ANNEX 1: LIST OF PERSONS MET DURING THE EIA FIELD VISIT

(October 1, 2013)

SN	Name	Designation/Organization
1	Alhaji Rahman	Geologist, CEMMATS Group Limited
2	Alhaji Samu	Youth Leader, Palima Village
3	Allassan .T. Lavali	Student, Momana village
4	Anthony Davies	Managing Director, ECOSYS SL
5	Anthony Pessima	Counselor ward 294
6	Borboh Fullah	Town Chief, Palima Village
7	Christian Johnson	Counselor ward 295
8	David Abdul Konneh	National Power Authority
9	Fatmata Kaiwa	Head, Biological Sciences Department, Fourah Bay College
10	Francis Musa	Farmer, Momana village
11	Prof. Herbert Kandeh	Chairman of the Moyamba District Council
12	Joe Nbrawan	Farmer, Petefu village
13	Joseph Samu	Farmer, Petefu village
14	Kelleh Mansaray	Officer-in-Charge, UNIDO Country Office, SL
15	Khama Bockarie	Community Health Officer
16	Mokiff Vandi	Farmer, Petefu village
17	P.C. Papapua	Paramount Chief of Sembehun Nancy Tucker
18	Prince Muzan-Ekpelu	Lecturer, Fourah Bay College
19	Theresa Sesay	Chair Lady, Moyamba District HQ
20	Usman Koroma	Farmer, Momana village

ANNEX 2: DISTRICT LEVEL STAKEHOLDERS' WORKSHOP

PROMOTING MINI GRID BASED SMALL HYDROPOWER FOR PRODUCTIVE USES IN SIERRA LEONE

Date: 25 January 2010
Venue: Conference Room, Moyamba District Council

List of Participants

SN	Name	Organization
1	Abdul K Bangura	Councillor
2	Ajaratu Mahor	Farmer/DBOC
3	Alhassan Koroma	Traders Union
4	Alok K Jindal	UNIDO Consultant
5	Alpha K Wonneh	District Chief Imam
6	Alpha Lalugisa	MODCAR
7	Alusire tofana	SLRA
8	Amadu T Daramy	ICS
9	Charles G Koroma	Bumpeh Chiefdorn
10	Charles M Dick	Central School
11	David S Harding	Human Rights
12	David S Woobay	Chairman, Moyamba District Council
13	David Tormay	MAFFS
14	Debajit Palit	UNIDO Consultant
15	Essa Fullah	Farmer
16	Esther Kamoha	U I Tailoring Shop
17	Festus Kpaka	NPA
18	Florence Karbo	Ngawo
19	Foday M Guhama	Parmanent Chief
20	Francis Sunaila	KRISS
21	Frederick Sesay	Private
22	Harry Will	Private
23	Ibrahim G M Coker	Ministry of Educations Y & S
24	Ibrahim S Karqbo	MIODEAR
25	Insp. S P Kamara	SLP
26	James Q Nawko	Contractor
27	John Alpha	NPA
28	John M Koroma	Njala University
29	John P Kainessie	U 79 C Primary School Salina
30	Joseph Kangaju	NFF
31	Kollia Kamara	Moyamba District Council
32	Michael Sam	M D C
33	Mohamed Lavalie	MIDIC
34	Momoh Kamara	Farmer - Forestry
35	Mr Moses I Labia	MSW & CA
36	Musu Yajah	Contractor
37	Peter Mibiatilo Lebbie	SLRCS

SN	Name	Organization
38	Rev S E A Jammie	KMC
39	Sarah Gbani	FAFA-Shenge
40	Sdrissa S cole	Si Michacls Sec School
41	Sepaimins T A Bono - Dick	MAFFS
42	Shaikh Ahmed Turay	Njala University
43	Tambo G Gbetume	Action Aid
44	Teddy Kpmuuah	Council

ANNEX 3: STAKEHOLDERS CONSULTATION WORKSHOP

PROMOTING MINI GRID BASED SMALL HYDROPOWER FOR PRODUCTIVE USES IN SIERRA LEONE

Date: 27 January 2010
Venue: Conference Room, Ministry of Trade and Industry

List of Participants

S N	Name	Designation	Organization
1.	A. P. Y. Kamara	Ag. CPH	NPA
2.	Abdul Bangura	Infrastructure Specialist	African Development Bank
3.	Abdula Mansaray	Acting Director PPRD	Ministry of Trade and Industry
4.	Abubakaur Bal	Reporter	CTN
5.	Alok Kumar Jindal	UNIDO Consultant	TERI, New Delhi, India
6.	Ansu Moigua	Reporter	Democrat Press
7.	Aureola Cole	Administrative Assistant	UNIDO
8.	Charles Kamanda	Deputy Secretary	ECOWAS
9.	Chennon Manju Jalloh	Engineer	Energy for Opportunities
10.	Christian Thomas	Multimedia Officer	UNDP
11.	Daisy Scott-Boyle	Ex Secretary	S L Chamber of Commerce Industries
12.	David Peters	Technician	GTZ
13.	David S Worbay	Chairman	Moyamba District Council
14.	Debajit Palit	UNIDO Consultant	TERI, New Delhi, India
15.	Evely Alpha	UNIDO Consultant	UNIDO
16.	John M Koroma	Lecturer	Njala University
17.	Junisa A P Mongotquee	Provincial Service Manager	NPA
18.	Mickail N Turay	National Coordinator	UNDP GEF SHP Project
19.	Mohamed Bame	Program Assistant	SLANGO
20.	Mohamed K Turay	Engineer	Energy for Opportunities
21.	Moses Sesay	Head, Corporate Banking	Eco Bank
22.	R P Singh	IDO	UNIDO
23.	S P Kamara	Deputy Finance Secretary	Ministry of Finance
24.	Syril S J Jusu	Executive Director	Environment Protection Agency
25.	Zainab Kanu	Reporter	Concord Times

ANNEX 4: VALIDATION WORKSHOP

PROMOTING MINI GRID BASED SMALL HYDROPOWER FOR PRODUCTIVE USES IN SIERRA LEONE

Date: 15 August 2012
Venue: Bintumani Hotel in Freetown

List of Participants

No	Names	Organisation
1	J. A. P. Mongoquee	National Power Authority
2	Abu Sesay	Njala University
3	Sophie Johnson	Solar ERA (SL) Ltd
4	Fatmata B. Bah	Ministry of Energy and Water Resources
5	Anthony Davies	ECOSYS (SL) Ltd
6	Mahmood Timbo	National Power Authority
7	Ajaratu Machi	Campaign for Womens' Rights
8	Vivian Senesie	Moyamba District Council
9	P. C. Robert Papapwe III	Paramount Chief of Bagruwa Chiefdom
10	David S. Woobay	Chairman, Moyamba District Councul
11	Naasu Fofanah	Gender Adviser to the President
12	Matilda Williams	Ministry of Finance and Economic Development
13	Milton Gegbai	National Power Authority
14	Abdul Jalloh	Ministry of Energy and Water Resources
15	Jatou Diallow	Environment Protection Agency
16	John M. Koroma	Njala University
17	Alie Lamin	Supreme Venture (SL) Ltd
18	Dr. Apollinare Tini	ECOWAS Bank for Investment and Development (EBID)
19	P. C. John J. Russell Nyama	Paramount Chief of Lower Banta Chiefdom
20	Dr. Kolleh Bangura	Environment Protection Agency
21	Robin F. Mansaray	Ministry of Energy and Water Resources
22	Hawa Moseray	SLBC
23	Patrick Sallia	Star Radio 103.5 FM
24	Anthony Morsay	UNIDO Consultant
25	Charles Mereweather-Thompson	Ministry of Trade and Industry
27	Dr Patrick Tarawalli	Private Consultant
28	Prince A. Soriba	Moyamba District Council
29	James Alfred	Journalist
10	Aruna P. Kamara	SLBC/TV
32	Albert Smith	Solar Era SL Ltd.
33	Dr. Issa Fofana	Njala University
34	P.K. Monga	UNIDO
35	Stephen B. Kargbo	UNIDO
36	Rana P. Sing	UNIDO
37	Kelleh Mansaray	UNIDO

Programme **15 August 2012**

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

SIERRA LEONE

UNIDO/GEN

PROMOTING MINI GRID BASED SMALL HYDROPOWER FOR PRODUCTIVE USE IN SIERRA LEONE

Day One: 15 August 2012 **Workshop on SHP Project Development in Sierra Leone** **Venue: Conference Room 2, Bintumani Hotel, Freetown**	
Time	**Activity/Topic**
9:00 – 9:30	Registration
9:30 – 9:40	Short Introduction and Welcome Address • Stephen Kargbo, UNIDO
9:40 – 9:45	Objectives of the Workshop • Rana Singh, UNIDO
9:45 - 10:00	Hydropower Scenario in Sierra Leone • Dr. Abdul R. Jalloh, MEWR
10:00 – 10;30	Tea/Coffee Break
10:30 – 12:30	Statements: "Participants will give their perspective on different issues regarding small hydropower project development for Productive Use in Sierra Leone". • Prof. Abu Sesay, NU – As Beneficiary • Prof. J. Redwood-Sawyer – Capacity Building • Prof. O. Davidson, USL – Technical Aspect • Ibrahim Wilson, MEWR - Policy and legal framework: licenses, water right, permits, etc.
12:30 – 13:00	Lunch Break
13:00 – 15:00	Formation and Validation of a Steering Committee on SHP Project Development in Sierra Leone???????
15:00	Closing Remarks and Wrap-Up of the Day

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ANNEX 5: NATIONAL STAKEHOLDERS' WORKSHOP

PROMOTING MINI GRID BASED SMALL HYDROPOWER FOR PRODUCTIVE USES IN SIERRA LEONE

Date: 16 August 2012
Venue: Bintumani Hotel in Freetown

List of Participants

No	Names	Organisation
1	Abu Sesay	Njala University
2	Robin F. Mansaray	Ministry of Energy and Water Resources
3	John M. Koroma	Njala University
4	James Alfred	Voice of Salone
5	Sophie Johnson	Solar ERA (SL) Ltd
6	Fatmata B. Bah	Ministry of Energy and Water Resources
7	Anthony Davies	ECOSYS (SL) Ltd
8	Alimatu Jalloh	Premier News N/P
9	Alie S. Kamara	Standard Times
10	J.A.P Mongorque	National Power Authority
11	Milton Gegbai	National Power Authority
12	Ajaratu Machi	Campaign for Womens' Rights
13	Vivian Senesie	Moyamba District Council
14	Prince A. Soriba	District Officer Moyamba
15	K. Srinivas Redoi	Best food Ltd
16	B.V. Mohan Kuma	Best food Ltd
17	Madhvkar	Best food Ltd
18	Kelleh Mansaray	UNIDO
19	P.C Roberts CS Papapwe III	Paramount chief Bagrnwa Chiefdom
20	P. C. John J. Rusell Nyama	Paramount Cgief of Lower Banta Chiefdom
21	P. K. Monga	UNIDO
22	David S. Woobay	Chairman, Moyamba District Council
23	Apollinare Ibrahim Tini	ECOWAS Bank for Investment and Development (EBID)
24	Stephen B. Kargbo	UNIDO
25	Rana P. Sing	UNIDO
26	Patrick Sallia	Star Radio 103.5 FM
27	Richard F. Marrah	Environment Protection Agency
28	John Baimba Sesay	Tourchlight Newspaper
29	Abdul Rahaman Dumbuya	KDC
30	Mahmood Timbo	National Power Authority
31	Aruna P. Kamara	SLBC/TV
32	Shek Turay	Njala University
33	Chenor M. Jalloh	Energy for opportunity

Programme **16 August 2012**

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

SIERRA LEONE

UNIDO/GEN

STAKEHOLDRES' CONSULTATION MEETING

PROMOTING MINI GRID BASED SMALL HYDROPOWER FOR PRODUCTIVE USE IN SIERRA LEONE

Agenda

Day Two: 16 August 2012 Workshop on SHP Project Development in Sierra Leone Venue: Conference Room 2, Bintumani Hotel, Freetown	
Time	**Activity/Topic**
9:00 – 9:30	Registration
9:30 – 9:40	Welcome and Introductions • Stephen Kargbo, UNIDO
9:45 - 10:00	Progress/Status of the Small Hydropower Project Development in Sierra Leone • Pradeep Monga, UNIDO
10:00 – 10:30	Tea/Coffee Break
10:30 – 12:00	Statements: • Paramount Chief Gulama – As Beneficiary • Chairman, Moyamba District Council - Ownership and Management structures • Director of Trade and Industry – Impact on Trade and Industry • Director of Agriculture – Impact on Agriculture • EPA Executive Director/Director - Social and Environmental Impact • Rana Singh, UNIDO - General success and risk factors: Analysis of technical, financial, organizational etc. factors having an impact on success or failure of the project
12:00 – 12:30	Lunch Break
12:30 – 14:30	Discussion/Feedback: "Promoting Mini Grid Based Small Hydropower for Productive Use in Sierra Leone".
14:30	Closing Remarks and Wrap-Up of the Day

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ANNEX 6: CONSULTATIONS

Stakeholder Consultations

The following section briefly describes the point of discussion with the key stakeholders.

Ministry of Energy and National Power Authority (NPA)

Persons met:

- Ms Yvette Stevens, Advisor, Energy Policy, Ministry of Energy
- Mr. Junisa A.P. Mongorquee, Provincial Services Manager, NPA
- Mr. Abdul P.Y. Kamara – Acting Corporate Planning Head, NPA Mr. Mahmood Timbo, Director, Technical, NPA

Key points

- The Ministry has drafted the National Energy Policy and Strategic Plan 2009 - Energy for Poverty Alleviation and Socio-Economic Development. The document is expected to be passed by parliament soon and adopted as the National Energy Policy.
- The NPA is looking at the Moyamba small hydropower project as one of the priority project and wished that it will be implemented soon.
- The NPA shared that there is currently no Independent Power Producer in Sierra Leone and wished that with the adoption of the Energy Policy, private sector participation is expected to develop the energy sector.
- The NPA also shared relevant information with the TERI team based on the checklist provided by TERI team to NPA.

Economic Community of West African States (ECOWAS)

Persons met

- Mr Donald A Ngegba, Director, Regional Integration & South-South Cooperation & Charles Kamanda, Deputy Secretary

Key points

- ECOWAS is providing priority to develop renewable energy in the sub-region. However, for obtaining funding from ECOWAS, the Government of Sierra Leone has to approach them with the project proposal.
- The budget for 2010 has already been submitted and also approved by the ECOWAS Secretariat. However, a ECOWAS team would be in Sierra Leone to discuss energy project in the sub-region and therefore Mr Ngegba advised that UNIDO should try to submit the project proposal through the Government at the earliest time.

African Development Bank (AfDB)

Persons met

- Dr Samuel O Onwona, Resident Representative and
- Ing Abdul P A Bangura, Infrastructure Specialist

Key Points

- AfDB financing depends on the viability of the project. The Bank supports project to the private sector based on a commercial approach or provides grant support for infrastructure project under the African Development Fund (ADF) umbrella.
- Sierra Leone is still considered as a fragile country after the war and the country is experiencing policy vacuum in the energy sector. Until there is energy policy with respect to electricity pricing and other regulatory aspects, private sector participation is not expected in the country. The lack of concrete policy and regulatory framework for energy projects is seen as a risk and so the bank is yet to consider commercial lending for Sierra Leone.
- Sierra Leone is qualified to take concessional loans and or grants and not commercial loans for any project.
- Under the ADF 12th cycle i.e 2011-2013, the Sierra Leone Government has requested for AfDB's support for transport, water and sanitation sector and this has already been approved by the Board. It may be difficult to revisit the same and include the energy project as these will require the Board approval again. Further the request for any such change has to come from the Government.

ECO Bank

Person met

- Mr Clement Dodoo, Executive Director, Eco Bank

Key Points

- Eco Bank is a commercial institution and so they only support commercially viable projects. Eco Bank would however be keen to support infrastructure projects, but will not be interested for startups.
- The Bank also may not be interested to support long term projects expect those that are commercially viable, or any social sector projects that are not profit making. However, in case NPA approached the Bank for support, they can support such projects.
- To avail project funding, the Director suggested submitting the project document with clear timeline for project completion, expected profitability and cash flow analysis.
- The involvement of UN agency in the project can be considered as a positive factor to consider funding from the Bank.

Sierra Leone Chamber of Commerce, Industry and Agriculture

Persons met

- Mr Mohammad B Cole, President and
- Ms Daisy Scott Boyle, Executive Secretary

Key points

- There are over 300 industries registered with the Chamber including about 20 manufacturers in soft drinks, beer, aerated water, vegetable oil, soap, and textile.
- There is still power deficiency in Freetown inspite of the commissioning of the Bumbuna project as power transmission infrastructure is very poor.
- Mr Cole shared that the Chamber feels it would be prudent to go for the maximum power supply in the order of 10 MW rather than developing 3 MW, considering the rising population and potential in terms of industrial development.
- Mr Cole also shared that there are two big mining companies in the Moyamba district, namely rutile and bauxite, who could be potential customers for the project. The mining companies mainly depend on generators with total power demand of about 20 MW for bauxite and about 5 MW for the rutile mining. Both these mining companies use fuel oil and diesel at very high cost.
- He also shared that the district is rich in agricultural production, so there is potential for development of food processing industry such as Cassava gari processing, ginger drying, rice milling, palm oil mills, and cattle feed production, if sustainable energy supply can be ensured.
- Any excess power from the project can also be exported to the West African Power pool.

European Union (EU)

Person met

- Mr Sigvard Bjorck, Head of Section-Infrastructure &
- Mr Sergio Oliete Josa, Project Officer – Infrastructure

Key points

- EU is currently supporting infrastructure projects in the country mainly building road network in the country including the Moyamba highway project.
- EU also has plans to develop the electricity sector in the country especially to build grid infrastructure. The EU also has about 12 million euro under the energy facility which could possibly be utilised for the small hydro power project including developing the grid network for evacuation of power. However, the Government has to approach EU officially along with the detail project report.
- It would be prudent to have a project of the order of 10 MW instead of 3 MW, with construction of the dam and the laying of transmission network being separately considered for funding by different agencies.

Ministry of Trade and Industry

Person met:

- Mr. David O. Carew, Hon'ble Minister of Trade & Industry

Key Points

- The Hon'ble Minister said that they are very supportive of UNIDO intervention into the energy sector as it would enhance the power supply to some of the growth centres and thus improve their productivity. This would further encourage new industries to be developed.
- He assured his support for the Moyamba project and wished that the project will be implemented soon.

Ministry of Energy and Water Resources

Person met

- Prof Ogunlade Davidson, Hon'ble Minister of Energy

Key Points

- Prof Ogunlade Davidson shared during the meeting that the Ministry now had a Policy Advisory Unit as a technical/ professional wing which is currently putting in place policies for the energy sector.
- He further informed that the Ministry has already approached EU for financing the Moyamba project and soon write an official letter seeking their support for the project.

United Nations Development Programme

Person met

- Mr Keith Wright, Principal Technical Adviser
- Mr Eldridge Adolfo, Youth Employment & Conflict, UNIPSIL, Sierra Leone

Key Points

- Mr. Keith shared that their focus is mainly on the employment of youth. However, they could be involved in the development of vocational training school with one or two components for the technical capacity building for the small hydropower project, manufacturing simple spare parts.
- In this context, he suggested that the Ministry of Energy need to write to UNDP for collaboration in line with the SHP project requirement.

Other stakeholders

In addition to the above key stakeholders, the TERI team also met the following stakeholders:

- Mr David S Woobay, Chairman, Moyamba District Council
- Mr Edward A Soloku, Hon'ble Member of Parliament, Moyamba, Sierra Leone
- Prof Jonas Redwood-Sawyer, Vice Chancellor & Mr A B Savage, Dean, Faculty of Engineering
- Mr John M Koroma, Lecturer, School of Technology, Njala University
- Mr Foday Melvin Kamara, CEO, FINIC, Sierra Leone

Stakeholder Workshops

The following section briefly describes the workshops and the key conclusions from the workshops.

Village level workshop

The village level workshop was conducted at Palima village in Bagruwa chiefdom on 24 January 2010. The workshop was attended more than 100 persons including the Hon'ble Member of Parliament, the Paramount Chief of Bagruwa chiefdom, Ward Councillors, Youth leaders, women leaders, religious leaders, representatives from Njalah University. The meeting was chaired by Mr Robert C S Papapuweii, Paramount Chief, Bagruwa Chiefdom.

In his opening remarks, the Paramount Chief said that the stakeholders meeting was the first meeting for the hydro power project and he congratulated all for the large participation of people from all sections. He further said that the overwhelming attendance showed the seriousness of the community in getting electricity supply in their villages. He shared that the Singimi fall forms a common boundary between Bagruwa and Lower Banta Chiefdoms and wished that both the chiefdoms will get benefit from the project. He mentioned that light is life and energy is development and pledged to work with his people, jointly with the Hon'ble Member of Parliament and the Moyamba District Council to make the project a success.

Figure 1 Stakeholder consultations in Bagruwa Chiefdom

The Hon'ble Member of Parliament in his address said that he totally support the project as the community is in dire need of the same. He further said that "if there is light in Moyamba, there will be

development; people will not be in darkness. If there is light, there will be money and people will benefit". Rev Anthony Pessima, one of the Councilor stated that that they would want light in their houses if not on the streets. He further said that unlike the Bumbuna project where electricity is wheeled to Freetown, this project should benefit the local community and any excess electricity may be evacuated for other districts. Mr Edmond Sullu, the youth leader and the women leader pledged support to the project on behalf of the entire youth and women community respectively. One of the master farmer present at the meeting shared that farmers are poor in Sierra Leone because of the lack of electricity which prevents them from processing their produce into finished products which they could sell at higher prices. He mentioned that the World Bank has provided machines and diesel generators for select farmers in Bagruwa Chiefdom to be installed at four different locations in the Chiefdom for processing cassava into various products. However, they are unable to operate the same as the running cost is very high because of high landed cost of diesel. He wished that with implementation of the small hydro project, they could use cheap electricity thereby earning more income.

The Principal of the local school said that they are unable to use their computers or lab equipments due to absence of electricity. The Njala University representative also highlighted their case of not being able to use their electronic equipments due to absence of electricity. One of the participants shared that the rutile mining is expected to start in the Bagruwa chiefdom. The mining company always cite high fuel cost as one of the reason for not paying a higher royalty to the Chiefdom. In case the mining company is served with cheap electricity from the hydro project, the chiefdom can claim higher royalty which could be utilised for development of the local area.

The Paramount Chief concluded the meeting by asking the audience whether they need the project to come up and everyone present echoed in one voice - YES.

The key conclusions from the stakeholder workshop are:

1. The community showed its strong desire for local mini-grid based project to support local area electrification;
2. The community also showed its willingness to pay for reliable electricity services;
3. The households of Palina village, which is the nearest village to the proposed site of the small hydro power project showed its willingness to relocate from the current location in case of submergence of villages due to the project;
4. Moyamba district produces good quantity of fish. However, in absence of electricity, it can not be stored locally so all the fish are sold at cheap price and taken to the Freetown. Fish cold storage can be developed with supply of electricity, thereby enhancing the local income.
5. The Paramount Chief expressed that he would work with the Councillors and the Council Chairman for construction of the road from the nearest village to the proposed hydro power site.
6. A local level committee will be formed to oversee and facilitate the implementation as and when work on the project is initiated.
7. The aspects of tourism development in the district also came out as the possible development with electricity.

8. Organisation providing training can come to the district to provide capacity building on income generation and other activities.
9. Rutile mining is mostly concentrated in the Moyamba district and with electricity services available the mining company will be attracted towards the Bagruwa chiefdom.
10. With availability of power, children cab study at night, water supply can be ensured through piped supply in the villages

District level workshop

The district level workshop was organized at the District Council Hall in Moyamba town on 25 January 2010. The meeting, chaired by Mr David S Woobay, Chairman, Moyamba District Council, was attended by about 45 participants. The Paramount Chief of Kayamba Chiefdom, representatives from Njalah University, National Power Authority, Ministry of Agriculture, Ministry of Education, Ministry of Finance, NGO's such as Action Aid, Religious Heads, Farmers and Traders Union participated at the workshop. Appendix 1 provides the list of participants of the workshop.

In his opening remark, the Chairman welcomed the visiting team and the rest of the participants and wished that the project is implemented during his term of office as the council Chairman. He stated that, there are lot of pending economic projects in the district whose implementation mainly depends on energy supply. The Paramount Chief elect of Kayamba Chiefdom expressed his happiness about the project and expressed his total support for the project. Mr. Donald Dick from the Ministry Of Agriculture mentioned that the hydropower project was very important for the entire district and therefore the community should be encouraged to stop any deforestation around the site. The District Council Chairman shared that the proposed site will be declared as a 'no go' area to stop any deforestation. Mr. Ibrahim Coker from the Ministry of Education shared that there are 48 secondary schools, 10 vocational institutions and one University in the district. These institutions are unable to perform science practical because of the lack of electricity. He regretted that inspite of the fact that we are in a computer world; Moyamba district has no computer programme in the school system because of absence of electricity. He further said that all categories of beneficiaries should have to be educated about what and how to pay for the electricity services. He also suggested that the Government give Moyamba the opportunity to have their own local mini grid as it would create more jobs for the people in the provinces.

Mr John Koroma, Lecturer at the Physics Department, Njala Campus, reiterated the Chairman's remark that Njala Campus would be the main beneficiary of the project. He said that they are unable to carry out any meaningful research without electricity supply. He further said that Njala campus utilizes electricity from diesel generation and it costs about Le1,000,000 for every 4 hours of electricity supply. He also offered their service to the project from the Environmental Science and Technology Department to do the environmental impact assessment and maintenance and repairs during implementation and operational stages. In conclusion, he stated that all stakeholders should put their hands on the deck and push together for the project to succeed.

The Action Aid representative stated that they believe that poverty is not made by God but is man made through injustices and marginalization. He added that poverty often provokes migration and that their main objective is to alleviate poverty in rural areas. With light there would be transfer of opportunities like education, job creation, etc. to the provinces. He pledged Action Aid's support for the project and specifically stated that Action Aid would assist in the resettlement of villages in case of any relocation due to the project. Mrs Sarah Gbani, women representative stated that the Moyamba people are expecting a lot from the mini hydropower project sighting specific examples of her friends and donors wanting to set up industries at Mokombo River for salt processing and fishing; at Kagboro for fishing industry; and cold rooms in the district for preservation but that, no progress has been made about project because of the lack of electricity in the district. She further said that more women and children are suffering from health hazard in Moyamba district because of lack of light in the hospitals and clinics. In conclusion, she also suggested for an independent grid at local level rather than the national grid.

Dr Harry Will, Ex Minister of the Republic of Sierra Leone said that the role of the local community in the project's implementation should be made clear at the planning stage. Accordingly, the human resources should be strengthened through proper technical training. He also highlighted that hydropower shall encourage setting up of agro processing industries in the district thus alleviating poverty. In conclusion, he laid emphasis on the speedy of implementation and raised concern as to what extent the Government would be financially committed to the project in order to expedite the implementation.

Figure 2 Stakeholder workshop in Mpyamba town

The key conclusions from this workshop are:

1. The workshop reiterated the wish of the community for local mini-grid based project to support local area electrification.
2. Moyamba District Council to provide local logistical support, facilitate project development, and if required take-up project management at local level;
3. The Ministry of Education may run a program on schools to educate and sensitize the people about the importance of electricity, its optimum use and the importance of paying for it.
4. Njala University can also play a big role in sensitization and capacity building of the people. Njala University shall also support capacity building and provide post implementation repair and maintenance services to the project.

5. Action Aid is ready to collaborate with District Council and provide their services for relocation and resettlement of the villagers if there will be any need due to the project construction activity.
6. The District Council shall take steps to construct the approach road to the proposed project site before construction activity is initiated for the project.
7. The community expressed its willingness to pay for reliable electricity services
8. Ministry of Agriculture, Forestry and Food Security to do catchment development and afforestation.
9. The district also has good timber and furniture/wood carving industry can be initiated in the district
10. Computers can be put to use in the schools and colleges in the district with availability of power.
11. Gari processing in the district will be benefited through mechanisation with power from the project.

National level workshop

The workshop was organized on 27th January 2010 at the Conference Hall of the Ministry of Trade and Industry. The workshop was chaired by Mr Syril James Jusu, GEF Focal Point for Sierra Leone and Director of Environment. About 25 participants representing the government, Chamber of Commerce, Banks, bilateral/multilateral agencies, Universities and NGOs attended the workshop. Appendix 2 provides the agenda and the list of participants at the workshop.

This workshop attempted to share the small hydro project with all key stakeholders, learn from past experiences and also discussed how the project can enhance the electricity access and contribute to the sustainable development of the country. This workshop also attempted to understand the stakeholders' involvement including possible co-financing for this particular project to take the project forward towards implementation.

Mr Rana P Singh, UNIDO Industrial Development Officer responsible for the small hydro project welcomed the audience and recognized the interest shown and support given to the project by the Government of Sierra Leone. He also highlighted the genesis of the project and the role being played by UNIDO to develop the energy sector and rural industrialization in the country. He mentioned that UNIDO is playing a facilitation role to develop the project and accordingly has approached GEF for financing. GEF has agreed to provide a support of 2 million US dollars, while the rest has to be arranged through co financing from other sources.

The Director, Trade and Industry shared that UNIDO initiated the project with request from the Ministry in accordance to the PRSP strategy. He mentioned that the industrial sector will become viable only after provision of sustainable generation and supply of electricity. He also wished that the consultative meeting will come out with a document which could be used by the Ministry for its benefit. Thereafter, Mr Rana P Singh provided a very brief review of the power sector in Sierra Leone.

Mr Debajit Palit, UNIDO consultant briefed the audience about the project and also shared the findings from the stakeholder meetings, baseline survey and stakeholder consultations organised at the chiefdom and district level. During the presentation several key factors of the project was discussed

ranging from technical, management, finance, environment, information and coordination, risk, obligation and duties, Government policies and program and possible replication and scaling up. Some of the key issues which were discussed in the workshop are as follows:

- Policy and regulatory framework development
- Possible implementation arrangement and project timeline
- Possible Co financing sources (EU, ECOWAS, AfDB, others)
- Constitution of project management committee
- Local grid vs connectivity to national grid
- Identification of institutions for capacity development & technical support services

All the issues were threadbare discussed in the meeting with participation by all stakeholders. The key points that emerged from the discussion are:

1. All participants expressed their happiness with the continuous work and immediate follow up of UNIDO for the project.
2. There is good potential for consumption of all power generated from a higher project capacity i.e. up to 10 MW
3. The project of higher capacity would be feasible but raising funds for the larger project may be a challenge.

Figure 3 National stakeholder workshop in Freetown

4. It was suggested that it would be prudent to go in for phase wise development. At first instance the smaller capacity project should be focused for early materialization of the project. Thereafter capacity can be enhanced. However, during construction of the 1st phase, provision should be kept for the additional capacity.
5. The mining industries can be contacted for the financing of the project based on the actual technical potential of the project.
6. The Chamber wished that the management of the project should be in the hand of private sector for better project operation.
7. The AfDB suggested that the Government should properly package the project or club number of rural electrification projects to make it attractive for financing by AfDB.
8. AfDB also suggested that the project document being developed for GEF may also be consistent with the Bank's requirement for its consideration to finance the project.
9. It was reiterated that the Moyamba SHP project, with a potential capacity of about 10 MW, could provide power to Njala University, fish cold storages, food processing, gari processing, carpentry/wood works and other agro-based industries, as well as the schools, health clinics, households and shops in the district.

ANNEX 7: PROJECT FINANCING MEETING

Office of The Hon. Minister
Ministry of Energy and Water Resources
Republic of Sierra Leone

29th August, 2012

Dr. Stevens Kargbo
Head of Operations
UNIDO
76 Wilkinson Road
Freetown.

Dear Dr. Kargbo,

SUBJECT: OUTCOME OF HIGH LEVEL MEETING ON UNIDO GEF PROJECT PROMOTING MINI-GRIDS BASED ON SMALL HYDROPOWER FOR PRODUCTIVE USES IN SIERRA LEONE

Please find attached Memorandum of Understanding of the Outcome of High Level Meeting on UNIDO GEF Project Promoting Minigrids Based on small Hydropower for productive uses in Sierra Leone on 14 August 2012 in Freetown.

Thank you for your usual support and ongoing process of His Excellency the President Agenda.

Yours sincerely,

Oluniyi Robbin-Coker
Minister

Enc:

UNIDO RECEIVED
DATE 30/8/12
SIGNATURE

Electricity House, Siaka Stevens Street, Freetown.

Outcome of High Level Meeting on UNIDO GEF Project: Promoting Mini-grids based on Small Hydropower for Productive uses in Sierra Leone

14 August 2012 at Freetown, Sierra Leone

Background:

The proposed UNIDO GEF small hydropower project will be located at Singimi Falls in the Moyamba District, Southern Sierra Leone. According to the feasibility study carried out during the preparatory phase, the project is designed for 10 MW of power generation at a total project cost of $32 million; out of which $2 million has been approved by the Global Environmental Facility (GEF) to cover different supportive activities on hydropower development and productive activities in the country, whereas $30 million is expected to be mobilized as co-financing. Once the co-financing commitments are received and the institutional mechanism is in place, the project will start implementation of the key activities on the ground by January 2013.

Main Issues:

The high level meeting took place on Tuesday August 14, 2012 at the Ministry of Energy and Water Resources in Freetown to review the status and discuss the implementation modalities and co-financing commitments required under the project, and reach an agreement with key partners on the implementation timeline and co-financing commitments. OPEC Fund for International Development (OFID), ECOWAS Bank for Investment and Development (EBID), the European Union (EU) and the Embassy of the People's Republic of China in Sierra Leone were represented as potential co-financiers at the meeting. UNIDO facilitated the organization of the meeting, which was chaired by the Honourable Minister of Energy and Water Resources, and attended by key officials of the concerned ministries such as finance and economic development, energy and the State House (participant list is attached).

The specific procedures for establishing institutional mechanisms for coordination between financing partners and the respective ministries on behalf of the Government of Sierra

Leone were discussed in detail. In particular, EBID and OFID highlighted the importance of detailed feasibility studies covering not only the technical, financial and market aspects, but also the environmental and social impacts of the project for securing approval of their boards for co-financing required under the project.

The following key decisions were reached at the meeting:

1. **Timeline:** It was agreed that the project will start its implementation beginning January 2013. Hence it was decided that all technical, legal and financial agreements with donors, concerned ministries and local institutions that would have impact on the implementation of the project activities, will be reached by December 2012.

2. **Project Appraisal:** In order to facilitate the timely appraisal of the project by EBID and OFID in line with their requirements, it was agreed that UNIDO will share the detailed feasibility studies prepared during the preparatory phase of the project with them. It was further agreed that environmental assessment reports together with social and economic aspects under the project will be shared with all concerned partners including EBID and OFID. Wherever needed, additional studies will be facilitated by UNIDO and MEWR, and circulated to meet the requirements of the partners (EBID and OFID) and the statutory bodies in the country.

3. **Steering Committee**: It was agreed to set up a project steering committee which will be chaired by the Minister of Energy and Water Resources with representatives from the relevant institutions and co-financing partners including EBID and OFID. The project steering committee will provide oversight and overall guidance to the project.

4. **Co-financing:** It was agreed by the key partners – Government of Sierra Leone, EBID and OFID to provide co-financing (grant /concessional loans) to the tune of US $ 30 million as under:
    - Govt. of Sierra Leone: USD 3.6 million (2.0 in kind and 1.6 in cash)
    - OFID: USD 16.4 million
    - EBID: USD 10.0 million

The modalities and conditions of soft / concessional loans to be provided by EBID and OFID will be discussed and agreed with MOFED and MEWR.

5. Follow-up Action:

- MOFED to send a letter of financial request to OFID and EBID, indicating government priority to the UNIDO GEF SHP project at Moyamba. The request should specify which type/window of funding is required, that is, whether public or private sector funding.
- MEWR to request MOFED to make required budgetary provision in national budget starting from 2013.
- MEWR will set up the project steering committee for providing oversight and overall guidance to the project.
- EBID and OFID to review the documentation received from UNIDO, and complete the project appraisal needed for their board approval. Both agencies will target at receiving approval of their respective boards by December 2012.
- UNIDO will facilitate coordination between the co-financing partners; share relevant project studies, documents and information; and assist field visits as well as provide additional technical inputs to partners as and when required.
- UNIDO will support steps by MEWR to put in place project implementation mechanisms – project management unit (PMU), project advisory committee to involve key stakeholders in decision making, and project technical committee to provide technical inputs.
- MEWR will facilitate completion of agreements and approvals needed from various government ministries, departments and agencies including environmental protection agency (EPA) and other statutory bodies as well as local authorities, so that project implementation could start on January 2013.

All commitments and actions are agreed upon by:

H.E. Mr. Oluniyi Robbin-Coker
Minister of Energy and Water Resources

15/08/12
Date

H.E. Mr. Momodu L. Kargbo
Deputy Minister of Finance and Economic Development

29/8/12
Date

Dr. Pradeep Monga
Director, Energy Branch, UNIDO

15.8.2012
Date

Ms. Mona Alessa
Public Sector Operations Officer, OFID

15/08/2012
Date

Dr. Apollinaire Ibrahim Tini
Civil Engineer, Private Sector Operations Department
EBID

15-8-2012
Date

OLC

ATTENDANCE CO-FINANCIERS MEETING, 14 AUGUST 2012				
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ANNEX 8: EIA TRAINING REPORT

Training-Workshop on
Environmental Impact Assessment for Small Hydropower Development in Sierra Leone

23 September – 2 October 2013
Fourah Bay College, University of Sierra Leone
Freetown, Sierra Leone

TRAINING REPORT

Batu Krishna Uprety
International Trainer

November 2013

Acknowledgement

A week-long Training-Workshop on Environmental Impact Assessment for Small Hydropower Development in Sierra Leone was organised jointly by the Government of Sierra Leone – Environment Protection Agency, UNIDO and GEF and the University of Sierra Leone in Freetown from 23 to 30 September 2013.

I would like to express my sincere gratitude to the UNIDO Office at Vienna for involving me in the training-workshop. I express my sincere appreciation to Mr. Rana Pratap Singh, Industrial Development Officer, Energy and Climate Change Branch and Ms. Karel Young at UNIDO, Vienna for all necessary arrangement they made to attend this training programme and for their valuable and practical supports to reach to Freetown on time. I also sincerely appreciate Dr. Kelleh Mansaray, Officer-in-Charge, and other staff of the UNIDO Country Office in Sierra Leone for the excellent arrangement of the training and all logistical supports including the field visit.

I would like to take this opportunity to appreciate the support of Prof. Herbert Bob Kandeh, Chair and officials of the Moyamba District Council for joining the field trip and institutional mapping activity of the study team. I would equally appreciate the support of the Sembehun Paramount Chief and people of Palima village including other villages.

Batu Krishna Uprety
International Trainer
(for EIA Training, SL)

November 2013
Kathmandu, NEPAL

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Executive Summary

Ex ante consideration of the environment provides multiple opportunities to make the development initiatives environmentally sound and sustainable. Small hydro offers benefits especially for rural areas and socially and economically disadvantaged people and is of paramount importance for sustained social development and economic growth, and contribution to reduce anthropogenic emissions of greenhouse gases. Development projects could be made environment-friendly and sustainable through the use of environmental assessment – a tool that helps to identify, predict and evaluate environmental impacts of the development initiative, and avoid, minimise and compensate adverse impacts on the environment.

The Government of Sierra Leone (GoSL) has promoted use of environmental impact assessment (EIA) tool for legally prescribed development initiatives. The GoSL-Environment Protection Agency (EPA), UNIDO and GEF in collaboration with the Fourah Bay College, University of Sierra Leone organised 7-days long training-workshop on EIA for Small Hydropower Development (SHP) in Sierra Leone as a part of human resource development.

The objective of this training-workshop was to provide participants an in-depth understanding of the principles and practices of the EIA as a tool for improving decision-making processes and increasing awareness on environmental effects of renewable energy projects, with an emphasis on SHP. The training course contained 4 modules: (i) country information; (ii) Environmental Assessment: principles and practices; (iii) review and decision-making; and (iv) group work and presentation. The training was followed by the field visit to the proposed 10 MW Moyamba SHP including institutional mapping in the Moyamba district. A total of 35 participants of engineering, natural resources, geology, ecology, entomology, sociology, environmental science and economics background attended the training programme.

Opening the training-workshop, Madam Jatu Jalloh, Executive Chair, GoSL-EPA informed the vision of the EPA to improve and use environmental assessment process. She commended UNIDO and expressed her satisfaction for supporting the government in building human resources and urged the participants to participate actively, noting that EIA is important in planning and management process and can assist in decision-making process. She informed that 'EPA is planning to promote environmental monitoring, reform environmental laws, and ensure coordination to benefit from environmental management efforts'. Dr. Kelleh G. Mansaray, OIC-UNIDO welcomed the Chief Guest, guests and participants and highlighted the objectives of the training-workshop. Mr. Batu Krishna Uprety, International Trainer outlined the course structure and modality of sharing experiences. Dr. Andrew Baio, chair of the session, urged participants to use this opportunity of learning EIA.

A total of 21 presentations and 2 group works were made during the technical sessions. It focused on all aspects of EIA from principles to practices and followed lecture-discussion approach to group work. Participants' understanding on EIA was collected and presentations were tuned accordingly. National resource persons focussed presentations on EIA process, shared core values of EIA, need for involving relevant stakeholders and adopting transparent process. The GoSL requirements on EIA were thoroughly discussed. The EIA process starts with environmental screening and ends with auditing. Important topics such as screening, scoping, ToR, baseline information, impact identification, prediction and evaluation, and alternative analysis were presented and discussed with examples. Similarly, selection of environmental protection measures (benefits enhancement measures, and adverse impact mitigation measures), environmental monitoring, auditing, and preparation of the environmental management plan including public consultation and stakeholder participation were thoroughly discussed with relevant examples. Furthermore, review and decision-making process of EIA report was discussed, including ways to implement EIA recommendations. Participants considered

the training very useful, educative and exhaustive, and recommended to organise such training regularly.

Participants worked in groups to identify and prioritise issues on physic-chemical, biological, and socio-economic and cultural environment of the Moyamba SHP. The groups also evaluated the hypothetical environmental impacts and proposed corresponding measures to augment beneficial impacts and mitigate adverse impacts. The group works should have enhanced confidence of the participants in prioritising issues, evaluating impacts and proposing environmental measures.

On 30 September 2013, Mr. Victor H.O. Swayerr, Deputy Director, EPA, in his closing remark on behalf of EPA Executive Chair, advised the participants to use what they have learned, engage in conducting EIA study, and communicate the positive aspects of their learning as EIA is everybody's issues. He touched upon the legal requirement on EIA and distributed certificate of attendance to the participants. On behalf of the participants, Mr. Joseph Blakie and Mrs. Elizabeth B. Amara appreciated the efforts of the government and UNIDO in organising the EIA training and expressed satisfactions on detail information provided about the EIA methodologies and processes. Ms. Amara urged to engage women in an early stage to make the development sustainable and environment-friendly.

The Lead Trainer, Mr. Batu Krishna Uprety appreciated the organisers for their commendable effort of developing human resources in the field of EIA and also appreciated the participants for their eagerness, willingness, attentiveness and learning attitude. Dr. Kelleh Mansaray informed that selected participants will join the field for actual experience and also informed that UNIDO Regional Office has prepared Country Programme Framework for Sierra Leone and UNIDO's operational components include, *inter alia*, renewable energy and capacity development aspects. Mr. Anthony Orsay thanked the institutions and participants including the resource persons for making the training successful and effective.

A team of selected participants, UNIDO-OIC and Lead Trainer left Freetown to see the proposed 10MW Moyamba SHP on 30 September 2013. Prof. Herbert Bob Kandeh, Chairman, Moyamba District Council joined the Team and visited the Project site on 1 October 2013. The Team met Sembehun Paramount Chief twice on 1 October before going to, and after visiting, the project site and talked about potential development activities in and around the project area. Mr. Chief informed about the concessional mining site (SRL area 4) located at about 10km far from the proposed hydro project site and expressed his interest to support project activities. The Team observed the proposed damsite of the Moyamba SHP and interacted with the local people to seek their inputs, concerns, ideas and views about the project. On 2 October 2013, the Team conducted institutional mapping at Moyamba District to collect views, know sectoral programmes, and possible inputs on the project activities.

On 3 October 2013, members of the Study Team met Mr. Victor H.O. Swayerr, EPA and briefed about the proposed project site and interaction with the local people and district administration. Mr. Swayerr informed about the key legal provisions on EIA and expressed willingness to offer support, when necessary. Members of the Study Team met Hon'ble Deputy Minister for Energy Mr. Alfred Bash-Kamara, and Mr. Benjamin Kamara, Director, Ministry of Energy on 4 October 2013. Hon'ble Deputy Minister showed high level of political interest and commitment to generate renewable energy, in particular the hydro-electricity.

In a nutshell, project location seems appropriate and District Council has a strong desire to implement this project, replace fossil fuel by clean energy, and improve the environmental condition of the area. The field visit was successful and productive to inform people and seek their inputs on Moyamba SHP.

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Introduction

1.1 Background

Sustained supply of clean energy offers multiple opportunities to promote sustainable development. Clean energy could be produced in an environment-friendly, socially acceptable and technically appropriate manner. Hydro-electricity, popularly understood as clean energy, provides multiple avenues to improve economic conditions keeping the area clean, green and environmentally sound. Furthermore, small hydro offers benefits especially for rural areas and for socially and economically disadvantaged people. Ensuring hydropower development in an environment-friendly and socially acceptable manner is of paramount importance for sustained social development and economic growth, and contribution to reduce anthropogenic emissions of greenhouse gases. This could be achieved through *ex ante* consideration of the environment by using an environmental assessment [Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA)] tool which is used to identify, predict and evaluate environmental impacts of any development initiative, and avoid, minimise and compensate adverse impacts on physical, chemical, biological, social, economic and cultural domains of the environment.

The Government of Sierra Leone (GoSL) has ensured the use of environmental assessment for the prescribed development initiatives (plans and projects) through legal provisions and institutional development. The GoSL has established Environment Protection Agency (EPA) to promote *ex ante* consideration of the environment into development process. For this, EIA tool is used before the construction and implementation of an environmentally sensitive project in any location.

Application of IEE and EIA tool requires knowledge-based and trained human resources to best utilise the tool in preparing, reviewing and approving and/or implementing IEE or EIA report of any development project. The GoSL has introduced EIA system through legislation and is making efforts to build and/or enhance the capacity of the environmental practitioners, reviewers and decision-makers including 'interest group' (stakeholders) in using such a tool to know the environmental impacts, both beneficial and adverse impacts, sufficiently in advance, and augment the beneficial impacts and mitigate the adverse impacts to make the development effort environmentally sound and sustainable.

The GoSL-EPA, United Nations Industrial Development Organisation (UNIDO) and Global Environment Facility (GEF) organised 7-days long training-workshop on Environmental Impact Assessment (EIA) for Small Hydropower Development (SHP) in Sierra Leone as a part of human resource development. The training was followed by a 5-days field trip and consultation at the capital including travel time to the proposed 10 MW Moyamba Small Hydropower Project (SHP).

1.2 Objectives

The objective of this training-workshop was to provide participants with an in-depth understanding of the principles and practices of the EIAs as a tool for improving decision-making processes and increasing awareness of the multifaceted environmental effects of renewable energy projects, with an emphasis on SHP.

1.3 Course Modules

The training programme was designed with 4 modules. They are:

1. **Country information**: In order to streamline knowledge, information and experience sharing initiative, country level presentations were made to share national systems and practices on policies, strategies, standards and guidelines relevant to the EIA, hydropower sector, environment and natural resource conservation. It also included presentation and discussion on the EPA Act, 2008 (amendment 2010), and major conventions and treaties to which Sierra Leone is a Party to enhance the understanding of the participants on the national and international obligations and commitments for the conservation and management of the environment and natural resources. The module provided an opportunity to share information and experiences on the current practices of undertaking EIA study in Sierra Leone (Annex 1).

2. **Environmental Assessment - Principles and Practices**: This module empathised on sharing guiding principles, types and origin of EIA system, international initiatives to promote and strengthen EIA through different processes of the United Nations system, multilateral development banks and legal instruments such as the Convention. This session focussed on a complete process from environmental screening to auditing. About 80 percent of the total training time was allocated for, and spent on discussing details of EIA process.

3. **Review and Decision-Making**: This module was designed to let the participants know about review criteria, process and practice of EIA report and how decision-making takes place in the competent government authority such as EPA in case of Sierra Leone. It also contributed to share information on ways to implement the EIA report during construction and operational stages of the project.

4. **Group Work and Presentation**: Participants worked in three groups on ways to identify, document, and prioritise environmental issues for the EIA study. They also revisited the issues, and evaluated the hypothetical impacts as a part of enhancing confidence on impact evaluation and selection of environment protection measures.

5. **Field Visit**: After the closing of the training-workshop, 4 trainees were selected based on their interest, academic qualification, and working discipline for the site visit in the proposed Moyamba SHP. The study Team comprised of UNIDO-OIC, 4 trainees as subject specialists, and lead trainer and the field trip was joined by the Chair of the Moyamba District Council. The Team observed the potential dam site, and discussed with the local people in Palime village and other villages about the current state of social infrastructures, biological resources in and around the project area, and their willingness to participate in the project activities. The Team also met twice with the Paramount Chief to inform about and to seek his guidance on the project. A half-day was also allocated for institutional mapping in Moyamba District Headquarter.

A total of 35 participants attended the training programme. Participants represent from engineering background (Civil, Mechanical, electrical, and Environmental Engineers), and other subjects such as natural resources, geology, ecology, entomology, sociology, environmental science and economics (Annex 2).

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Opening Session of the Training-Workshop

The training-workshop on 'EIA for Small Hydropower Project in Sierra Leone' was opened by Madam Jatu Jalloh, Executive Chair, Environment Protection Agency of the Government of Sierra Leone.

Welcoming the Executive Chair, guests and participants, Dr. Kelleh G. Mansaray, Officer-in-Charge, UNIDO Country Office in Sierra Leone highlighted the objectives of the training-workshop, urgency of developing human resources to reconcile development and environment to promote sustainable development, involvement of UNIDO in capacity building initiatives, and focus of the training followed by the field visit. Dr. Mansaray urged the participants to be attentive, regular, and best utilise this opportunity to learn more about the elements of the environmental assessment within a short period of time.

Mr. Batu Krishna Uprety, International Trainer opined that benefit of EIA has been lately understood in the Least Developed Countries. Environment agencies have to work with and coordinate comparatively bigger and well-established institutions and companies that sometimes make the voices of the environmentalists weak and unheard. Mr. Uprety informed that the training course has been designed based on 'learning by doing' approach, resembles with academic courses, and focuses on principles, processes and practices of EIA, review and decision-making on EIA report. It also provides information on who and when to implement the environment protection measures, and process for monitoring and auditing.

Opening the training programme Mrs. Jatu Jalloh, Executive Chair stressed that it is the vision of the EPA to improve and use environmental assessment process in Sierra Leone. Mrs. Jalloh commended UNIDO and expressed her satisfaction for supporting the government in building human resources. She urged the participants to participate actively, noting that EIA is important in planning and management process and can assist in decision-making on land and resource use, conservation and sustainable development. She further emphasised that EPA is a custodian of the environment, and uses EIA tool to ensure development sustainable. She informed that 'EPA is planning to promote environmental monitoring, reform environmental laws, and ensure coordination to benefit from environmental management efforts'.

From the chair, Dr. Andrew Baio, Fishery and Environmental Resource Economist in the Institute of Marine Biology and Oceanography urged participants not to miss the opportunity of learning EIA, and sharing experiences. The opening session was followed by technical sessions.

Highlights of the Technical Sessions

A total of 21 presentations and 2 group works were made during the 7-days training-workshop. It focused on all aspects of EIA from principles to practices and lecture-discussion to group work. The highlights of each topic and module are summarised below:

3.1 Country Information

23 September 2013, Monday

1. After the opening session, Prof. Johathan Allotay, EPA Consultant shared his experience on *overview of EIA process* and opined EIA as a key foundation and integrated tool for environmental management. In LDCs, poor people depend upon environmental resources and EIA provides information on how people will be impacted from the project activities. This tool also provides multiple options to make the development sustainable. Prof. Allotay emphasised that EIA is an orderly and systematic assessment of impacts, and help to identify, predict and evaluate likely environmental impacts of, including hydro dam, project consequences on livelihoods, mitigation and management of adverse impacts, and all about informs on prior knowledge on impacts. He highlighted the importance of environmental screening and scoping.

   Prof. Allotay also discussed about the benefits of EIA which are related to modifying and improving design, ensuring efficient use of resources, enhancing social benefits, avoiding serious and irreversible damages to the environment, and protecting human health. The core values of EIA are to ensure integrity, confirm to agreed values, and provide balance information for decision (utility). He also highlighted the guiding principles and concluded that EIA is only 43 years old (its use was started in 1970), and public hearing and involvement of interdisciplinary team provide opportunities to prepare good quality EIA report.

2. Prof. Ernest Ndomahina, IMBO presented a paper on *current practice of undertaking environmental assessment*. Prof. Ndomahina outlined the need for identifying stakeholders including governmental and non-governmental organisations, involving interdisciplinary study team, and meeting the local people to seek their concerns, ideas and views. He urged the need for good quality environmental scoping report to guide the EIA report preparation process. Prof. Ndomahina also urged to follow national regulatory provisions and World Bank's guidelines on EIA process. He equally focussed to look into alternatives, mitigation measures and opined that EIA is a business of everybody.

3. In order to know understanding of the participant on EIA, participants were encouraged to fill-up questions (Annex 3). Analysis of the questions indicated some participants familiar with the concept of EIA and some were noticed confused. Many participants

considered that Ministry of Energy should allocate budget for the implementation of the environment management plan, and that EPA should prepare EIA report. Most of the participants considered that proponent should bear the cost of environmental damage it has created, and proponent should be engaged in EIA report preparation and implementation. It contributed to tune presentations to help enhance understanding of the participants on EIA and associated activities.

4. Mr. Lahai Samba Keita, Senior Officer of the Environment Protection Agency presented a paper on *EIA requirements (National EIA or Environmental Guidelines) in Sierra Leone*, and shared provisions of, and experiences in implementing regulatory framework, in particular the EPA Act 2008 (amendment 2010) regarding EIA process. Mr. Keita emphasised from Section 23 to 29 of the EPA Act which provisions for prohibition of certain activities, project requiring EIA licence, public comments on EIA, and process for issuing licence. He also elaborated different stages of the EIA process based on regulatory framework such as registration, screening, scoping, report preparation, review, public participation, decision-making and issuance of licence, including licence fee, monitoring and reporting. Mr. Keita urged to 'keep the people first' as EIA focuses on peoples' participation.

5. Dr. Ralph Bona, Project Manager of the Revision of NBSAP (National Biodiversity Strategy and Action Plan) and Preparation of 5th National Report to the Convention on Biological Diversity shared information and experiences on *environmental and natural resource related legislations and major treaties and Conventions to which Sierra Leone is a Party*. Dr. Bona highlighted the focus of the national policies on environment, lands, energy, agriculture, forest and wildlife (draft), and fishery. He outlined a number of legislations such as EPA Act, Forestry Act, Electricity and Water Regulatory Commission Act, Fisheries Act, Wildlife Conservation Act, and Local Government Act that might be attracted while developing hydropower project. Dr. Bona informed that Ministries of Energy, Water Resources, Fisheries and Marine Resources, Agriculture Forestry and Food Security, Lands Country Planning and Environment, and Works Housing and Infrastructure are important institutions that need to be consulted during the EIA process. Dr. Bona listed Conventions such as UN Framework Convention on Climate Change, Kyoto Protocol, Ramsar Convention, Basel Convention, Convention on Biodiversity, and Convention on International Trade of Endangered Species of Wild Flora and Fauna to which Sierra Leone is a Party. He informed that those aspects not covered in national legislations and policies, World Bank's operational policies, IFC strategies and Equator principle of private investment shall prevail in the EIA process in Sierra Leone.

3.2 Environmental Assessment: Principles and Practices

24 September 2013, Tuesday

6. Mr. Batu Krishna Uprety presenting the *concept, definition, guiding principles and types of environmental assessment* introduced EIA as an amalgamation of both science and art. Mr. Uprety considered EIA a simple and user-friendly tool, used as 'prevention strategy' for environmental

management and to attain the goals of sustainable development. EIA has a well defined beginning and an end and the tool provides stakeholders and local communities, both to be affected and beneficiaries, multiple opportunities to participate in the project activities right from EIA study to project implementation and auditing. He elaborated the guiding principles, and listed commonly used terminologies in environmental assessment (EA) processes.

Mr. Uprety elaborated *origin of environmental assessment and EA provisions in legally non-binding and legally binding international instruments* with particular focus on major resolutions or decisions of the conferences between Stockholm Conference on Human Environment in 1972 and Johannesburg Summit on Sustainable Development in 2002. Three decades of global effort has encouraged each State to use the EA tool through policy and legal measures. Mr. Uprety also elaborated on Article 14 of the Convention on Biological Diversity that calls upon the Parties to take appropriate measures and ensure public participation to avoid or minimise the adverse impacts of project activities on biodiversity.

7. Mr. Momodu A. Bah, Senior Officer, EPA elaborated *EIA Process* in general, and in Sierra Leone in particular. He briefly discussed aims, objectives and coverage including benefits, of EIA. He also touched upon the core values and guiding principles, and discussed elements of the EIA process such as screening, scoping, impact analysis, mitigation, report, review and decision-making, EIA implementation and follow-up, and public involvement. Mr. Bah focussed both on technical and management aspects of EIA and project implementation. He also shared his experience in decision-making of EIA report in the EPA.

8. Mr. Batu Uprety, presenting a paper on *environmental screening* drew the attention of the participants on general screening criteria, including criteria and practices in the World Bank-funded projects, and Nepal's Environment Protection Rules to encourage participants to develop and use appropriate criteria when necessary.

25 September 2013, Wednesday

9. In the morning session, Mr. Batu Uprety informed the participants that screening leads to *environmental scoping*. He elaborated the objectives and methods for scoping, and identification and prioritisation of key issues that should be studied while conducting EIA. Mr. Uprety shared on how environmental scoping of Nepal's 20 MW Mai Khola Hydropower Project was prepared to inform participants on approaches to identify, collect, and prioritise environmental issues for the EIA study. He advised to give more emphasis to engage stakeholders as socio-economic and cultural issues are important and need to handle them carefully.

Participants were divided into three groups to do exercise on environmental scoping. The groups worked out on case information of Moyamba SHP, identified and prioritised issues on: (i) physical and chemical environment; (ii) biological environment; and (iii) socio-economic and cultural environment for both construction and operational stages, and presented their group work on the same day.

10. Dr. Ralph Bona discussed the generic format of the *Terms of Reference* for the EIA study including provisions of the EPA Act, 2008 (amendment 2010). Dr. Bona outlined the elements of ToR such as objectives of the ESIA study, key tasks such as field data acquisition, ecological surveys and hydrological monitoring, and methods for data collection and analysis. He also touched upon the deliverables and content of the ESIA report and environmental management plan (EMP) that include general EMP, waste management plan, occupational health and safety, emergency response and flood preparedness plan, decommissioning plan, and environmental monitoring plan. He also discussed on social management plan that may be included in the community development action plan, cultural asset management plan, resettlement action plan, and grievance redress mechanism. The ToR provides guidance on elements to be studied and requirements to be fulfilled during the EIA study.

11. Mr. Batu Uprety informed the participants about the *nature of data and information required and methods for data collection and analysis*. He advised to delineate the study area and collect data of, at least, the direct impact area, meaning area where 'impact will happen'. Depending upon the nature, location and scale of the project, several parameters under physico-chemical, biological and socio-economic and cultural domain of the environment could be considered. Mr. Uprety also described selected methods to collect and analyse data, also giving example of the hydro-electricity generation project.

26 September 2013, Thursday

12. In the morning session, Mr. Batu Uprety drew the attention of the participants on *generic methods for impact identification, prediction and evaluation*. About three hours was devoted to inform the participants about the categories of impacts, methods and techniques for impact identification, prediction and evaluation. It also discussed on evaluating the significance of impacts. Mr. Uprety informed that 'impact evaluation might be guided by the need, perception and understanding of the person involved' in impact assessment and assessment should consider the merits and interests of stakeholders, understand the values of resources likely to be affected, and find ways to have common understanding on impacts. In general, identified impacts will occur, and predicted ones might occur.

13. In the afternoon session, Mr. Uprety shared basics of, and ways to carry out, *alternative analysis* by giving examples of fossil fuel vs clean energy, hill road vs valley road, and commercial vs community forests. He cited an example of irrigation project where alternative analysis provided a basis to substantially least damage the matured forest area as a part of site clearance in Nepal. He also cited alternative analysis of operational forest management plan using scoring (points) approach for the selection of an appropriate alternative.

14. Selection of the best alternative provides opportunities to further identify, predict, and evaluate location-specific environmental impacts (for selected alternative) and propose appropriate measures to off-set significant adverse impacts and augment the beneficial impacts. Mr. Uprety drew the attention of the participants on *environmental impacts and selection of environmental protection measures*. He emphasised to avoid, minimise or compensate the adverse impacts using the avoidance-minimisation-compensation framework and also using precautionary principle where applicable, and 'no net loss'

approach, and promoting 'positive planning'. Mr. Uprety also focused to consider type, location, and significance of impact, and value of resources to be affected, and propose cost-effective and location-specific local options, to the extent possible, with example of road project.

27 September 2013, Friday

15. As a part of enhancing participants' knowledge on the content of the EIA report, Mr. Uprety outlined the elements of *environmental monitoring* to know the extent to which impacts enhancement and mitigation requirements are working, and help to evaluate the degree of implementation (level of compliance and effectiveness) of the environment protection measures. He urged to define objectives, review data and information, characterise monitoring parameters, identify monitoring types and methods, define monitoring intensity, locate monitoring site(s), define roles and responsibilities, allocate budget, staff and equipment, define analysis and evaluation methods, and also define report format and content in the monitoring framework. He also encouraged the participants to consider 5W (what, when, where, which method, who) and how much cost while proposing baseline, compliance or impact monitoring as a part of the EIA report by citing an example of Nepal's hydropower project.

16. Mr. Uprety, presenting *environmental auditing*, urged the participants to use the same method (used to collect and analyse baseline data) in auditing, to the extent possible, to minimise methodological variation. He elaborated different types of auditing in practice and advised to conduct project impact auditing to examine environmental changes arising out of the project implementation and to assess project-specific actual environmental impacts. He presented results of the environmental auditing report of hydropower project of Nepal to let the participants know about the variation between prediction and actual impacts as lessons for future impact assessment.

17. Once participants were informed about all elements of the EIA report, Mr. Uprety shared principles, practices and experiences on preparation of *environmental management plan* (EMP). An EMP is a 'living document' and should be reviewed periodically and improved and implemented throughout the life of the project to reflect the changing conditions. Again, EMP should be prepared using 5W (why, what, who, where and when) approach and management concept such as POSDCORB (Planning, Organisation, Staffing, Directive, Coordination, Reporting and Budgeting). Mr. Uprety shared a sample plan and encouraged to make user-friendly and 'easy to implement' plan.

18. Prof. Ernest Ndomahina, IMBO, presenting a paper on *public participation and stakeholder consultation*, urged participants to engage and seek inputs from stakeholders to facilitate the implementation of the EIA report. Prof. Ndomahina informed the need to review policy document, and contact appropriate ministries and departments, relevant people and paramount chief, local council, and land owning families. In general, elites capture the public consultations and it is necessary to seek the inputs of the project affected people, farmers group, medical group, cooperatives, women group, children group or all community-based organisations and local administrations, to understand their issues and concerns. Non-governmental organisations may be involved in raising awareness and public inputs could be collected through public hearing, focus group discussion, and open-house discussion. He opined

that such consultations would help to develop a practical community development action plan (CDAP), implement and monitor the plan with stakeholders' participation, where appropriate.

3.3 Review and Decision-Making

28 September 2013, Saturday

19. The EIA report should be approved by the competent government authority before implementation of the project (requiring EIA). On 28 September 2013, emphasis was given on *Module III: Review and Decision-making* of EIA reports. Mr. Batu Uprety presented the contents of *EIA report format*, used in funded projects and guided through the national system. As users of the EIA report might be public, professionals, decision-makers and implementers, such report should be technical with non-technical summary and should be prepared using simple language, linking each chapter in a concise form, and avoiding contradictory information and statements.

20. Mr. Uprety, presenting (i) *review of EIA reports: process, review criteria and practice,* and (ii) *review responsibility and decision-making process*, outlined the objectives of review to ensure the quality of the report that should contain correct, clear, understandable and technically sound information. Mr. Uprety elaborated review approach and method in developed and developing countries, review criteria (scoring and grading), questions-based review, and decision-making processes. He also shared Nepal's approach of review and decision-making. He informed that Nepal has made the proponent and study team responsible on the quality of information contained in the EIA report.

21. Dr. Andrew Baio, Fisheries and Environmental Resource Economist presenting a paper on *implementation of EIA recommendations* explained the EIA process from scoping to monitoring, and approaches to synchronizing EIA and project cycle. Dr. Baio elaborated components of the EIA report, particularly on environmental and social management plan (ESMP), resettlement policy framework (RPF)/resettlement action plan (RAP), and community development action plan (CDAP), and operational guidelines for contractors taking into consideration the mitigation measures. He opined that EPA should supervise the project to ensure that environmental commitments are being adhered by the project developer. He further shared issues in capitalizing on Nature and urged to measure ecological wealth as ecosystem is an economic asset.

22. Information related to tentative time required for the preparation of the EIA and its associated report (scoping and ToR) was also discussed. Participants further discussed on environmental scoping, and impacts evaluation.

23. At the end of the session, participants were encouraged to fill-up the evaluation form (Annex 4). Participants were found clear on issues related to EIA, except variation in topics related to their work and interest area. Some of the remarks are as follows:

    Mr. Alhaji A. R. Abdullah said that 'training was very useful. It was quite educative as it elaborated on various aspects of ESIA study and report writing. The guidelines outlined for Environmental Management Plan and decision-making have strengthened all participants in writing good EIA reports'. Some considered 'training very educative and exhaustive' while others recommended to 'organise training regularly'. Almost all participants appreciated UNIDO for organising this training-workshop in a timely and orderly fashion.

3.4 Group Work and Presentation

On 25 September 2013, participants were organised in three groups to look separately into: (i) physical and chemical environment; (ii) biological environment; and (iii) socio-economic and cultural environment to work on Moyamba SHP as a part of environmental scoping (Annex 5). The groups were advised to identify and raise environmental issues based on the case information, and prioritise issues for the EIA study for both construction and operational stages.

The Group A (physical and chemical issues) focussed on parameters related to air, water, land, marine and human environment. The group considered the need for studying aquatic biology, including bacteria, phytoplankton, macrophytes, micro and macro invertibrates, and terrestrial flora and fauna. After presentation, the group was advised to see the relevance of studying biological aspects under physical-chemical parameters.

The Group B (biological issues) identified generic issues and prioritised to study on habitat loss, fragmentation and depletion of biodiversity, ecosystem imbalance, and climate change during the construction stage. The Group considered the same issues and included turbulence issue for fish death during the operational stage.

The Group C (socio-economic and cultural issues) considered, *inter alia*, the importance of studying demographic issues (age, tribe, household size), landuse pattern, land tenure, social infrastructure (education, transportation, road, power & water supply), relocation, public health and possible spread of new diseases, downstream effect, and possible conflict between locals and workers. List of participants in different groups is annexed (Annex 6). Participants looked the issue from multi-disciplinary approach.

On 28 September 2013, same groups further worked and refined priority issues (scoping exercise) to develop confidence on selecting and prioritising issues. The Groups were also advised to evaluate environmental impacts of a sample case and propose mitigation measures. The following hypothetical impacts were provided to evaluate and propose mitigation measures to enhance understanding and improve confidence of the participants:

a. Employment of xxx no. of people during construction stage
b. Continuous supply of electricity to xxx no. of people in Moyamba district
c. Loss of core habitat of rare species (flora and fauna - aquatic and terrestrial), e.g. deer
d. Loss of xxx no. of timber quality trees
e. Likely occurrence of a landslide (500m^2) within 1 km upstream of damsite
f. 99% loss of fish species and their productivity in dewatered zone
g. Loss of xxx ha of agriculture land for project construction
h. Acquisition of 12 houses as a part of site clearance
i. Possible pressure from workers on local health, post/hospital for check up and medicines
j. Possible stress on community drinking water from workers
k. Likely regular injury to workers while working in steep damsite
l. Demolition of community religious site in project area

Closing Session of the Training-Workshop

On 30 September 2013, a closing ceremony was organised to distribute certificate to the trainees and seek their feelings and inputs on training itself.

Dr. Kelleh Mansaray, Officer-in-charge, UNIDO welcomed the chief guest of the closing ceremony Mr. Victor H.O. Swayerr, Deputy Director (Operations, Planning, Policy and Research), EPA and appreciated the good conduct of the participatory training approach. Dr. Mansaray encouraged the participants to use ' learning' in preparing and reviewing EIA reports for the benefit of the country.

On behalf of the male participants, Mr. Joseph Blakie appreciated the efforts of the government and UNIDO in organising the EIA training. He expressed his satisfaction on detail information provided about the EIA methodologies and processes and also expressed his confidence to conduct EIA including preparation of the Scoping Report of any project. He appreciated the information and experience sharing approaches and considered that field visit will help in enhancing the knowledge gained. Mr. Balkie thanked the Lead Trainer for his open and clear sharing approach.

Mrs. Elizabeth B. Amara, speaking on behalf of female participants, informed that she was very much delighted to have such an elaborated training on EIA, and she might now relate the information down to earth. She advocated the urgency of recognising women for their active involvement in natural resource management and sustainable use, and urged to engage women in an early stage of development to make it sustainable and environment-friendly.

The Lead Trainer, Mr. Batu Krishna Uprety appreciated the Government of Sierra Leone, UNIDO and Fourah Bay College for their commendable effort of developing human resources in the field of EIA and also appreciated the participants for their eagerness, willingness, attentiveness and learning attitude. Mr. Uprety advised the participants to be engaged in EIA study, review and/or monitoring to build confidence and know 'what works' and 'what does not' to improve impact assessment process.

Mr. Victor Sawyerr, on his closing remark on behalf of EPA Executive Chair, thanked the co-organisers UNIDO, GEF, and University of Sierra Leone, and expected that participants would have learned EIA process with focus on environmental and social health impact assessment which is carried out at the project level. He touched upon the legal requirement on EIA with particular focus on screening, scoping, environmental management plan, and community development action plan to reduce impacts of the project activities on the environment, including public inclusion and legal process to grant EIA licence. Mr. Sawyerr also informed on new projects under EIA

process that might engage the participants. He urged the trainees to teach friends about the importance of EIA to attain the goals of sustainable development. Mr. Sawyerr advised the participants to use what they have learned, and communicate the positive aspects of their learning as EIA is everybody issues. Mr. Sawyerr distributed certificate of attendance to all participants.

Dr. Kelleh Mansaray informed that selected participants will join the field for actual experience and informed that UNIDO Regional Office has prepared Country Programme Framework (CPF) for Sierra Leone and UNIDO's operational components include development of growth centres, promotion of agribusiness, renewable energy development, capacity development and implementation of quality assurance. The CPF focuses on agenda for prosperity through economic diversification, international competitiveness, and skilled labour. The CPF aims to strengthen other pillars as cross-curing issues such as women and youth. Dr. Mansaray thanked the participants, EPA and line ministries for sending participants as a part of human resource development.

Mr. Anthony Orsay, UNIDO thanked all the institutions in particular the EPA and Ministry of Energy, Fourah Bay College, and participants including the resource persons for making the training successful and effective.

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Moyamba SHP Field Visit

On 30 September 2013, a team of selected participants (representing physical, chemical, biological, socio-economic and cultural domain of the environment) and Lead Trainer under the leadership of Dr. Kelleh Mansaray, Officer-in-charge, UNIDO Country Office, Sierra Leone went to Moyamba district to see the proposed 10MW Moyamba SHP. The Team met Ms. Vivian Senessie, Chief Administrator, Moyamba District Council (MDC) in the evening and briefed about the objective and programme of the field visit.

Study Team

Kelleh Mansaray
Batu K. Uprety
Anthony Davies
Fatmata Kaiwa
Alhaji A.R. Abdullah
Prince Kpelu Muzan
David Abdul Konneh

Prof. Herbert Bob Kandeh, Chairman, MDC has kindly joined the Team and visited the Project site on 1 October 2013. The Team met Sembehun Paramount Chief twice on 1 October before going to, and after visiting, the project site.

The Team observed the proposed damsite of the Moyamba SHP and interacted with the local people to inform them about potential impacts and seek their inputs, concerns, ideas and views about the project. The Gbangba River was observed comparatively big taking into consideration the proposed hydro-electricity generation capacity of 10MW, and volume of water just after the confluence of the Singimie River into the Gbangba River on 1 October 2013. The proposed damsite on the natural drop in the Gbangba River looks visually appropriate with wide riverbank. The project site is also easily accessed with transportation facility. Local people also briefed the study Team about the nature of the rivers and drying up of Singimie River during the dry season. The project site was observed with luxurious forests of few species and with little ground vegetation.

The Team met and discussed with local people at Sembehun, Momana, Palima and Petefu villages. The Palima and Singimie are the nearest villages along the right and left bank of the river respectively. The Team interacted extensively with people at Palima village, about 8 km far from the proposed damsite. The Singimie village could be reached by crossing the river. Local people were found enthusiastic and supportive to the Moyamba SHP.

The Council Chair observed the proposed damsite and attended meeting with the villagers. The Team along with the Chair met with the Paramount Chief and discussed about the potential development activities in the project area. Mr. Chief informed that the concessional mining site (SRL area 4) is located at about 10km from the proposed hydro project site. It was observed that he is well informed about the hydro project, and expressed his interest to support project activities.

On 2 October 2013, the Team conducted *institutional mapping* at Moyamba District Headquarters to collect views, know sectoral programmes, and possible inputs on the project activities. Some institutions were visited taking into consideration the possibility of their participation during the project construction and operational stages.

Mr. Emmaneul Deoud, Deputy Chief Administrator of the MDC joined the Team and introduced the Team with head or deputy head of the following institutions in Moyamba District on 2 October 2013:

1. Ministry of Agriculture, Forestry and Food Security
2. National Commission for Social Action (NACSA)
3. Ministry of Health, Primary Health Care
4. Ministry of Education, Science and Technology
5. Divisional Headquarter of Police

On 3 October 2013, the members of the Study Team, including the Lead Trainer, met Mr. Victor H.O. Swayerr, Deputy Director, and Human Resource Officer of the Environment Protection Authority, and briefed about the information collected and inputs received from the local people and district administration. Mr. Swayerr informed about the key provisions on EIA as included in the EPA Act, 2008 (amendment 2010) and expressed willingness to offer necessary support from EPA, when necessary.

Members of the Study Team met and briefed to Hon'ble Deputy Minister for Energy Mr. Alfred Bash-Kamara, and Mr. Benjamin Kamara, Director, Energy, Ministry of Energy on 4 October 2013. Hon'ble Minister has instructed to work closely with Mr. Benjamin Kamara to develop the project and informed about the priority of the Government of Sierra Leone on renewable energy production, in particular the hydro-electricity, taking into account the high potentiality for clean energy generation. Hon'ble Deputy Minister also showed his interest to develop this hydropower as CDM (Clean Development Mechanism) project to benefit from the provisions of the Kyoto Protocol. Hon'ble Deputy Minister informed about the enforcement of the National Electricity Act, 2011. This indicates higher level of political commitment to generate renewable energy, in particular the hydro-electricity.

In a nutshell, project location seems appropriate and District Council has a strong desire to implement this project, replace fossil fuel by clean energy, promote clean energy use, and improve the environmental condition of the area. The field visit was successful and was productive to inform the people and seek their inputs on Moyamba SHP.

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Annex 1

Training-Workshop on Environmental Impact Assessment for Small Hydropower Development in Sierra Leone

September 23 – October 2, 2013

Fourah Bay College, University of Sierra Leone, Freetown

Training Programme

Time	Topics	Resource Person
Day 1: September 23, 2013 Monday		
08:30 – 09:00	Arrival of the Participants and Registration	
09:00 – 09:30	Opening Session	
	Chair: Dr. Andrew Baio, Fishery and Environmental Resource Economist, Institute of Marine Biology and Oceanography (IMBO) Welcome/Introduction: Dr. Kelleh Monsaray, Officer-in-charge, UNIDO, Sierra Leone Overview of the Training Workshop: Mr. Batu Krishna Uprety, Lead Trainer Keynote Address and Official Opening: Madame Jatu Jalloh, Executive Chair, Environment Protection Agency, Sierra Leone Chair's Remark: Dr. Andrew Baio, IMBO	
09:30 – 10:00	Tea Break	
10:00 – 10:30	Overview of the EIA Process	Mr. Jonathan Allotay, EPA Consultant
	Questionnaire fill-up to assess understanding of participants on EA tool	Mr. Batu Krishna Uprety, Lead Trainer
Module I: Country Information		
10:30 – 12:30	Current Practice of undertaking environmental assessment	Prof. Ernest Ndomahina, IMBO
12:30 – 14:00	Lunch	
	Introduction of the Participants (with academic qualification and experience)	
14:00 – 15:15	National EIA or Environmental Guidelines	Mr. Lahai Samba Keita, EPA
15:15 – 15:30	Tea Break	
15:30 – 17:00	Environment and natural resource conservation-related legislations, major treaties and convention to which country is a Party	Dr. Ralph Bona, CEMMATS Group Limited
End of the Day		
Day 2: September 24, 2013 Tuesday		
Module II: Environmental Assessment: Principles and Processes		
08:30 – 09:00	Arrival of the Participants	
09:00 – 10:30	Concept, definition, guiding principles and types of environmental assessment	Mr. Batu Krishna Uprety
10:30 – 10:45	Tea Break	
Module II: Environmental Assessment: Principles and Processes		
10:45 – 12:30	Origin of environmental assessment and EA provisions in legally non-binding and legally binding international instruments	Mr. Batu Krishna Uprety
12:30 – 14:00	Lunch	
14:00 – 15:30	Environmental Assessment process (screening to environmental auditing)	Mr. Momodu A. Bah, EPA

15:30 – 15:45	Tea Break	
15:45 – 17:00	Environmental screening – types of proposal	Mr. Batu Krishna Uprety
End of the Day		
Day 3: September 25, 2013 Wednesday		
08:30 – 09:00	Arrival of the Participants	
09:00 – 10:30	Environmental scoping: Methodology and Practice	Mr. Batu Krishna Uprety
10:30 – 10:45	Tea Break	
10:45 – 12:30	Group Work on Environmental Scoping • Physical and chemical environment • Biological environment • Socio-economic and cultural environment Group work presentation and discussion	Mr. Batu Krishna Uprety
12:30 – 14:00	Lunch	
14:00 – 15:30	Terms of Reference	Dr. Ralph Bona
15:30 – 15:45		
15:45 – 17:00	Nature of data and information required and methods for data collection and analysis	Mr. Batu Krishna Uprety
End of the Day		
Day 4: September 26, 2013 Thursday		
08:30 – 09:00	Arrival of the Participants	
09:00 – 10:30	Generic methods for impact identification, prediction and evaluation	Mr. Batu Krishna Uprety
10:30 – 10:45	Tea Break	
10:45 – 12:30	Generic methods for impact	Mr. Batu Krishna Uprety
12:30 – 14:00	Lunch	
14:00 – 15:30	Alternative analysis	Mr. Batu Krishna Uprety
15:30 – 15:45	Tea Break	
15:45 – 17:00	Environmental impacts and selection of environmental protection measures	Mr. Batu Krishna Uprety
End of the Day		
Day 5: September 27, 2013 Friday		
08:30 – 09:00	Arrival of the Participants	
09:00 – 10:30	Environmental monitoring	Mr. Batu Krishna Uprety
10:30 – 10:45	Tea Break	
10:45 – 12:30	Environment auditing	Mr. Batu Krishna Uprety
12:30 – 14:00	Lunch	
14:00 – 15:30	Preparation of Environmental Management Plan	Mr. Batu Krishna Uprety
15:30 – 15:45	Tea Break	
15:45 – 17:00	Public participation and consultation in EA process	Prof. Ernest Ndomahina, IMBO
End of the Day		
Day 6: September 28, 2013 Saturday		
Module III: Review and Decision-Making		
08:30 – 09:00	Arrival of the Participants	
09:00 – 10:30	EA Report Format	Mr. Batu Krishna Uprety
10:30 – 10:45	Tea Break	
10:45 – 12:30	Review of EA Reports: process, review criteria and practice	Mr. Batu Krishna Uprety
12:30 – 14:00	Lunch	

14:00 – 15:30	Review of EA Reports: Review responsibility and decision-making process	Mr. Batu Krishna Uprety
15:30 – 15:45	Tea Break	
15:45 – 17:00	Implementation of EA recommendations	Dr. Andrew C.M. Baio, IMBO
End of the Day		
Day 7: September 29, 2013 Sunday		
08:30 – 09:00	Arrival of the Participants	
09:00 – 10:30	Additional discussion on environmental scoping: Group Work and presentation	Mr. Batu Krishna Uprety
10:30 – 10:45	Tea Break	
10:45 – 12:30	Case study on impacts evaluation: Group Work and presentation	Mr. Batu Krishna Uprety
12:30 – 14:00	Lunch	
14:00 – 15:30	Time required for EIA and associate reports preparation	Mr. Batu Krishna Uprety
15:30 – 15:45	Tea Break	
End of the Day		
Day 8: September 30, 2013 Monday		
09:00 – 11:00	Closing Ceremony	
	Statements • Female Trainee Representative • Male Trainee Representative • Lead Trainer • Deputy Director/Executive Chair, EPA	 Ms. Elizabeth B. Amara Mr. Joseph Blakie Mr. Batu Krishna Uprety Mr. Victor H.O. Swayerr
	Closing Statement: Dr. Kelleh Mansary, OIC, UNIDO	
	Certification: Executive Chair of EPA, OIC of UNIDO and Mr. Batu Krishna Uprety, Lead Trainer	
	Vote of Thanks: Anthony Orsay, UNIDO	
End of the Training		

Day 8 –12: September 30 – October 4, 2013
Module IV: Field Visits and Meetings

Day 8 & 10 Field visit
Day 11 Meeting with the Environmental Protection Agency
Day 12 (first half) Meeting with the Ministry of Energy and the way forward

Note: From second day onward, recap of the previous day will be done in the first session of the day, although not reflected in the programme for each day.

Annex 2

Training-Workshop
EIA for Small Hydropower Development in Sierra Leone

September 23 – October 2, 2013

Venue: Fourah Bay College, University of Sierra Leone

List of Participants

SN	Name	Designation	Institution	E-mail
1	Adnan Mansaray	Mechanical Engineer	National Power Authority	Adnan_mansaray@yahoo.com
2	Alhaji Abdul Rahman Abdullah	Geologist, Mining and Processing Consultant and Admin Manager (Environmental)	CEMMATS Group Limited	aabdullah@cemmatssl.com
3	Alimamy S. Sesay	Research Assistant	IMBO	immy_sesay@yahoo.co.uk
4	Andrew Baio	Fisheries & Environmental Economist	UNIDO SL/IMBO	
5	Anthony Davies	Managing Director	ECOSYS SL	acimbaio@gmail.com
6	Arnold Okoni-Williams	Lecturer, Biological Sciences Dept.	Fourah Bay College	davisa@ecosyssl.com
7	Assiatu A. Jalloh (Ms)	B. Eng (Mech)	NP SL Limited	aokoni2001@yahoo.com
8	Bai Kamara	Peace and Conflict	Fourah College	jallohassiatuagnes@gmail.com
9	Bartham K. Otterbein	Geologist	Cemmats Group Limited	botterbein@cemmatssl.com
10	Brima A. Mansaray	Social/Environmental Scientist	EDRA Consultancy	Baleighmans57@yahoo.co.uk
11	David Abdul Konneh	Mechanical Engineer	National Power Authority	davidulkon@gmail.com
12	Elizabeth Boima Amara (Ms)	Lecturer	Institute of Marine Biology and Oceanography	eboima2002@yahoo.co.uk
13	Emmanuel M Bangura	Mphil. Student	Fourah Bay College	emma.electronics@yahoo.com
14	Fatmata J. Kaiwa (Ms)	Head, Biological Sciences Dept.	Fourah Bay College	fatmata_kaiwa@hotmail.com
15	Francis Peacock-Cole	Lecturer, Electrical Engineer	Fourah Bay College	frapcole@yahoo.co.uk
16	George Morris	Founder National Coordinator	Youth Action for Self-Development	youthaction4selfdevelopment@gmail.com
17	Ibrahim B. Lansana	Environmental & Management Officer	ECOSYS SL	ibrahimlansana@ecosyssl.com
18	Isha Juliana Moses (Ms)	Research Assistant	IMBO, Fourah College	ishajulianamoses@hotmail.com
19	Ishmael Aruna	Civil Engineer	Moyamba District Council	ishmaelsylaruna@yahoo.com
20	Ishmail Y. Kanu	Environmental Engineer	Environmental Protection Agency	ishmailbarnard@yahoo.com
21	Jamillatu Mansaray (Ms)	Power Engineer	National Power Authority	myjamilla@yahoo.com
22	John Paul Kaisam	Quality Expert/Environmentalist	Njala University	kaisamjp@yahoo.com
23	Joseph D. Blackie	Mechanical Engineer/MPhil Student	Fourah Bay College	joedomblack@yahoo.co.uk
24	Lansana M. Fortune	Research Assistant	KEA Consultancy Firm	lansanafortune@yahoo.co.uk
25	Millicent F. Bawoh (Ms)	Civil Engineer	SL Institution of Engineers	millicent_bawoh@yahoo.com

SN	Name	Designation	Institution	E-mail
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28	O. B. A. Davies	Lecturer, Civil Engineering Dept.	Fourah Bay College	obafemidavies@yahoo.com
29	Paul S. Dumbuya	Environmental and Social Officer	Western Area Rural District Council	paulsimah@yahoo.com
30	Prince K. Muzan-Ekpelu	Lecturer	Mechanical Engineering Department, Fourah Bay College	pkmuzan@gmail.com
31	Sahr T. Nyalloma	Acting Head	Mechanical and Maintenance Engineering Department, FBA	sahrnyalloma@yahoo.com
32	Sallay Sheriff (Ms)	Civil Engineer	Sierra Construction System Limited	ssallaytitoh@yahoo.com
33	Samuel Isaac Bangali	Civil Works Engineer	Moyamba District Council	samziza072013@gmail.com
34	Sheriff Kamara	Energy Engineer	Fourah Bay College	mechanicalchair@yahoo.com
35	Sidney Vandy Tucker	Sociologist	Fourah College, University oef SL	zainabmustwin@yahoo.com

Annex 3

Environmental Impact Assessment for Small Hydropower Development in Sierra Leone

23 September – 2 October 2013

General Understanding on EIA

1. Environmental Impact Assessment (EIA) is a tool used to:
   (i)
   (ii)

2. Please arrange in proper order:
   a. Pre-feasibility/feasibility study
   b. Approval of the EIA report
   c. Implementation of the project
   d. Carrying out EIA study of the proposal
   ....

3. Please arrange in the proper order:
   a. Environmental auditing
   b. Preparation of TOR for EIA study
   c. Scoping
   d. Project screening
   e. Environmental monitoring and evaluation
   f. Baseline information collection
   ....

4. List the key words that are frequently used in EIA report.
   (i) (ii)
   (iii) (iv)

5. ---------- is responsible for allocation of budget for implementation of Environmental Management Plan as included in the approved EIA report of small hydropower project.

   (A) Ministry of Energy (B) Ministry of Land (C) Consultant (D) Proponent

6. EIA is an environmental management and decision supportive tool: (a) True (b) False

7. Environmental scoping is carried out to identify the issues and concerns that should be considered during EIA report preparation: (a) True (b) False

8. EIA is prepared by the EPA in Sierra Leone: (a) True (b) False

Name of the participant: .....
Date: 23 September 2013

Annex 4

Training-Workshop on EIA for Small Hydropower Development in Sierra Leone

23 September – 2 October 2013

Evaluation Form

You are encouraged for straight-forward comments/suggestions. **Please tick mark (√)**

1. Is your participation for the first time on EIA training workshop? (a) Yes (b) No

2. Did the training meet your expectation? (a) Fully (b) Partially (c) No

3. Did you find the training useful? (a) Yes (b) No (c) Don't know

4. Which of the following topic(s) you find important and related to your work? (you can √ more than 1)

   (a) Policy and legislation (b) Scoping and ToR (c) Baseline information

   (d) Impact identification, prediction and evaluation (e) Environment protection measures

   (f) Environmental monitoring, evaluation and auditing (g) Report review and decision-making

   (h) Public participation (i) EIA process (j) Implementation of EIA recommendations

5. Which of the course content you enjoyed during the presentation and discussion? (you can √ more than 1)

   (a) Policy and legislation (b) Scoping and ToR (c) Baseline information

   (d) Impact identification, prediction and evaluation (e) Environment protection measures

   (f) Environmental monitoring, evaluation and auditing (g) Report review and decision-making

   (h) Public participation (i) EIA process (j) Implementation of EIA recommendations

6. Were you involved in EIA works in the past? (a) Yes (b) No (c) don't recall

7. Now, can you contribute to prepare and/or review EIA report? (a) Yes (b) No (c) don't know

8. Who is responsible to implement Environmental Management Plan?

   (a) EPA (b) Project developer (applicant for EIA)

9. What scoping report deals with? (a) Impacts and mitigation measures (b) Issues for EIA study

10. Who prepares the EIA report of government hydropower project? (a) EPA (b) Ministry of Energy

Comments and suggestions, if any. .....

.....

.....

Name of the participant: .....

Date: 30 September 2013, Monday

Annex 5

Case study for Scoping Exercise

Moyamba Small Hydropower Project in Sierra Leone

Located at about 39km from downtown of Moyamba district, Moymaba Small Hydropower Project (SHP) will have a proposed installed capacity of 10MW. The Moyamba downtown, South Province of the country, is 237 km away from the capital Freetown. The hydro-electricity that replaces diesel generators including of Njalah University will provide clean energy to people living at Moyamba downtown, and the University.

The Moyamba SHP is located on the Gbangba River which has good vegetation/forest condition within the river basin. The area receives an annual rainfall of 2,474mm. The average annual flow in the river is 83.2 m^3/s with highest in September (162 m^3/s). Rocks on both sides of the river are partially exposed, and most of them covered by good vegetation. The river basin above dam site is uninhabited and non-cultivated with pristine environmental quality.

The project has a catchment area of 1580 km^2 at the dam site. A reservoir of 10 million m^3 capacity will be developed to generate 10MW hydro-electricity. Along the dam site, river has a natural drop where bed-rocks are fresh, weakly weathered and exposed to the air. The right bank has a slope of about 25^0 and left bank with $5\text{-}10^0$ slope and river bed width of over 150m. Such a riverbed is favourable for layout of spillway structures, powerhouse and engineering diversion structures.

Main structures are weir dam of 13.5m high, flushing sluice as flood discharging sluice on the right end of the weir, and powerhouse with a 3.3m wide tail water emergency gate platform erected down powerhouse. Some area might be used for labour camp, material storage area, and development of temporary workplace. About 1.5km long access road will be constructed to join powerhouse site. An earth-rock cofferdam will be constructed. The Project will require significant quantity of coarse and fine aggregates.

Based on the above information, please **identify priority issues** for EIA study for the **construction and operational stages** on physical, chemical, biological, social, economic and cultural domain of the environment:

- Identify the issues as the expert of the EIA study team taking note of the above information;
- Raise issues being the stakeholders, interest group or affected people/community;
- Discard the irrelevant issues, if any (which is not directly related to the project activities), please note that issues included in the Scoping Document should be studied during the EIA report preparation); and
- Identify the priority issues for EIA study.

Role play: Environmentalists, hydrologist/hydro-geologist, water engineer, project developer/ investor, Hydropower Engineer, natural resource users/conservationist, socio-economist, religious leader, affected people (whose land should be acquired to construct the hydropower), local community (who will get employment and energy), EPA official, MoE official, etc.

Please mention

(a) Issues Identified
(b) Issues Raised
(c) Issues Discarded, and
(d) Prioritised Issues for EIA Study

25 September 2013, Wednesday

Annex 6

List of Participants in the Group Work

Group A: Physical and chemical issues

a. Anthony Davies
b. David A. Konneh
c. Francis Peacock-Cole
d. Jamillatu Mansaray
e. Millicent F. Bawah
f. Oba Davies
g. P.K. Muzan-Ekpeh
h. Samuel I Bangali
i. Sheriff Kamara

Group B: Biological issues

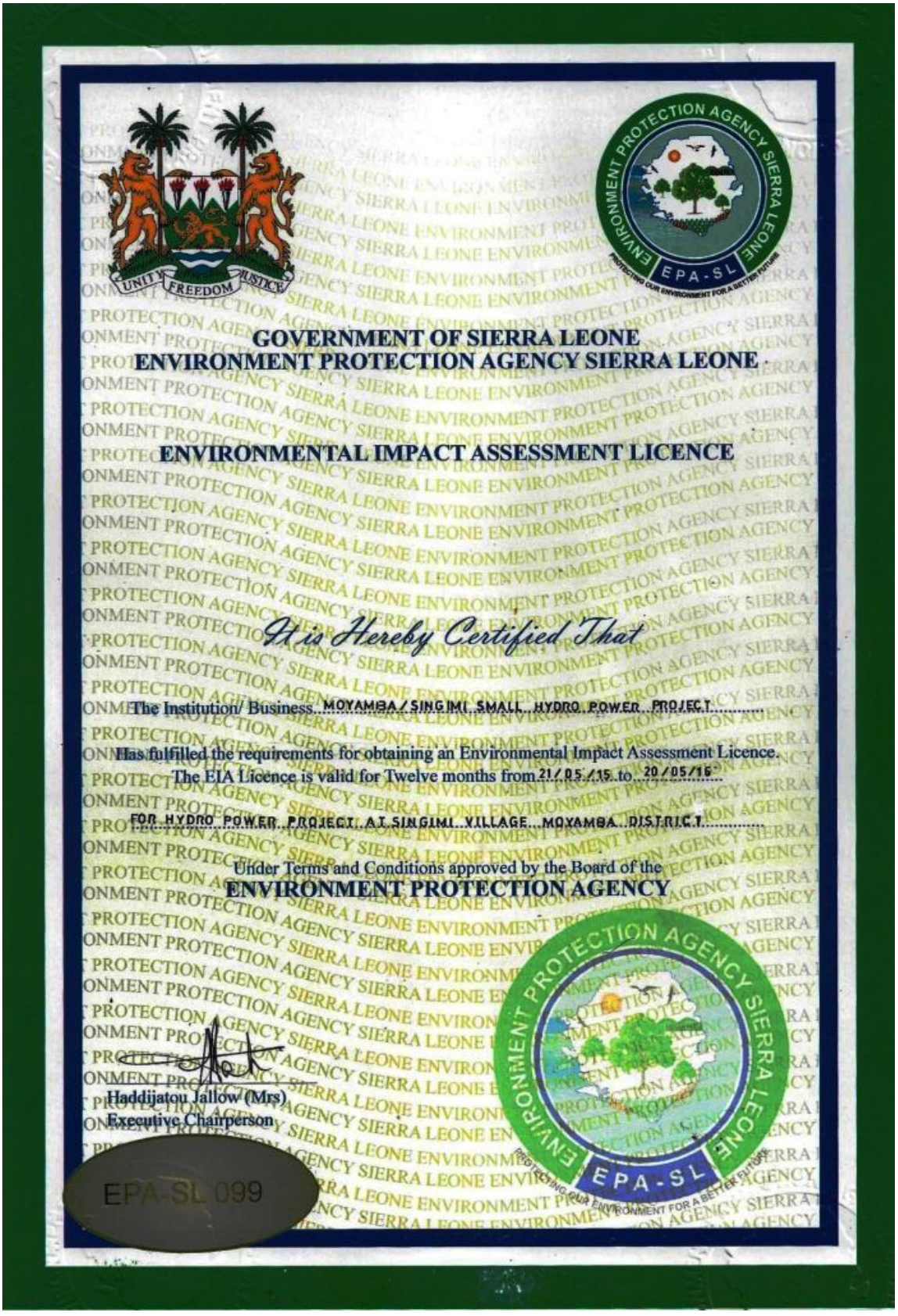
a. Alimamy Sesay
b. Bai Kamara
c. Elizabeth Boima Amara
d. FatmataKaiwa
e. George Morries
f. Isah J. Moses
g. Joseph Dominic Blackie
h. Sahr T. Nyalloma

Group 3 Socio Economic & Cultural

a. Adnan Mansaray
b. Alhaji Abdul Rahman Abdullal
c. Assiatu A. jalloh
d. Barttam K. Otterbein
e. Ibrahim B. Lansana
f. Ishmail Y Kanu
g. Lansana M. Fortune
h. Sallay Sheriff

oooooooooooo

ANNEX 9: EIA LICENSE



GOVERNMENT OF SIERRA LEONE
ENVIRONMENT PROTECTION AGENCY SIERRA LEONE

ENVIRONMENTAL IMPACT ASSESSMENT LICENCE

It is Hereby Certified That

The Institution/ Business MOYAMBA / SINGIMI SMALL HYDRO POWER PROJECT

Has fulfilled the requirements for obtaining an Environmental Impact Assessment Licence.

The EIA Licence is valid for Twelve months from 21/05/15 to 20/05/16

FOR HYDRO POWER PROJECT AT SINGIMI VILLAGE MOYAMBA DISTRICT

Under Terms and Conditions approved by the Board of the
ENVIRONMENT PROTECTION AGENCY

Haddijatou Jallow (Mrs)
Executive Chairperson

EPA-SL 099

ANNEX 10: SHP TRAINING REPORT

TRAINING WORKSHOP
ON
HYDROPOWER PROJECT DEVELOPMENT IN SIERRA LEONE

VENUE: Fourah Bay College,
University of Sierra Leone

July 03 – 12, 2013

Alternate Hydro Energy Centre
Indian Institute of Technology Roorkee
India

Contents **Page No.**



TIME TABLE

TRAINING WORKSHOP ON HYDROPOWER PROJECT DEVELOPMENT IN SIERRA LEONE

VENUE: Fourah Bay College, University of Sierra Leone

July 3 – 12, 2013

Day One: Wednesday, July 3 2013	
09:00 – 10:00	Registration of Trainees
10:00 – 11:00	**Welcome/Introductions:** Dr. Kelleh Gbawuru Mansaray, UNIDO Energy Coordinator. **Presentation:** Overview of Training Workshop, Dr. Arun Kumar, IITR, India. **Keynote Address & Formal Opening:** Dy. Minister of Energy.
11:00 – 11:30	Tea/Coffee Break
	TRAINING MODULES
11:30 – 13:00	• Overview of SHP Development and studies done in the past – *Dr Arun Kumar, IITR, India*
13:00 – 14:00	Lunch Break
14:00 – 15:15	• Approach for identification of potential sites – *Dr Arun Kumar, IITR, India*
15:15 – 15:45	Tea/Coffee Break
15:45 – 17:00	• Hands on catchment area delineation and project layout – *Dr Arun Kumar, IITR, India*
Day Two: Thursday, July 4 2013	
09:00 – 10:30	• Structure for pre- feasibility report and feasibility report– *Dr Arun Kumar, IITR, India* • Different types of investigations – *Dr GCS Gaur, India*
10:30 – 11:00	Tea/Coffee Break
11:00 – 13:00	• Hydrological Observations – Methods, Limitations – *Dr GCS Gaur, India* • Flood estimations – *Dr Arun Kumar, IITR, India*
13:00 – 14:00	Lunch Break
14:00 – 15:15	• Hydrology of un-gauged catchments – *Dr Arun Kumar, IITR, India*
15:15 – 15:45	Tea/Coffee Break
15:45 – 17:00	• Flow duration and installation capacity estimation – *Dr Arun Kumar, IITR, India*
Day Three: Friday, July 5 2013	
09:00 – 10:30	• Existing practice for meeting energy demand – *Mr B K Bhatt, India* • Survey of load demand – *Dr GCS Gaur, India*
10:30 – 11:00	Tea/Coffee Break
11:00 – 13:00	• Strategy formulation and regulation for SHP development – *Dr Arun Kumar, IITR, India* • Survey of power evacuation and distribution lines – *Dr GCS Gaur, India*
13:00 – 14:00	Lunch Break
14:00 – 15:15	• Environmental impact assessment related investigations (Air, water, soil, flora, fauna, wild life) – *Dr GCS Gaur, India*
15:15 – 15:45	Tea/Coffee Break
15:45 – 17:00	• Public participation and response – Mr B K Bhatt, India
Day Four: Saturday, July 6 2013	
09:00 – 10:30	• Topographical surveys– *Dr RD Garg, IITR, India* • Different scales for topographical surveys– *Dr RD Garg, IITR, India*
10:30 – 11:00	Tea/Coffee Break
11:00 – 13:00	• Instruments used for surveys – *Dr RD Garg, IITR, India* • Modern equipments for topographical surveys– *Dr RD Garg, IITR, India*
13:00 – 14:00	Lunch Break
14:00 – 15:15	• Survey for muck disposal – *Dr GCS Gaur, India* • Geological investigations – *Dr GCS Gaur, India*
15:15 – 15:45	Tea/Coffee Break

15:45 – 17:00	• Landslides and slope stability – *Mr B K Bhatt, India*
Days Five: Sunday, July 7 2013	
09:00 – 17:00	• Travel to project site in university campus for hands on training on discharge measurement, use of GPS, survey equipment, load demand survey, selection of sampling locations, method of survey and investigations – *Dr GCS Gaur, Dr RD Garg,Dr Arun Kumar, Mr BK Bhatt*
Days Six: Monday, July 8 2013	
09:00 – 17:00	• Travel to small hydro power station site outside of Freetown for hands on training on discharge measurement, use of GPS, survey equipment – *Dr GCS Gaur, Dr RD Garg, Mr BK Bhatt, Dr RP Saini, Mr MK Singhal, IITR*
17:00 – 18:00	Dinner
Days Seven: Tuesday, July 9 2013	
09:00 – 10:30	• Planning and preliminary design of diversion weir and intake works - *Mr MK Singhal, IITR*
10:30 – 11:00	Tea/Coffee Break
11:00 – 13:00	• Environment Impact Assessment – *Dr GCS Gaur, India.* • Planning and preliminary design of desilting tank and forebay tank – *Mr MK Singhal, IITR & Dr GCS Gaur, India.*
13:00 – 14:00	Lunch Break
14:00 – 15:15	• Selection and specifications of hydraulic turbines – *Dr RP Saini, IITR, India*
15:15 – 15:45	Tea/Coffee Break
15:45 – 17:00	• Selection and specifications of hydraulic turbines – *Dr RP Saini, IITR, India*
Days Eight: Wednesday, July 10 2013	
09:00 – 10:30	• Planning and preliminary design of channel, tunnel and pipes – *Mr MK Singhal, IITR*
10:30 – 11:00	Tea/Coffee Break
11:00 – 13:00	• Selection and specifications of hydro generators – *Dr RP Saini, IITR, India*
13:00 – 14:00	Lunch Break
14:00 – 15:15	• Planning and preliminary design of penstock and surge tank – *Mr MK Singhal, IITR*
15:15 – 15:45	Tea/Coffee Break
15:45 – 17:00	• Selection and specifications of power evacuation – *Dr RP Saini, IITR, India*
Days Nine: Thursday, July 11 2013	
09:00 – 10:30	• Planning and preliminary design of power house building – *Mr MK Singhal, IITR*
10:30 – 11:00	Tea/Coffee Break
11:00 – 13:00	• Planning and preliminary design of access road and temporary housing – *Mr MK Singhal, IITR* • Preparation of feasibility report – *Mr MK Singhal, IITR, India*
13:00 – 14:00	Lunch Break
14:00 – 15:15	• Cost estimates – *Mr MK Singhal, IITR, India*
15:15 – 15:45	Tea/Coffee Break
15:45 – 17:00	• Cost estimates – *Mr MK Singhal, IITR, India*
Day Ten: Friday, July 12 2013	
09:00 – 10:30	• Financial Analysis – *Mr MK Singhal, IITR, India*
10:30 – 11:00	Tea/Coffee Break
11:00 – 12:00	• Specification for turnkey execution – *Mr MK Singhal, IITR, India*
12:00 – 13:00	Closing Ceremony **Statement:** Trainee Representative **Closing Statement:** Head of UNIDO Operations **Certification:** UNIDO and IITR **Chief Guest:** Dy. Minister of Energy.
13:00 – 14:00	Lunch

SMALL HYDROPOWER PROJECT DEVELOPMENT TRAINING WORKSHOP IN SIERRA LEONE
July 3 – 12, 2013
Venue: Fourah Bay College, University of Sierra Leone

List of Participants

No.	Name	Designation	Institution	Contact	
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FEEDBACK
on
Programme for the

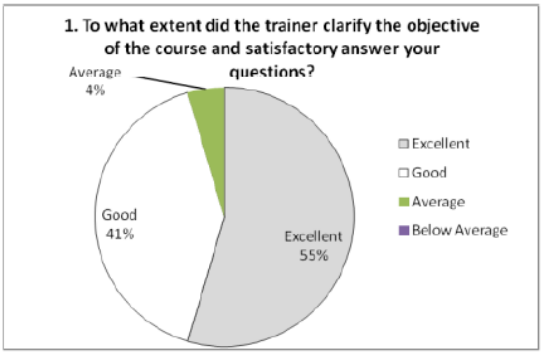
"Training Workshop on Hydropower Project Development in Sierra Leone"

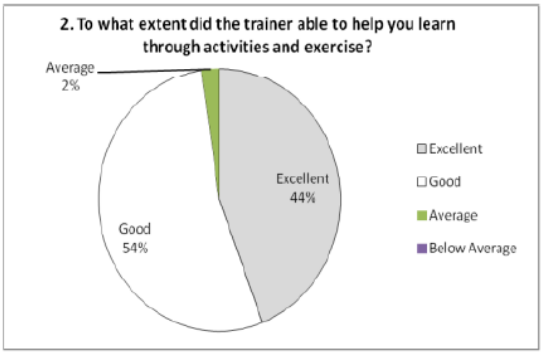
at
Fourah Bay College, University of Sierra Leone

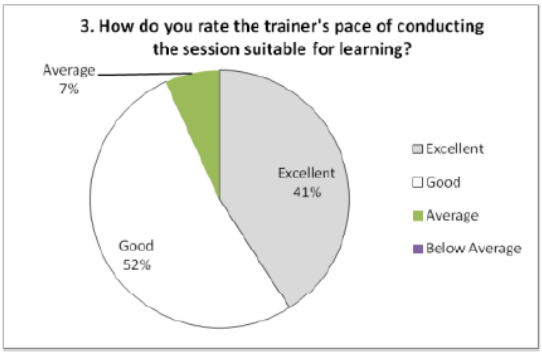
from 3rd to 12th July 2013
Freetown, Sierra Leone

Number of participants – 44

TRAINER







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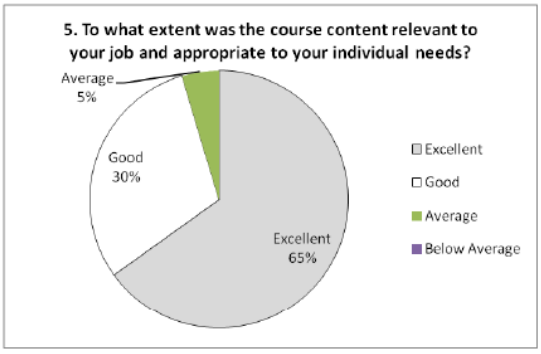

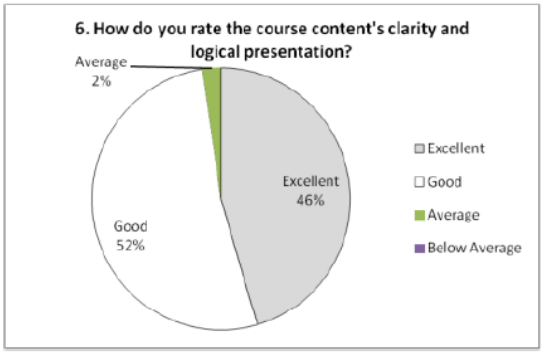

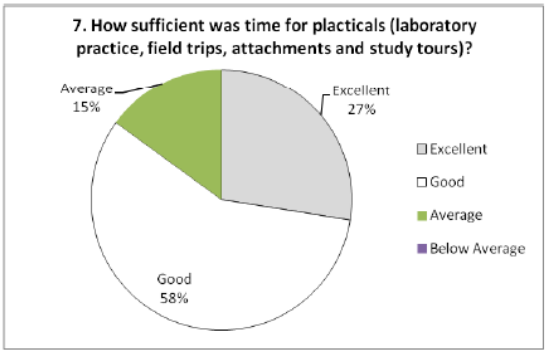

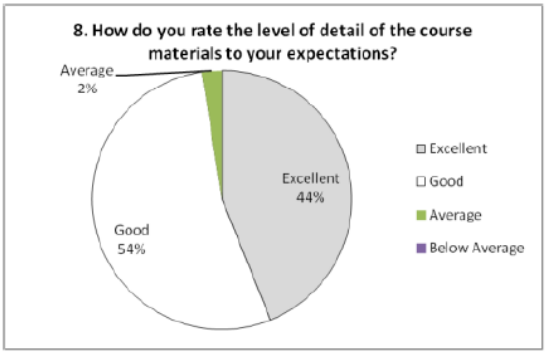

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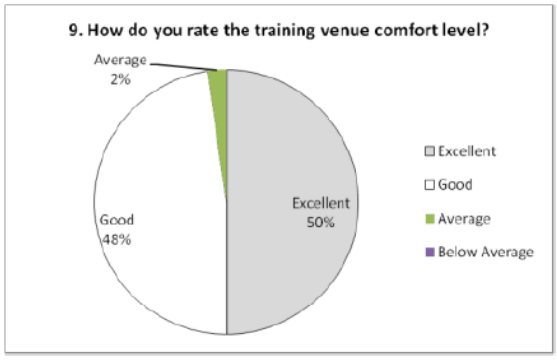

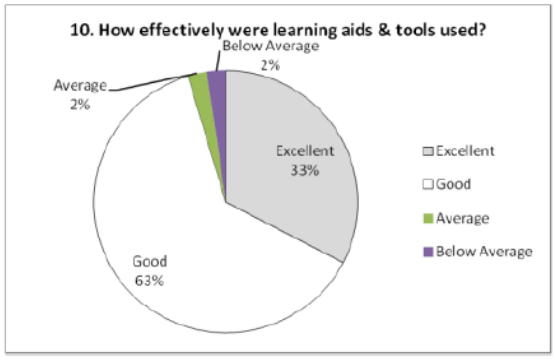

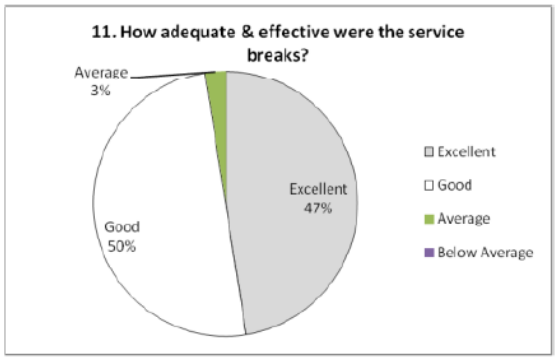

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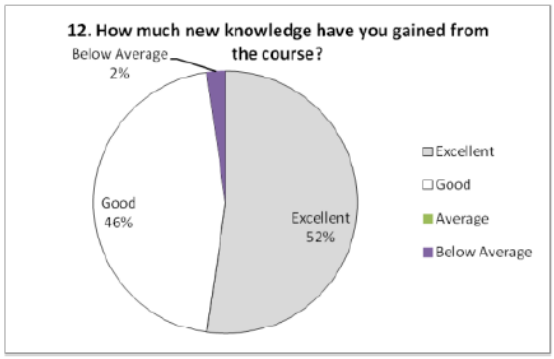

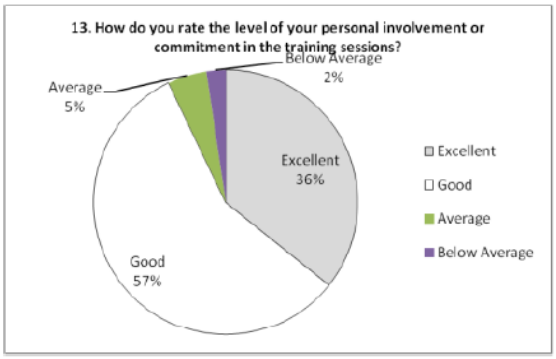

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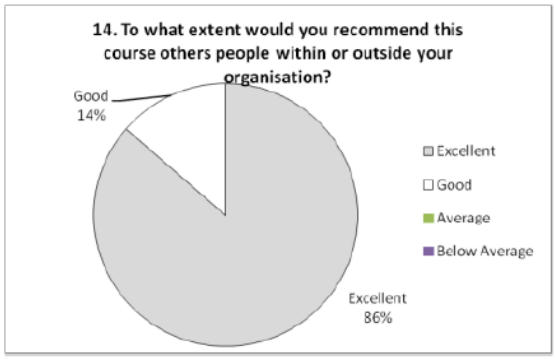
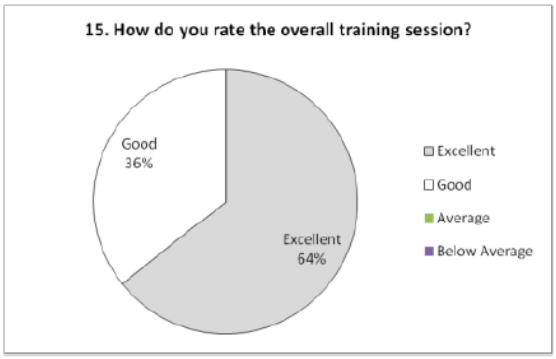




ADDITIONAL COMMENTS BY THE PARTICIPANTS:

1. The trainers have excellent knowledge about the programme. Fine if such a programme is conducted every year. The programme is very much appropriate for the development of Sierra Leone.
2. Appealing of UNIDO to be conducting such workshop at regular interval because it is really nice and educating. We appreciate you a lot for this wonderful gesture.
3. It will be nice next time for all participants to have a soft copy of the presentations at least one week before the start of the training.
   Content: Average for the industry. Need SCADA details. Soft copy of detail text looks will be necessary.
4. In conclusion, the entire process was worthy and very important for a developing nation (Sierra Leone); this type of training should be conducted in every 2 months.
   Trainers: The L1 was influencing the English making it very difficult to understand.
   Facility: They were not sufficient food served not good enough.
5. **Trainers:** This concept is good, simple method of teaching.
   Content: New Idea are developed, very interesting.
   Facility: Very comfortable.
   Learner: I can't explain the level of this knowledge.
   Overall: It is good to get this kind of training every time possible, very interesting.
   UNIDO to do continuation of the training.
6. I recommend for more detail trainings on Environmental and Impact Assessment for participants if possible extend invitations to more environmentalist.
   Trainers: Field instruments/equipments were insufficient for the practical.
   Content: As an environmentalist I am very much concern EIA issues. Not much priority was given to it. Weather conditions inhibited the field visits and also insufficient field equipments.
   Facility: Transportation was very difficult especially to the college campus.
7. Accent of some trainers were not clear to me. It would be nice for this kind of training to go on with a very good practical. **Content:** Trainees not well organized for practical training.
8. To redo such training again for both academic and professional level. Excellent training session and has contributed greatly towards my final year papers.
9. I will like this kind of course continuation and or go to India for additional training so we will have hydro engineers in Sierra Leone.
10. It is very good.
11. This group of trainers should be maintained.
12. This type of course requires a minimum time of 21 days for more hand on exercise and filed visits. Participants of such projects should be attached to ongoing similar projects to enhance or improve on what they have learnt.
13. More training must be done in detail in future. This has been very educative. Mistake in the chauhoffe project have been clearly seen.
    Trainers: It was too compressive for the very short time, very good and experienced.
    Content: Time too short.
14. Trainers should be organized for specific areas for deeper understanding of concept.
    Trainers: Too fast especially for fresher.
15. Please extend this programme to at least all final year mechanical & maintenance engineering students on Campus.

16. Government should encourage student to pursue this course at higher level and also the course should be free of charge at university.
17. I recommend this type of training to the Sierra Leone Institute of Engineers for the maintenance of our hydro systems.
18. There should be follow up courses to further enhance the capacity of the trainees and empower more engineers in the area of tapping the abundant hydro resources in the country.
19. Much was gained from the training, but trainer's medium of communication in terms of accent need improvement for proper grasp by us trainees.
    Trainers: Accent of trainers was slight hindrance. More time and equipment needed for practical sessions.
    Content: Course materials were very relevant. Exercises were hurriedly done.
20. The course is excellent but we need to visit some sights (hydro) in the future for higher learning.
21. I recommend this kind of training to be offered us in new courses in IITs for more studies (to pay visit in our country for site seeing). Next training helps us to have clarity of the book use, so that we may see and understand.
22. In case of future training provision should be making to visit the Bubua hydro power station.
23. In order to building human capacity in energy development, such course should be done regularly.
24. I recommend that such a course be done in further modules to enhance proper capacity building of participants.
25. It is a good opportunity as a participant to this course as it widens my hydrological view, with a comment; I will be delighted for more apparatus, emphasis to be laid in home country.
26. Much experience gain in the train especially at the sections of turbines for the type of output to be generated. I wish this type of training will be done for further advancement study in the area.
27. For the development of our nation, there should be a continuation of such programme. Further studies involving other engineers for us to become fully experienced and stand on ourselves to develop our country.
28. The course is very interesting and it's very elaborate, so I think that the time should be increase for any time similar workshop is to done in the country. The experts were very good in their presentation and I suggest they are maintained for similar workshop in the near future.

Programme on

TRAINING WORKSHOP ON HYDROPOWER PROJECT DEVELOPMENT IN SIERRA LEONE

Venue: Fourah Bay College, University of Sierra Leone

(July 03 – 12, 2013)

Course participant's Evaluation Form/Feedback Form

Dear Participants,

We request you to provide us with objective feedback to make this training process more effective. The rating scale is: 4 – Excellent, 3 – Good, 2 – Average, 1 – Below average (Please write your remarks in case the rating is 2 or 1)

Sl. No.	INDICATOR/DESCRIPTION	RATING	REMARKS
	TRAINERS		
1.	To what extent did the trainers clarify the objective of the course and satisfactory answer your questions?	3	
2.	To what extent did the trainers able to help you learn through activities and exercise?	4	
3.	How do you rate the trainer's pace of conducting the session suitable for learning?	4	
4.	How do you rate the overall ability of the trainers?		
	CONTENT		
5.	To what extent was the course content relevant to your job and appropriate to your individual needs?	4	
6.	How do you rate the course content's clarity and logical presentation?	4	
7.	How do you rate the hand on exercise and field visits?	3	
8.	How do you rate the level of detail of the course materials to your expectations?	3	
	FACILITY		
9.	How do you rate the training venue comfort level?	3	
10.	How effectively were learning aids & tools used?	3	
11.	How adequate & effective were the service breaks?	3	
	LEARNER		
12.	How much new knowledge have you gained from the course?	4	
13.	How do you rate the level of your personal involvement or commitment in the training sessions?	3	
	OVERALL		
14.	To what extent would you recommend this kind of training to others and or go for new courses in future if offered?	4	
15.	How do you rate the overall training session?	4	

Additional Feedback: (Write in the space below any other comments concerning this course)

The trainers have Excellent knowledge about the programme
Hope if such a programme is conducted every year
The Programme is very much appropriate for the development of Sierra Leone

Thank you for your time to complete this form.

SOME PHOTOGRAPHS TAKEN DURING TRAINING PROGRAMME AND SITE VISIT

Mr M A Bash Kamara, Dy. Minister of Energy, Govt. of Sierra Leone at the time of Inauguration

Training on Day 1

Mr M A Bash Kamara, Dy. Minister, Govt. of Sierra Leone

With Professor Ogunlade Davidson, Ex. Minister of Energy and Water Resources

Trainers from IITR India with Dr. Kelleh Gbawuru Mansaray and Mr Benjamin Kamara, Director Energy

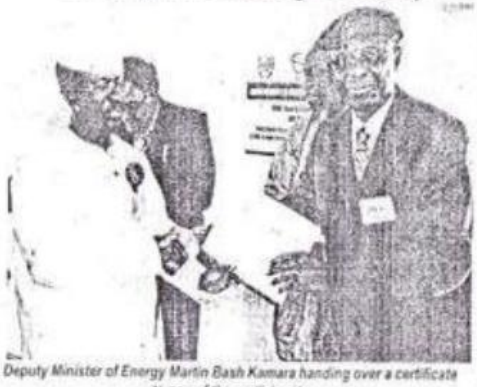
Dy Minister distributing the Certificates

Trainees In the field

TRAINING IN NEWS AT FREE TOWN, SIERRA LEONE

COUNTRY UPDATE

UNIDO Concludes Ten Day Hydropower Development Training Workshop



Deputy Minister of Energy Martin Bash Kamara handing over a certificate to one of the participants

By John Josemata Sesay

As one of the implementing agencies for Global Environment Facility and the implementation of Small Hydro Power [SHP] at Singimi Falls in the Moyamba District, the United Nations Industrial Development Organization [UNDO] under the Mini Grid based $32 Million project with an approximate capacity of 10MW to be applied between 2013 to 2017 has successfully completed a ten day Hydro Power [HP] development training workshop at the Committee room of Fourah Bay College.

Despite the fact that a key challenges facing SHP development in Sierra Leone are the lack of technical planning, design, operation and maintenance equipment and plant, yet UNIDO in concert with GEF, the Indian Institute of Technology [IIT] and the Ministry of Energy has exhibited delight in overcoming such challenges.

During a ten day training, trainees were exposed to planning, designing, operating, management, technical support for HP development in Sierra Leone and were given an insight to HP type and layouts, design of civil works, hydro mechanical components, turbine, generator, control monitoring and protection, power transformers, switchyard and power evacuation system.

The objective of the training was to provide theoretical understanding and practical insights to planning and designing of SHP and as expressed by the participants through their representatives they are in a position to address the various stages of SHP development from site location, to design, implementation and cost analysis, analyze and create the preliminary design of a HP scheme and evaluate the impact of SHP plants on the environment and society.

The participant's expressed gratitude for the training and commended UNIDO and partners for imparting knowledge in them.

They confessed that HP is more efficient, beneficial and lasting, outlining the potential knowledge they have gained on HP. They added that Sierra Leone has the potentials to generate above 5,000MW HP expressing the awareness that such can be built and improved.

The participants expressed optimism that capacity building is a major component in any nation building and with what they have learnt they can undertake 1 to 15 MW solar installation and design. In soliciting the Energy Ministry for continuous support, they promised that more testimonies will come from the group because value has been added to their lives. They called for the establishment of a HP group.

Victor Sawyerr from the Environmental Protection Agency [EPA] underscored the essence of Environmental Impact Assessment stating that HP can be made easily available and does not contribute to environmental harm. He said environmental concern must be taken seriously and the gains of any environmental development should match with the development undertaken to prevent future danger. He advised that in as much as the country should develop, which he said is a must, the environmental consequences must be taken into consideration and appropriate actions taken to prevent it from harm.

The Deputy Minster of Energy Martin Bash Kamara, in his short remarks said the potential for HP development in the country are enormous. He said he is impressed that there are engineers that have the willingness to be part of the country's HP development adding that as well equipped engineers they can be contacted to be involved in varied solar projects.

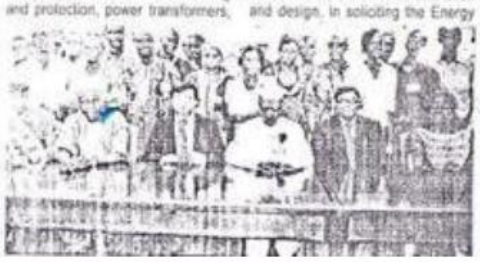
He congratulated UNIDO, the trainees and trainers and pleaded for the sustainability and replication of the training as he joined the UNIDO Acting Country Director, Dr. Kelleh Gbawuru Mansaray to distribute certificates to the participants.

The resource person from IIT encouraged the trainees to base their knowledge on what have been learnt and to make good use of such knowledge assuring them that they can develop SHP. He asked the Energy Deputy Minster to always render support to the beneficiaries when it is necessary to do so.

Dr. Kelleh G. Mansaray reiterated that UNIDO is supporting yet another important government function for a better tomorrow. He said the training is well chosen prior to the launch of the Agenda for Prosperity.

He mentioned that the Moyamba 10MW project costing $35M is a four to five years project of which capacity training is a requirement by the donor along side the EIA.

He assured that by 2017 the whole of Moyamba District will be powered. Dr. Kelleh G. Mansaray therefore commended the participants for the new adventure undertaken and said he is looking forward to their valuable contributions in hydro power development.



UNIDO Commences 10-Day Hydro Power Development Training

From Front Page

implementation and cost analysis, analyze and create the preliminary design of a HP scheme and evaluate the impact of SHP plants on the environment and society.

The participants [40] are degree holders with engineering/scientific background and are representatives of selected government departments, academic institutions, industry and NGOs who are contributing or intend to contribute in HP development in Sierra Leone and therefore are of no age limit.

The resource persons are qualified individuals from Sierra Leone and India.

In his own response the acting head of UNIDO Operations in Sierra Leone Dr. Keeleh Gbawuru Mansaray who also is the UNIDO National Energy Coordinator said the training is the first of such kind. He said in the next five years there will be Industrial Growth Centers in all Chiefdom Head Quarter towns as they are assisting the government in achieving its aim.

Officially opening the workshop, the Deputy Minister of Energy, Martin Alex Bash Kamara said no country develops without energy stating that it creates economic viability.

He said the president is focused on providing affordable electricity to all Sierra Leonean and therefore shared the determination the Energy Ministry has in generating electricity. He admonished the participants to pay attention to the training and make good use of the opportunity accorded them.

He appraised UNIDO for been instrumental in their assistance and to develop Hydro Energy. He said the Moyamba Hydro project is between 10-11 Mega Watts to provide steady flow of electricity to the Southern Province.

He paid tribute to the Indian government for the help they have been rendering to the government and People of Sierra Leone and therefore declared the training open.

The training ends on the 12th July 2013.

UNIDO Commences 10-Day Hydro Power Development Training

By John Josemata Sesay

The United Nations Industrial Development Organization [UNIDO] being one of the implementing agencies of the Global Environmental Facility [GEF] has been successful in obtaining GEF funds and leverage co-financing for the implementation of a Small Hydro Power [SHP] project at Singimi Falls in the Moyamba District Southern Sierra Leone.

The $32 Million project dubbed 'Mini Grid Based on SHP for productive Uses in Sierra Leone' has a capacity of approximately 10MW, and will be implemented between 2013 and 2017.

Despite the fact that a key challenge facing the SHP development in Sierra Leone is the lack of technical capacity to plan, build and run Hydro Power [HP] projects, the success of any HP plants depends on successful planning, design, operation and maintenance of the plant and equipment.

In view of this challenge, UNIDO, in collaboration with GEF, Indian Institute of Technology, [IIF] and the Ministry of Energy [ME] is organizing a 10 day training workshop to provide technical support for HP development in Sierra Leone at the Committee Room of the University House Fourah B ay College.

The workshop will cover various aspects of SHP development including planning, design and operating management. The participants will be provided an insight to HP type and layouts, design of civil works, hydro mechanical components, turbine, generator, control monitoring and protection, power transformers, switchyard and power evacuation system.

The objective of the training is to provide theoretical understanding and practical insights to planning and designing of SHP and it is expected at the completion of the training that participants will be able to address the various stages of SHP development from site location, to design,

Contd. Page 10

UNIDO Hydropower Project Development Workshop commences at Fourah Bay College

BY ALIE SONTA KAMARA

The United Nations Industrial Development Organization (UNIDO), in joint effort with the Global Environment Facility (GEF), the Indian Institute of Technology and the Ministry of Energy, has commenced a ten-day Hydropower Project Development workshop at the Fourah Bay College.

The training, which started past Wednesday to end next Friday at the same venue, saw the participation of forty participants amidst six seasoned Indian energy lecturers from the Indian Institute of Technology.

The training workshop will cover various aspects of Small Hydropower (HP) development, including planning, designing and operating management. The participants will be provided an insight to HP type and layouts, design of civil works, hydro mechanical components, hydro turbine, generator, control monitoring and protection, power transformers, switchyard and power evacuation system.

The objective of the training is to however provide theoretical understanding and practical insights to planning and designing of SHP plants.

In his remarks as the chairman of the opening ceremony, the Director of Energy at the Ministry of Energy, Mr. Benjamin Kamara, said their vision is to provide a modernized energy for the wellbeing of all. He furthered that one cannot talk about prosperity leaving out energy. "It is our aim of developing 1000W energy by the end of 2017. In reality, we have more than 25 hydropower sites round the country, which will enable us to meet this target line," he said, revealing that the country is currently sustaining 91 mega watt energy, thanking UNIDO and the Indian delegates for their relentless effort.

The Acting Director of UNIDO Operations in Sierra Leone, who doubles as the Director energy in the country, Dr. Kelleh Mansaray, assured all and sundry that by the end of the ten-day training, Sierra Leone will boast of 40 well trained hydropower development personnel. On matters of industrial development, he said it is part of UNIDO's plan to work towards having growth centers in all the chiefdoms in the country.

Prior to formally open the workshop, the Deputy Minister of Energy, Martin Alex Bash Kamara, believes that no one can live without energy. He said that it is the view of President Koroma that energy should be accessible to every Sierra Leonean at an affordable cost. "The Ministry is devising new ideas to have a year-round sustainable electricity supply as the Bumbuna Hydro Power plant provides less energy during the course of the dry season," he said, thanking UNIDO and line partners for their intervention. He urged the trainees to take the training seriously.

UNIDO trains 40 Hydropower Engineers

BY ALIE SONTA KAMARA

The United Nations Industrial Development Organization (UNIDO), in joint effort with the Global Environment Facility (GEF), the Indian Institute of Technology and the Ministry of Energy, ended a ten-day Hydropower Project Development for 40 engineers, which took place at the Fourah Bay College early this month.

The training, which started past Wednesday and ended last Friday at the same venue, saw the forty participants become hydropower engineers having been taught the requisite skills by the Indian energy lecturers from the Indian Institute of Technology. The training workshop covered various aspects of Small Hydropower (HP) development, including planning, designing and operating management. The participants were provided with an insight to HP type of layouts, design of civil works, hydro mechanical components, hydro turbine, governor, control monitoring and protection, power transformers, switchyard and power evacuation system.

The objective of the training was to how to provide theoretical understanding and practical insights to planning and design of SHP plants.

In his remarks as the Chairman of the closing ceremony, the Director of Energy at the Ministry of Energy Mr. Benjamin Kamara said their vision is to provide a modernized energy for the wellbeing of all. "We now depend on you whenever the need for hydropower programme arises", he stated. He furthered that one cannot talk about prosperity leaving out energy. "It is our aim of developing 1000W energy by the end of 2017. In reality, we have more than 25 hydropower sites round the country, which will enable us to meet this target line," he said, revealing that the country is currently sustaining 91 mega watt energy, thanking UNIDO and the Indian delegates for their relentless effort in providing the necessary support.

The Acting Director of UNIDO Operations in Sierra Leone, who doubles as the Director of Energy in the country, Dr. Kelleh Mansaray, expressed his gratitude for the funding of the programme. "We are doing this programme for the betterment of Sierra Leone. This project will contribute to the achievement of the energy dreams of the country. We are willing to support the government to achieving this target line," he said, thanking the participants for taking part in the training and hoping that they will put to practice what they learned. On matters of industrial development, he said it is part of UNIDO's plan to work towards having growth centers in all the chiefdoms in the country.

Closing the ten-day workshop, the Deputy Minister of Energy, Martin Alex Bash Kamara, congratulated all for taking part in the programme. He appealed that the engineers be absorbed into the energy programmes in the country so that they can exercise their knowledge. He said that it is the view of President Koroma that energy should be accessible to every Sierra Leonean at an affordable cost. He believes that management is always important. "The Ministry is devising new ideas to have a year-round sustainable electricity supply as the Bumbuna Hydro Power plant provides less energy during the course of the dry season. "We rely on you," he said, thanking UNIDO and line partners for their intervention. He urged the trainees to make use of the knowledge learned.

Two of the forty participants, one male and the other female, thanked UNIDO and the Indian delegates for the hydropower education given them. They realized that the country has the potential of producing 1000W of energy and that it is obvious that they can resolve for an energy revolution with the knowledge they now have. "We learnt about turbines and generators and how to use them. We believe we are going to make a positive impact in the energy sector. We know that capacity building is important", they maintained, appealing to UNIDO and the Government of Sierra Leone to once in a while be organizing such programmes.

The Indian delegates confessed that this was the only programme that they saw people eager to learn. They believe that hydropower can be started from a lower level. "We saw willingness in the trainees; this is good," they said.

The Representative from the Environment Protection Agency (EPA), Victor Sawyer, said that it is a necessity to undertake an Environment Impact Assessment programme to do energy work. "We should take environmental concerns very seriously. Unmanaged energy undertakings can destroy the environment by taking sediments to river basin. We should always think about environmental consequences when undertaking projects like this," he said.

The distribution of certificates to the trainees climaxed the ten-day workshop.

LIST OF PRESENTATIONS

1. Overview of SHP Development and studies done in the past – *Dr Arun Kumar, IITR, India*
2. Approach for identification of potential sites – *Dr Arun Kumar, IITR, India*
3. Structure for pre- feasibility report and feasibility report– *Dr Arun Kumar, IITR, India*
4. Different types of investigations – Dr Arun Kumar/*Dr GCS Gaur, India*
5. Hydrological Observations – Methods, Limitations – *Dr GCS Gaur, India*
6. Flood estimations – *Dr Arun Kumar, IITR, India*
7. Hydrology of un-gauged catchments – *Dr Arun Kumar, IITR, India*
8. Flow duration and installation capacity estimation – *Dr Arun Kumar, IITR, India*
9. Existing practice for meeting energy demand – *Mr B K Bhatt, India*
10. Survey of load demand – *Dr GCS Gaur, India*
11. Strategy formulation and regulation for SHP development – *Dr Arun Kumar, IITR, India*
12. Survey of power evacuation and distribution lines – *Dr GCS Gaur, India*
13. Environmental impact assessment related investigations (Air, water, soil, flora, fauna, wild life) – *Dr GCS Gaur, India*
14. Public participation and response – *Mr B K Bhatt, India*
15. Topographical surveys – *Dr RD Garg, IITR, India*
16. Different scales for topographical surveys– *Dr RD Garg, IITR, India*
17. Instruments used for surveys – *Dr RD Garg, IITR, India*
18. Modern equipments for topographical surveys– *Dr RD Garg, IITR, India*
19. Survey for muck disposal – *Dr GCS Gaur, India*
20. Geological investigations – *Dr GCS Gaur, India*
21. Landslides and slope stability – *Mr B K Bhatt, India*
22. Planning and preliminary design of diversion weir and intake works – *Mr MK Singhal, IITR*
23. Environment Impact Assessment – *Dr GCS Gaur, India*
24. Planning and preliminary design of desilting tank and forebay tank – *Mr MK Singhal, IITR & Dr GCS Gaur, India*
25. Selection and specifications of hydraulic turbines – *Dr RP Saini, IITR, India*
26. Selection and specifications of hydraulic turbines – *Dr RP Saini, IITR, India*

27. Planning and preliminary design of channel, tunnel and pipes – *Mr MK Singhal, IITR*
28. Selection and specifications of hydro generators – *Dr RP Saini, IITR, India*
29. Planning and preliminary design of penstock and surge tank – *Mr MK Singhal, IITR*
30. Selection and specifications of power evacuation – *Dr RP Saini, IITR, India*
31. Planning and preliminary design of power house building – *Mr MK Singhal, IITR*
32. Planning and preliminary design of access road and temporary housing – *Mr MK Singhal, IITR*
33. Preparation of feasibility report – *Mr MK Singhal, IITR, India*
34. Cost estimates – *Mr MK Singhal, IITR, India*
35. Financial Analysis – *Mr MK Singhal, IITR, India*
36. Specification for turnkey execution – *Mr MK Singhal, IITR, India*

ANNEX 11:

SMALL HYDRO POWER TECHNOLOGY CENTRE INAUGURATED AT FOURAH BAY COLLEGE

The United Nations Industrial Development Organization (UNIDO), in collaboration with the Global Environment Facility (GEF) and the Ministry of Energy, handed over Small-Hydro Power (SHP) equipment worth about One Hundred and Fifty Thousand United States Dollars ($150,000) to the Small-Hydro Power Technology Centre located at Fourah Bay College (FBC), University of Sierra Leone on 24th April, 2014. The centre was established through a Memorandum of Understanding (MoU) signed between UNIDO and FBC on 24th March, 2014 to promote clean energy innovation by teams of scientists and engineers from UNIDO and FBC. UNIDO also donated a 5 kW solar photovoltaic power plant and computers to the FBC library.

The handing over ceremony was called to order by Dr. Kelleh Gbawuru Mansaray and chaired by the Director of the University Research and Development Services Bureau Dr. Isaac Palmer. The University Registrar, Mr. S. N. Dumbuya, welcomed the participants to FBC and stressed the importance of the Small-Hydro Power Technology Centre for the training of future energy practitioners.

On his part, the UNIDO Representative, Mr. Rana P. Singh, highlighted the potential of small hydro power to boost universal access to electricity services. Mr. Singh explained that small hydro power is one of the most advanced and flexible sources of renewable energy. It is considered as reliable, low-cost and is independent of the energy price volatility associated with plants using fossil fuels. He said that there is significant hydro power resources that remain untapped in the country due to lack of appropriate and affordable technology. With the establishment of this well-equipped centre, graduates will be imparted with vast expertise in small hydro power technology, he continued. “UNIDO has supported many energy-sector activities in Sierra Leone that help reduce poverty and foster economic growth. Our aim is to continue to assist Sierra Leone in developing technical and institutional capacity to achieve environmentally sustainable energy solutions. Today, UNIDO is here to support yet another energy-sector programme, small-scale hydro power”, he concluded.

The Acting Vice Chancellor and Principal of the University of Sierra Leone, Professor Ekundayo J. D. Thompson, described the Small–Hydro Power Technology Centre as a fruit of a unique partnership which is in line with the country's development agenda. He urged the FBC authorities to properly utilize the Centre so it will have a ripple effect on the entire University and the country in general. We are result oriented and will therefore heed to the signed MOU, he said, thanking UNIDO for their intervention and donation of the equipment.

Mr. S. N. Bumbuya

Mr. Rana P. Singh

Prof. E. J. D. Thompson

The Deputy Vice Chancellor and Principal of FBC, Professor Sahr Gbamanja, acknowledged the initiative by UNIDO to donate equipment and the decision to establish a Small-Hydro Power Technology Centre at FBC. He noted that the centre will upgrade the capability of FBC to plan, deliver and evaluate "hands-on" training to transfer know-how on small hydro power technology assessment and project implementation to policy makers, utilities and students. GEF representative, Dr. Kolleh Bangura, expressed his support for the small hydro program of UNIDO and urged FBC to conduct a SHP capacity needs assessment to identify the training needs of different stakeholders and to define appropriate modalities to best meet such needs. The Energy adviser to the President of Sierra Leone, Mr. Mustapha Kargbo, commended the scheme as access to energy needs to be improved but proposed that hydro power should be complemented by solar photovoltaic systems for consistency in the supply of energy.

Prof. S. Gbamanja

Dr. Kolleh Bangura

Mr. Mustapha Kargbo

Delivering the keynote address, the Executive Chairperson of the Environment Protection Agency (EPA), Madam Jatou Jallow, highlighted the potential benefits that small hydro power can unleash in our quest to ensure energy access for the Sierra Leone populace. She said that

hydro power can contribute significantly to meet the electricity needs of urban areas as well as isolated rural areas. “The traditional barriers to renewable energy project development include difficulties in early stage project development due to high costs and lack of capacity to carry out feasibility studies. Projects also need to complete environmental impact assessments and have proper financial structuring. EPA is willing to work with FBC in this UNIDO sponsored programme to realize energy generation from small hydro resources”.

Keynote Address by EPA Executive Chairperson Madam Jatou Jallow

Opening of the SHPT Centre and Handing Over of Equipment

In his vote of thanks, the Dean of the Faculty of Engineering and Architecture, Mr. A. B. Savage, expressed his appreciation and thanks to UNIDO, the Government of Sierra Leone and GEF for their kind collaboration in donating the equipment and establishing the centre in his Faculty. He also thanked all participants and concluded that the centre will be used to implement targeted and effective Research and Development (R&D) programmes which can spur local SHP innovation and ultimately support the development of a resilient local green energy technology industry.

ANNEX 12: MOU BETWEEN UNIDO AND FOURAH BAY COLLEGE

UNIVERSITY OF SIERRA LEONE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

MEMORANDUM OF UNDERSTANDING

Between

The University of Sierra Leone
Freetown, Sierra Leone

and

The United Nations Industrial Development Organization
Vienna, Austria

SMALL-HYDRO POWER TECHNOLOGY CENTRE – FOURAH BAY COLLEGE

Memorandum of Understanding

This Memorandum of Understanding ("MoU") is made this 24th day of March 2014 by and between:

United Nations Industrial Development Organization, having its registered office in Vienna, Austria (hereinafter referred to as **"UNIDO"** which expression shall mean and include its successors-in-business and permitted assigns), of the FIRST PART;

AND

University of Sierra Leone, Freetown, having its registered office at A. J. Momoh Street, Freetown, Sierra Leone, (hereinafter referred to as **"USL"** which expression shall mean and include its successors-in-business and permitted assigns), of the SECOND PART

Also collectively referred to as the "PARTIES"

Whereas, UNIDO was established by the Member States of the United Nations in 1961, initially as a Centre for Industrial Development, at its Headquarters in New York. On the 17th November 1966, the United Nations General Assembly passed resolution 21/52 setting up the United Nations Industrial Development Organization as its industrial development arm. The following year, UNIDO moved its Headquarters to Vienna, Austria. In 1985, it became a specialized agency, with its own budget, Member States and executive board.

UNIDO supports governments, institutions, businesses and other stakeholders in their efforts to meet the challenges of, and to remove the barriers to, their industrial development. To do so, UNIDO mobilizes knowledge and information, builds capacity, and facilitates the transfer of technology to enhance competitiveness and advance the adoption of climate change mitigation measures. UNIDO's strategy is built upon three pillars, these being:

- Poverty reduction through productive activities
- Trade capacity building
- Energy and Environment.

Celebrating UNIDO's services including the implementation of renewable energy demonstration projects, policy support to create a favorable environment for renewable energy technologies, and capacity-building in the form of local training, workshops and targeted publications.

Resolute in its pursuit of improving the quality of life of the world's poor by helping countries achieve sustainable industrial development.

And

Whereas, USL with constituent colleges of Fourah Bay College (FBC), College of Medicine and Allied Health Sciences (COMAHS), the Institute of Public Administration and Management (IPAM), of which FBC was affiliated to Durham University, United Kingdom, in 1876 but which affiliation was abrogated on the 22nd of February 1967 this being the date of the Royal Assent to the act creating the new federal University of Sierra Leone and reconstituting the college as a constituent of the USL.

Recognizing the key role FBC played in promoting higher education in West Africa as the first Western style university in Africa, South of the Sahara, founded in 1827 by the Church Missionary Society (CMS), initially for the training of clergy and catechists as well as teachers and later grew into a college with presently four faculties, these being:

i. Arts
ii. Social Sciences and Law
iii. Engineering and Architecture
iv. Pure and Applied Sciences.

Celebrating FBC's pioneering role in promoting scholarship in the mid-19th and 20th centuries as an affiliated college of **Durham University** with an impressive portfolio of academic programmes and research publications and attracting the accolade 'Athens of West Africa.'

Resolute in its pursuit of academic excellence in the programmes offered in all the constituents departments and faculties of USL.

NOW THEREFORE

Motivated by their common interest of promoting renewable energy, energy efficient technologies and sustainable development, **USL** and **UNIDO** have agreed, subject to the availability of human, financial and other resources, on the general conditions as herein contained.

PART I GENERAL

The MoU commits both parties to establish a Small-Hydro Power (SHP) Technology Centre ("the Centre"), to be located at Fourah Bay College, University of Sierra Leone. The overall aim of the establishment of this Centre is to promote clean energy innovation by teams of scientists and engineers from **USL** and **UNIDO**. This MoU will provide USL with the opportunity to partner with a global leader in SHP, for knowledge transfer and information exchange. This can be used to implement targeted and effective Research and Development (R&D) programmes, which can spur local SHP innovation and ultimately support the development of a resilient local green energy technology industry.

The implementation of this MoU will undoubtedly enhance the use of SHP in Sierra Leone and provide greater public awareness of the potentials of these systems. The issue of utilizing indigenous energy sources for useful energy such as power generation will assist Sierra Leone with the provision of more efficient high quality energy.

The spin-offs of such projects will create local expertise in the design, installation and maintenance of SHP systems thereby facilitating their promotion and sustainability. The link between **USL and UNIDO** will also provide a multiplier effect in human resource development through demonstration, research and lectures for students, staff and visitors to the Centre.

PART II OBJECTIVES AND OUTPUTS

The main objectives of the Centre will be the following:

1. To provide sustainable support for the integration of higher engineering education with its SHP-related research activities.
2. To train man power with strong basics in energy including SHP, Energy Conservation, Sustainable Energy Systems etc.
3. To generate joint research activities in SHP and related fields, and seek assistance for financial and other resources to facilitate this linkage.
4. To provide a more relevant theoretical and practical base for students' development in the field of SHP and related fields.

The expected outputs of the Centre will be the following:

1. Strengthened human and material resources in SHP systems.
2. Greater participation in regional and international R & D projects through joint implementation projects and investments in Sierra Leone in the field of energy in general and SHP in particular.
3. Improved standard of living for rural communities and communities far removed from the mains grid by the provision of electric power for lighting, refrigeration and other energy-related activities.
4. Optimization of resources by collaboration in research and technical training.

The specific activities within the different areas will be detailed through annual work plans.

In the event that UNIDO or third parties request to schedule additional activities at or in cooperation with the Centre, USL authorities and the Joint Committee shall be duly notified. Such additional activities will not be subject to unreasonable restrictions or costs imposed by USL or any affiliated parties (excluding applicable maintenance fees).

It is the responsibility of USL to ensure that all equipment and technology at the Centre is in safe and operable condition at all times.

PART III IMPLEMENTATION OF CENTRE ACTIVITIES

A. Working Group

In order to coordinate the above-mentioned activities and decide upon project proposals related to the development of SHP, the parties intend to establish a "Joint Committee" with the following objectives:

1. Identifying areas of mutual interest and cooperation for the development of SHP and related technologies.
2. Monitoring and evaluating cooperation activities.

The parties will designate one main representative each to the Joint Committee. For the aforesaid activities, the Joint Committee shall to the extent possible conduct its work through electronic communication, but meet alternately, when this is deemed necessary. The Joint Committee can co-opt other members from scientific institutions or any other entity, as and when considered essential.

B. Equipment and Conditions of Use

UNIDO will contribute a set of equipment as detailed per the attached specifications (Annex 1). Such equipment shall be the joint property of USL and UNIDO, subject to the following conditions of use:

1. USL may not restrict the future use of such equipment by UNIDO or any third party endorsed by UNIDO for research or any other specified purposes;
2. USL may not charge any fees for such usage, barring reasonable maintenance fees as applicable.

C. Encouragement of other Cooperation Activities

Both parties shall encourage organizations, private companies, government institutions at all levels and research institutions on both sides to establish cooperation activities aimed at fulfilling the objectives of this MoU.

In the event that a third party is permitted use of any equipment or technology at the Centre or intends to conduct cooperation activities, UNIDO shall be duly informed and due recognition shall be given to it as donor of the equipment in any exchange of letters or other agreement established between USL and such third party.

D. Financial Resources and Fundraising

Should any financial resources be needed for the development and implementation of the scope of the partnership in this MoU, **USL** and **UNIDO** will discuss the most appropriate means by which to secure such funding, and will enter into a separate and specific agreement at the appropriate time for the execution of those activities.

The objective of the present MoU is that the Centre shall be financially self-sustaining, without any need for additional funding from UNIDO.

PART IV INTELLECTUAL PROPERTY RIGHTS AND CONFIDENTIALITY

1. In the event that proprietary documents, technology, products and information are generated out of the collaborative research activities undertaken as part of this "MoU", these shall be the joint property of **USL** and **UNIDO** including patenting rights where applicable. This would be made available in the public domain as well as in the Parties' respective websites based on the mutual agreement of the Parties.
2. **USL** and **UNIDO** shall respect all issues pertaining to the confidentiality of documents disclosed to parties in the execution of the terms of this MoU and shall not disclose them to third parties without the written consent of the other party.

   The confidentiality and non-disclosure commitment stated above shall remain in force and remain binding on the Parties even after the termination of this MoU.

PART V ENTRY INTO FORCE AND TERM

1. This MoU shall enter into force upon signature by the Parties and upon official approval by their respective authorized bodies. It may be amended by mutual agreements of the Parties.
2. The validity of this MoU shall be initially for three (3) years from the effective date and may be renewed or extended by mutual consent.
3. Each party shall have the right to withdraw from the MoU upon the completion of two months after submitting notice in writing to the other party. Such termination shall however, not affect the activities/compensation already approved jointly or under progress under the terms of this MoU.

PART VI AMENDMENT(S) TO THE MOU

Amendments to this MoU shall be made by mutual consent of the Parties in writing. No variation in the terms and scope of this MoU shall be valid or binding unless previously expressly agreed upon in writing between the Parties in the form of a letter entitled "Amendment to MoU".

PART VII INDEMNIFICATION

The Parties warrant holding each other fully indemnified and harmless and at all times against any loss, damages, costs and expenses including Attorney's fees, which may be incurred by the Parties as a result of any action on the part of the Parties in connection with this MoU.

In the event that equipment use or any cooperation activities as defined in Part C above are undertaken by third parties at the Centre, UNIDO will not be held liable for any costs or liabilities incurred through USL's acts or omissions in fulfilling the totality of obligations under any agreement with such third parties.

PART VIII RESOLUTION OF DISPUTES

The parties shall endeavour to resolve any dispute, claim or controversy that may arise out of or in connection with this MoU or its implementation, validity, breach or termination by consultation.

THE PARTIES HERETO HAVE CAUSED THIS MEMORANDUM OF UNDERSTANDING TO BE DULY EXECUTED BY THEIR RESPECTIVE AUTHORISED REPRESENTATIVES THE DATE AND YEAR FIRST ABOVE WRITTEN:

SIGNED ON BEHALF OF USL

Ekundayo J.D. Thompson

Vice Chancellor and Principal

Name: Professor Ekundayo Thompson

Date: 20 2014

Witness:

Name: Ing Badamasi Savage

Position held: Dean, Faculty of Engineering & Architecture

Signature and Date 20/3/14

SIGNED ON BEHALF OF UNIDO

UNIDO Representative

Name: BAFOTIGUI SAKO

Date: 24 March 2014

REPRESENTANT DE L'ONUDI * CONAKRY *

Witness:

Name: Ralleh Mansaray

Position held: Energy Coordinator

Signature and Date 24/03/14

Annex 1: List of Equipment

No.	Quantity	Description
1	3	Flow Meter
2	1	Acoustic Doppler Current Profiler Port Channel Master
3	2	Propeller Current Meter
4	2	Extions Rods (4 x 1 Meter)
5	6	Weirs Plate (Steel)
6	2	Digital Multi Probe Anemometer
7	6	Global Positioning System (GPS)
8	6	Carrying Case for Global Positioning Systems (GPS)
9	6	Battery Charger + 2 x batteries
10	1	Hand-held Differential Global Positioning System
11	6	DISTO Meter
12	10	Measuring Tapes
13	1	Total Station
14	1	Wooden heavy duty tripod, carrying strap (GST 120-9)
15	1	Reflector pole, telescopic, aluminium (GLS 12)
16	1	Circular prism with holder and target plate (GPR 111)
17	1	Tribrach, without optical plummet, pale green (GDF 111-1)
18	1	Extra hard box container for accessories (GVP609)
19	2	Wooden heavy duty tripod, carrying strap (GST 120-9)
20	2	Circular prism with holder and target plate (GPR111)
21	2	Tribrach, without optical plummet, pale green (GDF111-1)
22	6	Altimeter
23	4	Digital Camera
24	6	SD-Card
25	6	Carrying Case for Camera
	1 Set	Included in each consignment is a comprehensive manual of all items listed above + USB stick containing same

ANNEX 13: GEODATABASE

REPORT ON THE DEVELOPMENT OF SIERRA LEONE REGIONAL HYDROLOGICAL GEODATABASE (Sierra Leone Watershed Information System – SiLWIS)

Jinnah S Momoh[1], Solomon P Gbanie[2]

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[2]School of Environmental Studies, University of New South Wales, Australia

1.1 INTRODUCTION

Hydro-electricity is considered to be a clean energy production option, and the identification of potential hydro-power generation sites is exceedingly important. Delineation of watershed boundaries and development of hydrological geodatabase are extremely essential for the establishment of hydro-power facilities. Traditionally, watershed boundaries were drawn manually onto a topographic map which seems to be daunting and time-consuming. In contemporary times and research, delineation of watershed boundaries is typically based on a Digital Elevation Model (DEM), and Geographic Information System (GIS) offers an efficient and effective DEM to derive watershed boundaries.

Hydropower is generally a major energy source. Sierra Leone is naturally endowed with water resources (mainly rivers) which could be harnessed to provide hydropower facilities and generation; thereby holding great energy promises for the country. The HydroChina Corporation (September 2012) presented a feasibility study conducted on the hydropower resources of Sierra Leone. The study clearly confirmed that Sierra Leone is endowed with great hydropower potential of about 2,000 MW due to adequate natural water resources for most of the season (Tarawalli, 2012).

To date, Sierra Leone has built the following four hydroelectric plants (Tarawalli, 2012):

- The 2.4 MW Guma hydropower plant installed in 1967 in the west-end of Freetown Area. This plant was decommissioned in 1982, but the river site has the potential for another hydropower plant.
- The 6 MW run-of-the river hydro power plant, Dodo, located in the Eastern Province, some 380 km from Freetown and 69 km from the headquarter town of Kenema and Bo
- The 50MW Bumbuna Hydropower Plant located at Bumbuna Town in the northern part of Sierra Leone which is about 204km from Freetown.
- The Yele Hydro Power Plant 120KW Located in Yele, Tonkolili District on the Teye River

Sierra Leone is a tropical country located in western Africa (**Figure-1**). It borders the Atlantic Ocean, with a diverse range of land cover. The coastal regions are low-lying and are

predominately by swamp and mangrove. The interior regions are mountainous and densely forested, and the northern reaches are dry savannah lowlands.

The climate of Sierra Leone's climate is divided into two seasons, namely: a rainy season that ranges from May to November and a dry season ranging from December to May. However, during the dry season, there is still a large amount of moisture in the atmosphere, making satellite data capture a challenge. Given the moisture and cloud cover, the ability of Synthetic Aperture Radar (SAR) to penetrate cloud cover and dense vegetation measurements makes it the ideal form of remotely sensed data capture for this country.

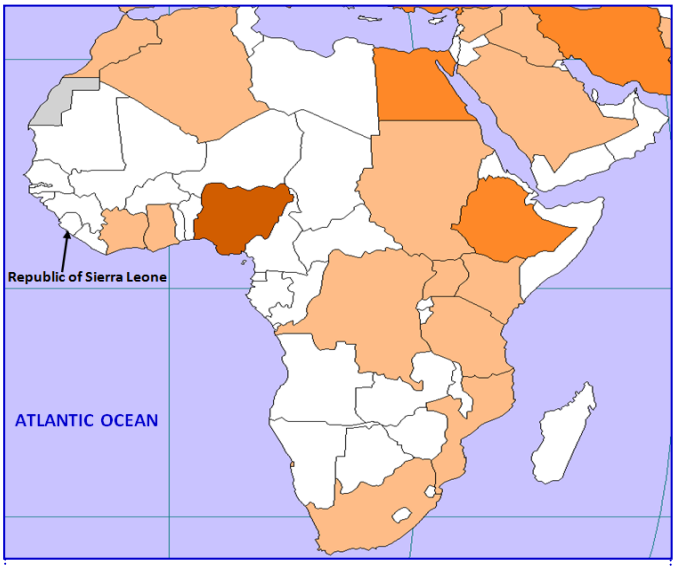


Figure-1: Location of Sierra Leone

1.2 OBJECTIVES AND OUTPUTS

In addition to the four hydroelectric plants installed, Sierra Leone is in the process of developing more potential sites, given the huge water resources it has. Unfortunately, no work has been done to develop its hydrological geodatabase and related DEM for easy access by potential investors at readily available planning and management levels. In its effort to enhance the Hydro Electric Power (HEP) generation and energy for all in Sierra Leone, the United Nations Industrial Development Organisation (UNIDO) funded this study to develop a Sierra Leone Regional Hydrological Geodatabase, herein after proposed to be known as the ***"Sierra Leone Watershed Information System (SiLWIS)".***

- This study is therefore generally aimed at developing a comprehensive GIS-DEM database for the hydrological network of Sierra Leone.
- The achievement of this general aim will require the following specific objectives:
  - Creating specialised Feature Datasets
  - Creating relevant related Feature Classes
  - Creating a Geodatabase to house these features. This will eventually form the intended comprehensive hydrological view of the country that can be used for the identification of hydrological resource potential to generate hydro-electricity.
- The main output from this work will include a developed Sierra Leone Regional Hydrological Network Geodatabase and comprehensive report on the database structure. This geodatabase will form the warehouse for importing and storing information on Sierra Leone

hydrology and hydro potentials, and also for developing a Sierra Leone Rainfall-Runoff Model in the future.

1.3 DATA ACQUISITION AND SELECTION METHODS

1.3.1 Desktop Study

A detailed desktop study was carried out to capture and review existing data/information/map on the general hydrology of Sierra Leone. A desk review of reports on the technical assessment of the potential of the identified sites was done.

Given the available existing information, it became clear that only the twelve (12) river basins in Sierra Leone have been delineated; and no sub-watersheds delineation to the smallest unit has been done. It was also observed from the desktop study that while most hydrology maps show the eighteen (18) major rivers, most of the areas in Sierra Leone lack river tributary networks, which necessitated the need to use a DEM for proper and detailed delineation of streamlines and sub-watersheds. Finally, the Sierra Leone Hydrology literature completely lack the existence of a hydrological geodatabase to which hydrology and related data on Sierra Leone can be imported as and when new data become available in the future.

1.3.2 Data Acquisition

Hydrological modeling has become an integral component of effective Hydro Electric Power (HEP) generation planning. An essential requirement for this process is the Digital Elevation Model (DEM) *(Djokic, 2000).* A DEM is an integral part of the process of deriving drainage streamlines for the purpose of hydrological modeling. DEMs are used in water resource information projects to identify drainage features such as ridges, valley bottoms, channel networks, and surface drainage patterns, and to quantify sub-catchment and channel properties such as size, length, and slope *(Djokic, 2000).* A high-quality DEM is therefore an essential component of streamline delineation for this study.

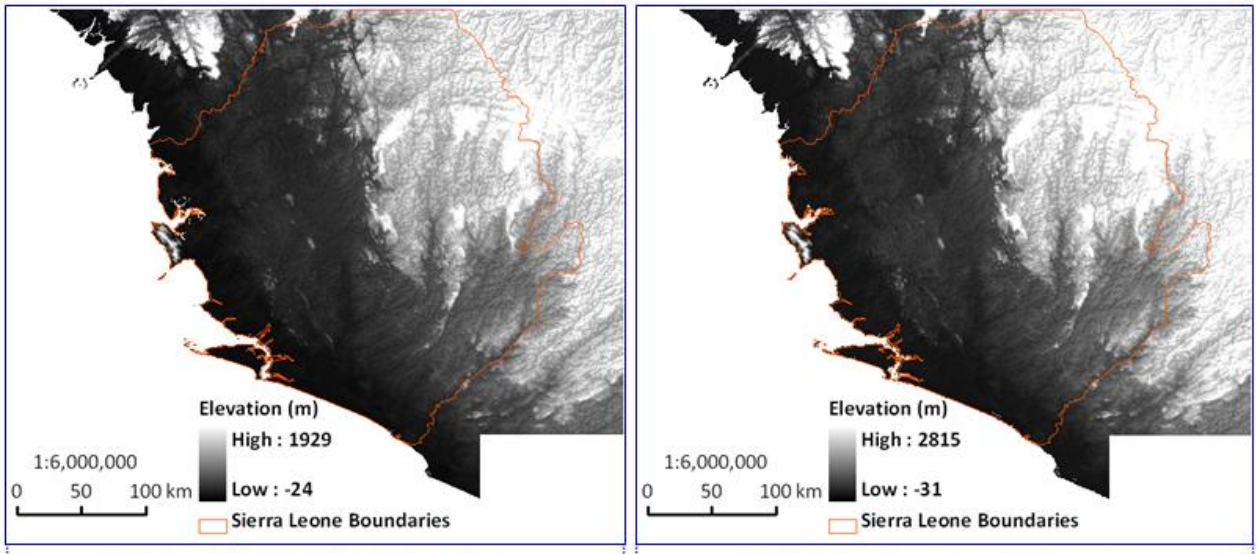


Figure-2: SRTM and ASTER DEMs for Sierra Leone and Surrounding Areas

In the process of selecting a suitable DEM data, geographic location and topographical characteristics of the area being modeled must be taken into consideration, with different datasets working better for different scenarios. Noting the availability of high quality DEM data for Sierra Leone, an assessment of the suitability of such data captured and released by two different remote sensing satellite sensor systems was made, namely: the Shuttle Radar Topography Mission (SRTM) and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). These data will make the development of national watershed information systems possible.

Both the ASTER and SRTM Dem data tiles were obtained from a mission conducted by the U.S. National Aeronautics and Space Administration (NASA) for a decision to be made on which dataset to utilise for this purpose (**Figure-2)**. The SRTM data was obtained at 90-m resolution through the CGIAR Consortium for Spatial Information http://srtm.csi.cgair.org and the ASTER data from the NASA Jet Propulsion Laboratory (http://asterweb.jpl.nasa.gov/gdem.asp) at 30-m resolution (3-arc-second) with an absolute vertical height accuracy of 16 m.

A control river-network dataset for Sierra Leone was also generated through manually heads-up digitising of verified 1:50,000 scanned topographic base maps of Sierra Leone. It was also an essential requirement to compare streamlines derived from the DEM datasets to the hydrological dataset manually digitised from the topographic base map of Sierra Leone.

1.3.3 Data Selection Method

As seen in **Figure-2**, both the SRTM and ASTER datasets are visually similar and have similar elevation feature data ranges, which makes it impossible to visually decide and select a preferred DEM dataset.

To justifiably select which DEM dataset to utilise for this purpose, ArcHydro was used to generate and delineate vector streamlines and flow direction and accumulation grids to delineate drainage lines from both the ASTER and SRTM DEMs, based on different trial-and-error threshold values. To determine which DEM streamlines more represent those present in the control dataset, streamlines from the control digitised river dataset were loaded alongside those generated from the ASTER and SRTM dataset. Qualitatively, it was observed that while the ASTER-derived streamlines show greater sinuosity which is reflective of its finer (higher) resolution (30-metre), the SRTM streamlines apparently follow the control data streamline more closely across Sierra Leone.

Both DEM datasets have individual advantages and disadvantages depending on the geographical nature and location of the study area as well as the purpose of study. For regions such as Sierra Leone, with humid climatic conditions and dense vegetative canopy cover, the

available SAR datasets: SRTM and ASTER represent the most comprehensive datasets for western Africa. Although generally, large cell size rasters such as SRTM (90-m resolution) cannot adequately represent the precise location of spatial features, thus increasing the chance of having mixed features such as forest, pasture, and water in a cell, which can be minimised by using the smaller cell-size raster such as for ASTER (30-m resolution), for the specific purpose of automatically delineating major stream networks in Sierra Leone, SRTM proves to be significantly more effective than ASTER, and was therefore selected as the preferred DEM dataset for this work.

The choice of SRTM DEM for this work is further supported from the comparative study of the "Suitability of ASTER and SRTM DEMs for Hydrological Modelling in three Pilot Areas in Sierra Leone *(Jeffrey. I, Charbonneau. S, and Parisien. A, 2009).* The three selected areas are geographically diverse to enable a robust comparative analysis of the ASTER and SRTM capabilities for Sierra Leone. Their study established that the ASTER elevation dataset produced a more significantly greater amount of T-tests distance error than the SRTM elevation datasets when compared to the manually digitised streamlines in Sierra Leone. This is because the SRTM dataset has a slightly higher vertical accuracy, which overrules its lower ground resolution; and for the purpose of hydrological modelling, vertical accuracy is highly significant and an essential requirement for acquiring accurate elevation measurements. Finally, flow path direction is a function of elevation gradients; and therefore the more accurate the elevation values are, the more likely accurate streams will be generated and delineated. On the other hand, ground resolution would have a greater effect on the overall sinuosity and shape of streamlines as produced by the ASTER datasets rather than the actual location at which they exist.

1.4 DATA PREPARATION AND ANALYSIS

1.4.1 Data Preparation

Since the SRTM DEM dataset ***(Figure-2)*** cover other areas that are not of interest to the study area (Sierra Leone), the Sierra Leone DEM-covered area was demarcated first using ArcGIS functionality. Also, since most DEM datasets are processed and stored in Geographic Coordinate System (GCS), the Sierra Leone national boundary shapefile in GCS was used to mask the SRTM DEM-covered area in Sierra Leone.

The demarcated Sierra Leone ASTER DEM-covered area and the control river-network of Sierra Leone were then projected to WGS 1984 Zone 28N Geodetic System.

1.4.2 Watershed Delineation from the SRTM DEM Dataset

ArcHydro was used to delineate vector streamlines from the SRTM DEM. Firstly, terrain preprocessing steps were taken to ensure all sinks were filled in both datasets to a fill threshold (DEM Z-unit) of 10. A Flow Direction grid was produced and then used to generate a Flow Accumulation grid to delineate drainage lines. From here, streams were defined using a

threshold value of **500** ***(default value was 21307.79).*** This value was chosen through a series of trial-and-error iterations of qualitatively analyzing the streamlines derived from the elevation dataset at different stream thresholds, noting that the higher the threshold value, the less dense the stream network and fewer internal sub-watersheds that will be generated. It is observed that the streamlines generated matched the streamlines in the control river-network dataset. Streamlines were then defined from these delineated stream components, segmented into cohesive streamlines, and converted from raster to vector for the purpose of further analyses. The Streamlines *(Atlantic Blue)* derived from the SRTM elevation datasets using ArcHydro were compared to a hydrological streamline dataset *(Ultra Blue colour)* manually digitized from a series of verified scanned base maps of Sierra Leone. **Figure-3** clearly demonstrates the congruent spatial relationship between the vector streamlines and their parent SRTM DEM.

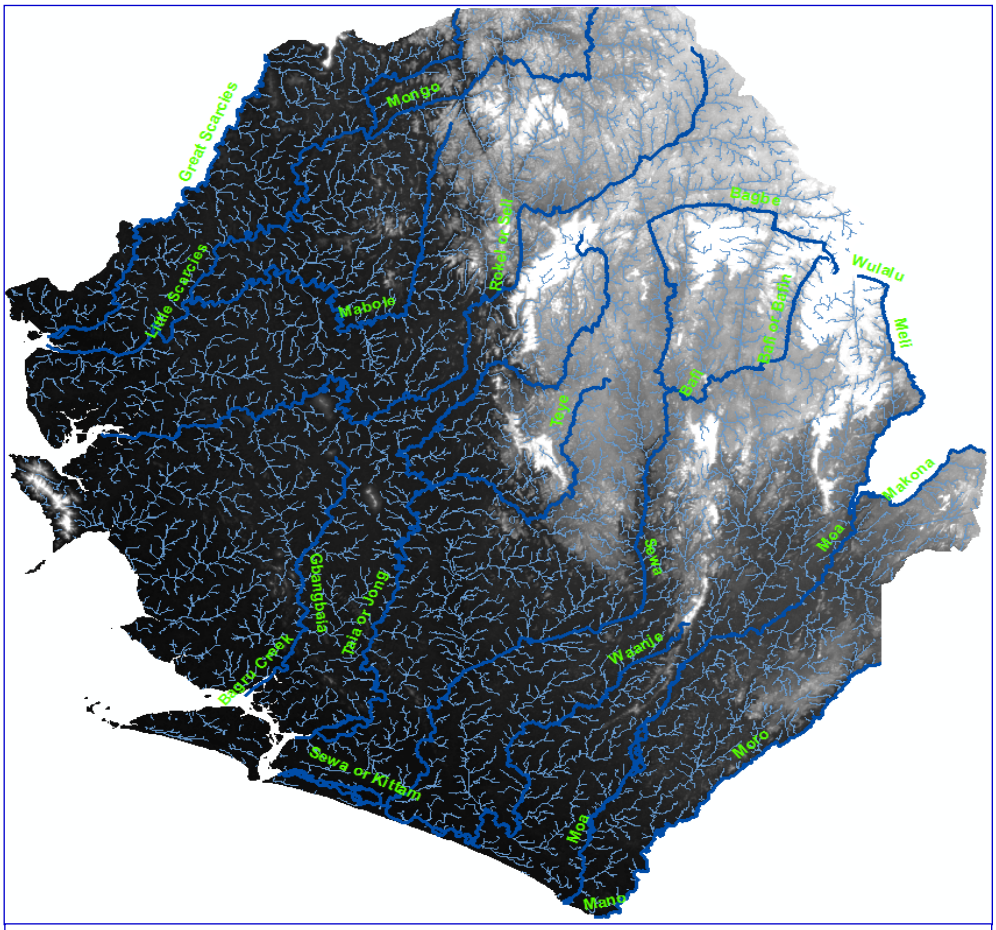
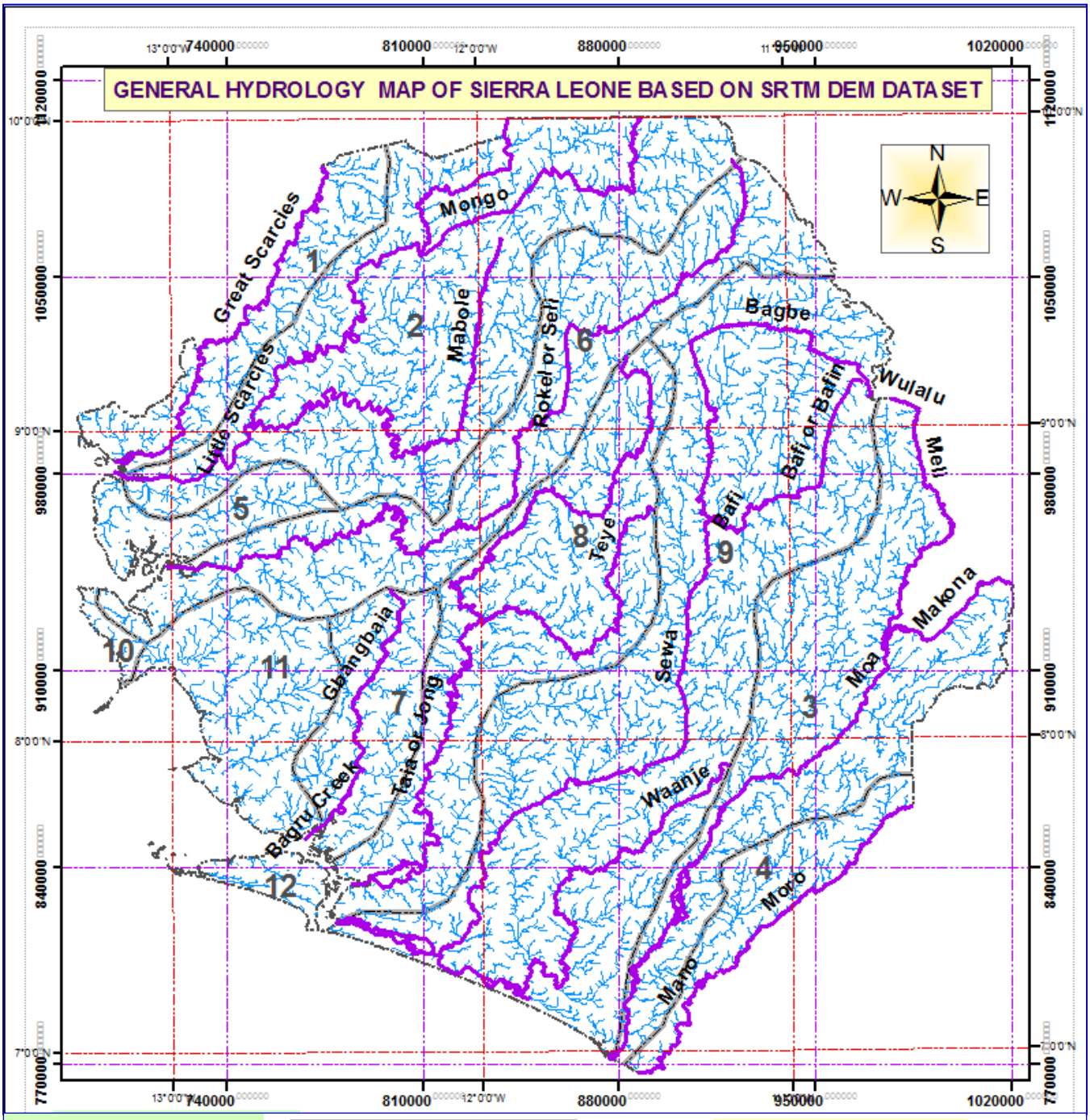


Figure-3: Comparative analysis of the parent SRTM-DEM, manually digitised streamlines, *(Ultra Blue),* and SRTM-derived stream dataset *(Atlantic Blue)*

Digitised main Sierra Leone River Basins ***(Appendix-D)*** also show a perfect spatial congruence when overlain with the digitised and SRTM-derived streamline datasets ***(Figure-4),*** which further justifies the preferred selection of SRTM DEM dataset for this work.



LEGEND

- Major_Rivers
- SLeone_Delineated_Streams
- Watershed_Boundary
- Country_Boundary

Grid Lines

Blue Dashed Line: UTM Grid Line
Grey Dotted Line: Geographic Coordinate

Projection and Coordinate

Projection: UTM
Geodetic Datum: WG S 1984

DISCLAIMER

The spatial existence and availability of most streams is both temporal- and weather-dependent, and water courses do change over time. Therefore, the DEM-delineated streamlines on this map are valid only at the time of the DEM satellite data capture.

DRAINAGE BASIN MAP INDEX

Basin Index	Basin Name
1	Great Scarcies Basin
2	Little Scarcies Basin
3	Moa Basin
4	Mano Basin
5	Lokko Basin
6	Rokel (Seli) Basin
7	Gbangbala Basin
8	Jong (Taia) Basin
9	Sewa Basin
10	Western Water Resources Area
11	Ribbi/Thauka Water Resources Area
12	Sherbro Water Resources Area

Reference Scale
1:2,000,000

25 12.5 0 25 50 75 Kilometers

AUTHOR(S) AND DATE

Jinnah S MOMOH, PhD: Lecturer, Department of Geography, FBC
Solomon P GBANIE: PhD Student, University of New South Wales, Australia

Production Date: June 2016

Figure-4: Comparative analysis of manually digitised streamlines *(Ultra Blue),* digitised main Sierra Leone River Basins and SRTM-derived Stream Dataset *(Cretean Blue)*

1.4.3 Sierra Leone Watershed Information System (SiLWIS) Geodatabase Development

Noting that a Geodatabase is a warehouse of geographic datasets of various types used for representing features, images, tables and other data types, the current ***SiLWIS*** Geodatabase comprises *Feature Datasets*, *Feature Classes*, and *Raster Datasets (DEM).* SiLWIS is so designed that other feature datasets, feature classes, images, and tables can be imported into it in future. The components of the SiLWIS Geodatabase structure are illustrated in ***Figure-5.***

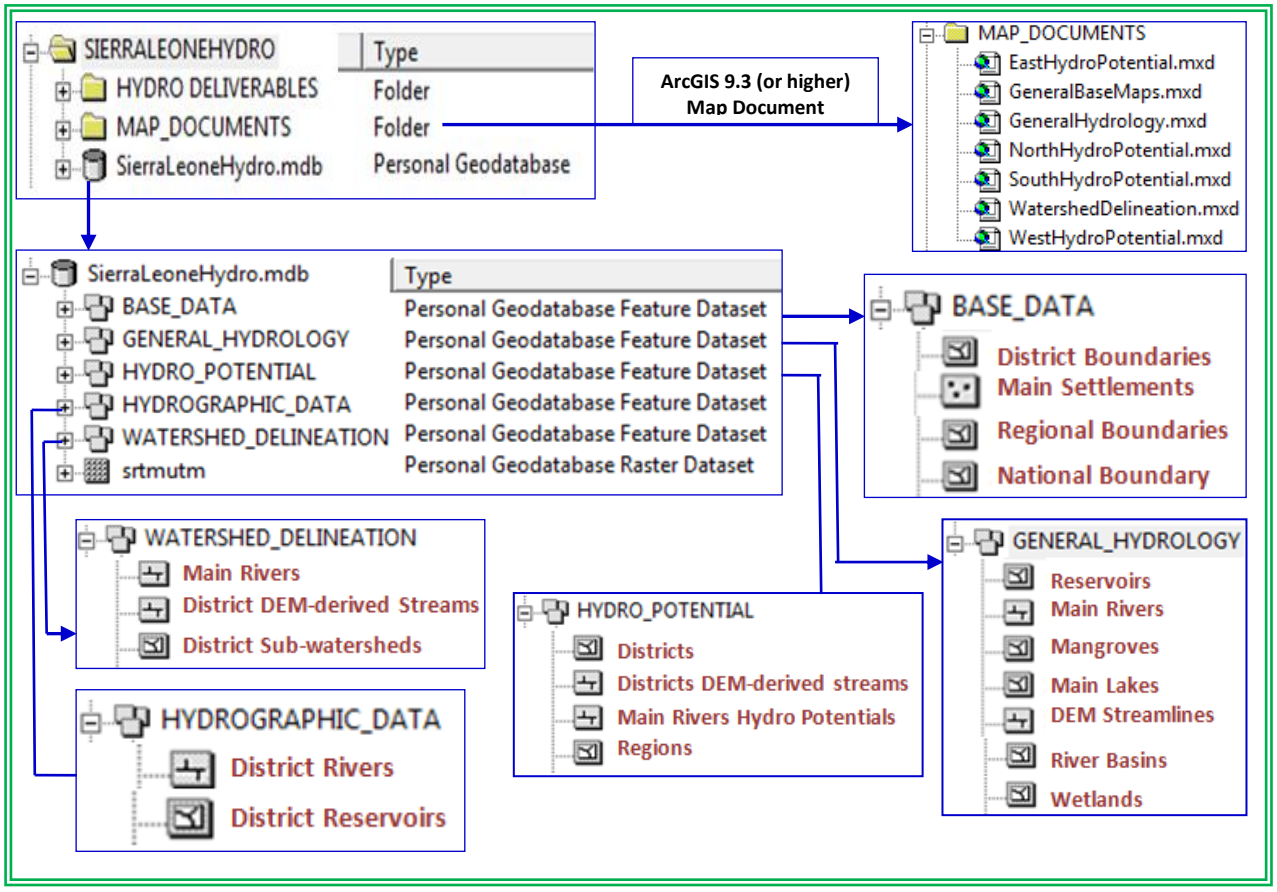


Figure-5: Simplified Sierra Leone Watershed Information System (SiLWIS) Geodatabase File Structure

In his report, *Tarawalli (2012)* established that based on careful assessment of the feasibility studies conducted by *Lahmeyer (1996) and HydroChina Corporation (2012),* the current estimated hydropower potential along the Sewa, Little Scarcies and Rokel or Seli rivers are 356 MW, 383 MW and 554 MW respectively. He further established that based by good scientific reasoning, the base line estimation of the total hydropower potentials of the major rivers in Sierra Leone is in ***Appendix-B.*** These data have been imported into the ***Sierra Leone Watershed Information System (SiLWIS) Geodatabase.***

1.5 MAIN OUTPUTS

The main outputs of this study include the following in maps PDF File formats:

1. **Appendix-C:** General Base Map of Sierra Leone
2. **Appendix-D:** General Hydrology Map of Sierra
3. **Regional Hydro Potential Maps of Sierra Leone**
   a. **Appendix-E:** Eastern Region Water Resources Hydro Potential Map
   b. **Appendix-F:** Northern Region Water Resources Hydro Potential Map
   c. **Appendix-G**: Southern Region Water Resources Hydro Potential Map
   d. **Appendix-H:** Western Region Water Resources and Hydro Potential Map
4. **Sub-watershed Delineation Maps**
   a. **Appendix-I:** Eastern Region Sub-watersheds
   b. **Appendix-J:** Northern Region Sub-watersheds
   c. **Appendix-K:** Southern Region Sub-watersheds
   d. **Appendix-L:** Western Region Sub-watersheds

1.6 MAIN RECOMMENDATIONS

The following recommendations are based on the initial intensions of this study and the outputs achieved:

- It was an intended objective of this work to integrate both the Area-Based (to divide the river basins into a series of sub-watersheds, one for each stream section and Point-Based (used to derive a watershed for each select point of interest, which may include gauge stations such as rain-gauge and stream-gauge) methods for watershed delineation. While the Area-Based method was accomplished in this study, the Point-Based techniques could not be achieved because there are no hydrological gauge stations. It is therefore recommended to install gauge stations along the main river networks so that the Point-Based method can be implemented in the future.

- The hydro potential data obtained from a report by Tarawalli (2012) were for the entire stretch of each main river system. In view of the fact that rivers traverse many district with different terrains, the volume, velocity and hence hydro potential of a river cannot be the

same for its entire length. While these values were only as a demonstration of further updating the Geodatabase, it hereby recommended that detailed hydro potential computations at specific locations (GPS-determined) be done along all the main rivers in Sierra Leone

1.7 MAIN REFERENCES USED

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9. WMO Guide to Hydrological Practices – Vol. 1. 2008

APPENDIX-A

Table-2: Estimated Area Watersheds in Sierra Leone

(Sources: SAWACO, 2012 - WMO Guide to Hydrological Practices, Vol.1, 2008; ESCG, 1998)

Scarcies Basin	Great Scarcies River	160	3115
	Little Scarcies River	280	13000
Rokel Basin	Rokel/Seli River	380	10620
	Western Area Coastal Streams and Creeks	120	6969
Jong-Pampana Basin	Jong-Pampana River	300	7511
Sewa Basin	Sewa River	430	14140
	Wanje River	200	4510

Moa Basin	Moa River	320	9220
	Mano River	180	2530

APPENDIX-B

Table-1: Estimated Hydro Potentials of Main Rivers in Sierra *Leone (Tarawalli, 2012)*

No	RIVER	HYDRO POTENTIAL (MW)
1	Bagbe	200
2	Bafi	200
3	Gbangbaia	200
4	Great Scarcies	200
5	Jong orTaia	200
6	Little Scarcies	400
7	Mabole	200
8	Makona	200
9	Mano	200
10	Meli	200
11	Moa	400
12	Mongo	200
13	Moro	200
14	Pampana (or Seden)	300
15	Ribbi (Songo Area)	100
16	Rokel or Seli	700
17	Sewa	500
18	Tabe	100
19	Teye	100
20	Wanje	200