WUA-facilitators in the series of engagement sessions at UNIT-WUA level. The WUA-facilitators would each need to be equipped with their own training manual that guides their field-interactions and specifies what and how will be addressed in each progressive WUA sessions, with guidance on media to be used. In summary three manuals will be produced (a) Training Programme for the Training of WUA Facilitators (b) Lesson Plans and Training Guidelines for WUA-Facilitators to conduct Training of WUAs (c) WUA Manual for WUA members.

• Development of a communication strategy and related targeted media: Investment in this sub-activity would support the development of a sophisticated communications strategy to facilitate attitudinal change and increased uptake and effectiveness of the WUA-centered, PIM approach among farmers, local leaders, scheme administrators and higher levels of Government. The strategy will identify key target audiences from farmers to high-level Government officials, assess their perceptions and bias, analyze the key messages to be communicated and set-out and justify the selection of various multi-media options to be pursued. The strategy will provide scripted outlines of videos, should these be warranted, define the messaging to be included in posters, hand-outs and pamphlets and consider radio messaging, targeting key audiences and messages of PIM.

• Development of a WUA Media toolkit: Investments would transform the various learning materials and WUA manuals defined above, and the defined media specified in the communication strategy, through graphic design of print media, and with specialist video-production input if specified in the communication strategy, to produce an inspirational and visually attractive toolkit. The WUA Media Toolkit would then comprise the WUA training manuals (three separate manuals), visual media (possibly including video, posters, pamphlets) and possibly completed radio adverts.

21. **Activity (2) Water User Association Human Capital and Institutional Development for improved scheme operations.** The investments in Activity (2) would be the field level implementation of the WUA training process developed under Activity (1), at
scale over an extended period. The implementing agent would conduct a review of the status of WUA development on each scheme and develop a training programme in consultation with existing WUA and scheme management structures. The training programme would have three phases: the first being the selection and training of the WUA-Facilitators in an intensive course using the training approach and media from Activity (1); the second phase would be the rollout at scale of the WUA training programme extending over 2 to 3 years depending on scheme size and the total number of UNIT WUAs using manuals and media developed in Activity (1); the final phase would be a reduced phase of WUA support and a phase-out from the scheme.

22. A key element of the WUA training rollout would be close collaboration with the existing scheme management and the contractor in coordinating the construction programme with the various WUAs. Disruptions to irrigation water supply are likely to be unavoidable, potentially for extended periods. The intention in the consultation process would be to use the WUA organizational development process as a point of collaboration and negotiation engagement process, thereby supporting the WUA in action, and strengthening their systems and functions in the process.

**Expected outputs from Subcomponent 2.2**

23. The WUAs will be strengthened to manage, operate and maintain the irrigation and drainage systems at turnout and tertiary levels. It is believed that delegating these responsibilities to the farmers will result in systems that are operated and maintained with a resultant improvement in agricultural production and water use efficiency. These benefits include:

- **Improved maintenance of canals**: Maintenance of civil works is essential to ensure that the system can deliver irrigation water to all beneficiaries. WUAs will play a critical role to ensure local engagement in maintaining these systems.

- **Improved water distribution**: WUAs can apply pressure to the RBDA to provide a reliable, timely and adequate service. Working in partnership with RBDA, WUAs can agree on the seasonal cropping pattern and associated water requirements and prepare an agreed irrigation roster. During the seasons, WUA can work with RBDA to ensure that the roster is followed; water is allocated and distributed to the WUAs. This improved cooperation between the parties will lead to improvement in water delivery and consequently in agricultural production and water use efficiency.

- **Increase in irrigated area**: The redesign of the irrigation system may pose a problem of head-tail-end disparities with those nearer the source of water taking a greater share of irrigation water at the expense of the tail-end farmers. WUA will facilitate dialogue between the farmers, agree of rotational calendars and provide water to all.

- **Increased level of water fee collection and revenue generation**: The water fee collection is now seen as a tax by the farmers, with the money collected is sent to the FMWR. Under the transformation, WUA will be authorized to collect water fees and
then receive back from RBDA a specified portion for O&M of the system they will be managing.

- **Enhanced transparency and accountability**: WUA will jointly manage the available water resources and this will increase the transparency in irrigation management, system maintenance and water fee collection.
Annex 11 Chance Find Procedures

In the event of chance finds of items of cultural significance, all forms of excavation in and around the site will be stopped. Subsequently, experience archaeologists and anthropologist would be recruited to carry out an investigation and proposed plans for the preservation of such cultural artifacts.

During the project site induction meeting, all contractors will be made aware of the presence of an on-site archaeologist who will monitor earthmoving and excavation activities. The following procedure is to be executed in the event that archaeological material is discovered:

- All construction activity in the vicinity of the find/feature/site will cease immediately.
- Delineate the discovered find/feature/site will be delineated.
- Record the find location and all remains are to be left in place.
- Secure the area to prevent any damage or loss of removable objects.
- The on-site archaeologist will assess record and photograph the find/feature/site.
- The on-site archaeologist will undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer.
- In consultation with the statutory authorities the on-site and Project Archaeologist will determine the appropriate course of action to take.
Annex 12 Evidence of Registration of the ESIA with FMEnv

RE: ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF THE PROPOSED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE BAKOLORI IRRIGATION PROJECT IN TALATAN MAFARA LGA, ZAMFARA STATE.

Please refer to your letter on the above project.

2. I am directed to acknowledge the receipt of evidence of payment of the sum of Fifty Thousand Naira only (50,000.00) only in Diamond Bank Draft No. 05005787 on 20th November, 2013 for the EIA Registration fee of the proposed project.

3. Please note that the next stage of the EIA Process is site verification exercise which has been scheduled to hold in November, 2013. The exercise will be carried out by the Officials of the Ministry.

4. Consequently, you are to provide the sum of Four Hundred and Eighteen Thousand Naira (N418, 000.00) only to cover the cost of the site verification exercise. You are also requested to kindly provide necessary logistics to ensure a hitch free exercise.

5. You may contact Mr A. O. Ebelendu on GSM number 08037803555 to confirm the receipt of this letter and for further information on the exercise.

6. Thank you for your co-operation.

[Signature]

For: Honourable Minister
### Annex 13 List of ESIA Preparers

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
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</thead>
<tbody>
<tr>
<td>Dr. Obi A. Anyadiegwu</td>
<td>Lead Consultant</td>
</tr>
<tr>
<td>Dr. Benjamin Ekeke</td>
<td>Ecologist</td>
</tr>
<tr>
<td>Dr. Dago Ngerebara</td>
<td>Hydro-geologist</td>
</tr>
<tr>
<td>Engr. Ezekiel Ogani</td>
<td>Irrigation Specialist</td>
</tr>
<tr>
<td>Miss Cindy Ijeoma Ikeaka</td>
<td>Environmental Assessment Specialist</td>
</tr>
<tr>
<td>Mr. Oliver Nwuju</td>
<td>Social-economic Specialist</td>
</tr>
<tr>
<td>Dare Ologe</td>
<td>Mechanical Engineer</td>
</tr>
<tr>
<td>Dr. Isaac Lekwuwa</td>
<td>Human/Animal Health specialist</td>
</tr>
<tr>
<td>Dr. Victor Nwachukwu</td>
<td>Occupational Health and Safety Specialist</td>
</tr>
<tr>
<td>Miss Ifeoma Eni-Kalu</td>
<td>Environment Assessment</td>
</tr>
<tr>
<td>Chukwueloka Okongwu</td>
<td>Environmental Technologist</td>
</tr>
<tr>
<td>Wallat Denis</td>
<td>Mechanical Engineer</td>
</tr>
<tr>
<td>Simon Emogene</td>
<td>Baseline Assessment</td>
</tr>
<tr>
<td>Adebisi Ogunboye</td>
<td>Data compilation</td>
</tr>
<tr>
<td>Adure Njoku</td>
<td>Data compilation</td>
</tr>
<tr>
<td>David Yakubu</td>
<td>Translator</td>
</tr>
</tbody>
</table>