

Prefeasibty report
For
Micro hydropower development



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Mining and energy agency

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Introduction

As it is known Ethiopia has large water resource potential for the micro hydropower development but the utilization is limited. Considering this the GTZ-ECO has started the design and implementation of the MHP in different parts of the southern region which doesn't have access to energy from EEPCO. Besides this the GTZ-ECO also makes a collaboration work in energy aspects with mining and energy agency, Sidama development cooperation and different universities.

The design and implementation of one pilot project with the mining and energy agency is one of the different activities of GTZ-ECO with the partners. For this a prefeasibility is done by the experts from both office. The study aims to get the most feasible site both technically and socioeconomically.

Technically the best geographical areas for micro hydropower systems are those where there are steep rivers, streams, creeks or springs flowing throughout the year, such as in hilly areas with high year round rain fall. The location of the head work structure, forbay, penstock and powerhouse should be more feasible and economical. The socioeconomic studies also focus on the public and commercial demand of the energy and the capacity of the people to pay for the energy used.

Objective

- The objective of the Prefeasibility study was to access the most feasible site which has a potential of 10- 20KW
- Giving the required hydrological and socioeconomic data of the feasible site (design discharge head and demand) for procurement of electro mechanical equipment.

Prefeasibility study sites

Based on the above objective four potential rivers were studied around the Bensa and Bona Woreda of Sidama zone. The detail technical and socioeconomic studies of rivers and the demand centers are described below:

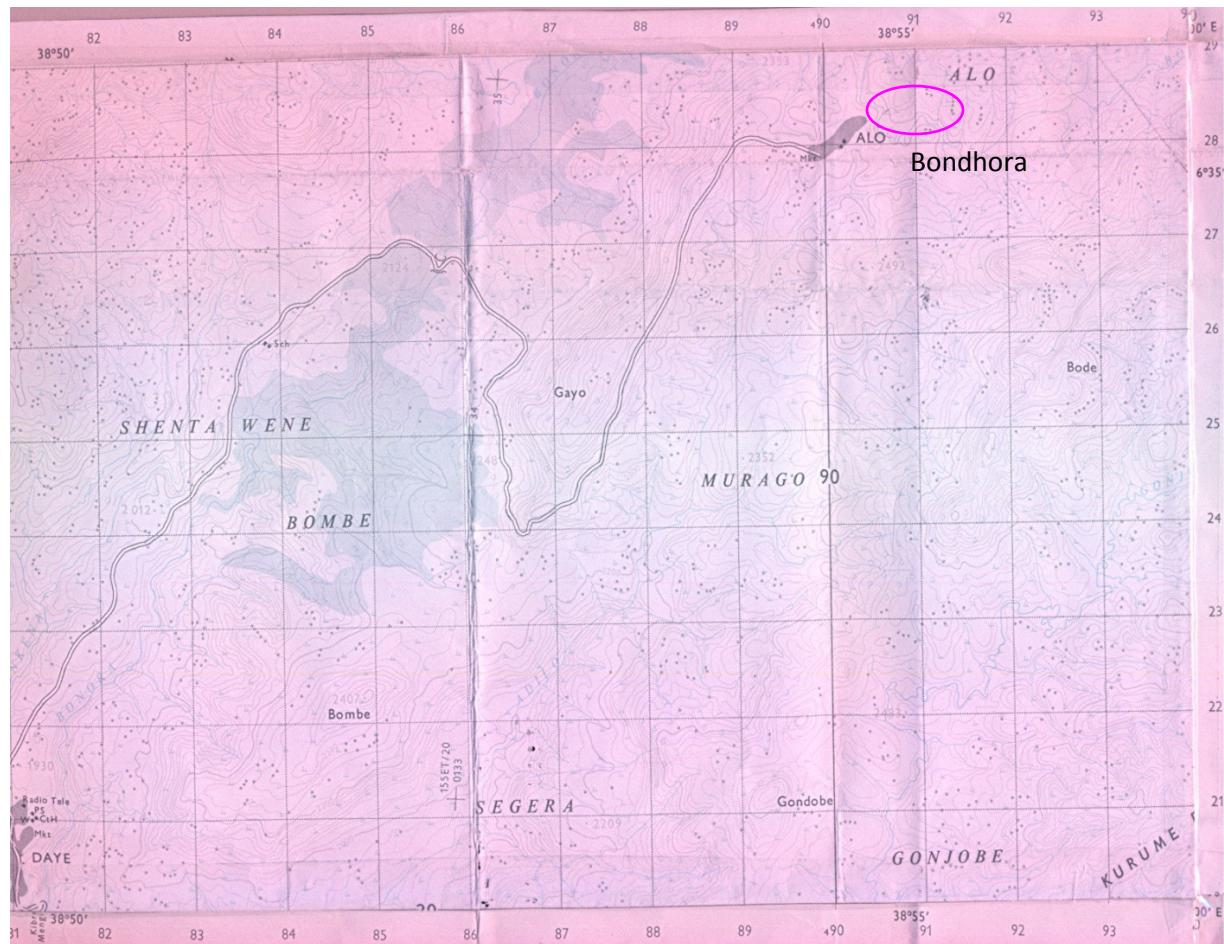


Figure 1: Location of the study area

1. Bondhora river

Bondhora River is located in the southern region of Sidama Zone, at Bensa woreda in Alo kebele. It is about 19km from the woreda capital Bensa. The main road, which connect the two woredas, Bensa and Chire, pass through the demand center of the kebele.



Figure 1: Bondhora water fall

The socio economic survey done at the demand center of the kebele, Alo, is presented as follows:

General

- The demand center is 11 km away from the EEPSCO grid and approximately $\frac{1}{2}$ km away from the proposed power house location
- Total HHs in the demand center of the kebele is 480
- Total HHs of the kebele is around 800
- Total population in the demand center is 5760

- Average household size is 12 persons per HH
- Average HHs in the demand center considered rich =16, medium=384 and poor=80
- Nearest year round operational road is Bensa-Chire road.
- Road type all weathered road and accessible
- Neighboring villages: Ketena (2hrs by foot) and Mura (1.5hrs by foot)
- Occupations/Source of incomes are Agriculture and small commercial businesses(tea houses, local bars, shops, kiosks etc)
- Nearest big market for grain mill and material assortment is Bensa market.
- Fire wood is the only available energy for cooking and kerosene for lightning
- Average kerosene consumption is 1.3L per HH per month
- An average monthly expense for kerosene is 22 birr per HH.
- Total iron roofed HHs are 150
- Estimated average monthly income per HH is 400 birr
- Major problems in the kebele are energy and transportation
- Locally available construction materials are stone ,sand and trees for scuff holding
- No grain mill
- Road accessible

Public Sectors

Health centers

- One health service which is Inaugurated on 06/05/10
- 36 rooms including toilets and kitchen
- About 1/2km away from the proposed power house location
- Ready for service
- 2 socket and two light bulbs per room installed
- One health center which has 5 rooms

School

- One elementary school (1-8 grade)
- 52 rooms / toilets and teachers' residential included/
- 2500 students currently attending their education

- 32 teachers
- About 1/2km away from the proposed power house location
- There is a plan to upgrade to high school(grade 9&10)
- One KG school

Others

- One kebele administration office which has 4 rooms, about 1km away from proposed power house location
- One FTC/Farmers Training Centre/which has 8 rooms including toilets and kitchen, about 1km away from proposed power house location
- There are 8 churches in the kebele out of which four of them are very close to the proposed power house location. There is an average of 3 rooms in each church.
- Commercial centers: Tea houses=18, shop/kiosks=21, store=8 and local bars=6

Associations

Youth association

- Established in 1999 E.C
- Capital 22,000ETB
- Number of members 31
- Not participated on any trainings
- Trades involved are buy and sell different cash crops and farming
- Major problems are managerial and financial skills (accounting, leader ship etc)

Women association

- Established in 1999 E.C
- Capital----
- Number of members 120
- Trades involved are buying and selling different cash crops and farming
- Major problems managerial and financial skills (accounting, leader ship etc)
- Not participated on any trainings

Farmers association

- Established in 2001E.C
- Capital 6000 Birr
- Last year profit 1190 Birr
- Number of members 41
- Trade: money lending and farming
- Not participated on any trainings
- Major problems leader ship and accounting training gaps, lack of demand
-

The detail technical characteristics of the rivers are described below:

- The upstream coordinate (weir) is 37N0490653, 0728340
- The powerhouse is located at 37N0490618, 0728367
- The estimated penstock length is 26.10 meter
- The canal length become 10 meter
- The width of the river at the diversion site become 5.80 meter
- The gross head of the river is 10 meter
- The available power become 10.0KW in the driest period

The discharge of the Bondhora river is measured with the floating method on date 07/05/2010.

The discharges of the river at this particular date become $0.864 \text{ m}^3/\text{s}$.

2. Upper and lower Osoricho river

The upper and lower Osoricho River is located in the southern region of Sidama Zone, at Bona woreda in Chancho and Shegado kebele. The River is very close to Upper Ererte River. It is about 11 km away from Bensa - Bona road to the left side.



Figure 2: Upper Osoricho water fall

The demand centers of both Chancho - Shagado and Holancho - Bulancho kebele are located in the same area. The people of the kebeles share every facility together.

The socio economic survey done at the demand center of Chancho - Shagado Kebele is as follows:

General

- The demand center is 9 km far from the EEPCO grid and approximately 1km from the proposed power house location.
- Average household size is 11 persons per HH
- Nearest year round operational road head is Bensa - Bona road.
- Neighboring village Holancho - Bulancho and Bashro Gute(2km) kebeles
- Occupations/Source of incomes are Agriculture, and small businesses (tea houses ,kiosks, local bars)
- Nearest big market for grain mill and material assortment is Bunsa market.
- Fire wood is the only available energy for cooking and kerosene for lightning
- Average kerosene conception is 1.3L per HH per month
- An average monthly expense for kerosene is 22 birr per HHs.
- Total iron roofed HHs is 35
- Estimated average monthly income per HH is 350 birr
- Locally available construction materials are stone and trees for scuff holding
- Major problems in the kebele are energy and transportation
- No grain mill
- Road accessible

Public Sectors

- One clinic which has 4 rooms including toilets
- Two health center each has 2 rooms
- One elementary school (1-8 grade) which has 32 rooms / toilets and teachers' residential included/ and currently 690 students attending their education using 30 available teachers.
- One kebele administration office which has 5 rooms
- One FTC/Farmers Training Centre/which has 8 rooms including toilets and kitchen
- There are 7 churches in the Kebele.

Associations

- Women association
- Farmers association
- Youth association

The detail technical characteristics of the upper Osoricho river is described below:

- The upper part of the fall (diversion site) is located at 37N0460326, 0727593
- The downstream of the fall is located at 37N0460359, 0727608
- The gross head of the river become 13 meter
- The topography become difficult for the construction of the canal, forbay , powerhouse and other structure

The detail technical characteristics of the lower Osoricho river is described below:

- The upper part of the river (diversion site) is located at 37N 0461122, 0727556
- The downstream of the water fall is located at 37N0461121, 0727526
- The gross head of the river is 15 meter
- The canal work will be difficult due to intensive rock excavation

The discharge of the lower osoricho river is measured with the floating method on date 06/05/2010. The discharges of the river at this particular date become $1.553 \text{ m}^3/\text{s}$.

3. Upper Errerte

Upper Errerte River is located in the southern region of Sidama Zone, at Bona woreda in Holancho - Bulancho Kebele. It is 10 km away from the main road to Bona to the left side.



Figure 3: Upper Errerte

The socio economic survey done at the demand center (Holancho - Bulancho kebele) is presented as follows:

General

- The demand center is 9 km far from the EEPCO grid and approximately 1km from the proposed power house location.
- Average household size is 11 persons per HH
- Nearest year round operational road head is Bensa - Bona road.
- Neighboring village Chancho - Shagado and Bashro Gute(2km)
- Occupations/Source of incomes are Agriculture, and small businesses (tea houses ,kiosks, local bars)
- Nearest big market for assortment of material is Bensa market.

- Fire wood is the only available energy for cooking and kerosene for lighting
- Average kerosene conception is 1.3L per HHs
- An average monthly expense for kerosene is 22 birr per HH.
- Total iron roofed HHs is 30
- Estimated average monthly income per HH is 350 birr
- Major problems in the kebele are energy and transportation
- Road accessible
- No grain mill

Public Sectors

- One health center which has 6 rooms including toilets
- One elementary school (1-5 grades) which has 12 rooms / toilets and teacher's residential included/ and currently 690 students attending their education
- One kebele administration office which has 6 rooms
- One FTC/Farmers Training Centre/which has 8 rooms including toilets and kitchen
- There are 9 churches in the kebele out of which four of them are very close to the demand centre and have their own power supply by using Solar and Battery.

Associations

Youth association

- established in 1997 E.C
- capital 17000ETB
- number of members 35
- trades involved are buying and selling different cash crops and farming
- major problems managerial and financial skills (accounting, leader ship etc)

Women association

- established in 1997 E.C
- number of members 48
- trades involved are buy and sell different cash crops and farming
- major problems managerial and financial skills (accounting, leader ship etc)

Farmers association

- established in 1997 E.C
- capital----
- number of members is 530
- trade farming

The discharge and the head of this river have enough potential to fulfill the demand of the public services (health service and school). The topography of this river is feasible for the construction of civil component of the micro hydropower and grid distribution. The proposed location of the diversion site is upstream of the Errerte micro hydropower plant, which under implementation. The Beshiregute kebele, which is the nearby demand center is already planned to be covered by the Errerte micro hydropower plant. Then the demand center of the upper Errerte are Holancho-bulancho and Chancho-shagado kebeles which are approximately 1 km and 1 ½ km far from the power house location respectively.

4. Da-Ela river

Da-Ela River is located in the southern region of Sidama Zone, at Chire woreda in Da-Ela kebele. The river is very close to the demand center of the kebele. It is about 37km from the woreda capital Chire and 29km far from Bensa town. Like Alo Kebele, the main road, which connects the two woredas, Bensa and Chire pass through the demand center of the kebele.



Figure 4: Da-Ela water fall

The socio economic survey done at the demand center of the kebele, Da-Ela, is presented as follows:

- The demand center is 19 km away from the EEPCO grid from Bensa side and 37 km from Chire side and approximately $\frac{1}{2}$ km away from the proposed power house location
- Total population in the kebele is 17618 out of which 11666 are females
- Total HHs of the kebele is around 1600
- Total HHs in the demand center of the kebele is 1176
- Total population in the demand center is 12900
- Average HHs size is 11 persons per HH
- Nearest year round operational road is Bensa-Chire road.
- Neighboring villages: Bonjabe (10km) ,Sheko (7km) and Aroresa(6km)
- Occupations/Source of incomes are Agriculture, and small commercial businesses(tea houses, local bars, shops, kiosks etc)

- Nearest big markets for assortment of materials are Bensa and Chire markets.
- Fire wood is the only available energy for cooking and kerosene for lightning
- Average kerosene consumption is 1.4L per HH
- An average monthly expense for kerosene is 23 birr per HH.
- Total iron roofed HH is 378
- Estimated average monthly income per HH is 450 birr
- Major problems in the kebele are energy and transportation
- Road type all weathered road, accessible
- Locally available construction materials are stone ,sand and trees for scuff holding

Public Sectors

Health centers

- One clinic
- 40 rooms including toilets and kitchen
- About 1/2km away from the proposed power house location
- 22 workers
- Three health centers which have a total of 9 rooms

School

- One elementary school (1-8 grade) in the demand center
- 25 rooms including toilets
- 2278 students
- 42 teachers
- About 1/2km away from the proposed power house location
- Additional 4 schools are available in the kebele

Others

- One kebele administration office which has 7 rooms, about 1/2km away from proposed power house location
- One FTC/Farmers Training Centre/which has 12 rooms including toilets and kitchen, about 1km away from proposed power house location

- There are 29 churches in the kebele out of which 11 of them are close to the proposed power house location. There is an average of 3 rooms in each church.
- Commercial centers: Tea houses=75, shop/kiosks=65, store=7 and local bars=28,Cafteria=15

Associations

Two Youth associations

- both established in 2001 E.C
- capital 38000ETB and 19000ETB
- no. of members 50 each

The discharge of this river is more than all the above mentioned rivers and the gross head become 6 meter. The location of the canal and the forbay become difficult for the construction due to massive bedrock. The river width at the diversion site is so wide, this increases the cost of the diversion head work.

Conclusion

As it is known the objective of this prefeasibility study is to get the most feasible site which have the capacity of 10-20KW. In order to get this the above four potential sites, Bondhora, upper and lower Osoricho, Upper Errerte and Da-ela are compared both technically and socio economically. The Upper Errerte river is technically and socioeconomically feasible but the capacity of the river is above the required amount and the demand center is a little far from the source. The upper and lower Osoricho rivers are technically not feasible even though it is feasible socioeconomically. In these rivers the construction of the diversion head work, canal, forbay and powerhouse become difficult. The Da-ela river has higher potential than all the others but it has construction difficulties at civil components of the MHP.

The Bondhora river is more feasible both technically and socioeconomically compared to all others. The gross head of the river is 10 meter and the discharge at 07/05/2010 is $0.864 \text{ m}^3/\text{s}$. The river will have the potential of 10.00 KW during the driest period of the year. The required cost for the civil work and grid work become less as compared to all other site. The demand center has a maximum of 0.5 km from the powerhouse location which is so short than others. Based on the above criteria the rank is given for the rivers according to their feasibility.

1st Bondhora

2nd Upper Errerte

3rd Upper and lower Osoricho

4th Da-Ela

Then the team proposes the Bohdhorra river for the pilot micro hydropower project which is to be implemented by the Mining and energy agency in cooperation with GTZ-ECO.