TRANSFORMING IRRIGATION MANAGEMENT IN NIGERIA (TRIMING) PROJECT
FINAL TERMS OF REFERENCE
FOR THE PREPARATION OF AN ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) FOR INTERVENTION TO SUPPORT LIVELIHOOD OPTIONS FOR THE MARADUN COMMUNITY AFFECTED DURING THE BAKOLORI DAM CONSTRUCTION

1.0 BACKGROUND

In an effort to diversify the economy and create significant welfare improvements for the Nigerian citizens, the Federal Government of Nigeria is implementing a project aimed to achieve sustainable growth in agricultural production and productivity. To achieve this objective, the development of irrigation infrastructure cannot be over emphasized, given its global growing competitiveness in achieving higher output as well as raising incomes sustainably for the agricultural labour force with the overall gains of reducing the number of people living below the poverty line.

To achieve this objective, the Federal Government is collaborating with the World Bank towards the implementation of a seven-year program dubbed "**Transforming Irrigation Management in Nigeria (TRIMING) Project**". The development objective of the program is to support and improve agricultural productivity in selected large-scale public schemes in Northern Nigeria through strengthened institutional arrangements and improved access to irrigation and drainage services including value chains with active involvement of the stakeholders.

The TRIMING Project intervention is necessitated by the fact that although agriculture is regarded as an integral part of the Nigeria's economy, accounting for close to 30% GDP and a major rural activity, the country's population is regarded to have exceeded the carrying capacity of its land resources when cultivated at low levels of technology, that is, without irrigation (FAO, 1987). This calls for sustainable development of irrigated agriculture in Nigeria, given its importance to rural economy, being a major tool for reducing poverty and promoting shared prosperity.

2.0 Project Development Objectives

The TRIMING Project Development Objective is to improve access to irrigation and drainage services and to strengthen institutional arrangements for integrated water resources management and agricultural service delivery in selected large-scale public schemes in Northern Nigeria

3. 0 Project Components

The Project's objective will be achieved through the implementation of four components, the design of which responds to the reality that water infrastructure (dams and irrigation systems), the farmers who use the water and irrigation lands, and the input and output markets for agricultural services and products are all interrelated in a larger connected system of technical, economic and social relationships. The project components and main activities under each component are as tabulated below.

Table 1: TRIMING Project Components

Project Components	Main Activities
Component 1: Water Resources Management and Dam Operation Improvement	
Subcomponent 1.1: Support to Integrated Water Resources Management	The *piloting* of anticipated provisions for separation of government regulatory and operational powers and responsibilities for integrated water resources management (IWRM) of basin-wide allocation, control, and river channel maintenance for sustainable public irrigation scheme functioning.
Subcomponent 1.2: Dam Operations Improvement and Safety	Investments for sustainable operational safety, improved operational practices and increased dam safety of selected dams and reservoirs including: Bakolori, Zobe, Goronyo, Tiga, Challawa Gorge and Dadin Kowa dams (i e. 6 dams), and Ruwan Kanya operational reservoir and Hadejia Barrage.
Component 2: Irrigation Development and Management	
Subcomponent 2.1: Irrigation Infrastructure Investments	Rehabilitation of 27,000 ha to improve the performance of a total of 50,000 ha irrigation area in five schemes downstream of the existing storage reservoirs and major investment in irrigation

	civil works and related studies.
Subcomponent 2.2: Improving Irrigation Management at Scheme Level	Aims to ensure the long-term viability of the irrigation and drainage services delivered on public irrigation schemes by implementing a progressive management transfer to Water Users Associations (WUAs) and to autonomous professional operators, either public or private.
Component 3: Enhancing Agricultural Productivity and Support to Value Chains Development	
Subcomponent 3.1: Support to agricultural productivity and market linkages	Provide resources to enhance farmers' productivity in the rehabilitated schemes and improve their participation in value chains through a matching grant mechanism; and the establishment of Farmers' Management and Service Delivery Centers on each scheme, supported by extension and marketing agribusiness professionals.
Subcomponent 3.2: Support to Innovation and R&D	Technical assistance for farmers, water schools, applied research such as improving irrigated agronomy, and introduction of innovations such as new crops or production techniques as part of emerging commercial partnerships.
Component 4: Institutional Development and Project Management	
Subcomponent 4.1: Institutional Development and Governance	This subcomponent includes five activities: capacity building and training of FMWR staff; support to RBDAs; consensus building and supporting the change process; generation, feedback, and dissemination of data, and strengthening supervision and accountability in the sector.
Subcomponent 4.2: Project Management and M&E	The activities here will support the establishment of the Project Management Unit and other key coordination institutions within Government, and will provide guidance on change management processes. The M&E activities will develop an Information System for project purposes, studies and analytical work and a records and document management system.

3.1 Highlights of Project Sites

Bakolori Irrigation Scheme (BIS) in Zamfara state. This is the 'first-mover' as the Environmental and Social Impact Assessment studies have been prepared and disclosed; feasibility studies have also been prepared and the detailed designs which have been completed needs updating to accommodate for recent concerns of the Project beneficiaries. Construction commenced in November 2017. The Project is currently implementing the Environmental and Social Management Plan. Likewise, the Resettlement Action Plan (RAP) has been elaborated and disclosed. RAP implementation is currently on-going

Maradun Community in Zamfara state. The Jankarawa sprinkler irrigation system was developed to provide a means of livelihood for the people displaced by the construction of the Bakolori Reservoir. The sprinkler system failed due to lack of maintenance and the displaced framing families, now mainly resident in Maradun, were left with a grievance which the project only decided to address relatively late in the overall Bakolori Programme development. The focus is on profitable farming enterprises and other livelihood options including fisheries and poultry.

Middle Rima Irrigation Scheme (MRVIS) in Sokoto state. This is an area of approximately 2,000 ha equipped for irrigation with very low agricultural intensification. Furthermore, there is an existing contract for finalizing the works for a total of 5,000 ha. In this scheme, the TRIMING Project would focus on the hardware for the dam safety requirements; flood protection works and on the software for the irrigation scheme. The Environmental and Social Impact Assessment report has been prepared and disclosed. The Resettlement Action Plan has been prepared.

Kano River Irrigation Scheme (KRIS) in Kano state. The equipped irrigation area is 15,000 ha though only 12,000 ha are being irrigated. The Project would focus in the first instance to rehabilitate the equipped irrigation area so that it becomes fully operational. The Environmental and Social Impact Assessment and the Resettlement Action Plan reports have both been prepared and disclosed. Implementation of these instruments commenced 4th quarter of 2018.

Hadejia Valley Irrigation Scheme (HVIS) in Jigawa state. The equipped irrigation area is 6,000 ha though only 5,000 ha are being irrigated. The project would focus in the first instance to rehabilitate the equipped irrigation area so that it becomes fully operational. The Environmental and Social Impact Assessment and the Resettlement Action Plan reports have both been prepared and disclosed. Implementation of these instruments commenced 4th quarter of 2018.

Dadin Kowa Irrigation Scheme (DKIS) in Gombe and Borno states. This is a scheme with 5,000ha in total including 2,000ha that can be commanded by gravity. Primary infrastructure including main canal and inverted siphon are in place. The Environmental

and Social Impact Assessment and the Resettlement Action Plan reports have both been prepared and disclosed. Implementation of these instruments commenced 3rd quarter of 2020

This Terms of Reference is for Maradun community in Zamfara state.

4.0 THE PROPOSED PROJECT AND GOAL OF THE ASSIGNMENT

The legacy issues at Jankarawa, and for the people of the associated village of Maradun, have persisted since the commissioning of the Bakolori Irrigation Scheme (BIS) in the 1970s. The present location of Maradun village was created as part of the programme to re-settle local people displaced by the creation of the Bakolori reservoir.

At the time it was thought that the provision of a sprinkler irrigation system, relying on water pumped from below Bakolori Dam to a reservoir within the Jankarawa area and then onwards to water towers which would provide the head to drive the sprinklers, would provide suitable compensation. However, the settlers, whose farming experience lay mainly in fadama rice production in the lowlands flooded by the reservoir, now found themselves in an upland area and expected to grow sprinkler irrigated crops.

Daily management of the sprinklers was beyond the capabilities of farmers and there were no resources to effect repairs to the system which quickly broke down across much of the scheme.

The Maradun re-settlers were further handicapped by the fact that the Jankarawa scheme was a government scheme on which they were only short-term tenant farmers having to negotiate their right to rent land on an annual basis from the SRRBDA, the scheme managers. Farmers from elsewhere could also rent the land creating problems with tenure security.

Although the irrigation scheme in the sprinkler area quickly failed, some small pockets of irrigation survived, and a few farmers gained useful experience in irrigated agriculture. But for the community, already embittered by their displacement from their homelands flooded by the reservoir, the failure of the Jankarawa scheme only served to increase their sense of betrayal by government.

With the rehabilitation of the BIS the Maradun community, through their Emir, believed that their grievances would at last be addressed. They assumed that they would receive access to fadama lands (lowlands) to grow rice and that the Jankarawa scheme would be rehabilitated.

During the Feasibility Study a soil survey of the approximate 2,000 ha of the Jankarawa scheme showed that while about 50 % of the area had soils of sufficient depth to be suitable for mechanised agriculture, the blocks of suitable land were fragmented by the scattered distribution of shallow soils and rock outcrops as might be expected on a ridge top some 30 m above the level of the BIS command area. When this was taken into account only about 500-600 ha was considered practicable and, with some concerns about the ability to create a sustainable water source from immediately below the Bakolori Dam, it was decided not to proceed with the scheme. Of particular importance in this decision was the fact that the re-settlers had no security of tenure on the Jankarawa plots which were available for rent, on an annual basis, to anyone who wished to take them, even if they had not been impacted by the construction of Bakolori dam.

No alternatives were proposed at the time and the SRRBDA became concerned that the already embittered community might start to create trouble and hinder the rehabilitation and operation of the main scheme. Transforming Irrigation Management in Nigeria (TRIMING) Project - Feasibility study of livelihood options for the Maradun community affected during the Bakolori dam construction: Feasibility Report Atkins and ENPLAN Group 4 Hence a new Terms of Reference was developed by the PMU, in conjunction with the consultants, and for which the main focus was to improve the livelihoods of the Maradun people and to provide the technical means to achieve this.

The following options have been finalized for the TRIMING Project intervention in Jankarawa and the feasibility study/Detailed designs are conducted only for these options. More details on these options are presented in the feasibility study report.

- Drip Irrigation of Jankarawa
- Fisheries
- Poultry
- Food Processing
- Rice milling
- Oil Processing

An Environmental and Social Screening checklist was applied in January, 2020. The screening team used the environmental and social screening form disclosed in the project Environmental and Social Management Framework (ESMF). The form was designed to assist in identification of potential environmental and social impacts of the proposed Project intervention so that the appropriate safeguards tools can be recommended and the categorization of the sub-project activities. The screening template was administered with the Project manager of the Bakolori Irrigation Scheme. A copy of the screening checklist is attached to this Terms of Reference.

Under the Federal Government of Nigeria Environmental Impact Assessment (EIA) act, these aforementioned activities for Jankarawa falls under Mandatory study activities. Although the screening exercise perceive that the envisaged impact from these works should require the preparation of a full Environmental and Social Impact Assessment (ESIA), it is important to note that the Nigerian EIA act allows for 'the use of previously conducted mandatory study to whatever extent the 'Agency' considers appropriate for the purpose of complying with the relevant sections of the EIA Act'.

In this case the Federal Ministry of Water Resources 'the Client' had initially prepared an Environmental and Social Impact Assessment (ESIA) for the Bakolori Irrigation Scheme (BIS), Zamfara state in 2013/2014.

Based on the understanding that the ESIA for BIS documented relevant information on the study area, findings from this screening exercise thus call for an Environmental and Social Management Plan (ESMP) studies to ascertain the extent of the development impact. Furthermore, there is need to also prepare a Resettlement Action Plan in view of the proposed development to determine the extent of possible land take and potential disruption of existing economic activities within the subject area.

Peculiar salient aspects and any significant changes in the circumstances of the project will be taken into account.

5.0 DESCRIPTION OF PROPOSED INTERVENTION

The Maradun multiple livelihood intervention in agriculture-based livelihood activities project will support investments in small-scale farmer-managed drip irrigation systems, fisheries and community managed Agricultural Business Centres. The sustainability of the infrastructure improvements will be supported by establishing and strengthening water user associations / cooperatives, and training for beneficiaries in appropriate agricultural and processing practices. The project will include drip irrigation, fisheries, poultry, rice milling, oil extraction and juice extraction.

The project will adopt a sector approach through multiple projects using agreed procedures and criteria for identification, screening and final selection. During the Feasibility Study analysis were undertaken for project options and for a typical cluster of four Agricultural Business Centres.

In order to finalize project options, a Participatory Workshop was held for two days (16th - 17th December 2019) in the conference hall of the palace of the Emir of Maradun, His Royal Highness Alhaji Garba Muhammad Tambari.

The workshop commenced with the introduction of attending dignitaries. Thereafter the first paper was presented introducing the aims and objectives of the Project and the Workshop.

The following papers were presented on the first day of the workshop;

- Project and workshop introduction
- Community consultation study results
- Women livelihood options study results
- Presentation of agriculture and community livelihood options (SWOT)

During discussions, representatives insisted that irrigation of the Jankarawa area was the top priority and other options were diversionary. The community was informed that to irrigate Jankarawa, pumping would be required and the maintenance of the pumps would be handled by the farmers themselves as per the Federal Government's policy i.e. to rehabilitate the scheme and hand it over to the farmers for both operation and maintenance.

The second day was mainly used to discuss options and finalise their selection for inclusion in the feasibility study and preliminary design. Very few women were present at the workshop and those that were present remained silent and did not contribute to the first day's discussion. However, women did contribute towards the selection of options during the second day. There was a field trip to agree some of the technical issues related to the sources of water for the Jankarawa irrigation scheme.

The workshop was attended by the Emir, LGA representatives, participants from four main villages, BIS representative, TRIMMING project representatives and the consultants. The feasibility study was conducted only for these agreed options. Relevant excerpt of the feasibility study is contained in Annex 1

In line with the above, The Federal Ministry of Water Resources wishes to engage the service of an firm to prepare an Environmental and Social Management Plan (ESMP) prior to commencement of the civil works. The study will be carried out to establish modalities of implementing the projects in line with Nigeria environmental and social policies and laws and the World Bank Environmental and Social Safeguard policies.

6.0 OBJECTIVE OF THE ASSIGNMENT

The specific objective of the study will be to assess the potential environmental and social impacts of the Maradun multiple livelihood intervention in agriculture-based livelihood activities project as described above in the scope of work and prepare a detailed Environmental and Social Management Plan (ESMP).

7.0 SCOPE OF WORK

The core tasks for the consultancy assignment shall include but not limited to the following. It is mandatory to use quality maps, XY coordinates and other professional representation where applicable

1. Review existing documentation of the TRIMING Project, all relevant safeguards documents and the PAD, ESMF, PIM and Environmental and Social Impact Assessment prepared for the Bakolori Irrigation Scheme, Zamfara state
2. Review Environmental and Social Safeguards policies of the World Bank especially the applicable polices triggered on the project i.e. Environmental Assessment OP/BP 4.01; Natural Habitats OP/BP 4.04; Pest Management OP 4.09; Physical Cultural Resources OP/BP 4.11; Involuntary Resettlement OP/BP 4.12; Safety of Dams OP/BP 4.37; Projects on International Waterways OP/BP 7.50
3. Describe the proposed project by providing a systematic description of the project relevant components and presenting plans, maps (proposed works, base camps, environmental and social sensitivities, staging areas, alternative routes etc with details of XY coordinates), figures and tables.
4. Identify and summarize the policy, legal and administrative framework relevant to the project.
5. Define and justify the proposed project study area for the assessment and management of environmental and social risks and impacts.
6. Describe and analyze the environmental, social, physical, biological, Occupational health and Safety conditions in the study area before project implementation. This analysis shall include a mapping of the project area of influence as well as discussions on the interrelations between environmental and social components and the importance that the society and local populations attach to these components.
7. Identify and assess the risk of labor influx and GBV on the subproject as well as recommend mitigation measures in managing the risks and potential adverse impacts associated with labor influx and GBV. Define stakeholders' identification criteria, carry out stakeholders' mapping and categorization. Carry out consultations with primary and secondary stakeholders in order to obtain their views on and perception about the project. These consultations shall identify key environmental and social risks and impacts, and obtain comments from stakeholders on the proposed mitigation/enhancement measures.
8. Define the potential environmental and social impacts resulting from proposed project activities and appropriate mitigation/enhancement measures to prevent, minimize, mitigate, or ameliorate for adverse impacts or to enhance the project environmental and social benefits, including responsibilities and associated costs.
9. Define other monitoring and implementation roles to include creation of awareness on STDs such as HIV/AIDS and other STIs, VAC and child labor, forced labor and other contractual obligations
10. Review institutional framework for environmental and social management. Use the outcome of this review to identifying responsibilities and actors for the implementation of proposed mitigation measures. By extension assess the capacity available across all relevant actors to implement the proposed mitigation measures, and suggest recommendation in terms of training and capacity building, and applicable budget.
11. Discuss other salient related concerns that could be triggered as a result of project development.
12. Prepare an ESMP matrix table.

The ESMP should capture:

The potential environmental and social impacts resulting from project activities including an assessment of Environmental, Social, Occupational Health and Safety (ESHS) risks

- The proposed mitigation measures;
- The institutional responsibilities for implementation of mitigation and enhancement measures;
- The monitoring indicators;
- The institutional responsibilities for monitoring the implementation of mitigation and enhancement measures;
- The costs of mitigation and enhancement activities; and sources of funds
- A calendar for implementation.

13. Develop an environmental and social monitoring program, including indicators, institutional responsibilities and associated costs.
14. As appropriate, prepare an Occupational health and safety hazard plan including an analysis of the risk of accident, the identification of appropriate security measures and the development of a preliminary contingency plan.
15. Based on the outcome of the consultation with stakeholders, the consultant should provide a summary of key indicators of community support for the project, as well as perceived benefits from the project expressed by different stakeholder groups.
16. Participate in the finalization of the detailed designs for the project intervention for the Maradun community

8.0 Content of the Environmental and Social Management Plan

The typical content of an ESMP is presented below. It shall be noted that the presentation of the report may be modified depending on the nature and specific requirements of the project.

Preliminary pages

- Cover page
- Table of contents
- List of acronyms and their definitions
- Executive Summary

Chapter 1: Introduction

- Background information
- Description of the proposed intervention
- Objectives of the ESMP
- Rationale of the ESMP
- Relevant Maps

Chapter 2: Policy Legal and Administrative Framework

Chapter 3: Environmental and Social Baseline

- Description of the environmental baseline conditions
- Description of socio-economic baseline conditions

Chapter 4: Identification of potential environmental and social impact

Chapter 5: Environmental and Social Management Plan (including):

- Discussion of the potential adverse environmental and social impacts of the proposed sub-projects
- Proposed mitigation measures and institutional responsibilities for Implementation including cost estimates;
- Environmental and Social Monitoring programs and instructional responsibilities for implementation including cost estimates;
- ESMP Training requirements
- Implementation schedule
- Contractual measures
- Indicative budget for ESMP implementation
- ESMP disclosure

Chapter 6: Stakeholder Consultation

- This chapter shall summarize the actions undertaken to consult the groups affected by the project, as well as other concerned key stakeholders including Civil Society Organizations. The detailed record of the consultation meetings shall be presented in the annex to the ESMP.

Chapter 7: Grievance Redress Mechanism (GRM)

Explore opportunities of mainstreaming the TRIMING Project's GRM into the existing structure available within the local community to ensure that emanating grievances are managed effectively. This chapter should contain reporting of the establishment of an active Grievance Redress Mechanism within the participating communities.

Chapter 8: Recommendations

Annexes

Annex 1: Terms of Reference
Annex 2: List of Persons met and pictures
Annex 3: Summary of World Bank Safeguard Policies triggered for this project.
Annex 4: Records of Inter Agency and Public/NGO Communications including photos
Annex 5: List of participants in consultations and summaries of consultations
Annex 6: General Environmental and Social Management Conditions for Construction Contracts
Annex 7: Occupational Health and Safety (OHS) Plan
Annex 8: Sample of Questionnaire for socio-economics
Annex 9: Waste Management Plan
Annex 10: Environmental and Social Performance Monitoring Checklist
Annex 11: Traffic Management Plan
Annex 12: Workers Code of Conduct for both contractors and supervision consultants
Annex 13: Labor Influx Management Plan to include salient aspects such as Gender Based Violence (GBV)/ Sexual Exploitation and Abuse (SEA)
Annex 14: Workers Camp Site Management Plan
Annex 15: Sample Content of Contractor Environmental and Social Management Plan
Annex 16: Sample Borrowpit management plan
Annex 17: COVID 19 prevention and active response plan
Annex 18: Pest Management Plan. This should be captured in the bidy of the report and Executive summary succinctly

9.0 Consultant Qualifications

The firm must have expertise and proposed key staffs must have advanced degrees earned in relevant fields including but not limited to: civil/environmental engineering, environmental sciences, or the social sciences.

Minimum experience should be eight (8) years with a minimum specific experience of four (4) years on planning related to infrastructure development or disaster response.

The firm must have experience in design and preparation of an Environmental and Social Management Plan (ESMP) for infrastructure projects. The consultant(s) must have competency and documented experience in social and environmental scientific analysis and development of operational action plans.

The consultant(s) must have a working knowledge of World Bank operational safeguards policies gained through hands-on experience in the preparation and implementation of environmental and social management plans in Northern Nigeria.

10.0 Duration of work:

This assignment will have to be completed within a period of twelve (12) weeks commencing immediately after contract signing.

11.0 Reporting

The consultant shall report to the National Project Coordinator through the Environmental and Social Safeguards Specialists

12.0 Responsibilities of the Client

In addition to the project supervisory and other responsibilities contained in this assignment, the proponent shall provide the consultant with the following project documents:

- Project Appraisal Document
- Environmental and Social Management Framework (ESMF) for the TRIMING Project
- Resettlement Policy Framework (RPF) for the TRIMING Project
- Feasibility study report and subsequently, the Engineering designs
- Disclosed Environmental and Social Impact Assessment report for the Bakolori Irrigation Scheme
- Grievance Redress Mechanism report and Communication strategy report for the TRIMING Project
- Reports on the TRIMING Project's Integrated Pest Management and safe use of chemicals approaches
- Other relevant Safeguard instruments prepared for the TRIMING Project

13.0 Deliverables:

A comprehensive and fully referenced report including detailed ESMP table and implementation process must be submitted at the end of the assignment.

- **Inception Report:** Expected in two weeks after the date of contract signing. This should include methodology and work plan with clearly defined community entry strategy that ensures free prior and informed consent. Consultant shall submit (3) hard copies and a soft copy of the inception report.
- **Draft Report:** Expected in eight (8) weeks after contract signing, detailing out findings from desk reviews, fieldwork, environmental and socioeconomic characteristics, and stakeholder's engagement/consultation, etc which will be circulated for comments and relevant recommendation. Consultant shall submit (6) hard copies and a soft copy of the draft report.
- **Draft Final Report:** Expected in ten (10) weeks after contract signing, after all comments and inputs from the PMU and the World Bank have been addressed and incorporated in the report. Consultant shall submit (6) hard copies and a soft copy of the draft final report to the PMU.
- **Final Report:** Expected in twelve (12) weeks after contract signing, detailing all relevant information and addressed comments. Consultant shall submit (8) hard copies and a soft copy of the final draft report to the PMU.

Activities	*Weeks*						
	0	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12
Signing of Contract							
Submission of Scoping report							
Submission of Draft Report							
Submission of Draft Final Report							
Submission of Final Report							

14.0 Payment Schedule

The consultant shall be paid on a lump sum all-inclusive basis in four (4) instalments upon acceptance of deliverables of the reports as stipulated in the scope of work:

(i) Upon acceptance of Inception Report 15% of the agreed sum
(ii) Upon acceptance of Draft Report 35% of the agreed lump sum.

(iii) Upon acceptance of Draft final report	35%of the agreed lump sum
(iv) Upon acceptance of Final report	15% of the agreed lump sum

ANNEX 1

A1 OPTIONS SELECTION WORKSHOP OUTCOMES

A1.1 Participatory Workshop

A Participatory Workshop was held for two days (16th - 17th December 2019) in the conference hall of the palace of the Emir of Maradun, His Royal Highness Alhaji Garba Muhammad Tambari.

The workshop commenced with the introduction of attending dignitaries. Thereafter the first paper was presented introducing the aims and objectives of the Project and the Workshop.

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The second day was mainly used to discuss options and finalise their selection for inclusion in the feasibility study and preliminary design. Very few women were present at the workshop and those that were present remained silent and did not contribute to the first day's discussion. However, women did contribute towards the selection of options during the second day. There was a field trip to agree some of the technical issues related to the sources of water for the Jankarawa irrigation scheme.

The workshop was attended by the Emir, LGA representatives, participants from four main villages, BIS representative, TRIMMING project representatives and the consultants.

A1.2 Final List of options

The following options were finalised and this feasibility study was conducted only for these options.

- Drip Irrigation of Jankarawa
- Fisheries
- Poultry
- Food Processing
- Rice milling
- Oil Processing

A2 IRRIGATION DEVELOPMENT

A2.1 Introduction

A2.1.1 Irrigation Options

For irrigation in the Jankarawa Area, three possibilities were identified - surface irrigation, drip irrigation and sprinkler irrigation. All the three types of irrigation would rely on pumping water from Bakolori Dam to the Jankarawa area as the area lies above Bakolori Reservoir (about 34m).

Drip irrigation has been selected as the most promising method as the irrigation water supply is limited and the previous attempt using sprinkler irrigation was unsuccessful. However drip systems require a high level of management which, if present, permit high levels of water use efficiency at lower pumping costs than sprinkler systems.

The lands surrounding Maradun are undulating and generally unsuited for surface irrigation except for small areas of fadama land in the valley bottoms which have mostly already been included in the main Bakolori Project.

Drip is also more suited to the patchy nature of the areas with soils suitable for irrigation and can lead to much higher water use efficiency provide that operators have received adequate training and are able to work in close co-operation with the overall system managers. Furthermore drip equipment is more readily available in northern Nigeria with better support systems than for sprinklers.

Since Maradun farmers have little or no experience of the use of drip systems it has been decided to limit the drip irrigation system to 200 ha under this project.

A2.1.3 Beneficiaries

The people of Maradun (Maradun North, Maradun South and Gidan Kano districts) will be the sole beneficiaries of the re-development of the Jankarawa Project. Dosara District has been excluded as it was not part of the community directly affected by the Bakolori dam construction.

The selection of farmers to be allocated plots in the Jankarawa area will be undertaken by BIP management in consultation with the community elders from the three districts. It is envisaged each farmer would be allocated 0.5ha thus 400 farmers would benefit from these districts through leasing / tenancy rights.

A2.2 Jankarawa Drip Irrigation Development

A2.2.1 Development Plan

About 200ha (4 x 50 ha areas) of drip irrigation is proposed for initial development in the Jankarawa area from the 500-600 ha identified as potentially suitable for irrigation in the Bakolori Feasibility Study. The areas will be located in the JDS and JES sectors (Figure 1).

The Bakolori feasibility soils investigations at Jankarawa concluded that soils are of limited and patchy suitability for large-scale irrigation. The deep loamy soil types on flat land are suitable but occur in a complex with unsuitable shallow soils and rock outcrops. The area is irregular in shape and soils show considerable variability.

A2.2.2 Description of the Irrigation Scheme

As mentioned above four sectors of about 50ha each are proposed for drip irrigation development. The Water source will be by lift from a station situated immediately downstream of the dam. The system would draw water from the Bakolori reservoir through a 1.25m diameter duct embedded in the concrete portion of the dam and then pumped via the conveyance line consisting of two 0.7m diameter buried A/C pipes to the former Jankarawa sprinkler irrigation area (Sectors JAS to JES).

The lifting station will be refurbished and equipped with two new pumps (one working, one standby). Water would be pumped through a main pipe to the location of the 200ha farm area. Because of the silt laden nature of the reservoir water a filtration system would be put in place immediately after the inlet of the conveyance pipe just outside the lifting station building.

FIgure 4.1 below shows the agricultural suitability areas. It is evident that only about 50% of the area is suitable and they are located in the three northern units of JCS, JDS and JES. The proposed farm area is located at the JDS and JES sectors where the soils are suitable for cultivation.

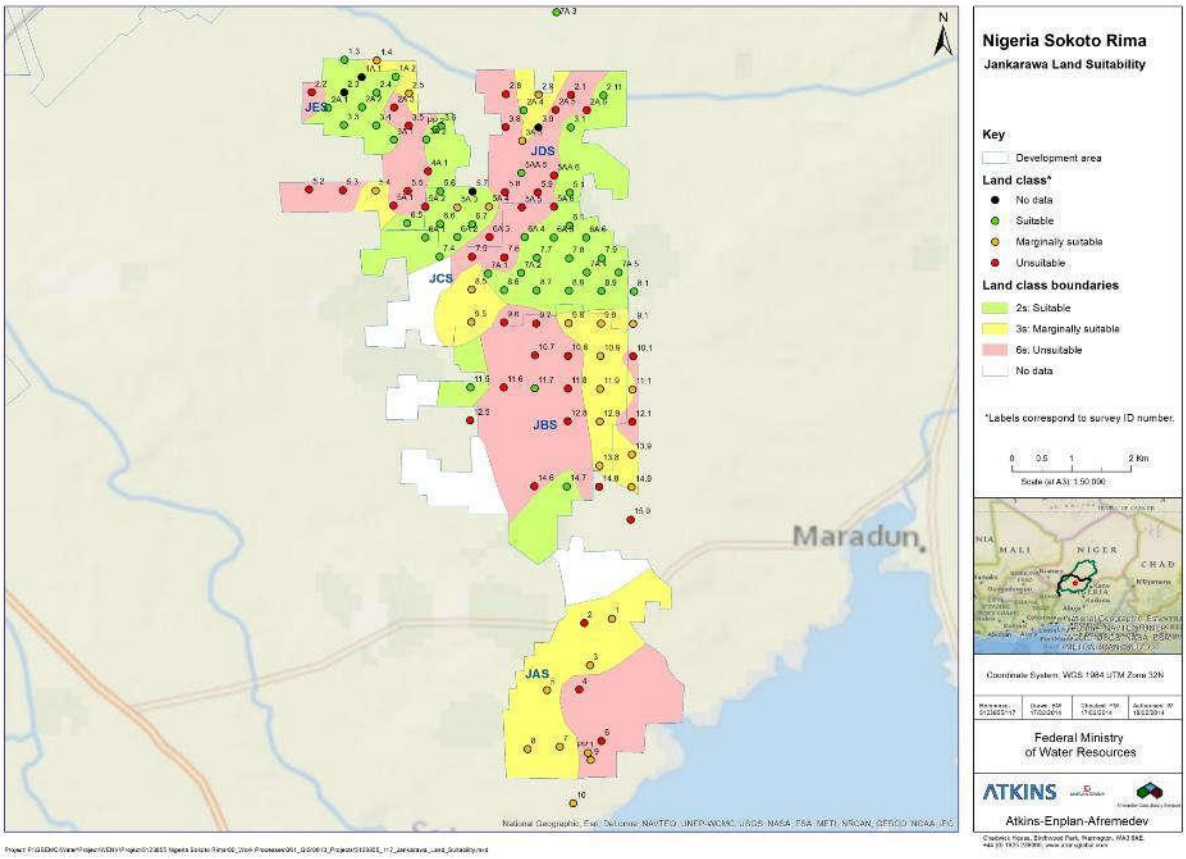


Figure 4-1: Land suitability for Agriculture in Jankarawa

The proposed farm area with drip irrigation layout is presented in Fig 4.2. This is divided into two types of drip irrigation system. Sector 1 (50 ha) will have overhead tanks to pressurise pipes, whereas, Sectors 2,3 & 4 will have pump systems to pressurise pipes.

At the proposed farm area sub-main pipes would branch off to feed a 10ha block from the 50ha sector so that each 50ha farm area would have five sub-main lines branching of from the main conveyance pipeline. Laterals of about 100m would be connected to the submains. The laterals would be fitted with drip lines (100m long) and spaced at 1m intervals (assumed row spacing). The details are as shown in the layout for sectors 2, 3 and 4 in Figs 4.3 and 4.4.

For the purpose of comparing simplicity in operation one of the four 50ha sectors will be modified to operate with its pressurised water coming from overhead tanks, rather than direct from the pump at the lifting station, as is the case with the other three 50ha sectors. With the overhead tank system the submain pipeline, branching off the main pipeline, would feed the overhead tank that will serve a 5ha block. Water would be delivered to the block through a submain pipeline from the overhead tank. The submain pipeline would then feed 100m laterals each fixed with drip lines (100m long) and spaced at 1m intervals (assumed row spacing) as shown in Figure 4.5 for Sector 1.

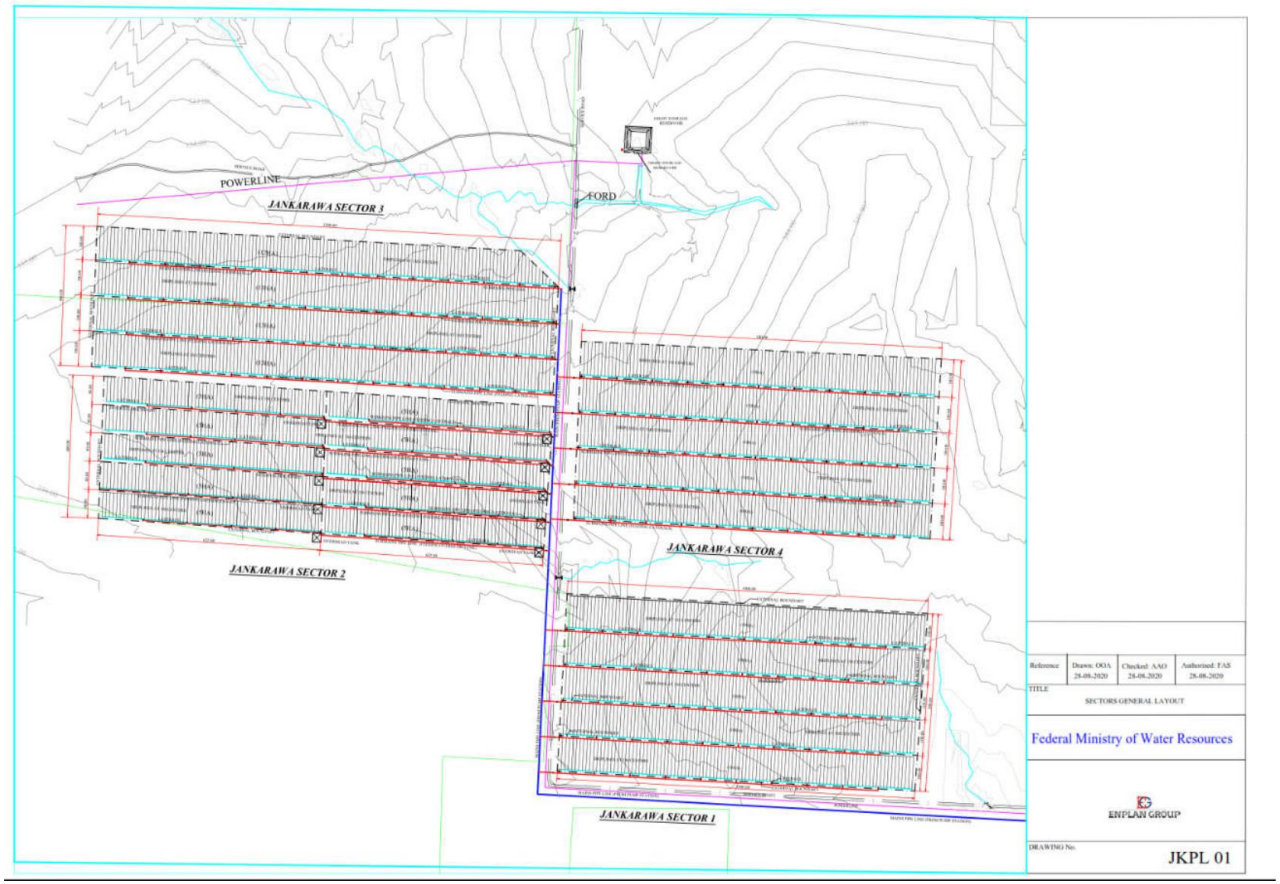


Figure 4-2: Location of the200ha Jankarawa Drip Irrigation at the JDS and JES Sectors

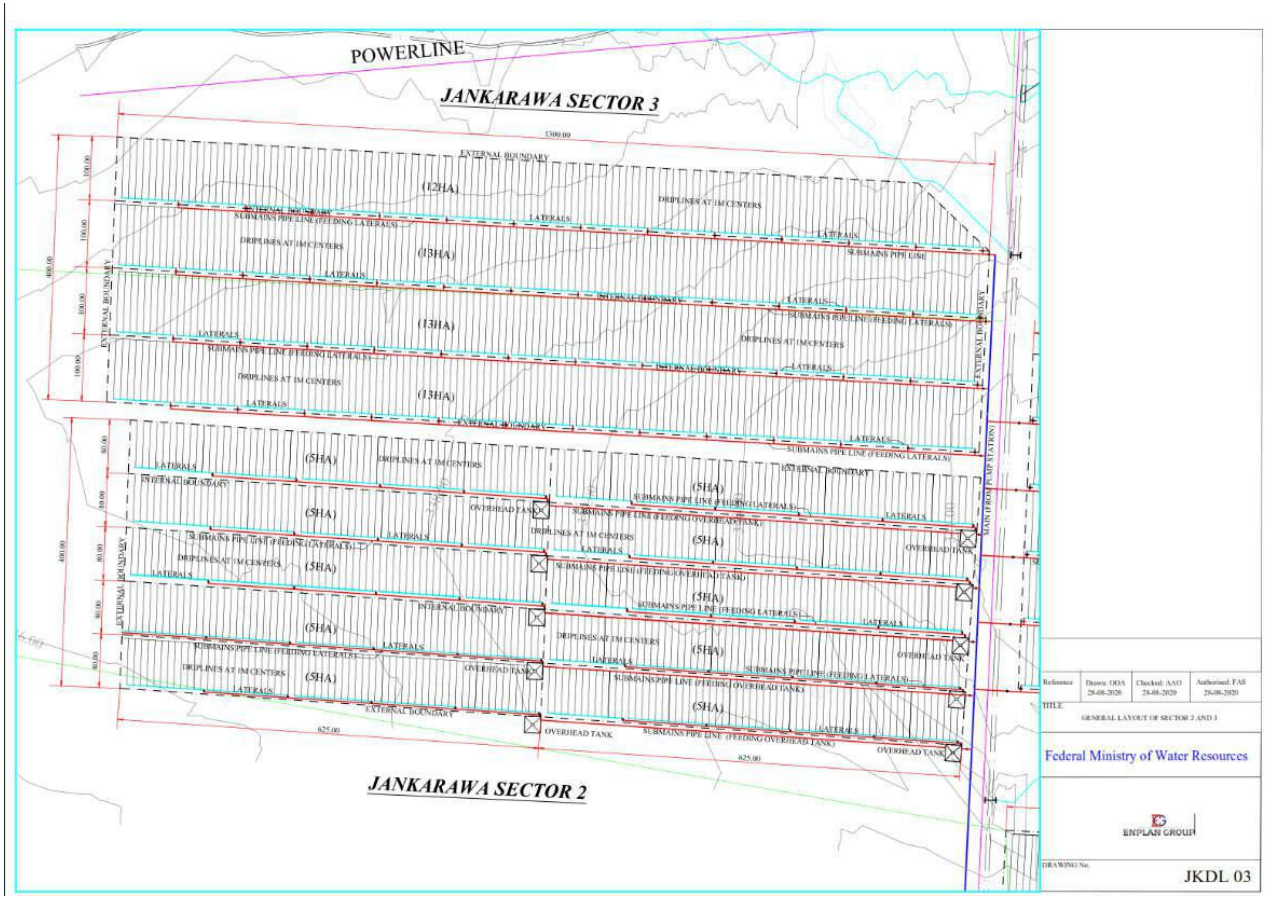


Figure 4-3: Layout of Jankarawa Sectors 3 and 2

Figure 4-4: Layout of Jankarawa Sector 4

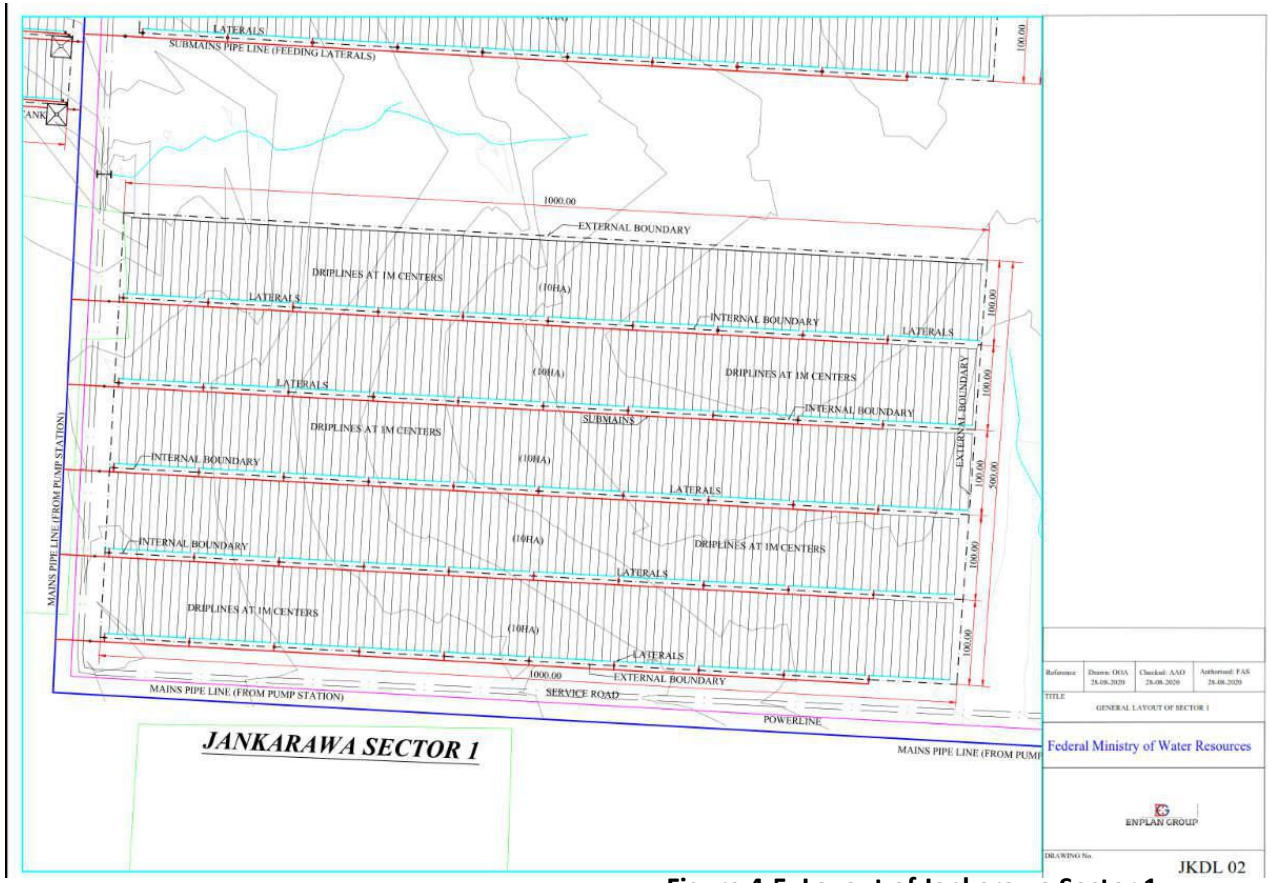


Figure 4-5: Layout of Jankarawa Sector 1

A3 Crop Water Requirement

A3.1 Proposed Crops

Crop production is influenced by climate, soil properties and fertility status, improved and new technologies, management practices, access to markets, availability of irrigation water, etc. Based on the responses of farmers within the project area to the questionnaires applied, the following crops are proposed for production within the Jankarawa area using drip Irrigation during the dry season

- Maize,
- Sweet Potato
- Soyabeans
- Groundnut
- Sesame

Tree crops to be grown for the juice production are mango and orange. It is planned to have each crop growing in a 2.5ha plot at this initial stage.

A3.2. Crop water requirement

The crop water requirement calculations are presented in Annex 1. The table below highlights the crop water requirements of the five crops proposed at the Jankarawa Drip Irrigation Area.

Table 4-1: Summary of Crop Characteristics

Crop	Crop Duration (Days)	Irrigation Water Requirement (mm)	Peak Irrigation Requirement (lt/sec/ha)	Month of Peak Irrigation Requirement
Maize	120	863.5	1.21	January
Sweet Potato	130	1028.5	1.14	January
Soyabean	85	662.6	1.20	December
Groundnut	130	965.0	1.13	January
Sesame	110	754.4	1.10	January

A3.3 Design Assumptions for the Irrigation Scheme

For the Jankarawa drip irrigation system the following assumptions have been made:

Field application and conveyance efficiencies of 95% and 90% respectively. Thus, the overall project irrigation efficiency (IE) (0.95x0.90) = 0.855 = **85%** is derived.

From the SWRs above the most critical irrigation requirement occurs for maize in January when the hydromodule is 1.21lt/sec/ha hence for the project the hydromodule becomes (1.21/85%) = **1.42l/s/ha**.

For the total 200 ha and irrigating for 130 days (max growth period for sweet potato and groundnut) the total water demand is estimated at (1.42x60x60x24x130x200)/1000 m^3 = **3.19million m^3.** This amount, when compared with the irrigation requirement of BIP estimated at 200 million m^3, is just about **1.5%.**

A3.4 Design Assumptions for the Irrigation Scheme

To achieve the highest yields and water savings possible with a drip irrigation system, it is necessary to monitor the system and adjust as necessary. In addition, regular system monitoring may give advance warning of potential problems.

The maintenance of drip systems centres on identification of the factors which can lead to reduction of the

performance of the system and procedures to mitigate these negative impacts. Factors that can slow or stop flow through the drip system include suspended materials, chemical precipitation, biological growth, root intrusion, soil ingestion and crimping of the dripline. This may require water treatment and a systematic program for regular maintenance.

Some of the various potential issues that can adversely affect the drip system and offer procedures to mitigate the potential damage are as follows:

- Water quality
- Suspended solids
- Chemical precipitation
- Biological growth
- Filter maintenance
- Dripline flushing

Preventive maintenance is aimed at preventing clogging of the drippers and can be divided into three categories:

- Flushing the system
- Chemical injection
- Irrigation scheduling

There should also be corrective maintenance which consists mainly of removal of obstructions already present in the drippers:

- Flushing the system and one or more of the following practices according to the nature of the obstruction:
- Organic formation - treated with hydrogen peroxide.
- Mineral sedimentation - treated with acids (or a combination of acid and hydrogen peroxide).
- Organic formation and mineral sedimentation - treated with a combination of acid and hydrogen peroxide.
- Flushing of the irrigation drip system is comprised of 3 processes listed as follows:
- Filter back-flushing
- Flushing main and sub-main lines
- Flushing dripper lines.

As a thumb of rule, the general cost for the annual operation and maintenance of drip irrigation system is about 5% of the original investment cost.

A3.5 Jankarawa Lift Station

A3.5.1 Present Status

The Jankarawa lift station is situated immediately downstream of the Bakolori dam and comprises six pumps (five high lift pumps which are basically end suction pumps and a back wash of 20l/s at 50m head). These pumps were installed to serve the Jankarawa Sprinkler Irrigation project, which was about 2,100ha. The high lift pumps were operated on 3 duty and 2 standby with the duty pumps delivering water to a piezometric tower at an elevation 62m above the lift station. The other two towers received their supplies through gravity from the first tower.

At the time of inspection, the prime movers (electric motors) were missing suggesting that they were cannibalised or faulty with no spares to repair or replace them.

Physical examination of the pump heads revealed failed mechanical seals and faulty bearings, wear rings were absent and the impellers had jumped out of alignment due to wear. There were wounds and fret-corrosion around the stainless steel shafts suggesting some mishandling which might have affected the thoroughness and integrity of the shaft.

An inspection of the electrical panel control room showed that each pump had a separate control panel. Four out of the six available control panels have burnt while the other two were in a non-functional state.

The pumps were installed and operated about 40 years ago and have exhausted their useful life and are now obsolete. There was no evidence that good maintenance practice was in place nor availability of adequate spare parts.

Based on the flow requirement for the Jankarawa 200ha farm area, two pieces of WILO efficient pumps with bronze impeller, MODEL: FD 350 - 300 - 550 end suction pumps of capacity 320l/s at 62m (1 duty and 1 standby) or similar type is recommended. WILO pump model MISO 50 - 200 with a flow rate of 20/s at 50m head as backwash for the servicing and maintenance of high lift pumps or similar type is also recommended.

All the control electric panels for the pumps should be scrapped and replaced with more efficient ones and a minimum level of spare parts for the pumps provided for.

Figure 4-6: Obsolete Pumps at the Jankarawa Lift Station

A line diagram of pipeline and the pump station are presented in the Fig 4.7 below.

A3.5.2 Present Status of Pipeline from Reservoir to Irrigated Area

The initial arrangement of the pipeline conveying water from the Jankarawa Lift Station to the irrigated area (JAS -JES) was through two 0.7m diameter buried A/C pipes. These pipelines have several leaks at their joints and can hardly be replaced as the danger to health posed by the handling of asbestos in pipe manufacture and on site, particularly due to the risks of inhaling asbestos dust during cutting and handling pipes, has resulted in cessation of production in many countries. Hence the pipeline would be replaced with a high pressure 300mm diameter uPVC or HDPE Pipes.

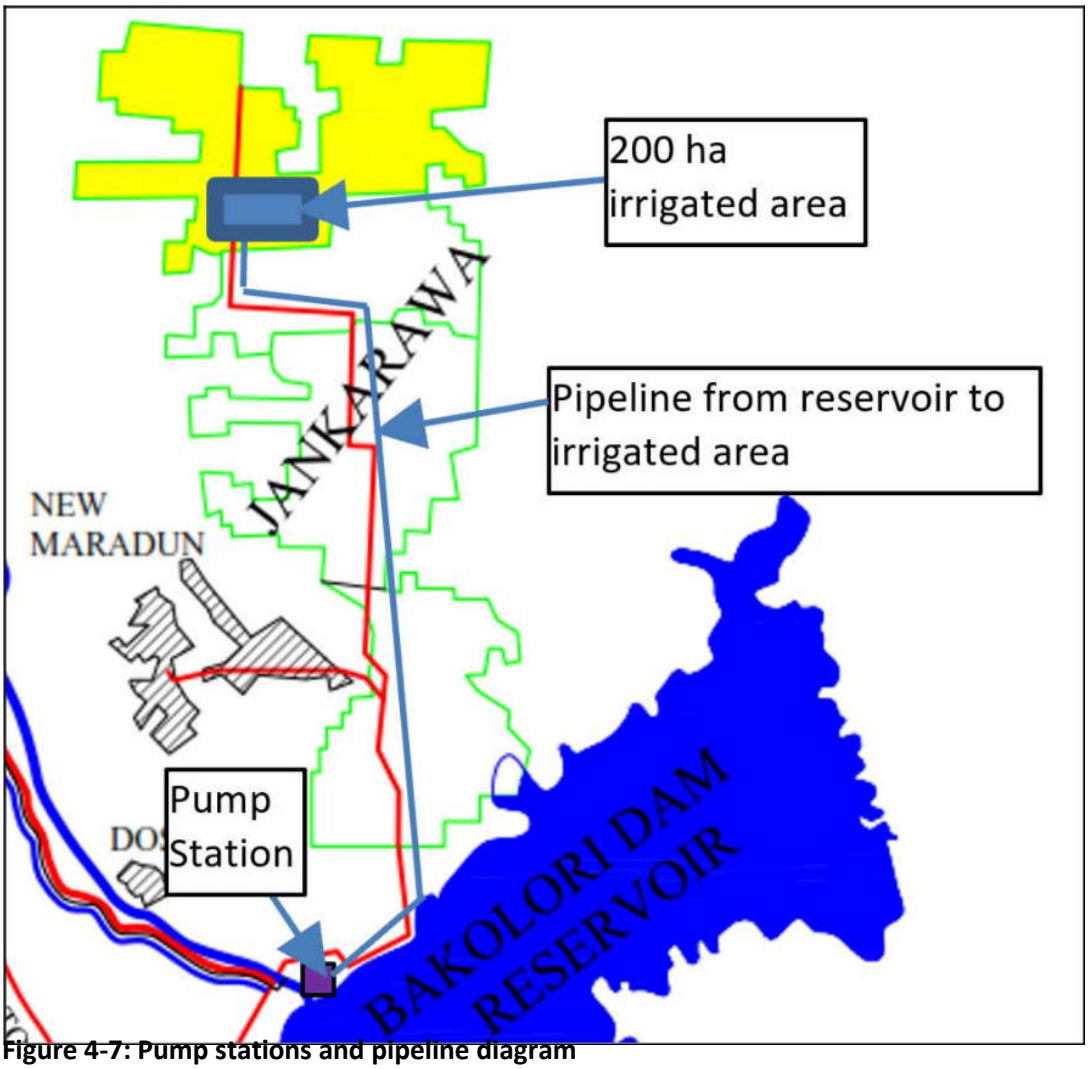


Figure 4-7: Pump stations and pipeline diagram

A4 Budget

The estimated cost of the Jankarawa Drip Irrigation covering an area of about 200ha is put at N3,550,686,000.00 covering equipment, three years input (operation and maintenance etc), capacity building and technical assistance as indicated below.

Table 4-2: Budget for Jankarawa Drip Irrigation System

Sl.No	Description	Amount (Naira)
1	Building infrastructures	0
2	Equipment and accessories	3,112,520,000
3	Three years input	150,000,000
4	Capacity building	0
5	Technical assistance	259,766,000
	Total	**3,550,686,000**

B. FISHERY DEVELOPMENT

B1 Introduction

This section provides the findings on reconnaissance survey on the fisheries component of the Maradun Intervention Project, with respect to identification of fisheries project, assessment of the training needs of participants and site selection. Stakeholder meetings and site inspections were conducted from 21st to 23rd March 2020.

There are four districts in the community (Maradun South, Maradun North, Gidan Kaya and Dosara), and each was represented at the stakeholder meetings. Four categories of fisheries related livelihoods were identified: (a) Full time fishing, (b) Fishing and crop farming, (c) Fish processing and marketing, and (d) Fishing, fish farming and crop farming.

Each category of participants catalogued their needs but, after deliberations, they eventually agreed on two activities: (a) Fish Farming and (b) Fish Processing and Marketing.

The community supplied a list containing 417 participants, of which 232 indicated interest in fish farming while 185 opted for fish processing and marketing. The distribution of the participants by district for each of the two livelihood options is attached as annex to the report.

The site selected by the community is located in Dosara district at Latitude 120 30.916' N and Longitude 0060 10.652' E at an elevation of 257m. It comprises approximately 14 ha below the dam wall. An alternative site between the irrigation canal and the river, stretching from the bridge downward, was proposed and the community is to give feedback on this. Both sites may have to be used depending on the number of beneficiaries. The sites have been assessed for soil types, water supply strategies and design options for fish culture tanks.

B1.1 Objectives of the Component

- Familiarise with the community representatives on the essence of the component and set out actions on how to achieve them together.
- Identify and select desirable fisheries projects for the community based on input of the participants who are the expected beneficiaries.
- Interact with the fish farmers to understand their training needs and aquaculture entrepreneurial competencies.
- Locate the appropriate site for fish farming together with the proposed participants.

B2. Stakeholder Meeting

The first meeting was held on the 21st March 2020, at the old Emir's Palace with two representatives of the of Maradun Emirate Council, a representative of Enplan and the fisheries stakeholders of the four districts that make up the area – namely:

- Maradun South District
- Maradun North District
- Gidan Kano District
- Dosara District
- Alh. Yusf M. S. Bango – Rep. of Maradun Emirate Council
- Mal. Rabiu Zarumi Maradun – Rep. of Maradun Emirate Councils
- Mal. Abubakar Halidu - Rep. of ENPLAN in the community

The essence of the meeting was spelt out to the participants as follows:

a. Enquire about the extent of fish production which they are interested in and in what competences do they require training

b. Categorise the beneficiaries.
c. Establish the number of beneficiaries.
d. Locate a site of suitable size that will accommodate the project.

B2.1 Fishermen Groups

The attendees were divided into groups based on their present business engagement as shown in Table 5.1:

Table 5-1: Categories of Fisherfolks and Fisheries Related Livelihoods

s/n	Type of Fish Trade	Beneficiaries
1.	Fishermen (primarily engaged in fishing only as source of livelihood)	9
2.	Fishermen and field crop farmers (engaged in both fishing and field crop production as sources of livelihood)	14
3.	Fishmonger/fisherman/processors (engaged in fishing, fish processing and marketing as sources of livelihood)	2
4.	Fish farmer, fisherman and field crop farmer (engaged in fishing, fish farming and crop farming as sources of livelihood)	1

A breakout session was created according to the four groups. Each group were asked to deliberate and bring up anticipated requirements that would be needed to improve their livelihood and improve their business considering the resources available to them.

B2.2 Needs Assessment

After all deliberations, each of the groups presented their requirements. They indicated their needs for fishing materials or financial assistance to procure equipment to aid fishing from the Bakolori reservoir where it is understood they form a large majority of the fishermen using the lake.

B2.2.1 Fishermen

- Hooks and line
- Boats and outboard engine
- Fishing nets (gill nets)

B2.2.2 Fisherman / Fishmongers

- Equipment for fishing
- Expansion of fishponds to increase stock
- Knowledge on how to better culture fish
- Financial assistance/link to secure good fish seed and quality feed
- Water pumps and harvesting nets

B2.2.3 Fishmonger / Fisherman / Processors

- Financial assistance to buy/sell fresh or processed fish.
- Financial assistance to procure equipment (smoking facilities, deep freezers, generators etc.) for preserving, storage and processing of fish.
- Require marketing stalls or sheds where they can market / trade their fish products.

B2.2.4 Fishermen/ Field Crop Farmers

- Require materials for fishing.
- Require alternative source of livelihood like fish farming to support their earning from fishing.

Having presented their needs, discussions ensued on how they think their needs could be met considering some basic challenges regarding the exploitation of the fisheries resource in the reservoir. Issues raised included the following:

- The long term/short term advantages and disadvantages of each option were discussed (long term restocking programme, species catch composition and endangering of species, catch of smaller fishes needed for recruitment etc.).
- The issues of investment on fishing effort and not getting commensurate catch/yield which can lead to loss on investment was evaluated and understood with contributions on the effect by the resource users.
- Advantage of investment in aquaculture and fisheries resource value addition to aid sustainable fish production, generate income and help conserve the reservoir resources were discussed and understood by all stakeholders.

The following were the subsequent resolutions from the deliberations;

a. Establishment of a fish farm.

Categorisation of the beneficiaries based on gender and participation along the value chain of culture fish production was undertaken and it was resolved for i) Fish producers and ii) Fish farmers)

Lists of beneficiaries from the four districts were subsequently made available according to the two categories above.

b. Location of a suitable site where resource needs (water, water pumping, feed production and environmental management) can easily be achieved, utilised and co-managed by a cooperative/ association.

Each of the four districts representatives opted for project sites in their various district. The options were weighed in relation to the requirements for the fish farming site. Reasons were established why the suggested sites could be chosen for fish farming or not.

It was resolved as follows:

- Maradun South, Maradun North and Gidan Kaya Districts:

Surface water not available, and the cost of supplying water from a borehole including maintenance could be high. This would threaten profitability and sustainability of the fish farming project.

- Dosara District

Close to water sources (the main canal and the down-stream river of the dam).

- All stakeholders agreed to locate the fish farm for the beneficiaries from the four districts of Dosara District downstream of Bakalori dam.

B2.3. Agreed Identified Locations

The team met at the proposed area in Dosara District on 23rd March 2020 and identified a suitable site at Latitude 12° 30.916'N and Longitude 006° 10.652'E at an elevation of 257m. The land lies between Bakolori Dam to the east, the bridge opposite Bakolori dam to the west, the main canal to the south and the river downstream of Bakolori Dam to the north covering an area of approximately 14 ha (698m x 200m).

B2.4. Training Requirements

Careful interaction and training needs analysis were carried out to develop a systematic understanding of where training is needed and who will be trained among the fisher folk. The Majority of the participants do

not have formal western education and no experience or formal training in fish farming and modern fish handling and processing techniques. Therefore, the training needs of each of the groups for fish farming and fish processing and marketing have been identified accordingly.

B2.4.1 Training on Fish Farming

A comprehensive/hands-on training on the following are required;

a. Adult learning principle (Andragogy) will be adopted throughout the training sessions.
b. Fish farming techniques from preparation of enclosure, farm management up to fish harvest and marketing.
c. Fisheries business/enterprise development.
d. Co-management of common and shared resources and cooperatives association development.
e. Environmental resource management.

B2.4.2 Training on Fish Processing

Comprehensive/hands-on training in the following arerequired;

a. Adult learning principle (Andragogy) will be adopted throughout the training sessions.
b. Training on various techniques of fish handling, processing, preservation and storage and marketing.
c. Business/enterprise development in fish products development.
f. Various fish value addition techniques towards enhancing utilisation of less valued species of fish and improvement of rural nutrition.

B2.4.3 Module Development

Simple modules with practical steps and self-explanatory in (Hausa and English) languages. Illustrations will be developed for the training.

B2.5 Preliminary Recommendations

The two fisheries projects selected for the community (Fish farming, and Fish Processing and Marketing) considered the desirability for feasible and sustainable empowerment of the potential beneficiaries in the community. Importantly, these two projects are key areas in the aquaculture value chain that would be of immediate and long-term benefit to livelihood in the community as well as reducing fishing pressure on the already degraded fisheries resources of the Bakolori reservoir. A total of 417 participants have indicated interest in these two projects.

It would be better to establish one or two Fish Farm Estate(s) where many of the fish enclosures could be constructed so that the participants could share common resources, such as water, at minimum cost. This approach would also enable the participants to form and take advantage of co-operative groups by way of input procurement, credit support, exchange of ideas and security. 232 participants indicated interest in this project. It will be necessary to confirm the actual number of beneficiaries the project could provide for to enable a decision on the land area, capital and other resources required.

The Fish Processing and Marketing option has fewer potential participants at 185. The facilities required for this group are quite different from the first one but it is also advisable to confirm the actual number potential beneficiaries.

Fish farming is not a commonly used system in the community and the majority are not familiar with the technologies involved. Therefore, for the success of the project, the participants must be trained in basic fish farming practices identified above. Similarly, the second group must be introduced to more hygienic and improved fish handling practices and the operation of improved fish smoking kilns to be supplied.

The major consideration in the proposed site(s) is the critical need for a reliable and adequate water supply of sufficient quality. The design of the farm in the next phase would address these issues. However, further decisions on the size can only be taken when we are sure of the number of beneficiaries for fish farming. The site requirements for the fish processing and marketing project is not so demanding.

The outstanding decisions to be taken before project commencement include the number of beneficiaries by category and district, an estimate of the financial commitment per beneficiary and approval for use of the proposed site(s). These are required for decisions on the number and design of fish culture enclosures and processing units, required land area, start-up packs and costing of the facilities and materials.

It was observed that the community was anxious to see the take-off of the fisheries programme and it is advisable that efforts should be made so as to sustain the enthusiasm and cooperation of the people.

B3 Fisheries Survey

B3.1 Existing Fishery Resources

The aquatic resources of commercial importance in the Bakolori Reservoir and within the project area are composed of various types of fish, frogs and aquatic macrophytes. A total of 24 fish species belonging to 13 families were identified (see Table 5.2) from field assessment of catches at the various landing sites around the reservoir. The family *Charachidae, Cichlidae, Clariidae, Mochokidae* and *Mormyridae* were represented by three species each. Four species (*Lates niloticus, Malapterurus electricus, Protopterus annectens* and *Gymnachus niloticus*) were caught mainly in the Sokoto River within the command areas of the project.

The field survey revealed that four species, hitherto abundant in the Bakolori reservoir, have been almost fished out or become extinct. The species are *Lates, Gymnarchus, Labeo* and *Hydrocynus. Lates* and common carp were reportedly re-stocked or introduced some years ago but have since disappeared. SRRBDA records show the reservoir being stocked annually with 40,000 fingerlings each of clarias and tilapia from 1984-87.

The relative abundance of species in catches and their potential yield or the sustainable level of stocks were not estimated at this stage but this will be required should the project proceed with investment in fisheries.

Table 5-2: Fishery Resources within BIP

Family	Species	English Name	Hausa Name
Bagridae	*Bagrus bayad macropterus*	Silver Catfish	Ragon ruwa
Centropomidae	*Lates niloticus*	Nile Perch	Giwan ruwa
Characidae	*Alestes baremose*	Silversides	Shemani
	A. nurse		Rajiya
	A. leuciscus		Kwanda, Shemanta
Cichlidae	*Tilapia zilli*	Tilapia	Buku, Gargaza
	Sarotherodon galilaeus	Tilapia	Gargaza
	Oreochromis niloticus	Tilapia	Gargaza
Claridae	*Clarias angularis*	Mudcatfish	Kulumi, Tarwada
	Clarias gariepinus	Mudcatfish	Kulumi
	Heterobranchus bidorsalis	Catfish	Ramboshi
Cyprinidae	*Labeo coubie*	African carp	
	L. senegalensis	African carp	
Gymnarchidae	*Gymnarchus niloticus*	Tunk fish	Yauni
Distichonditae	*Distichodus sp.*	Grass eater	
Malapteruridae	*Malapterurus electricus*	Electric catfish	
Mochochidae	*Synodontis clarias*	Silver catfish	
	S. docmac	Silver catfish	
	S. membranaceus	Silver catfish	
Mormyridae	*Hyperopisus bebe occidentalis*	Elephant snout fish	Kuma
	Mercusinus sp.	Trunk fish	Lilla
	Mormyrus rume	Trunk fish	Sawagya
Polypteridae	*Polypterus sp.*	Snakehead fish Sail fish	
Schilbedae	*Schilbe mystus*	Catfish	Harya

Source: Field Study, October 2013

The other aquatic fauna of both Bakolori reservoir and the water bodies within the project areas are frogs, monitor lizards, crabs and water birds. The most common macrophytes of economic importance include Typha, water lettuce, Mimosa and Nymphea.

B3.2. Socio-economic Characteristics of Fishing Households

Household information was collected through a questionnaire administered on 50 randomly selected fishermen at 13 fish landing sites in nine fishing communities in three LGAs around the reservoir and the command areas of the BIP (see Table 5.3).

Table 5-3: Villages Selected for Field Survey

S/N	Name of Village	Fish Landing Site	Local Government Area
1	Banden lade	Bandan	Maradun
2	Dosara	Rami	Maradun
3	Gidan Barebin	Kwatan barebari	Maradun
4	Dumamau	Gidan mai gemu	Maradun
5	Maradun	Kango	Maradun
6	Mafara	Bakin gulbi	Mafara

The demographic characteristics of the fishermen revealed that 24% were traditional title holders and 10% were Heads of Fishermen (Sarkin ruwa) in the different fishing communities (Table 5.4). The fishermen were basically all Hausa, all males and Muslims. Their educational status showed that 22% had attended primary school and most had Islamic knowledge. The majority (98%) were married, 65% had two wives and 47% had 6-10 children. The children and other dependants assisted in fishing activities. The minor occupations of the fishermen included fadama and up-land farming (60%), livestock rearing and various artisanal work, while some were full-time civil servants.

Table 5-4: Socio-economic Characteristics of Bakolori and R. Sokoto Fishermen

Variable	Frequency	Percent	Variable	Frequency	Percentage
Fisherman status			**No. of children**		
Head of fishermen	5	10	0	2	4
Traditional title holder	12	24	1-5	9	18
Member of fishermen Cooperative society	33	66	6-10	23	47
Sex			11-16	7	14
Male	50	100	>16	8	16
Tribe	50	100	**No. of other dependants**		
Hausa	50	100	0	19	39
Religion			1-5	23	47
Islam	50	100	>6	7	14
Educational status			**No. of children in school**		
Quranic	50	100	0	17	36
Primary	11	22	1-5	14	30
Adult	4	8	>6	16	34
Marriage status			**No. of children assisting in fishing**		
Married	49	98	0	20	42
Single	1	2	1-5	24	50
No. of Wives			>6	4	8
1	10	20	**Major occupation**		
2	32	65	Fishing	50	100

3	5	10	Up/lowland Farming	9	18
4	2	4	Artisan	8	16
			Civil Servant	14	28
			Minor occupation		
			Farming	30	60
			Livestock Farming	6	12
			Artisan	8	16
			Others	16	32

Source: Field Survey, October 2019

The social assets of the fishermen Table 5.5 showed that majority (64%) owned houses which were either mud thatched (28%) or zinc roofed (76%). 54% owned TV, VCD and radio.

The majority of the fishing villages around the reservoir are situated in remote locations that are difficult to access and lack basic social infrastructure. The access roads from the main road to the reservoir are bad tarred roads or footpaths. Fifty percent of the few respondents indicated that they had latrines built by fishermen cooperatives. Stalls were the most common (62%) types of market facilities used by the fishermen. Thirty three percent indicated that they had no markets in their villages and 67% indicated a distance of more than three kilometers from their villages to the nearest fish market. The sheds were the most common (88%) market facilities.

B3.3 Fishing Activities and Practices

The fishing activities around the reservoir and the catchment areas of the Project were assessed through field observations, inspection of fishing gear and a questionnaire covering 50 fishermen. The reservoir fisheries and those within the command areas were generally artisanal or small-scale and involved the use of simple fishing gear, equipment and methods.

The fishing gear employed consisted of gill-nets, hook and line and various types of locally fabricated traps for passive fishing and cast net for active fishing, while the fishing equipment were mainly gourds and un-motorised plank canoes (see Table 5.5 below). Several other fishing methods and devices were also employed.

The most common fishing gear were monofilament gill-nets (MFG) and hook and lines employed by 84% and 88% of the fishermen respectively, while the least were clap nets used by 28% of fishermen. The mesh sizes of the nets were mostly 25-50 mm while a 37 mm mesh size was being used by 20% of fishermen. About 62% of the fishermen had 0.5 to 2 bundles of MFG of 91.4m.

Table 5-5: Social Assets of Fishermen and Infrastructure Fishing Communities

Variable	Frequency	Percentage	Variable	Frequency	Percentage
House ownership			**Market facility at fish**	**landing site**	
Owned	32	64	Shelf/hangers	13	26
Inherited	20	40	Table	17	34
Types of house			Stall	31	62
Mud, thatched	14	28	**Type of road to market**		
Mud, zinc roofed	29	58	Good Tarred	9	18
Mud brick with zinc	9	18	Bad Tarred	9	18
Assets owned			Good laterite	3	6
Bicycle	16	32	Bad laterite	21	42
Motor cycle	37	74	Foot path	9	18
None	4	8	**Latrine built by**		
Communication facility			Government	1	12

Radio only	19	38	Community	3	38
TV, VCD and Radio	27	54	Fishermen cooperative	4	50
None	4	8	**Borehole built by**		
Fishing item			Government	27	82
Gourd	42	84	Community	5	15
Dug-out/Planked Canoe	18	36	Fishermen cooperative	1	3
			Market Interval		
			7 days	50	100
Access road from main road			**Market distance to fish landing site**		
Good Tarred Road	13	26	Within 1km	10	30
Bad Tarred	18	36	1-2km	1	3
Good Laterite	4	8	>3km	22	67
Bad Laterite	4	8	**Market facility**		
Footpath	18	36	Stores	10	20
			Cold room	2	4
			Shed	44	88
			Stalls	18	36

Source: Field Survey, October, 2013

Gourds were the most common equipment employed by 74% of fishermen, 28% had plank canoes while only 2% fished from dug-out canoes. The 60-80 l gourds were the most frequently used while plank canoes measured 5-9m in length. The fishermen had 1-3 gourds and 1-2 plank canoes.

Talata Mafara was the main source of fishing gear and equipment for 58% of fishermen while others sourced fishing items directly from Lokoja in Kogi State and Onitsha in eastern Nigeria. The costs indicated for the fishing gear varied greatly depending on the source. As high as N 2,500 for MFG, N 5,000 for MLFG and N 1,200 for hook and line. Canoes sold for between N 15,000 and N 20,000 while gourds could sell up to N 6,000 (see Table 5.6).

Other fishing practices devised by the fishermen of Bakolori and the Sokoto River, within the area of the project, are locally called Labuni, Dumba, Bilili, Ara, Dalala, and Kwalhe.

Table 5-6: Fishing Gear and Equipment

Variable	Frequency	Percentage	Variable	Frequency	Percentage
Fishing Gear			**Sources of Gear & Equipment**		
Monofilament Gill net (MFG)	42	84	Talata Mafara	27	58
Multifilament Gill net (MLFG)	15	30	Sokoto	11	23
Cast net (CN)	20	40	Bakura	7	15
Clap net (CLN)	14	28	Other sources	2	4
Malian Trap (MT)	20	40	**Cost Per Unit Item(Naira)**		
Hook and Line (H&L)	44	88	**(a). MFG**		
Other traps	17	34	1,000-1,500	4	8
Mesh size			1,500-2,500	20	40
0.75”	10	20	>2,500	15	30
1-2”	37	74	MLFG		
>2.5”	26	32	3,000-5,000	16	32
Dimension of MFG			>5,000	16	32
91.4m	34	68	H&L		
Other sizes	15	30	700-1,200	2	4
Quantity of MFG (bundle)			>1,200	31	62
0.5-2	31	62	**(b). Canoe (dugout/plank)**		

>3	18	36	15,000-20,000	6	12
Fishing Equipment			>20,000	5	10
Gourd	37	74	**(c). Gourd**		
Dugout Canoe	1	2	4,000-6,000	5	10
Plank Canoe	14	28	>6,000	8	16
Dimension of	**Gourd**		200-500	1	2
50-80 l	34	100	>500	4	8
Dimension of	**Canoe**				
5-9m	15	100			
Quantity of G	**ourd**				
1-3	37	100			
Quantity of Ca	**noe**				
1-2	15	100			

Source: Field Survey, Oct. 2013

Practices varied with the mode of fishing, type of fishing gear, month and season of the year and engagement in other socio-economic activities (Table 5.7). For passive fishing gear, such as gill nets and Malian traps, 32% of the fishermen fixed their gear between 4 and 6pm while 56% used other means of catching fish. Those who employed active gears, operated at any time of the day and night. Inspection of passive gear was normally undertaken in the morning between 6 and 8 am, as indicated by 44% of the fishermen, while 52% of those using active gear inspected the set gear at any hour of the day.

Table 5-7: Fishing Practices of the Fishermen of Bakolori Reservoir

Variable	Frequency	Percentage	Variable	Frequency	Percentage
Endangered	**species**		**Period of high fishing**	**activities**	
Lates niloticus	14	28	May/June	13	26
African Carp	13	26	July/September	31	62
Hydrocynus	16	32	November/February	3	6
Gymnacus	16	32	March/April	3	6
Others	17	34	**Period of low fishing activities**		
Species introduced			May/June	1	2
Lates niloticus	16	36	July/September	2	4

Common carp	25	56	November/February	29	58
Others	4	8	March/April	17	34
Fish Harvested	**(kg/day)**		**Period bigger fish are caught**		
1-5	7	14	May/June	11	22
6-10	4	8	July/September	22	44

Source: Field Survey, October 2013

Most fulltime fishermen spent a great deal of time in fishing activities. About 70% of the fishermen spent four to six hours a day in fishing activities while 16% spent more than six hours. For reasons relating to religion and engagement with other socio-economic activities, the number of fishing trips undertaken on the Bakolori reservoir and the command areas varied between fishermen. However, about 94% went fishing every day and there was no area or season of fishing restriction.

Fishing practices were most intensive between July and September (62%) and least between November and February. Larger fish were usually caught during the months of July-September, as reported by 44% of fishermen, while the leanest period (10%) was March/April. Similarly, smaller fish were caught, also in the months of July to September, as reported by 48% of the fishermen, while 14% indicated March and April. The periods of high fishing activities indicated by the fishermen coincided with the high flood levels when areas around the reservoir are usually inundated.

Fishermen often take advantage of shallow waters in the expansive littoral zones for easy fishing by removing all sizes of fish.

During fishing operations, fish bearing eggs were caught by the fishermen (Table 5.6) from the months of May to September. There was no restriction on catching of any of the fish species within the command area but, in the reservoir, when some fish species were first introduced, the catching of *Lates niloticus* and common carp was prohibited.

B3.4. Fish Production and Livelihoods

Data were not available on fish catches from the reservoir either currently or historically and there was no machinery in place for collection of statistics of fishermen's catches. Therefore, assessment of fish production from the reservoir and the project areas of the BIP was based on responses from the 50 sampled fishermen for their gross catches. The Majority (62%) of fishermen indicated that they caught more than 15kg of fish per day, followed by those who caught 6-10 kg/day. The catches were comprised various types and sizes of fish, as also observed on the field, but information was not available on the relative proportions

of the different species in the catches. The projected annual fish catch ranged from 600 to 5400 kg/fisherman with an average of three tons/fishermen.

The prices at which the fishermen sold their catches varied greatly (see Table 5.8) due to many factors, such as the types and sizes of fish, season, buyer and market location.

The income of the majority (62%) of the fishermen was more than N 4,000/day while those who realised N 500-2000/day constituted 20%. Incomes were influenced by factors such as the mode of fishing, types and quantities of fishing gear owned and the types and sizes of fish caught. Projected incomes ranged from N 150,000 to N 1,200,000 per fisherman per annum with an average of N 800,000 per fisherman per annum.

The relatively small quantities of fish caught and the low income of the fishermen reported are characteristics of artisanal or small-scale fisheries. However, the quantity fish caught greatly and depended on many factors such as the mode and scale of fishing, season, quantities of fishing gear owned and ingenuity or skill of the fisherman. The paucity of fish stocks in the reservoir, caused mainly by excessive fishing, must have contributed to the low catches and hence low income from fishing.

Table 5-8: Average Fish Catch, Prices and Revenue

Variable	Frequency	Percentage
Average catch (kg/day)		+
1-5	5	10
6-10	9	18
11-15	5	10
>15	31	62
Average price (naira/kg)		
100-200	19	38
201-300	25	50
301-400	6	12
Average revenue (naira/day)		
500-2000	10	20
2001-4000	9	18
>4000	31	62

Source: Field survey, October 2013

B3.5 Fish Processing, Storage, Transportation and Marketing

Most fishermen sold their catches to fish processors, fishmongers or occasionally, directly to consumers at designated fish landing sites located around the reservoir or the command area. Some fishermen (14%) sold their catches in major town markets, while the majority (44%) sold in nearby markets. Fishmongers constituted 95% of the buyers. Some of the fishmongers also doubled as fish processors, transporting fresh or processed fish to nearby villages and towns for sale. Some of the fishmongers traded in fresh fish in distant towns such as Gusau in Zamfara State and Sokoto in Sokoto State. Fresh fish were transported in baskets covered with grass or leaves and the pack kept constantly wet. Preservation or storage of fresh fish before transportation and/or sale was not a common practice among fishermen or fishmongers. However, fish such as *Clarias* and *Heterobranchus*, could be kept alive for days or transported in gourds or other receptacles for sale in distant markets.

The fish processing techniques employed were mainly smoking (64%) and frying (36%) depending on the size of fish (**Error! Reference source not found.**). Large sized fish were cut into chunks before smoking or

frying. In either case fresh fish were first salted and then dried for a few hours in the sun or air dried in a shaded area on mats fabricated using corn or millet stalks before smoking. The smoking kilns were either mud-built (34%) or half-cut drum/metal type (32%).

Table 5-9: Fish Processing, Transportation and Marketing

Variable	Frequency	Percentage
Processing method		
Smoking	31	64
Frying	18	36
Sun drying	10	20
Best processing method		
Smoking	17	77
Frying	5	23
Materials for processing		
Mud smoking Kiln	13	34
Drum smoking Kiln	12	32
Cooking oil	13	34
Storage/Preservation met hod		
Packaging carton	15	34
Storage in store	14	33
Salting/Sun drying	14	33
Fish selling place		
Landing Site	20	42
Mini market (dam site)	21	44
Town market t	7	14
Fish buyers		
Retailers	2	5
Fish mongers	38	95
Quality of fish arriving market		
Excellent	2	5
Good	37	84
Fair	5	11
Transportation		
Bicycle	13	29
Motor cycle	22	49
Lorry/car	6	13
Others	4	9
Market distances (km)		
1-6	18	41
>6	26	59

Source: Field Survey, October 2013

The challenges to fish processing included low technologies for fish handling and processing with a resulting poor product, fish preservation, storage and marketing.

The major limitations in fish processing were poor handling, unhygienic conditions for frying, smoking and drying and low quality of the dried or fried products. Products were characterised by burnt patches due to excessive heat of fire or oil and lack of uniformity of the finished products. Some of the products were also only half-smoked and still contained a high moisture content. Such products are aimed at immediate buyers and could deteriorate easily if not sold quickly. In most cases the smoked products were expected to dry

further in the process of retailing, but they often spoil in the process, unknown to the buyers. About 84% of the respondents claimed good quality fish products reaching the market but this was doubtful.

Motorcycles were the most frequent (49%) mode of fish transportation followed by bicycles (29%). The distance of the markets varied according to the location of the fishing village but 59% of fishermen, who sold their fish in the nearest town markets, indicated that the distances were more than six km from their fishing villages.

B3.6 Management of the Reservoir Fisheries

This survey revealed clear evidence of negligence in the management of the fishery resources of the reservoir on the part of the government agencies (SRRBDA and Zamfara State) charged with the responsibility. A major problem identified was conflict between the apex organisations responsible for fisheries governance and administration created mainly by inconsistency in Government policy on the mandates of the agencies. The SRRBDA, charged with the responsibility of managing the BIP project including the water resources, lacked the manpower and resources for management of the fishery. On the other hand, responsibility for fisheries governance rests with the Federal Department of Fisheries and the Fisheries Department of the Zamfara State Government. The two agencies have no direct mandates in the management of the project including the water resources. Meanwhile the Fisheries Division of the Zamfara State Government licensed some of the fishermen to collect revenue without implementation of any programme for management of the fisheries.

These situations have brought about the near total neglect of the fishing resource. Long-term abuse over the years has caused overfishing with much damage to the fish stocks. The reservoir fishery is now on the verge of collapse. There were clear indications of overfishing just as low fish catch was indicated as one of the major problems of the fishery (see Table 5.10). The catches comprised mostly small fish that were far below a commercial size. The fishermen also indicated low catch as one of their major problems.

The study revealed that many fish species have been fished to extinction. These included Lates niloticus, African carp, Hydrocynus species, Gymnacus niloticus, Heterotis niloticus, and Malapterirus electricus. The disappearance of these species could also be due to an inability of some fish to adapt to the lacustrine environment.

There is no comprehensive scientific information on the fish stocks of the reservoir since the preliminary study conducted by the National Institute for Freshwater Fisheries Research, New Bussa, in 1982. Like some other works, the present baseline survey is restricted to the catches of fishermen and the information generated is inconclusive on the status of the fish stocks. This means that the basic information required on the fish stocks on which to base management decisions is not known.

Table 5-10: Fishermen's Perception of Management of the Bakolori Reservoir Fisheries

Variable	Frequency	Percentage
Agency controlling the water bodies		
Rima Basin	48	96
Zamfara State Govt.	2	4
Water bodies management level		
Good	10	20
Fair	20	40
No management	20	40
Fishery management level		
Good	2	4
Fair	8	16
Not Manage	40	80

Problem in managing water body		
Not part of management	10	30
Lack of enforcement	2	6
Lack of concern by fishermen	3	9
Lack of coordination in water use	4	12
Other problems	14	42
Problem in managing fishery resources		
No stake holders participation	4	10
Lack of Government support	2	5
Lack of regulation	7	18
Lowe fish catch	15	38
Other problems	11	28
Fishermen's problem		
Inadequate fund	25	50
High cost of fishing inputs	16	32
Floods and tree branches in reservoir	12	24
Others	14	28
Sources of funding		
Personal saving	49	98
Loan	1	2
Bank loan		
Benefited	2	4
No access	48	96

The SRRBDA tried to stock the Bakolori reservoir with clarias and tilapia from 1984 to 1987 but the programme collapsed most probably due to a change in policy that affected the fisheries component of all the river basin projects in the country.

The findings showed that only a few fishermen operated canoes, whether dug out or plank canoes and there were no outboard motor-powered canoes in any of the fishing communities visited. The fishermen also spent much time in fishing activities, most probably due to the paucity of fish stocks and limited opportunities for alternative incomes.

The prices of gear and equipment varied with markets and the seller as well as the year of purchase. However, the prices were always beyond the purchasing powers of fishermen.

Table 5-11: Fisheries Extension Activities and Fishing Licenses

Variable	Frequency	Percentage	Variable	Frequency	Percentage
Access to Fish	**ery Extension**	**Officer**	**Involvement of wome**	**n**	
Benefited	24	48	Yes	15	30
No access	26	52	No	35	70
Extension me	**ssage**		**Role of women**		
Fishing license	20	83	Processing	12	80
Fishing regulation	4	17	Marketing	3	20
			Limitation to women	**participation**	
Reason for non-access to extension			Fishing is men's job	14	40

Unaware	18	69	Fishing not attractive	11	31
No dedication	6	23	Other reasons	10	29
Others	2	8	**Possession of fishing l icense**		
Functionality	**of fishermen c ooperatives**		Yes	46	92
Excellent	2	5	No	4	8
Good	19	49	**License issuing agency**		
Fair	14	36	Rima Basin	44	96
Poor	4	10	Zamfara State	2	4
			Others	7	14
			Cost of license/year		
			200-500	8	17
			1000-2500	22	48
			3000	16	35
			Reason for not having license		
			Not contacted	3	75
			Not important	1	25

Source: Field survey, Oct. 2103

B3.7. Conclusion on the Status of Capture Fisheries

This study has revealed traditional fish processing methods characterised by poor hygiene, inefficient traditional smoking kilns, low quality fish products, lack of proper fish storage and market facilities and poor transportation. These practices bring into question the safety of the fish products for human consumption. They were not in a state meant for a long shelf life and they rarely arrive at markets in good condition. Excess fish not processed and not sold immediately, must hurriedly be disposed of before becoming worthless. Fish landing sites and markets were devoid of suitable storage facilities. In all the markets visited only one had a refrigerator for storing beef and fish alongside other perishables.

The other challenges to the reservoir fisheries and fish production within the BIP command area include lack of skills, inadequate funding, lack of extension and delivery systems (Table 5.11), poor resource base of fishermen, coupled with the lack of access to credit facilities Table 5.10 , low literacy and ineffective fishermen cooperative societies (Table 5.11 above).

Based on the above findings a series of interventions are required to improve sustainability in fish production and to protect the livelihoods of fishing communities.

B4 Capture Fisheries Development and Key Interventions Areas

In deciding on an appropriate and holistic intervention programme aimed at enhancing fish production and livelihoods of the fishing communities of the Jankarawa areas, it is important to consider the special characteristics of fisheries as a system in which the intricate relationships of the fish population, water and fishermen individually and collectively influences fish production. Therefore, the capture fisheries development programme must ensure total and concurrent control of these three sub-components of the fisheries system otherwise the expected impact may not be achieved. Consequently, some of the interventions proposed in this report are complementary and need to be implemented as a package rather than as separate entities.

The six key interventions are re-stocking, control of fishing, credit facilities, fish processing and marketing, co-management of the fisheries and improved extension services.

B4.1. Stocks Improvement

Re-stocking of the Bakolori Reservoir with indigenous fish species in order to improve the commercial status of the fisheries is a key action. The existing stocks are composed of small and large size fish with diverse

growth, breeding and feeding habits, all of which have been overfished. A thorough assessment of the existing stocks is important to provide baseline scientific information for re-stocking and subsequent monitoring. The present level of fish production, the density, ratio and ecological roles of the different species and the potential yield of the Reservoir need to be investigated through comprehensive stock assessment study beyond the scope of the present baseline study.

Except the study conducted by the Kainji Lake Research Institute, New Bussa, in 1982 when the reservoir was about three years old there has not been another study of the fish stocks of the reservoir. In the study Cichlids were found to be dominant and the total density of all species was put at 3,707 fish per ha with a total standing crop of 31.5kg/ha. This study was conducted about three decades ago and the findings would most likely be at variance with the current status of the fish stocks.

The Reservoir is estimated to have a 450 x 106 m^3 maximum water storage capacity and covers 8,000 ha. The cost considerations for re-stocking relate to the establishment of a reliable and sustainable source of good quality fish juveniles, live fish transportation facilities, skilled personnel and other vital back-up facilities. Considering the costs components, the expected scale of operation and the need for a sustainable re-stocking programme coupled with fish farming activities within the command areas of the BIP, the establishment of a functioning fish hatchery would be a cheaper strategy. Details of interventions programmes on fish breeding and table fish production are contained in the report on culture fisheries in the next section.

It is recommended that the existing fish species in the reservoir be used for re-stocking. Of the available species the *Clarias*, *Heterobranachus* and tilapia species hold the greatest potential for achieving a successful re-stocking programme. The choice of these species is based on existing technology for hatchery production of the fingerlings which is proposed as one of the key interventions in the next section. Re-stocking with other fish species would require sourcing the fingerlings from other wild water bodies.

Meanwhile, considering that the stocks have deteriorated over the years due to overfishing, the need to achieve stock recovery within the shortest possible time and available data on similar stocking programmes, a stocking density of 2,500 fish per ha may be adopted subject to further studies and review as the re-stocking progresses. The stocking ratio should be 2:2:1 for *Clarias, Heterobranchus* and tilapia respectively. A three-year programme should be adopted: 1,000 per ha each in the first and second year and 500 per ha in the third year based on findings from a comprehensive stock assessment to determine the success of stocking achieved with the stocking in the previous year. A total of 20 million fingerlings of the three species would be required over the three-year period.

Estimates of some of the cost components are as follows:
(a). Establishment of Fish hatchery (see below under fish culture)
(b). Fish juveniles production 20 milliion @ average cost of N 15/fingerling N 300 million)
(c). Feeds and medication N 5 million per year
(d). Transportation facilities (Receptacles and vehicles) N 15 million

B4.2. Control of Fishing Activities

Effective control of fishing activities is imperative for successful stock improvement through the re-stocking project and for sustainable fish production from the Bakolori Reservoir. The perception of fishermen and the general public on fisheries resources as common property and abuse in the exploitation methods must be treated with all seriousness as this could undermine the investment in the fisheries of the reservoir. Fishing licensing must be appropriately adopted as an important management tool, not just to generate revenue for the project as currently done and the licensing fees must be commensurate with the catches.

The relevant provisions of the fisheries edicts with respect to types and sizes of fishing gear, fishing methods, closed season and area, sizes of fish to be caught and prohibited fishing methods must be aggressively enforced. Penalties for defaults must be sufficiently punitive and/or prohibitive. The Inland Fisheries Edict of Nigeria (1992) could form the basis for coming up with a separate fishing regulation for

the project area. The Fisheries Edict of the Zamfara State Government could be considered for adoption but some of the provisions would need modifications to suit the project area.

B4.3 Credit Scheme

Empowerment of fishermen through input package' to enable them acquire plank fishing boats and outboard engines and replace their worn-out fishing gear. The input loan, to be recovered in instalments, should be for certified resident members of registered fishermen cooperative society. This package would ensure that only the right types and sizes of fishing gear, as provided for in the fishing regulations. are used by fishermen and to encourage their cooperation in the management of the reservoir. A sum of N 50 million is proposed for this package and should be a revolving fund.

B4.4. Fish Processing and Marketing

Two fish processing and marketing centres should be established in the two landing sites identified around the reservoir. The centres should be equipped with more efficient smoking kilns and facilities for storage of fresh fish and processed fish products. The facilities should be managed by the fishermen cooperative societies. The centre should be self-sustaining after initial provisions by the Project. It is envisaged that this intervention would facilitate centralisation of fish landings, monitoring of compliance with fishing regulations, better handling of fresh fish, hygienic processing environment, high quality fish products, reduce post-harvest losses and encourage more efficient fish marketing.

5.4.5. Extension Services and Education

Effective fisheries extension services should be developed with clear-cut messages on responsible fishing and fish processing practices. The extension agents should not be involved in the transmission and enforcement of fisheries regulations as is currently being done. Effective fisheries extension mechanisms must be adopted. The area covered by the project is enormous and most of the important fishing villages are in remote locations. Therefore, the extension agents requires, and must be equipped with, both land and water transportation facilities, and given sufficient incentives. The same also goes for those that will be involved in fisheries surveillance and enforcement of the regulations.

There should be official occasional forum or opportunities for direct interactions with the fishermen and fish processors for the purpose of enlightening them on modern and responsible fishing techniques and processing methods.

B4.6. Co-management of the Fisheries Resources

The perceptions of communities on the ownership of fisheries resources and the right of usage have continued to undermine the achievements of well-conceived intervention programmes on capture fisheries. The host communities including the fishing villages around the project area must not be left out due to their poverty and limited means of livelihoods. To alleviate the problem and ensure success of the intervention programmes, the communities and other stakeholders should be involved in the management of the Reservoir. Participation of the village heads, heads of fishermen (Sarkin ruwa), representatives of the fishermen cooperative societies, the Local Government Councils, politicians and other community leaders should be included in the design and implementation of the programme. Through stakeholders' forum communities would be able to appreciate the good intensions of government by investing in the development of the fisheries resources to enhance their means of livelihoods.

It is also important to emphasise the need to avoid conflicts in the activities of the apex agencies responsible for fisheries governance and administration through stakeholders' participation. The Zamfara State Government should respect the jurisdiction of the BIP on the fisheries resources of Bakolori Reservoir and the command areas and make the fishermen accept the authority of the project. Specifically, issuance of fishing licenses to fish on the Reservoir and control of the fishing activities should be the exclusive responsibility of the project. The ultimate goal is to achieve increased fish production for enhanced

nutrition, income and means of livelihoods of the immediate communities and Nigerians at large, irrespective of the funding and supervising government agency.

B4.7. Fish Culture Systems, Practices, and Inputs

The BIP offers tremendous opportunities for fish production through the development of various systems of culture fisheries. The practicing fish farmers in the project area rely on other means of livelihood and majority of them, and the potential participants from the host communities, are low income earners. Fish culture is unavoidably capital intensive and the basic resources required to establish a medium size fish farm is beyond the reach of most of the potential participants in the business. The required skills are largely unfamiliar compared to livestock and crop productions where there are traditional practices. Government still needs to create favourable environment, including free or subsidised services, to encourage participation of the rural communities and corporate organisations in fish farming ventures in the area.

Investment in the development of the culture fisheries would ensure optimum utilisation of the available environmental resources. The dividends would include increased fish production, reduced pressure on the Bakolori reservoir fisheries, employment opportunities, diversification of means of livelihood, empowerment of the rural communities and enhanced food security.

B4.7.1 Feed Mill

Fish farming, like other animal husbandry, requires feeding for increased production under semi-intensive or intensive production systems. However, the use of artificial feed is known to account for about 60% of the operational costs of fish culture thus undermining profitability. The farmers in the area do not have the knowledge to formulate fish feed funds to buy imported fish feed nor the capital to establish a feed mill and must be convinced of making a profit before committing resources to fish farming.

The establishment of a central feed mill for production of fish feed is considered a crucial intervention project, to make cheaper fish feed available to the famers within the project area and beyond. This is seen as an area suitable for private sector investment so has not been costed into the project. This also applies to fish processing.

B4.7.2 Capacity Building

Competent personnel are required to man the various aspects of the fish culture programme and provide extension services to the fishermen. Capacity must be improved by employing fisheries experts in fish breeding, nutrition, processing and extension. Training of the fish farmers should be an integral part of the culture fisheries programme in order to mobilize the communities for fish farming activities. Extension packages must also be developed, and the necessary facilities provided for massive transfer of fish farming technologies.

B4.7.3 Security

One of the major challenges of the fish farmers in the areas of the BIP is frequent fish theft. This could undermine the achievements of the culture fisheries development projects. Effective security measures must be put in place to protect the investments of government and private fish farmers.

B4.8. Operation and Maintenance

After construction of fish ponds, the maintenance and management of fish farm constitute the other important aspects of the fish culture. Suitable species of fishes are selected and their culture is practised cautiously.

Necessary measures to be taken are as follows:

1) Dike and other installations should be property checked. Repairing the broken parts of the dike, cleaning the screens and overflow drainage system should be watched constantly.
2) To check overpopulation in ponds, intermediate fishing is required. This allows more space and food

to remaining fishes which start growing until the ponds become overpopulated.

Besides, there are some principal measures to be adopted, including the restoration and improvement of pond bottom. All the ponds are required to be drained dry once in a year and it is essential to retain the productivity of ponds in following ways**:**

- Draining reduces mineralization of soil particularly when it has grown rich in cellulose contents owing to accumulation of submerged vegetation.
- Fish parasites, disease producing germs and various stages of their life cycle, harmful insects leeches, etc. are destroyed.
- The roots of emergent vegetation lying deep in the soil use up nutrients which would have otherwise been used by the fish for their growth.
- After drying the ponds the productivity is increased.
- Required repairs, which cannot be done when the pond is under water can be carried out after drying the pond.

B4.8.1 Pond Fertilization:

Pond fertilization is one of the key factor in increasing the maximum carrying capacity. Fish farmers adopted the method of manuring to rear fry long ago. In nursery and rearing ponds, fertilization is aimed at developing natural food and saving artificial food. Therefore, the significance of pond fertilization lies in the cultivation and propagation of various fish food organisms for the cultured fish.

B4.8.2 Control of Various Physico-Chemical Factors:

All the physico-chemical parameters of water should be thoroughly checked and corrected during total period of cultivation. This is necessary because their concentrations may alter depending upon the environmental conditions. To cite a few example, the pH of fish pond water may change in rainy season owing to flood water causing acidity, O_2 concentration may fall below the prescribed level in cloudy days and should be corrected quickly by aeration or by other means.

B4.8.3 Control of Predatory and Weed Fishes:

The fishes which feed upon cultivable species of carp hatchlings are called predatory fishes. Weed fishes are those which consume the aquatic vegetation and thus, compete with the fishes under cultivation. Certain predatory fishes breed prior to the breeding of major carps in pond waters and go on feeding the available planktons with fast increase in their growth and size. When carp spawns are introduced, the predators are large enough to feed on them. Weed fishes have relatively good fecundity and attain sexual maturity in summer and breed even without rain prior to the monsoon. So their young ones are abundant in number during monsoon.

B4.8.4 Role of Predatory and Weed Fishes in Ponds:

Predatory piscivorous fishes feed on the culturable species as well as on the minnows. Minnows being prolific breeders and profuse feeders on planktonic masses, consume almost all natural fish food organisms and occupy quite good space in the pond ecosystem. Therefore, these minnows not only compete for food but also compete for space with the culturable varieties of fishes. This reason necessitates complete removal or the control of predatory and weed fishes in carp culture farm.

Besides this, the stronger and larger sized predatory fishes show cannibalistic behaviour and may feed on the weaker and smaller fishes. Hence, it is desirable to completely eradicate the predatory and non-predatory minnows from culturable pond through management.

Secondly, the consumer's preference on minnows and predatory fishes is very low than the carp varieties. Therefore, carp culture is always preferable over predatory and weed fish culture.

B4.8.5 Control of Aquatic Insects:

For maintenance of fish farm, the eradication of aquatic insects is an essential requirement. Eradication of

harmful aquatic insects play an important role in increasing fry survival rate.

The piercing, cutting and sucking type of mouth parts of harmful aquatic insects cause direct or indirect death of culturable tiny fishes. However, common insects found in the culturable ponds being smaller in sizes, cannot make any harm to rather bigger sized fishes including fingerlings and yearlings. Thus, eradication of insects in the stocking tank is not compulsory.

Out of eleven orders of class *insecta*, three orders namely Hemiptera, Coleoptera and Odonata are relatively more common in freshwater ponds.

Waterbugs of order Hemiptera are relatively more dangerous. They bear strong piercing type mandibles and most fierce in praying upon fry. Belostoma, Lithocerus (Giant water bug), Nepa, (water scorpion), Ranatra (water stick insect), Notonecta (Back swimmers), Geris (water spider) etc., are other harmful insects belonging to order Hemiptera.

Order Coleoptera includes Cybister (water beetles), Dytiscus (diving beetles), Gyrinus (whirling beetles), Hydrophilus (scavenger beetles), etc. Both larval and adult life complete throughout in pond water. The death of the fry is due to their strong cutting mandibles.

Dragon fly and damsel fly are common aquatic insects belonging to order Odonata. The larval forms are aquatic while adult forms are terrestrial. Their nymphs are provided with sucking type of mouth parts and cause death of culturable fish fry.

B4.8.6 Eradication (Control) of Predatory Aquatic Insects:

Effective control of aquatic insects is obtained by using insecticides. Gamaxene when applied @ 0.6-1 mg/l, can safely eradicate aquatic insects within 1 to 11 hours. Pure gamaisomer of benzene hexachloride soluble in ethanol can kill aquatic insects within 6 hours at 0.01 mg/l concentration. The insecticides, however, also affect adversely zooplankton and fish spawn. Therefore, the insecticide should be of such type which may affect only insects but not the zooplanktons.

Spraying oil to kill the insects, which come up to the surface water to respire, is well known principle and a routine practice in malaria control. Emulsion of mustard or coconut oil and cheap washing soap in the ratio of 56:18 kg/ha. has been reported from CIFRI Cuttack to kill pond insects. Chatterjee (1970) has recommended the substitution of soap by Teepol B-300 in the emulsion. The recommended dose of Teepol is 560 ml. emulsified with 56 kg of mustard oil.

The use of diesel oil at 50 l/ha with $^1/_3$ to $^1/_4$ of washing soap can be applied to control insects.

Kerosene oil is also practiced among pisciculturists for effective eradication of aquatic insects. To kill water centipedes, quick lime can be applied before fry stocking. A drug namely dipterex crystal (concentration 90%) can be scattered into the entire pond in order to kill aquatic centipedes in nursery ponds.

B4.8.7 Artificial Feeding:

The stocking of nursery pond is best done at the rate of 12 -20 lakhs/ha. in late evening. Soon after stocking, spawns start feeding voraciously on zooplanktons. Till two days of stocking no artificial food is given to spawns. After this period artificial feed along with natural fond enhances the growth of spawns.

The commonly administered feeds for Indian carp are rice bran, oil cakes of groundnut, coconut and mustered etc. However, an artificial feed comprising of a mixture of dried, finally powdered and sieved aquatic insects (back swimmers), small prawns and shrimps and cheap pulses in the ratio of 5: 3: 3 reported by Lakshman et. al. (1967) gives better result in enhancing the growth of spawns than the mustard oil cake and rice bran (50:50). The use of powdered algae and other aquatic weeds as fish feed has also been suggested.

The artificial feed may be sprayed at a fixed place during specified hours or fed as a thick paste in small shallow earthen vessel, kept suspended in the pond water. Feeding is done usually in morning hours.

B4.8.8 Harvesting:

By draining the pond or by netting, harvesting i.e., fishing is done. By draining, harvesting is complete and predators can be eliminated. Much less labour is required and the pond can be dried, cleaned, repaired and soil enriched by applying fertilizers. If the ponds are constructed in rows, loss of water can be avoided and ponds drained by turns.

B4.8.9 Maintenance of Earthworks

During the first years of operation fish ponds need the most maintenance, as the unforeseen, hidden faults occur at this time. For example, the unexpected subsidence and settlement of dikes, and the more serious erosion on the surface of dikes and excavations occur. Maintenance must be carried out continuously from the first year of operation. One can expect the following troubles with dikes: slope failure, soil slip, notch, slight erosion of the slope, etc.

- Slight erosion in most of the cases is caused by precipitation and its trickling down the slope. Thorough soaking and drying of the surface and negligence in dike maintenance can also cause spalling of the upper surface of the slope. If there is a more serious erosion of slope, shoulders must be constructed on the slope and new horizontal layers must be compacted onto the top. After reconstruction the dikes have to be protected against erosion.
- Soil slip is caused most frequently by bad quality of compacting, drenching of the dike or quick water discharge. In such a case a bigger quantity of soil slips down from the slope in some places. The slipped soil has to be replaced with well compacted horizontal layers of earth and possibly with a retaining wall.
- Slope break-through is caused by the same things as soil slip. In this case a part of the slope slips down in a round shaped form. For reconstruction of such a failure first of all a foot wall should be constructed then good quality earth material should be filled and compacted in thin layers.
- Slumping is generally caused by a lack of proper compacting of the dike. It can also occur if the layers containing humus or organic matter were not removed from beneath the dike. Reconstruction in this case is carried out by putting a new layer of earth onto the top of the dike.

Not only the base of the dike but the dike itself may also settle. Settlement of smaller dikes is generally not higher than 2-4% of the height of the dike. If the settlement of the dike is higher the dike may have lost its load capacity after construction or its load capacity is not suitable. Protection generally can be made by constructing protecting shoulders/foot walls on one or both sides of the dike.

Bigger scale erosion generally occurs in canals of higher water current capacity or after a longer operation time.

Maintenance must ensure the original water supply capacity of the canals. Erosion occurring on the bottom level and on the surface of the slope, soil slip and notch must be corrected at least once a year. At the same time accumulated silt and mud must be removed and vegetation obstructing free water flow must be moved or removed.

On the bottom level of the fish ponds the mud must be removed from the internal harvesting canals after the drainage of the pond. Maintaining of good condition can be assisted by setting the feeding places in these canals.

B4.8.10 Maintenance of Biological Slope Protection

Biological slope protection needs constant thorough checking and maintenance, as wave action can cause erosion of the slopes. Usually a strip of planted reed is applied for biological slope protection. Where the reed is not strong enough temporary brush work protects the earth slope.

The deficiencies in the reed strip must be replaced. The protecting reed strip must be treated continuously.

Recently new biological slope protection methods have been elaborated, when some plastic materials (geotextile, plastic net) are applied on the earth slope desired to be protected and the plastic together with the plants and roots forms a protecting layer.

B4.8.11 Maintenance of Water Control Structures

Checking of structures must be carried out by separate checking of the elements (concrete parts, steel structures, flash boards). Sediments and the mud must be removed from the structures before operation begins.

Leakages occurring at the joints of structures can cause cavities which must be filled with properly compacted earth, and where it is necessary, with concrete. Leakage can be eliminated by repairing the joint or by application of bitumen filler.

If there are settlements of the structures or as a consequence of them there are cracks in the structures, the method of reconstruction must be determined separately in each ease depending on the given problem.

B4.8.12 Steel Structures

Elements of steel structures must be protected against corrosion. Each year, built-in structures must be cleaned with a wire-brush during breaks of operation then one layer of rust-preventing paint and two layers of oil paint must be applied. Moving elements of the structures must be regularly oiled or lubricated.

B4.8.13 Stone and Concrete Linings

If the stones become loose in the linings or the filling material is damaged the stones must be replaced. Settlement of the dike can cause damage of the lining. The same damage can occur if waves wash away the bed of lining or the supporting earth. In such a case the lining must be removed from the damaged areas, the slope must be filled up with bedding material, then new lining must be made.

The most frequent fault of concrete lining is under-washing. Reconstruction is the same as in the case of stone lining.

Erosion at the ends of the lining must be filled with gravel as soon as possible, as otherwise the lining will be destroyed very easily.

B4.9 Budget

The estimated cost for the establishment of the fishery options at two locations is put at N1,425,656,000.00 with details as shown below.

Table 5-12: Budget for Fishery Activities

Sl.No	Description	Amount (Naira)
1	Building infrastructures	194,000,000
2	Equipment and accessories	584,120,000
3	Three years input	384,570,000
4	Capacity building	3,200,000
5	Technical assistance	259,766,000
	Total	**1,425,656,000**

C1 AGRICULTURAL BUSINESS CENTRES

C1.1 Introduction

The aim of this sub-component is to support the creation of Agricultural Business Centres (ABCs) for both the men and women folk with the long-term objective of becoming commercial entities (limited liability company or cooperatives) providing services in the Maradun LGA. Expected services and provisions provided by ABCs supported by this project initially include access to input supplies; technical support to processing / value addition, post-harvest storage and marketing. In the long run, the services may be extended to enhance linkages to micro-finance, communications. Capacity will be developed in several areas, e.g. organisation and management, business and financial management and planning, machine operations, shopkeeping, partnerships, etc.

There will be eight ABCs, four for men and four for women. They will be located within four communities. There will be two sites (North and South), of Maradun, one site at Gidan Kano and one site at Dosara. The ABCs are to accommodate the rice milling machines, oil and juice extractors and other processing machines. Each of the ABCs will occupy a land area of one hectare (100 X 100 metre), and the land will have valid documentation of certificate of occupancy from relevant state government agency.

Additionally, each of the ABCs will be provided with two boreholes and overhead tanks located within the centres. One borehole will serve the centre and its various other *ad hoc* activities, while the other borehole will serve nearby communities with adjoining distribution standpipes located outside the centre and possibly by the security fence.

There would be extensive training on all the intervention livelihood options to be introduced to the communities. It would however be advisable to give out machines and equipment to groups or cooperative societies for effective management, rather than individuals. The beneficiaries will therefore be encouraged to form formidable groups and cooperative societies.

C2. General Facilities Design Considerations

There are some general items necessary to be taken into considerations before embarking on the design of the facilities pertaining to the ABCs. Some of them are briefly narrated as follows:

(a) It is necessary to ascertain the availability of the required raw products like paddy rice or poultry products and carry out minimal economic analysis to ensure that your plant will be able to process and sell enough products to cover cost of development. Remember there will be other buyers competing with the raw and finished products.

(b) It is necessary to produce consistent good quality finished products to attract a good price that can make up for higher cost.

(c) It is necessary to identify market outlets and customers for the finished products and understand and meet their needs. It is necessary to produce products that customers want and deliver them reliably when they need them, at a quality as good as the competition.

(d) It is necessary to identify the workers including reliable and trained leaders to operate and maintain the plants.

(e) It is necessary to carry out minimal financial analysis, thinking carefully about what the sales/revenues and costs are likely to be. Make realistic estimates of what prices are likely for the products and what the processing yield would be.

(f) It is necessary to base the plant design capacity on the daily production rate of different kinds of products and allow room for expansion to cater for future markets. If the plant can produce a range of product, then it should be made to adjust more easily to different run and market conditions.

(g) In selecting locations, the followings are to be taken into consideration:

- Location of source of raw products for the plant;
- Weather like winds and tides protection;

- Accessibility in and out of project site;
- Accessibility to utilities that are essential for the plant;
- It should be acceptable to the community/users, and does not conflict with other uses of or plans for the area;

(h) In selecting the type of building for the plant, the followings are to be taken into consideration:
- Ensure that the building comply with the regulations of buildings under specific value chains, like facilitation of maintenance and sanitary operations for food manufacturing purposes;
- Ensure the building includes all the spaces that will be required especially for offloading and storing of unprocessed raw products, processing line, blast freezing or chilling, packaging, cold storage, quality testing, lavatory, laundry and eating room, utility equipment and offices.
- Ensure that the different spaces fit together in a way that is efficient and convenient and that products under processing move smoothly through the plant for all stages, with separation of contaminated raw products from finished products;
- Ensure movement of people through the plant in an efficient and effective way,
- Ensure that floors, walls and ceilings may be adequately cleaned and kept clean and kept in good repair;
- Ensure provision of adequate lighting in hand-washing areas, dressing and locker rooms, and toilet rooms and in all areas where food is examined, processed, or stored and where equipment or utensils are cleaned, and provide safety-type light bulbs, fixtures, skylights, or other glass suspended over exposed food in any step of preparation or otherwise protect against food contamination in case of glass breakage;
- Ensure provision of adequate ventilation or control equipment to minimize odor and vapors (including steam and noxious fumes) in areas where they may contaminate food and locate operate fans and other air-blowing equipment in a manner that minimizes the potential for contaminating food, food-packaging materials, and food-contact surfaces;
- Ensure provision, when necessary, adequate screening or other protection against pests.

(i) In selecting equipment for the plant, ensure that consideration is given to amount of space available, the cost of power, the number of anticipated workers and the volume of raw products to be processed.

The consultant have contacted the National Centre for Agricultural Mechanization (NCAM), in Ilorin, Kwara State, an agency mandated to mechanize Nigeria's agriculture by developing simple need-based and low cost technologies using locally sourced materials that reduces drudgery, increase farmer's efficiency, productivity and their income. NCAM is assisting with agro-processing machines, capacity building and training especially with women folks.

C3. Processing of Cooking Oil

One of the livelihood options initially discussed as part of the intervention is the processing of cooking oil. Women will be encouraged to take up processing of groundnut, sesame and sunflower oils. There will be supply of oil milling machines with adequate milling rate and capacities, for about 1000kg of oil per month. Men will be encouraged to increase the cultivation of the groundnut, sesame and sunflower for oil seeds.

Figure 6-1: Typical Oil Extracting Machine

C3.1 Budget for Oil Extracting Machine

The estimated cost for the Oil mills is as shown below.

Table 6-1: Budget for Oil Extracting Machines (and its associated activities)

Sl.No	Description	Amount (Naira)
1	Building infrastructures	538,361,628
2	Equipment and accessories	132,960,000
3	Three years input	80,000,000
4	ABC and Borehole	115,162,987
5	Capacity building	6,400,000
6	Technical assistance	519,532,000
	Total	**1,392,416,615**

C4 Rice Milling Machines

Rice milling machines of average production rates of about 3 t/day will be supplied through ABCs for effective management. The annual production of paddy in the BIP is more than 10,000 t. Part of this production could be diverted to ABCs for processing.

The rice par-boiling and drying processes will be carried out separately prior to feed rice milling machines. The machines are referred to as Home Rice Millers and are capable of carrying out the de-husking stage through polishing, grading and de-stoner processes.

A single mini-automated rice milling plant should be adequate and is recommended for the Jankarawa intervention. Such plants have separate parboiling and drying sections, with the mode and methods depending on the required capacities. The remaining milling processes may be automated. The rice may be sun-dried on a flat concrete surface or using a separate mechanically operated dryer. Parboiling may be undertaken through a dual-purpose tank for steaming and husk soaking. This will be heated either through using firewood or electrically operated parboiling and soaking machines.

C4.1 General Processes and Milling Operations

The general processes and milling operations consist of the following:

(i) Dual Purpose Tank of about 500kg each for parboiling with husk soaking in hot water for about 8hrs;
(ii) Electrically operated parboiling stage of 600kg capacity (South Korea Made);
(iii) Mechanical Dryer of One Tonne Capacity;
(iv) Platform for Sun Drying, as against Mechanical;
(v) Home Rice Miller Machine Containing:
- De-husking Chamber
- Polishing Chamber
- Grading Chamber (Separate Broken and Unbroken)
- Primary De-stoner Chamber
- Secondary De-stoner Chamber
- Bagging and packaging

(vi) Paddy Store
(vii) Finished Store

TYPICAL HOME RICE MILLER

TYPICAL RICE PARBOILING UNIT

PADDY STORE AND WEIGHING SECTION

FINISHED PACKED RICE

Figure 6-2: Rice Mill Components

C4.2. Budget for Rice Mills

The total estimated budget for setting up the rice mill is put at N1,178,533,296.34 and detailed below as follows:

Table 6-2: Budget for Rice Mills and its associated activities

Sl.No	Description	Amount (Naira)
1	Building infrastructures	567,761,628
2	Equipment and accessories	700,000,000
3	Three years input	320,000,000
4	ABC and Borehole	243,372,965
5	Capacity building	6,400,000
6	Technical assistance	519,532,000
	Total	**2,357,066,593**

C5 Juice Making

One of the livelihood options initially discussed as part of the intervention is juice making. Women will be encouraged to take up processing of tomato, mango and other seasonal fruits and will also be encouraged to increase the cultivation of fruit.

Figure 6-3: Typical Juice Extracting Machine

C5.1 Budget for Juice Extractor

The amount budgeted for the Juice Extracting option is N711,616,135.65 and details below.

Table 6-3: Budget for Juice Extractor and its associated activities

Sl.No	Description	Amount (Naira)
1	Building infrastructures	538,361,628
2	Equipment and accessories	159,680,000
3	Three years input	80,000,000
4	ABC and Borehole	119,258,643
5	Capacity building	3,200,000
6	Technical assistance	519,532,000
	Total	**1,420,032,271**

C6 Poultry

C6.1 Poultry Housing Systems

There are various types of poultry practices depending on the freedom and exposure of the birds to pasture and sunshine. In the fadama areas due to limitation of land and the wetness of the areas, the best houses for birds are those that put them under confinement and most often are fixed buildings with high stocking rate for the birds. As a result of the confinement, the birds are under the greatest protection from physical hazards and so the system is suitable for fowls of all ages. Also, because of their confinement the birds are subject to greater environmental control, which promotes the highest level of performance. The high concentration of birds permits the most efficient utilisation of labour, in that the operator can reach many birds faster and automatic devices can be used. As a result of the high stocking rate a minimum area of land is required for establishing the poultry unit. Therefore, this system can be adopted especially where land is expensive or in short supply like the fadama areas. Some of the house systems falling under this category are deep litter, the wire or slatted floor, the straw yard and the cage systems.

Deep litter consists of a fixed building having suitable litter material spread on the floor. They are variable in size and are usually rectangular in plan, and function efficiently only if the width does not exceed 7.2 to 10m and internal fixtures are at a minimum to permit maximum straight-through ventilation of the house. Length is determined by the gradient of the ground, but a maximum of 72m is recommended. Houses for cage units may reach 12m in width, permitting four rows of cage units. The proposed proto-type design that could accommodate about 2000 birds, is as shown with the following dimensions:

Length 54m
Width 7.2m
Height at the eaves 2.1m
Height at the ridge 3.6m
Foundation 0.45m deep & 0.7m thick
Wall 0.23m thick & 1.0m high
Concrete floor 10cm thick & 2.5cm top coating
Rafters 3 x 5 cm
Purlins 7.5 x 5 cm

The top part of the side consisted of wire mesh supported with a framework of timber. Litter material is wood shavings and roof is made of asbestos cement sheet.

As shown, the floor of the house is usually divided up into pens along the length, and if sufficiently wide, there should be a central passage (gangway) running the length of the house. A store may be situated at the middle of the house but should preferably be a separate building. There should be two stores, one for eggs, the other for heed. The feed bags should be spread out in the stores rather than piled up to ensure air circulation. An estimated floor area for feed stores of $36m^2$ for 1000 layers is recommended.

The floor of the deep litter house should be cemented and strong to prevent entry of rats and mice. A cemented floor also improves the efficiency of washing the floor clean of old litter material. A floor that is poorly cemented is worse than one not cemented. It is necessary to cover the floor with litter materials like wood shavings, crushed cobs of maize (after removing the grains), crushed dry kenaf stems and peanut shells. Dry sawdust is not a suitable material as it may easily block the nostrils of the birds when they peck the litter or irritate the nasal passages and the throat-a stress factor contributing to respiratory infection.

Figure 6-4: Typical Poultry Pen

The initial depth of litter material on the floor should be about 7cm for chicks and about 20-25cm for growers and adults.

The wire and slatted floor housing systems have mesh wire as litter materials. The wire floor is raised 0.6-0.9m above the cemented floor, so that droppings are accumulated directly on the cemented floor and the birds are safe from direct contact with the droppings. The cost of constructing the wire floor may be higher than of providing the litter, but the problems of litter management are avoided. This system is not popular, probably because of problems of egg breakages.

The other proposed housing system is the cage system, where the birds are housed in individual compartments, each accommodating a limited number of birds, mostly one or two. This individual cage compartment is the basic component unit of the cage system and it is essentially a laying nest with a sloping floor, and feed and water troughs. It is constructed to permit ventilation from all sides. Usually, the sides, top and floor are constructed of heavily galvanised iron. The front, back and depth are on average 45cm, 57.5cm, and 45cm respectively, while the sloping floor extends forward and folds gently to form the cradle from which the eggs are collected.

The cage unit compartments are arranged in rows which share side walls, and the rows are arranged in tiers. Starting from a height of about 0.3-0.6m and reaching a height of about 1.8m, the tiers vary from three to six in number. Two rows in the same tier face opposite directions, and the respective cage compartments are back-to-back but not necessarily in contact. Running in front of each row of compartments are trough feeders and, in most cases, water troughs. The main body work of the cages is mostly of iron including the legs and feed troughs, while the water trough is of aluminium to prevent rust. In some cases the feed troughs are made of wood to avoid rusting.

The front widths of individual compartments determines the number of birds they can accommodate. Widths range from 22.5-25cm are for one bird, 30-38cm are for two birds and 42.5- 45cm are for three birds. The front lengths are controlled by the provision of enough feeding and drinking spaces for the birds.

C6.2. Poultry Equipment and Appliances

Poultry houses cannot function satisfactorily unless they are properly equipped and supplied with appliances. These are the basic requirements for the successful management of fowls. Poultry equipment and appliances vary from simple to the complex and from the most elementary makes to the most advanced electronic devices. The temptation is usually to go in for the complicated item, but it is worth realising that if an aluminium cup can be used satisfactorily for a purpose, it is wasteful to buy the gold cup.

Poultry appliances can be broadly grouped into those of general and those of specific application. The latter are used at all post-natal stages of growth. These consist mainly of feeders, drinkers and crates. The appliances used at specific stages of growth include brooders for chick-brooding and nests for layers.

In general, some of the equipment and appliances (Figure 6.5) are as follows:

Table 6-4: Poultry equipment and appliances

Feeders	Trough, tube and hanging feeders made from wood or metal
Drinkers	Water drinkers or fountains made from galvanised iron, aluminium or plastic. Usually conical or partly cylindrical with varying capacities of 2 to 8 litres.
Nests	These are compartments in which eggs are laid.
Crates	These are perforated or well-ventilated boxes for the transfer of adult fowls, made from light wood or plastic framework. They can be used to convey 15 to 25 birds at a time, depending on their age and size.

Other than providing the housing and other facilities for the poultry, it is necessary to supply the initial 1000 to 2000 birds (chicks, turkey and guinea fowl) to start the poultry project intervention and be responsible for the supply and provision of feeds, drugs and vaccines throughout the period of growth before laying of eggs (if applicable) and final disposal of the birds.

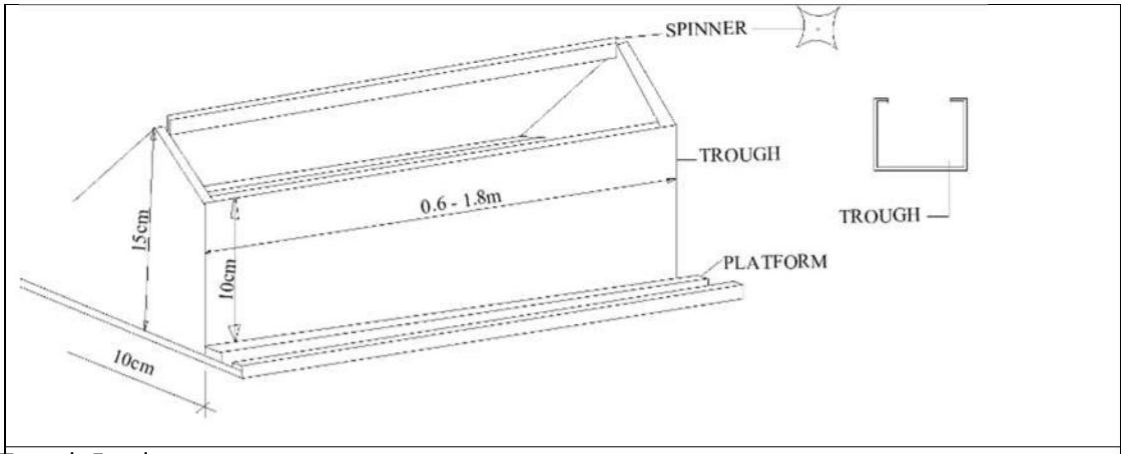
The other aspect of poultry that may be of benefit is the introduction of hatchery machines. In which case beneficiaries should be encouraged to raise broiler breeders for a total period of about 24 weeks, after which the breeders produce eggs that are kept inside hatchery and setter machines that acts as incubators for 21 days to produce day old broilers which are then sold out as profit. The broiler breeders after full laying of eggs are also sold out as profit.

The environment to which the fowl is exposed is determined partly by the system of management and this includes the design of housing used for the birds. Indeed, the birds are unlikely to perform satisfactorily if the housing is poor. Two important components of the environmental conditions influencing the construction of houses are temperature and humidity.

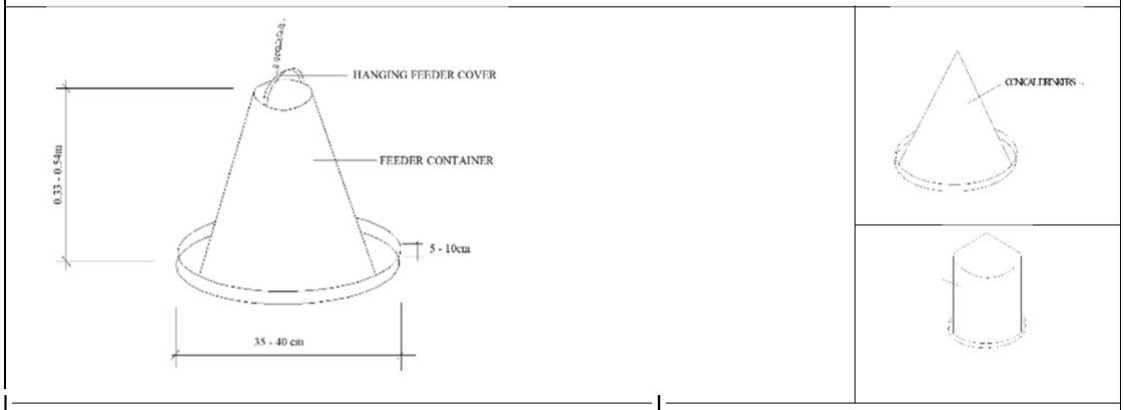
C6.1. Operation and Maintenance

Achieving good bird, barn and gut health requires operational excellence and attention to detail. A combination of quality nutrition, veterinary guidance, and increased consideration of barn and bird management will help to ensure birds have the best possible chance to perform at their maximum potential.

The acronym “FLAWS” has commonly served as a reminder to check feed, light, litter, air, water, (bio)security, sanitation, space and staff. FLAWS actually serves as a detailed approach to best management practices, not only during brooding but throughout the life of the flock.

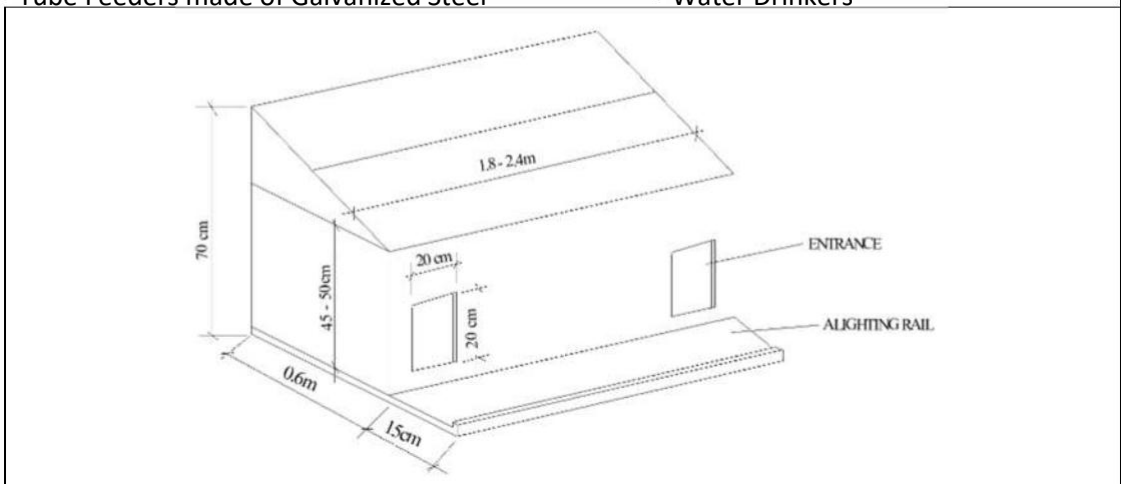


Trough Feeder



Tube Feeders made of Galvanized Steel

Water Drinkers



Laying Nests

Figure 6-5: Components of Poultry equipment and appliances

Some critical focus areas are as follows:

1. **Biosecurity**
    - Well-defined biosecurity practices throughout broiler production (pre-, during and post-placement) are crucial to successful poultry production.
    - Effective biosecurity can aid hygiene, vermin and insect control on-farm and help to limit disease transmission within and between barns.

2. **Downtime Between Flocks**
    - Adequate downtime of at least 14 days with appropriate cleaning and disinfection measures between flock placements helps to reduce transmission of disease between flocks and allows time to prepare for the next flock.
3. **Pre-placement Preparation**
    - Pre-placement preparation is needed before the new flock arrives to help prevent losses during brooding and the rest of grow out.
    - Checkpoints to keep in mind: heaters, floor temperature, temperature and relative humidity probes, ventilation, drinkers, feeders, etc.
4. **Coccidiosis Prevention**
    - Coccidiosis is a disease caused by a microscopic intestinal parasite. This parasite can have an impact on intestinal integrity and may predispose birds to other intestinal problems. Maintaining intestinal integrity during this time through innovative technologies is critical in allowing birds to perform to their maximum levels despite gut health challenges.
5. **Brooding Management**
    - With today's improved genetic capabilities and the fast growth of birds, more time is being spent during the critical brooding phase. As a result, ensuring a good start in poultry production can have a significant impact on the future health and performance of the birds.
    - The brooding period is an important time for intestinal growth and the development of a balanced microflora.
6. **Litter Management**
    - The litter in a poultry house acts as bedding for the birds. In addition to standing and resting on the bedding, birds will naturally peck at the litter. Litter condition and quality have an impact on broiler intestinal health and profitability, starting from when the chicks are placed all the way through production.
    - Wet litter presents a vicious cycle for intestinal health. Without proper management, even in patches, wet litter can serve as a breeding ground for potential pathogens and may be a starting point for intestinal stress that develops and leads to disease. As wet litter problems increase, ammonia levels in the barn rise, which can be potentially detrimental to bird health. It is much easier to prevent and manage litter moisture conditions before they start.
    - Some factors to consider which may help prevent the development of wet litter: type of material, quality of litter, litter depth, water quality, drinker line management, lighting management, ventilation and temperature.
    - Litter that is too dry and dusty can be one of many indications that the birds may not be drinking enough. Too much dusty material may lead to respiratory problems.
7. **Water Management**
    - Drinking water accounts for 70–80 percent of the bird's daily drinking needs. Poultry will generally consume more water than feed. As a result, water is the most critical nutrient for poultry. An abundance of clean water will reduce challenges and maximize performance.
    - Factors to consider when thinking about water management include:
        - Quality, height, pressure, mineral content and accessibility
        - Cleanliness of drinker lines/regulators prior to flock placement and during production
        - Flushing water lines between flocks and during production
        - Elimination of biofilms and mineral build-up
        - Drinker equipment maintenance
8. **Feed Management**
    - Birds must have easy access to feed. Proper feeder line height corresponding to the height of the birds helps to reduce feed wastage and mixing feed with litter, and it ensures that all birds have access to feed. Adequate feed access is also achieved by following the feed line

manufacturer's recommendations for the number of birds per feed pan or line of trough feeder.

- Birds will naturally peck at litter but avoiding "out-of-feed" events helps to reduce the potential for birds to peck excessively at the litter. Simple measures like activating trigger feed pans and monitoring feed bin levels during barn checks can help to prevent such events.
- Good feed quality that avoids contaminants like mycotoxins is important to ensure performance.

9. **Stocking Density**
    - A higher stocking density of poultry in addition to crowded housing conditions has been shown to have a negative impact on performance, causing stress to both the birds and intestinal microbiota.
    - Lowering stocking density throughout the overall production of the birds may help to reduce challenges.
10. **Environmental Management**
    - General environmental management of the barn includes many components, such as temperature, relative humidity, ventilation and lighting.
    - Understanding that these components work both separately and together can help to guide your management practices.
11. **Monitoring During Times of Transition**
    - Increasing the frequency at which barns are walked and examining the activity of the flock can help with early disease detection.
    - Daily monitoring of temperature, humidity and ventilation inside the barn as well as outside temperature is recommended.
    - Monitoring transition times can help with understanding what is happening in the barn (e.g., from day to night, when birds are placed, during half-house brooding, feed changes, etc.).
    - Monitoring feed and water consumption helps to monitor the flocks' progress.
12. **Keeping an Eye on Equipment**
    - Walking the barns routinely will also help to ensure equipment remains in working order.
13. **Mortality Checks**
    - Cull diseased birds as early as possible.
14. **Flock Health Management**
    - Work with your veterinarian to design a program customized for your flock's health.
15. **Communication and Teamwork**
    - Ensuring strong communication and coordination between all those involved in helping your farm run smoothly will ensure a stronger and more successful gut health management program for your birds.

C6.2. Budget for Poultry

For this option the amount budgeted is N1,090,283,330.41 for the Poultry livelihood option to be established in the four communities. The details for the various components are shown in Table 6.5 below.

Table 6-5: Budget for Poultry and its associated activities

Sl.No	Description	Amount (Naira)
1	Building infrastructures	215,560,000
2	Equipment and accessories	199,680,000
3	Three years input	1,019,480,000
4	ABC and Borehole	219,914,661
5	Capacity building	6,400,000
6	Technical assistance	519,532,000
	Total	**2,180,566,661**

C3. Operation and Maintenance of ABC

C3.1. ABC Management

The ABC will be managed by the men and women folks by having a registered ABC Organisation separately for each location. The important features of the ABC Organisation are

- All the men and women folk between and including the age of 18 and 64 will be members of the ABC. As a nominal fee, they have to pay a minimum of Naira 500 per annum to receive the profit sharing from the management of ABC. Otherwise they will be treated as a non-voting general member of the ABC and each of non-voting member will receive one-fifth of a one share's profit. Whereas, the voting general member will receive profit share depending on the share they purchased that year. The value of each share is N 500.
- The ABC members will also have voting share based on the annual contribution they make towards operation and maintenance of ABCs. Maximum annual contribution is restricted to N 10,000 per annum per member. One vote for each N 500 contribution.
- General voting members can elect the Management Committee (MC) each year. The MC will consist of a Chairperson, 4 Deputy Chairpersons (one for each activity – rice mill, oil mill, Juice making and poultry), a Secretary, a treasurer and 12 MC members (three for each activity – each member will look after operation, maintenance and marketing individually).
- The roles and responsibilities or the ABC management will be decided during the next stage, after discussing with the communities.

C3.2. Capacity building

The success of any agri-business depends mainly on its holistic approach, which involves provision of support services, market facilities, linkages to credit and market through networking and comprehensive training. The active members will receive training in the following areas

- ABC management
- Operation and maintenance of all machineries
- Marketing
- Input management
- Financial management

C3.3. O&M of Mills

The project will provide initial O&M costs for the machineries for the first three years. However, the ABC management costs will be borne by the members. From fourth year onwards, the O&M costs will be collected from the members. The brief O&M manual will be prepared as part of the detailed design (next stage). Thee major operation and maintenance costs related to running of machineries are

- electricity / diesel,
- regular running costs such as lubricants and cleaning
- Spare parts
- Machine operator cost
- Costs associated with purchasing of inputs and selling of processed product

The general precautions required, while operating the mills, are

a) ALWAYS learn the machines' applications, limitations and the specific potential hazards peculiar to it. Read and become familiar with the entire operating manual.
b) ALWAYS use a face or dust mask if operation is particularly dusty.
c) ALWAYS check for damage. Before using the machine, any damaged part, should be checked to ensure that it will operate properly, and perform its intended function. Check for alignment of moving parts, breakage of parts, mountings, and any other condition that may affect the machines' operation. Any damage should be properly repaired or the part replaced. If in doubt, DO NOT use the machine. Consult your local dealer.
d) ALWAYS disconnect the tool/machine from the power supply before servicing and when changing accessories.
e) ALWAYS wear safety goggles, manufactured to the latest European Safety Standards. Everyday eyeglasses do not have impact resistant lenses, they are not safety glasses.
f) ALWAYS keep work area clean. Cluttered areas and benches invite accidents.
g) ALWAYS ensure that adequate lighting is available. A minimum intensity of 300 lux should be provided. Ensure that lighting is placed so that you will not be working in your own shadow.
h) ALWAYS keep children away. All visitors should be kept a safe distance from the work area, especially whilst operating the machine.
i) ALWAYS maintain machine in top condition. Keep tools/machines clean for the best and safest performance. Follow maintenance instructions.
j) ALWAYS handle with extreme care do not carry the tool/machine by its' electric cable, or yank the cable to disconnect it from the power supply.
k) ALWAYS ensure the switch is off before plugging in to mains. Avoid accidental starting.
l) ALWAYS concentrate on the job in hand, no matter how trivial it may seem. Be aware that accidents are caused by carelessness due to familiarity.
m) ALWAYS keep your proper footing and balance at all times, don't overreach. For best footing, wear rubber soled footwear. Keep floor clear of oil, scrap wood, etc
n) ALWAYS wear proper apparel. Loose clothing or jewellery may get caught in moving parts. Wear protective hair covering to contain long hair.
o) ALWAYS use recommended accessories, the use of improper accessories could be hazardous.
p) ALWAYS remove plug from electrical outlet when adjusting, changing parts, or working on the machine.
q) NEVER operate machine while under the influence of drugs, alcohol or any medication.
r) NEVER leave machine running unattended. Turn power off. Do not leave the machine until it comes to a complete stop.
s) NEVER force the machine, it will do a better and safer job at the rate for which it was designed.

t) NEVER use power tools in damp or wet locations or expose them to rain. Keep your work area well illuminated.
u) DO NOT use in explosive atmosphere (around paint, flammable liquids etc.). Avoid dangerous environment.
v) ALWAYS ensure safety guards etc., are in place and working correctly, if not DO NOT use the machine until rectified.
w) DO NOT use the machine if the electric cable, plug or motor is in poor condition.
x) DO NOT allow the ventilation slots in the machine to become blocked.
y) NEVER change from high to low speed and vice versa whilst the machine is still running, always ensure the machine has come to a complete stop before doing so.
z) NEVER change from forward to reverse and vice versa whilst the machine is still running, always ensure the machine has come to a full stop before doing so.

If machine is fitted with a plug which is moulded on to the electric cable (i.e. non-rewireable) please note:

a) The plug must be thrown away if it is cut from the electric cable. There is a danger of electric shock if it is subsequently inserted into a socket outlet.
b) Never use the plug without the fuse cover fitted. Fuse Rating The fuse in the plug must be replaced with one of the same rating (5 amps) and this replacement must be approved to BS1362. If in doubt, consult a qualified electrician. Do not attempt any electrical repairs yourself.
c) Cable Extension Always use an approved cable extension suitable for the power rating of this tool (see specifications), the conductor size should also be at least the same size as that on the machine, or larger. When using a cable reel, always unwind the cable completely.
d) Should you wish to replace a detachable fuse carrier, ensure that the correct replacement is used (as indicated by marking or colour code).
e) Replacement fuse covers can be obtained from your local dealer or most electrical stockists.