Medium and Small Hydropower Resources in Some States of Nigeria

Site Visit Report

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Responsibility Page

Project Title: SHP Resources in Nigeria

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I. Purpose of Site Visit

The increasing shortage of electric power supply in Nigeria has seriously affected the economic development of the local community and the people's life. For vast number of cities, towns and villages in particular, there is basically no stable power supply. Therefore, making full use of local hydropower resources and developing and constructing a number of medium- and small-sized hydropower projects with moderate investment, short construction period and green and clean power supply is a feasible and practicable solution at present.

In order to make a general survey on the local hydropower resources and screen out hydropower projects with development value, at the request of the United Nations Industrial Development Organization (UNIDO), and with the close cooperation of relevant local government agencies, POWERCHINA Kunming Engineering Corporation Limited (KEC) organized the engineers of geology, water conservancy and electric power disciplines to come to five states including Gombe, Ondo, Ekiti, Plateau and Taraba states in Nigeria from February 19, 2024 to March 17, 2024, made a one-month site visit, focusing on the recommended reservoirs and river reaches as proposed by UNIDO and local government agencies.

Figure 1-1 Electric Power Supply in Nigeria

Based on the site visit to each recommended river reach, the comprehensive analysis

of technical conditions, construction conditions, economic benefits and other aspects of hydropower development, the feasibility for construction of hydropower project is preliminarily assessed and suggestions for follow-up work are put forward. The Site Visit Report is prepared and submitted to UNIDO for their references, so as to promote the implementation of the next step.

II. List of Projects under Site Visit

- **Gombe State**
- Balanga Dam Hydropower Project (installed capacity of 320kW) and associated solar power project (installed capacity of 700kW)
- **Ondo State**
- Owena Dam Hydropower Project (planned installed capacity of 1,000kW)
- **Ekiti State**
- Aisegba Dam Hydropower Project (not suitable for construction)
- Itapaji Dam Hydropower Project (planned installed capacity of 160kW)
- **Plateau State**
- Asop Falls Hydropower Project (planned installed capacity of 5,000kW)
- Kerang Hydropower Project (not suitable for construction)
- Shemarkar Hydropower Project (planned installed capacity of 21,000kW)
- **Taraba State**
- Mayo Selbe 1# Hydropower Project (planned installed capacity of 54,000kW)
- Mayo Selbe 2# Hydropower Project (planned installed capacity of 36,000kW)
- Mayo Selbe 3# Hydropower Project (planned installed capacity of 5,000kW)
- Donga Hydropower Project (not suitable for construction)

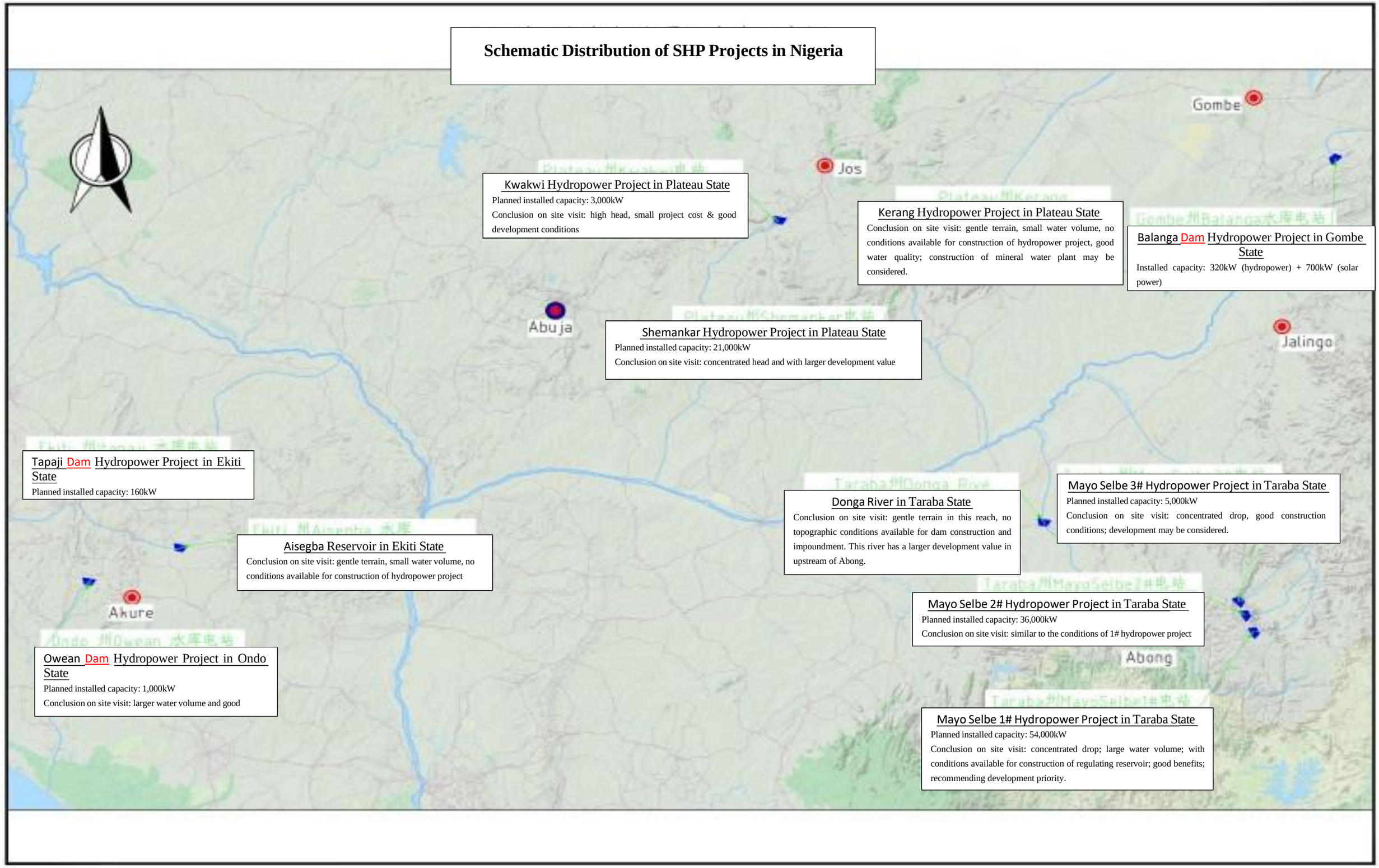

Figure 2-1 Schematic Distribution of Projects under KEC Site Visit

III. Gombe State

(I) Balanga Hydropower Project and Associated Solar PV Power Project

Date of site visit: February 23, 2024

Site visit agency: UNIDO, State Water Authority and Water Pipe Station and KEC

Figure 3-1 Site Visit Staff of Balanga Reservoir

1. Briefs of the Project

The Project is located in the southeast of Gombe State, about 100km away from Gombe State. The preliminary survey and design work has been completed for the proposed hydropower project of Balanga Reservoir, and *Detailed Feasibility Study Report of Balanga Dam Small Hydropower (SHP) Project* has been submitted, with an installed capacity of 320kW.

In view of the fact that the installed capacity of the hydropower project fails to meet the local power supply demand, at the request of the local water authority and with the consent of UNIDO, it is planned to add 700kW solar power project on the left bank downstream of Balanga Hydropower Project.

Figure 3-2 Balanga Reservoir

Figure 3-3 Water Transmission Gate of Balanga Reservoir

Figure 3-4 Location of Proposed Hydropower Project of Balanga Reservoir

Figure 3-5 Water Transmission Channel of Balanga Reservoir

Figure 3-6 Location of Proposed Solar Power Project on Balanga Reservoir (Recommended Scheme - Left Bank)

Figure 3-7 Location of Proposed Solar Power Project on Balanga Reservoir (Alternative Scheme - Right Bank)

Figure 3-8 Site Visit to the Dam of Balanga Reservoir

Figure 3-9 Site Visit to Pipeline of Balanga Reservoir

2. Assessment Comments

After site review by KEC experts, the originally designed 320kW small hydropower project is in line with the actual situation, and it is recommended to follow the original design scheme. The current water transmission pipeline has such problems as water leakage and foundation scouring, so it is recommended to carry out reinforcement at the construction stage of the hydropower project.

At slope toe on the left bank downstream of the dam, the terrain is open and gentle, with good site construction conditions, which can meet the requirements of adding 700kW solar power project. It is recommended that the solar power project and small hydropower project be connected to the grid for unified power supply.

3. Work Program for Next Step

1) Complete the environmental and social assessment impact report (ESIA, including the site of hydropower project and associated solar power project).
2) Complete signing of supplementary agreement with KEC for the survey and design of the associated 700kW solar power project and carry out the supplementary work for the feasibility study accordingly (the estimated survey and design period is one month).
3) Compile and complete the feasibility study report (hydropower project + associated solar power project) and the corresponding approvals.
4) Sign the agreement with the electric power authority on grid connection and power supply.
5) Confirm project construction funds and complete the permanent and temporary land acquisition for the project.
6) Negotiate and sign the EPC contract, establish the project management team, and commence construction.
7) In view of the short construction period for the associated solar power project, the 320kW small hydropower project can be constructed first, and then the 700kW

solar power project can be constructed during the process, both of which can achieve power generation at the same time.

IV. Ondo State

(I) Owena Hydropower Project

1. Briefs of the Project

The Project is located in Ondo State, about 35km west of Akure City. Owen Reservoir is the one built, which consists of embankment dam, spillway and water conveyance culvert pipes below the dam. The reservoir has a large storage capacity. As the downstream irrigation and water supply pipe network has not been completed, the current reservoir fails to impound water. The upstream water inflow of the reservoir is fully discharged to the downstream river channel through the culvert pipes of the reservoir. The visual discharge is 2-3m^3/s.

For the reservoir, one water conveyance culvert pipe is built below the dam, which can be considered as penstock of the proposed hydropower project, with water conveyance gate at inlet, and control valve and valve chamber at outlet.

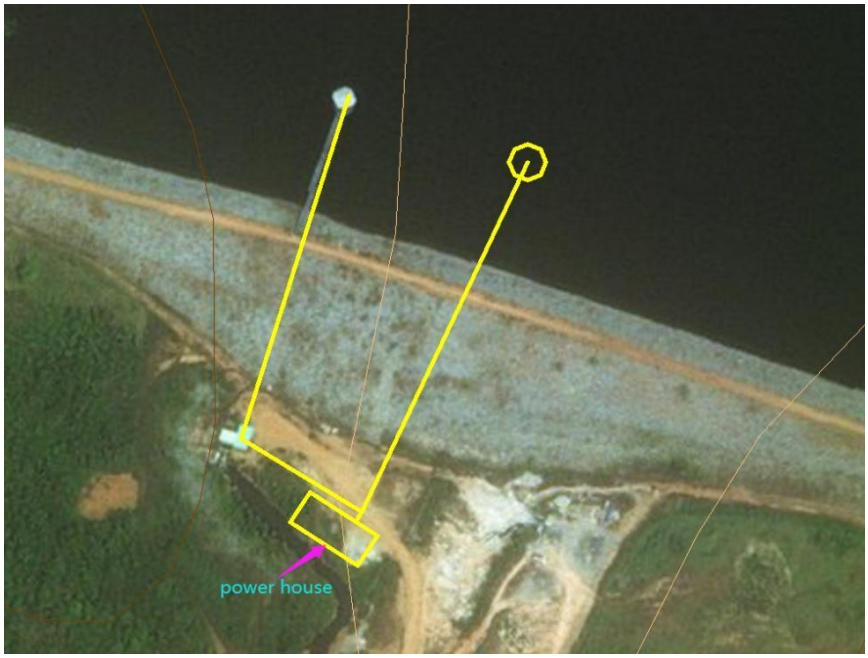

Figure 4-2 Schematic Construction Proposal of Proposed Hydropower Project of Owen Reservoir

Figure 4-3 Owena Reservoir

Figure 4-4 Upstream Dam Slope of Owena Reservoir

Figure 4-5 Water Transmission Gate of Owena Reservoir

Figure 4-6 Access Bridge of Water Transmission Gate of Owena Reservoir

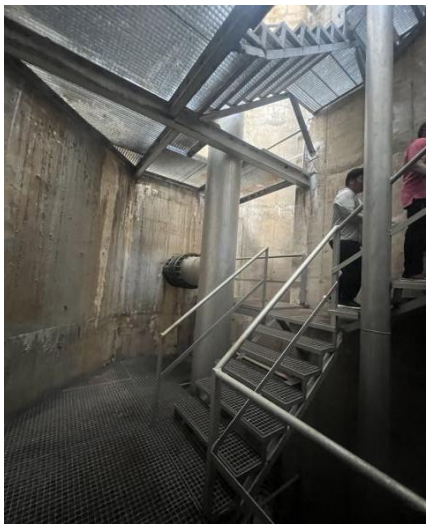

Figure 4-7 Inside the Water Transmission Gate of Owena Reservoir

Figure 4-8 Water Release through Culvert Pipe in Owena Reservoir

Figure 4-9 Downstream River Channel of Owena Reservoir

Figure 4-10 Proposed Powerhouse of Owena Reservoir

Figure 4-11 Spillway of Owena Reservoir

Figure 4-12 Water Transmission Valve Chamber of Owena Reservoir (Culvert Pipe Outlet)

Figure 4-13 Water Transmission Gate of Owen Reservoir

Figure 4-14 Valve Chamber at Outlet of Owena Reservoir

2. Assessment Comments

The reservoir has large regulating capacity, sufficient upstream inflow, and it is preliminarily estimated that a small hydropower project with an installed capacity of 1,000kW can be built. The hydropower resources and construction conditions are good, so it is recommended to develop it ASAP.

In addition, the original function of the reservoir is to supply water for towns and cities and for agricultural irrigation, thus limiting the installed capacity of the hydropower project. Considering that neither water supply nor irrigation has been achieved, it is necessary to communicate and coordinate with the water supply and irrigation authorities at the preliminary design of the hydropower project to maximize the power generation benefits while retaining the functions of water supply and irrigation as far as possible.

3. Work Program for the Next Step

1) Organize survey and design work at the feasibility study ASAP; KEC will work out the list of data collection, based on which the local water authority will timely collect and provide relevant basic data.

V. Ekiti State

(I) Aisegba Hydropower Project

Date of site visit: February 29, 2024

Site visit agency: UNIDO, Benin Owena River Basin Development Authority and KEC

1. Briefs of the Project

The Project is located about 35km away from the eastern suburb of Ekiti State. Aisegba Reservoir is the one built, which consists of embankment dam, spillway and water conveyance culvert pipe below the dam. The reservoir capacity is small. The current reservoir impoundment is below the full supply level (FSL), and there is no unused water in the downstream.

Figure 5-1.1 Aisegba Reservoir Area

Figure 5-1.2 Dam Height of Aisegba Reservoir

Figure 5-1.3 Site Visit to Aisegba Reservoir

2. Assessment Comments

As the reservoir is small in size, the catchment area is only 12m^2 and the runoff is low. It is estimated that it may be difficult to maintain the reservoir volume in low-flow years. In addition, the current dam height is about 10m, and the available head is only 5-8m. In light of this, it is estimated that the installed capacity of hydropower that can be developed is below 30kW. Due to low energy output and guarantee rate, it is not suitable to develop hydropower project.

(II) Itapaji Hydropower Project

Date of site visit: February 29, 2024

Site visit agency: UNIDO, Benin Owena River Basin Development Authority and KEC

Figure 5-2.1 Powerhouse of Itapaji Hydropower Project Built

1. Briefs of the Project

The Project is located about 35km north of Ekiti State. The current project consists of dam of Itapaji Reservoir (including flood release/overflow dam and stilling basin), lifting PS, penstock, powerhouse, etc. The penstock and powerhouse were originally planned to be incorporated into the construction works of the hydropower project, but the subsequent installation of the turbine generator (T/G) units and transmission lines (TLs) were not completed, which has been suspended for many years.

The operation of the reservoir shows that the reservoir has a large water inflow, with more water being unused, and the pump station (PS) is operating normally, but the equipment is aging seriously and needs to be repaired and replaced. In addition, the right bank of the dam has been built with one water plant (waterworks), but the internal equipment and associated water pipelines have not been completed and have been suspended for many years.

Figure 5-2.2 Itapaji Reservoir

Figure 5-2.3 Spillway of Itapaji Reservoir

Figure 5-2.4 PS of Itapaji Reservoir (Urban Water Supply)

Figure 5-2.5 Penstock of the Proposed Hydropower Project of Itapaji Reservoir

Figure 5-2.6 Proposed Powerhouse of Itapaji Reservoir

Figure 5-2.7 Inside the Powerhouse of the Proposed Hydropower Project of Itapaji Reservoir

Figure 5-2.8 Bifurcated Penstock of Itapaji Reservoir

Figure 5-2.9 Site Visit to Itapaji Reservoir

2. Assessment Comments

The water inflow and head of the reservoir are limited, and the corresponding installed capacity is small. It is estimated that a mini hydropower project with an installed capacity of 160kW can be built.

The main problems in the construction of the Hydropower Project are as follows: 1) The flow capacity at inlet of the penstock built is limited and is at risk of clogging; 2) The size of the powerhouse built is too small to meet the requirements for installation and operation of E&M equipment, and it may be necessary to reconstruct a larger powerhouse; 3) The subsequent turbine generator (T/G) units, transformers, outgoing line towers, and transmission lines (TLs) have not yet been constructed.

Therefore, if we consider to reconstruct penstock and powerhouse, the overall project cost may be higher together with the procurement and installation of E&M equipment. Corresponding to the installed capacity of the Hydropower Project, the Project is feasible, but the estimated economic indicators are poor.

The project is small in size. If it is determined to move forward, it is recommended to carry out all items of continued construction work on a simplified basis.

3. Work Program for the Next Step

1) The first step is to organize the design work. In general, the design of mini hydropower project does not need to be carried out by stage, nor does it need to be investigated in the usual sense; it can prepare *Implementation Scheme Description* (attached with layout map and calculations of cost estimates) on the basis of the necessary surveys at given points and in a one-step process.

2) Carry out funds raising and approval procedures for continued construction based on design outcomes.
3) Organize implementation of construction projects.
4) If funds are enough, it is recommended to complete the subsequent construction of the water supply, including the overhaul of the pump station (PS), the installation of water plant (waterworks) facilities and the laying of the water pipe network.

VI. Plateau State

(I) Asop Falls Hydropower Project

Date of site visit: March 8, 2024

Site visit agency: State Water Authority, village heads and KEC

Figure 6-1.1 Site Visit Staff of Kwakwi Hydropower Project

1. Briefs of the Project

The Project is located about 50km to the southwest of Jos City, Plateau State, with A3 road passing by and convenient traffic. The drop of the river reach under site visit is concentrated. Nearly 250m head can be obtained for a river length of nearly 4km. The river channel still has a certain discharge in low-flow season, about 0.5-0.8m^3/s by visual inspection. Due to the curved river reach, the waterway is short, with a length of about 4.5km.

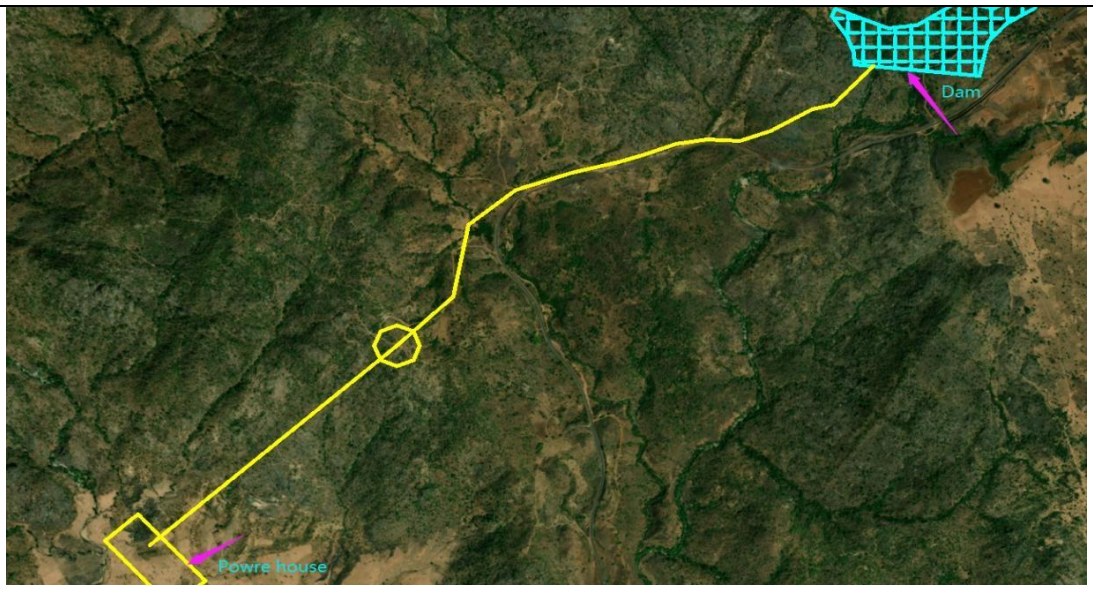

Figure 6-1.2 Schematic Diagram of Layout Scheme of Kwakwi Hydropower Project

Figure 6-1.3 Current Water Volume of River Channel of Asop Falls Hydropower Project

Figure 6-1.4 Water Volume in Upstream of River Channel of Asop Falls Hydropower Project (Tributary on Left Bank)

Figure 6-1.5 Proposed Dam Site of Asop Falls Hydropower Project

Figure 6-1.6 Site Visit to Dam Site of Asop Falls Hydropower Project 1

Figure 6-1.7 Site Visit to Dam Site of Asop Falls Hydropower Project 2

Figure 6-1.8 Proposed Powerhouse Site of Asop Falls Hydropower Project

Figure 6-1.9 Site Visit at Powerohouse Site of Asop Falls Hydropower Project 1

Figure 6-1.10 Site Visit at Powerohouse Site of Asop Falls Hydropower Project 2

2. Assessment Comments

The drop (head) of this reach is concentrated, the waterway is short, and there is a certain discharge in low-flow season. The hydrodynamic energy resource conditions are good. Furthermore, the existing roads and open site are available for the Project and construction conditions are good. In addition, the Project is adjacent to Jos city and other main power supply areas, which is convenient for power transmission and consumption.

It is preliminarily estimated that one small hydropower project with an installed capacity of about 5,000-8,000 kW can be built. The Project is feasible and economic efficiency is anticipated to be superior, so it is recommended to develop and construct ASAP.

3. Work Program for the Next Step

1) Constraints on the development of this reach should be identified, including the Government's requirements for water utilization, water supply, environmental protection, land acquisition and the electric power sales and consumption, and whether there are any constraints on the construction of the hydropower project.
2) Introduce developer on this basis, sign the MOU on development of the river, and obtain the development permit for hydropower project on the river reach and power supply right for the planned power supply scope.
3) The developer raises the preliminary work cost, organizes the survey and design work at the feasibility study stage, carries out necessary surveying and mapping, exploration and tests, determines the energy economic index, design scheme and cost estimate on this basis, organizes the preparation of ESIA report according to the design scheme, and submit it to the relevant agencies for approval together with the feasibility study report.
4) Carry out project investment and financing according to the feasibility study results, and sign power grid connection and power purchase agreement (PPA) with the electric power authority.
5) Organize construction bidding and tendering for EPC (including construction detail design, equipment procurement, civil works and installation, commissioning and trial operation).
6) Carry out construction operations and arrange for the mobilization of Operation Unit (Operator) to participate in the commissioning and trial operation of the equipment in the later construction period.
7) Project acceptance, completion and putting into operation.

(II) The Kerang River

Date of site visit: March 9, 2024

Site visit agency: State Water Authority, local leaders and KEC

Figure 6-2.1 Site Visit Staff of the Kerang River

1. Briefs of the Project

The Project is located about 5km west of Kerang Town, Plateau State. There is spring water on the right bank of the river reach under site visit. The water is clear and the discharge is about 0.1-0.2m^3/s. According to query, the catchment area of this reach is 64km^2, but there is no water inflow to the main river channel in the low-flow season. The terrains upstream and downstream of the river reach are gentle, and no topographic conditions are available for dam construction and impoundment. There are many cultivated lands on both banks of the river channel, and the water consumption is large. It is difficult to build hydropower project in this reach.

Figure 6-2.2 Water Outlet Point on Right Bank of the Kerang River

Figure 6-2.3 River Channel Downstream of the Kerang River

2. Conclusions and Recommendations

The terrain of this reach is gentle, the water volume is too small and zero flow basically occur in low-flow seasons, so there are no conditions available for constructing a dam for impoundment, and there is no development value.

(III) Shemarkar Hydropower Project

Date of site visit: March 09, 2024

Site visit agency: State Water Authority, local leaders and KEC

Figure 6-3.1 Site Visit Staff of Shemarkar Hydropower Project

1. Briefs of the Project

The Project is located on Shemarkar River reach about 25km southeast of Kerang Town in Plateau State.

Since the local government needs to build a hydropower project in Kerang Town and supply power, and the recommended place for site visit on the Kerang River does not have the conditions available for constructing a hydropower project, considering that the nearby Shemarkar River, about 25km away, has good hydroenergy resources, and KEC completed *Project Proposal Report* hereof in 2022, KEC recommended the Project and introduce local personnel to brief it.

The Project is to use R. Randa River, a tributary of the Shemarkar River and R. Matase River, the other tributary, to carry out hydropower development and construction after water diversion. The available drop is more than 250m, the catchment area of the Randa River at the proposed dam site is 240km^2, and the catchment area of the R. Matase River at the proposed water diversion site is 160km^2. According to the design layout of KEC, the water is diverted from R. Matase River to the dam site of the R.Randa River. The length of the tributary diversion is about 7.5km. The total length of the waterway after confluence is about 3.0km, the installed capacity is 21,000kW, and the estimated total cost (investment) is about 30 million USD.

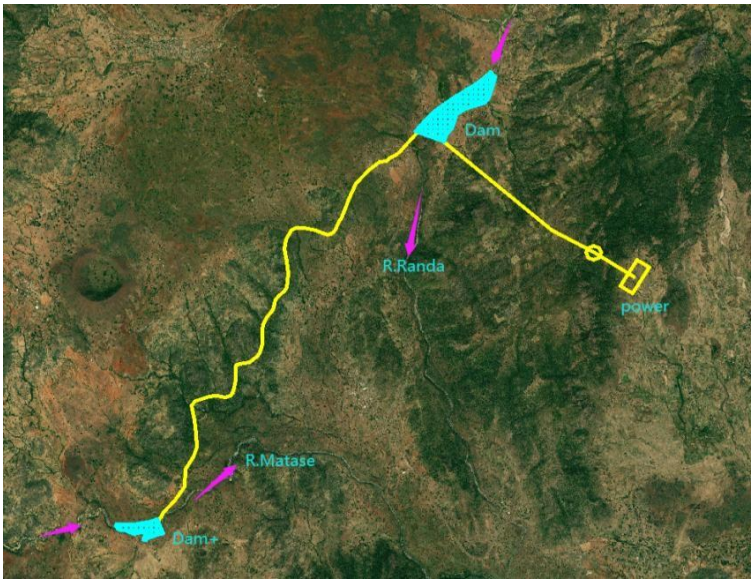

Figure 6-3.2 Schematic Layout Scheme of Shemarkar Hydropower Project

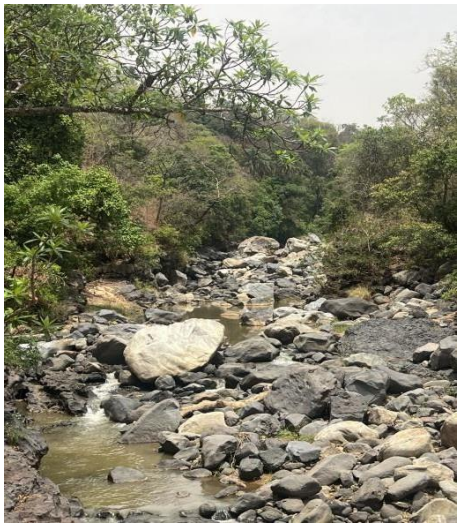

Figure 6-3.3 Current Water Volume of R. Randa Channel

Figure 6-3.4 Dam Site of R. Randa Channel

Figure 6-3.5 Current Water Volume of the R. Matase River

Figure 6-3.6 Dam Site of R. Matase River

Figure 6-3.7 Upstream of Shemarkar Hydropower Project

Figure 6-3.8 Site Visit to Shemarkar Hydropower Project

2. Assessment Comments

The Project has a large catchment area of river channel, a large installed capacity, a short waterway, convenient road traffic, and favorable conditions for comprehensive development.

3. Work Program for Next Step

At present, the follow-up feasibility study design of KEC has been suspended. It is suggested that the local relevant agencies negotiate as early as possible to continue carrying out the work.

VII. Taraba State

(I) Mayo Selbe 1# Hydropower Project

Date of site visit: March 11, 2024

Site visit agency: State Water Authority, local leaders and KEC

Figure 7-1.1 Site Visit Staff of Mayo Selbe 1# Hydropower Project

1. Briefs of the Project

The Project is located about 250km south of Jalingo City, Taraba State, and north of Mayo Selbe 2# Hydropower Project recommended by the local government. The distance between the two projects is only about 13km, belonging to the hydroenergy resource reserve area in the same geomorphic unit.

From the perspective of macro landform, the hydroenergy resource reserve area is composed of upper and lower platforms. The area between two platforms shows abrupt change state and the platform surface often forms intermittent huge cliffs and steep slopes. The elevation of the upper platform surface is about 1700m, while the elevation of the lower platform surface is about 500m, with a relative height difference of 1,200m. The upper platform has a vast catchment area, and the estimated catchment area in the area can reach more than 500km^2. Therefore, the region is rich in hydroenergy resources.

After further study by KEC, it is found that Mayo Selbe 1# Hydropower Project is located on the river reach where the available head is better, the discharge is larger,

and the development potential of the hydropower project is greater.

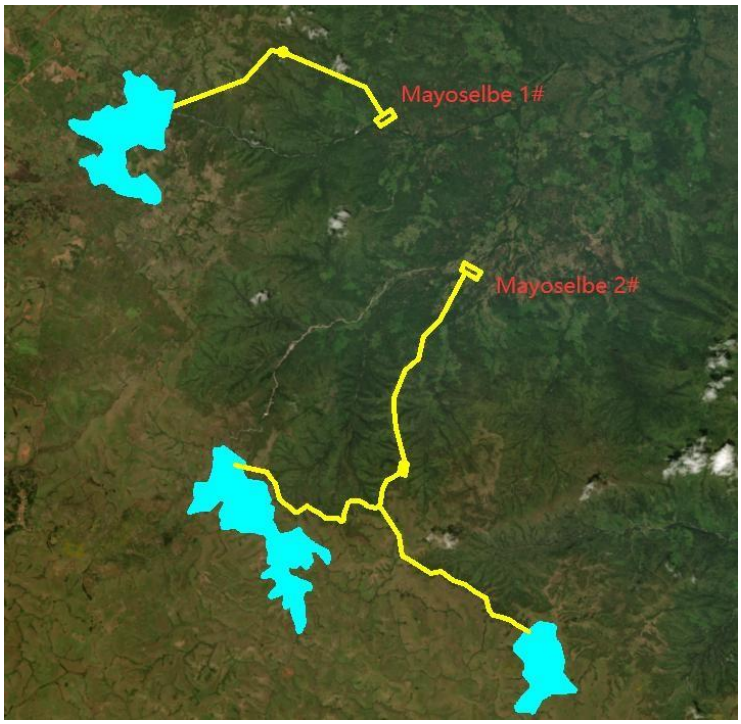

Figure 7-1.2 Schematic Layout Position of Mayo Selbe 1# and 2# Hydropower Projects

Mayo Selbe 1# Hydropower Project has an available head up to 1,000m, and 1m^3 water can generate 2kW.h of electric energy, with considerable benefits. The upstream catchment area of the river reach under site visit is 140km^2, and another river with a catchment area of 15km^2 can be can be fed for power generation. The upstream has the topographic conditions available for the construction of a regulating reservoir. The estimated regulating reservoir capacity can be above 10 million m^3 and the total length of the waterway from main river channel is about 11.5km. The construction conditions of the hydropower project are good.

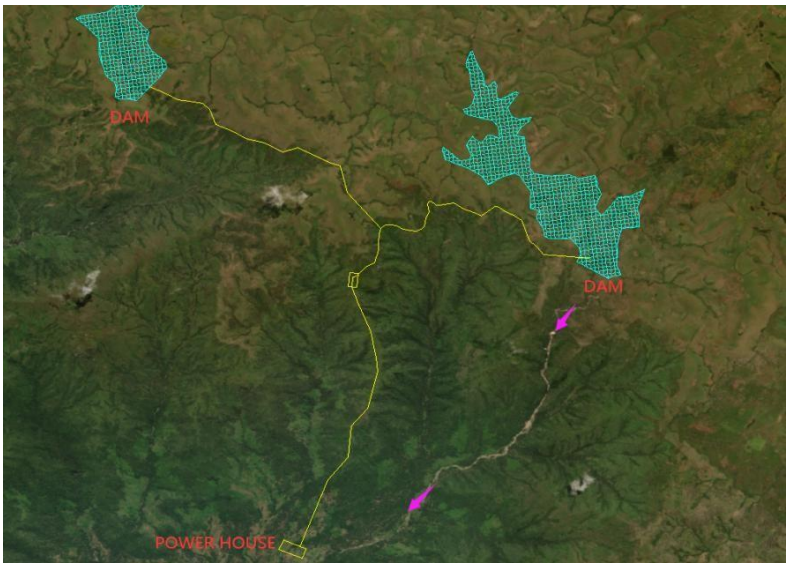

Figure 7-1.3 Schematic Development Scheme of Mayo Selbe 1# Hydropower Project

Figure 7-1.4 Water Inflow of Downstream River Channel of Mayo Selbe 1# Hydropower Project

Figure 7-1.5 Site Visit to Powerhouse Site of Mayo Selbe 1# Hydropower Project

Figure 7-1.6 Site Visit to Mayo Selbe 1# Hydropower Project

Figure 7-1.7 Site Visit to Mayo Selbe 1# Hydropower Project

2. Assessment Comments

The Hydropower Project has a concentrated drop, a short waterway, a large catchment area, and the topographic conditions available for the construction of a seasonal regulating reservoir. The initially proposed installed capacity is 54,000kW, with a good power supply guarantee rate and high economic benefits. It is a medium-sized hydropower project. The total cost (investment) is moderate (probably between 120 million USD to 150 million USD), and it is a high-quality river reach for development of hydropower project.

However, the Hydropower Project is far away from such central load area as Jalingo City, the state capital. If it is included in the recent development plan, it depends on if it can introduce investment and financing entities and if the power consumption in the adjacent areas can be determined.

3. Work Program for Next Step

1) First of all, the relevant local organization shall carry out the intention-based investment invitation/attraction activities and study the electric power consuming market.
2) The follow-up plan is the same as that of Asop Falls Hydropower Project in Plateau State.

(II) Mayo Selbe 2# Hydropower Project

Date of site visit: March 11, 2024

Site visit agency: State Water Authority, local leaders and KEC

Figure 7-2.1 Site Visit Staff of Mayo Selbe 2# Hydropower Project

1. Briefs of the Project

Mayo Selbe 2# Hydropower Project is the one recommended by the local government for development. The upstream catchment area is 120km^2 and the available head is 900m. The topographic conditions are available for the construction of a regulating reservoir with about 6 million m^3. In addition, it is featured by concentrated drop and abundant water volume and the initially proposed installed capacity is 36,000kW, belonging to a medium to small hydropower project. The total cost (investment) is expected to be controlled within 60 million USD to 70 million USD.

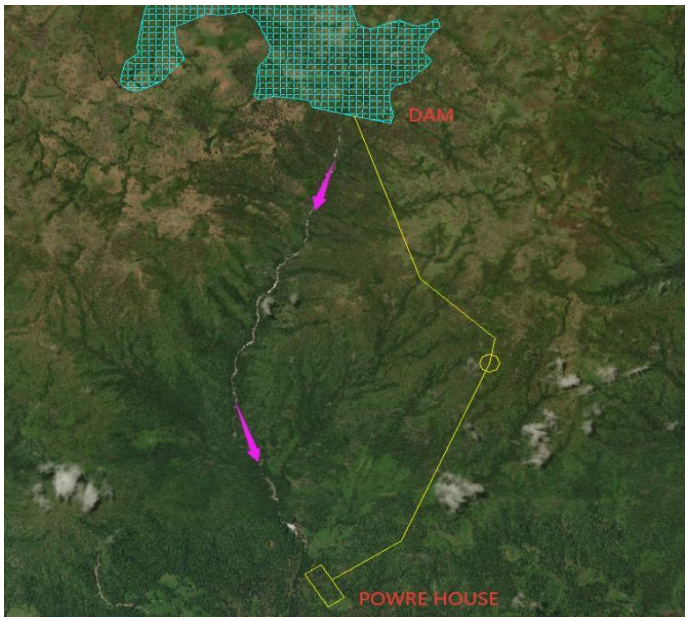

Figure 7-2.2 Schematic Layout Scheme of Mayo Selbe 2# Hydropower Project

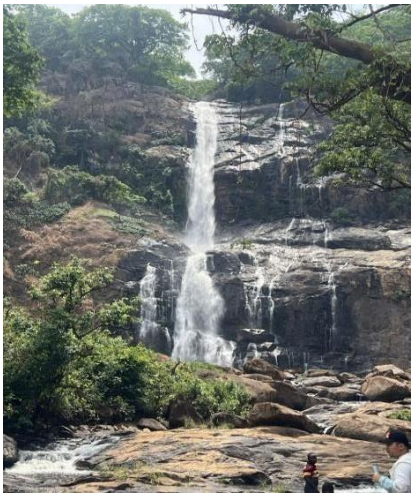

Figure 7-2.3 River Reach Drop of Mayo Selbe 2# Hydropower Project

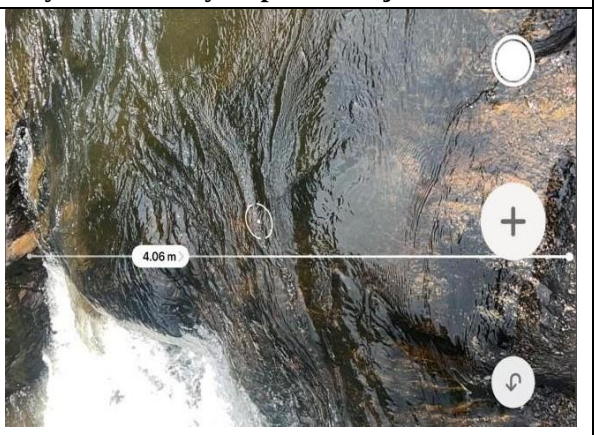

Figure 7-2.4 Current Water Volume of River Channel of Mayo Selbe 2# Hydropower Project

Figure 7-2.5 Site Visit to Mayo Selbe 2# Hydropower Project

Figure 7-2.6 Site Visit to Mayo Selbe 2# Hydropower Project

Figure 7-2.7 Site Visit to Mayo Selbe 2# Hydropower Project

Figure 7-2.8 Site Visit to Mayo Selbe 2# Hydropower Project

2. Assessment Comments

There are similar advantages to Mayo Selbe 1# Hydropower Project. The total cost is small, and the development conditions of hydropower project are very good.

Similar to Mayo Selbe 1# Hydropower Project, there are also the power consumption problems.

3. Work Program for Next Step

Same as that of Mayo Selbe 1# Hydropower Project above.

(III) Mayo Selbe 3# Hydropower Project

Date of site visit: March 11, 2024

Site visit agency: State Water Authority, local leaders and KEC

Figure 7-3.1 Site Visit Staff of Mayo Selbe 3# Hydropower Project (Some Personnel)

1. Briefs of the Project

The region is also rich in hydropower resources. According to KEC's query on Google and judgement on hydrometeorological conditions, the head of the river reach where the project is located is concentrated, and nearly 300m head can be obtained for a river length of nearly 3.5km. The topographic conditions available for the construction of the regulating reservoir are good, which can form a reservoir capacity of about 5 million m^3 or more. The waterway is short, with a total length of about 4km, and the estimated installed capacity is about 5,000kW.

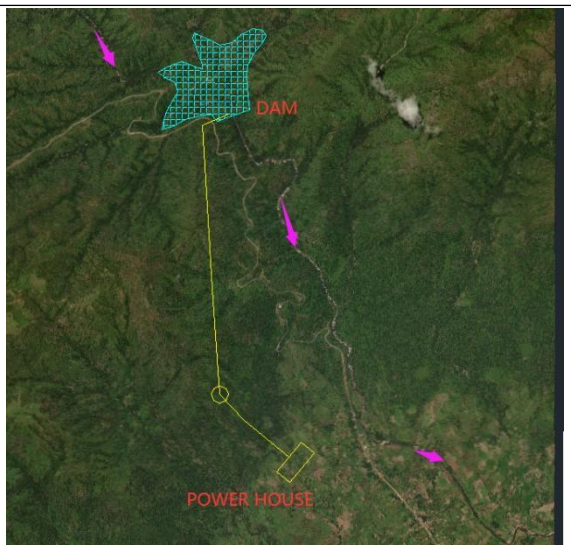

Figure 7-3.2 Schematic Layout Scheme of Mayo Selbe 3# Hydropower Project

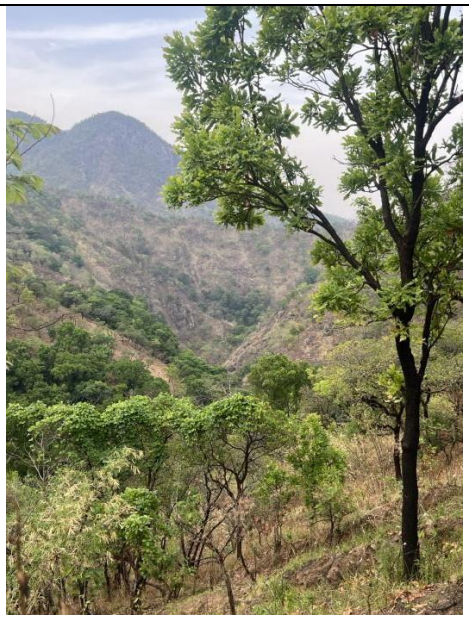

Figure 7-3.3 Topography of the Proposed Dam Site of Mayo Selbe 3# Hydropower Project

Figure 7-3.4 Proposed Dam Site of Mayo Selbe 3# Hydropower Project

Figure 7-3.5 Site Visit to Mayo Selbe 3# Hydropower Project

Figure 7-3.6 Site Visit to Mayo Selbe 3# Hydropower Project

Figure 7-3.7 Upstream River Channel of Mayo Selbe 3# Hydropower Project

Figure 7-3.8 Downstream River Channel of Mayo Selbe 3# Hydropower Project

2. Assessment Comments

In comparison, Mayo Selbe 3# Hydropower Project has a smaller installed capacity and slightly worse economic indicators than those of Mayo Selbe 1# and Mayo Selbe 2# Hydropower Projects, but the corresponding total cost (investment) can be significantly reduced (expected to be controlled within 2.5 million USD), the energy output is less and it is easier to transmit power to surrounding villages and towns for consumption.

In addition, from the perspective of macro planning, Mayo Selbe 1#, 2# and 3# can be combined, and together with other potential medium and small hydropower projects in the surrounding area, build a high-quality medium and small hydropower project (clusters) with a total installed capacity of about 100MW or even higher in the southern region of Taraba State.

3. Work Program for Next Step

Same as that of Asop Falls Hydropower Project in Plateau State above.

(IV) The Donga River

Date of site visit: March 12, 2024

Site visit agency: local water authority, local leaders and KEC

Figure 7-4.1 Site Visit Staff of the Donga River

1. Briefs of the Project

The Project is located downstream of the Donga River reach, about 220km southwest of Jalingo, Taraba State. The river channel is nearly 50m wide. The relative elevation difference between both banks is only about 3m. The discharge is large. The visual current discharge (low-flow season) is about 30-50m^3/s. In general, the terrain of both banks from 50km upstream to the downstream confluence of this reach is gentle, obviously lacking the topographic conditions available for dam construction and impoundment.

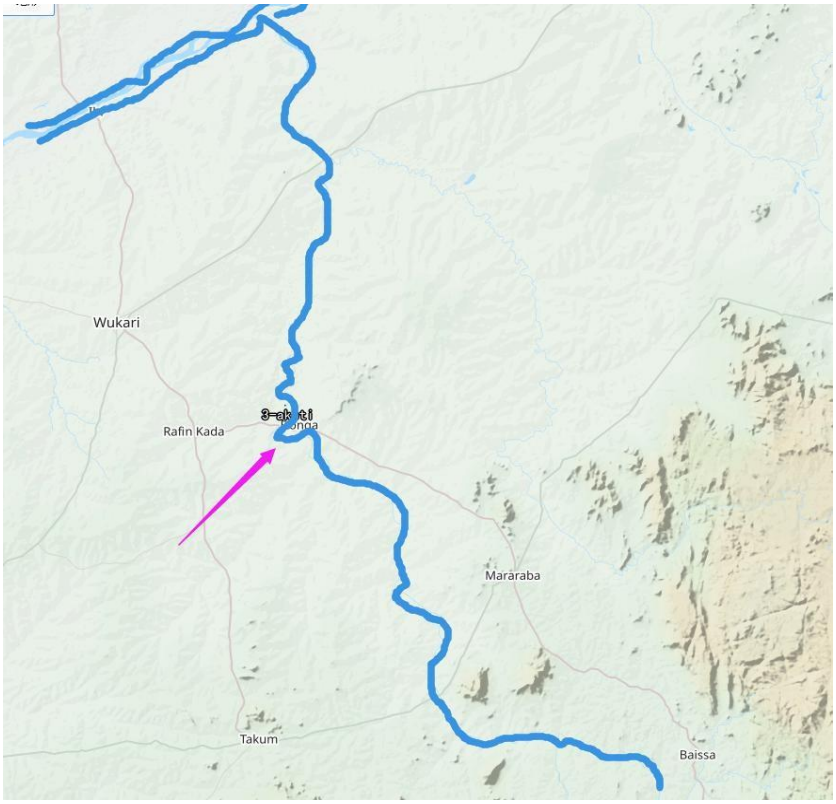

Figure 7-4.2 Reach of the Donga River under Site Visit

Figure 7-4.3 Site Visit to the Donga River

Figure 7-4.4 Gentle Terrain of the Reach of the Donga River under Site Visit

2. Conclusions and Recommendations

The terrain of this reach is gentle, with no concentrated drop, poor hydroenergy resources, and an obvious lack of topographical conditions for constructing a dam and impoundment, so the development of hydropower project is not recommended.

3. Work Program for Next Step

After preliminary study and judgment by KEC, it is suggested to separately select the site for development in upstream reach of Abong Town. This reach may have better hydroenergy resource conditions, and the installed capacity may be large.

VIII. Summary of Site Visit

The Site Visit was paid to a total of eleven medium and small hydropower projects (SHP) recommended by the local government, including eight sites with conditions available for constructing the hydropower projects and three sites with conditions unavailable for construction. The maximum installed capacity of each hydropower project is 5.4MW, and the minimum installed capacity is 160kW.

- Mayo Selbe 1# and 2# Hydropower Projects in Taraba State are the best in terms of hydroenergy resource condition. First, although the site visit period is the low-flow season, the current discharge of the river channels of the two hydropower projects is 1.0-1.5m^3/s. The upstream has the condition available for constructing a seasonal regulating reservoir, so the power supply guarantee rate is very high; Second, both river channels have a gradient of nearly 15%, and can obtain a head of 800m-1,000m, which is equivalent to an income of 0.15 USD per 1m^3 of water; Third, it is estimated that the installed capacity of the two hydropower projects will reach 90,000 kW and the energy output will be sufficient. If Mayo Selbe 3# Hydropower Project with good hydropower resources is jointly developed, the area can be used as an important power supply base adjacent to cities, towns, factories and mines in various states, and it is worth investing in the associated transmission lines (TLs) with long transmission distance.
- If we focus on small investment, short period and simple implementation, the Balanga Dam Hydropower Project and associated solar PV power project in Gombe state and Itapaji Dam Hydropower Project in Ekiti state, with good basic conditions for preparatory work, are the most suitable for upgrading and renovation.
- If we focus on the power supply to neighbouring cities, towns, factories and mines, and the investment is moderate, the two hydropower projects on the Kerang River and the Shemarkar River in Plateau State are worth developing and constructing ASAP.