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FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

Environmental and Social Impact Assessment for the Proposed Mini-Grid Solar Power Plant project in Andega, Dera Woreda, Amhara National Regional State

Equatorial Power Energy Services Private Limited Company

April 2023

Prepared by VERITAS Consulting and Geoscience PLC

The Federal Democratic Republic of Ethiopia Environmental Protection Authority

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Executive summary

1. Introduction

Equatorial Power is a next generation developer-operator of DRE infrastructure services, with a viable, and scalable, business model. Equatorial Power goes beyond electrons, to provide an integrated service offering to peri-urban and rural communities. Target customers are households, SME and businesses. Deployment includes productive use assets, for water purification, ice making, fish drying, water pumping, milling, cold storage for dairy other agro-processing. This is a key USP for EP making us much more than a Mini-Grid deployer. Since incorporation in 2017, Equatorial Power has developed an experienced and diverse management team, critical strategic partnerships and institutional relationships with Governments, donors and multilaterals to enable it to achieve its growth targets (Engie, InfraCo Africa, Shell Foundation, Rockefeller Foundation and more). Equatorial Power has active operations in Uganda, DRC, Rwanda and Mozambique, serving circa 30,000 customers via hybrid solar solution. Equatorial Power is currently entering the Ethiopian market to expand its value proposition to provide clean power to rural communities as well as bigger off takers such as irrigation systems.

2. Overview of the Project

Ethiopia depends on electric power generated from large hydropower stations to propel its economic growth and provide energy for domestic uses. To meet the rising demands for energy in rural areas where access is limited, off-grid electrification is seen as a favored option for the National Electrification Program 2.0 (NEP 2.0). This is particularly important for Ethiopia's rural settlements, which are often dispersed and inaccessible.

The mini-grid, which is a stand-alone AC-coupled solar photovoltaic (PV) system, is meant to provide a reliable power supply to the community and to an irrigation system that will replace the diesel pumps currently used by farmers for irrigation, the project is expected to go into commercial operation in September 2023 and supply electricity to smallholder farmers for irrigation purposes. The impact of the mini-grid system project components were identified and addressed in this Environmental and Social Impact Assessment (ESIA) report for the Andega project site in the Amhara National Regional State.

Goals and Specific Objectives

The broad goal of the Environmental and Social Impact Assessment (ESIA) is to provide decision-makers and project proponents with information on potentially significant environmental and social impacts and risks associated with the proposed mini-grid solar power plant project at Andega site. The specific objectives are: to identify potential positive and negative impacts of the proposed project; to suggest mitigation and enhancement measures for the identified significant adverse and beneficial impacts; to provide management and monitoring plans; and to ensure that the proposed project complies with the national environmental regulations and African Development Bank's integrated safeguards system.

Project components

The mini-grid solar system includes the following components: a mounting system that will be used to mount PV modules on structures made of aluminum or hot-dip galvanized steel. While the mounted PV panel modules absorb the sun's rays as a source of energy to generate electricity, inverters will be used to convert the Direct Currents (DC) produced by PV modules to grid-exploitable Alternative Currents (AC). Then, transformers will change voltage levels from low voltage (230V) to medium voltage (15kV or 33kV) and vice versa. Finally, overhead distribution lines mounted on wooden poles will be used to transfer power from the solar power plant to households and irrigation pumps.

Project alternatives

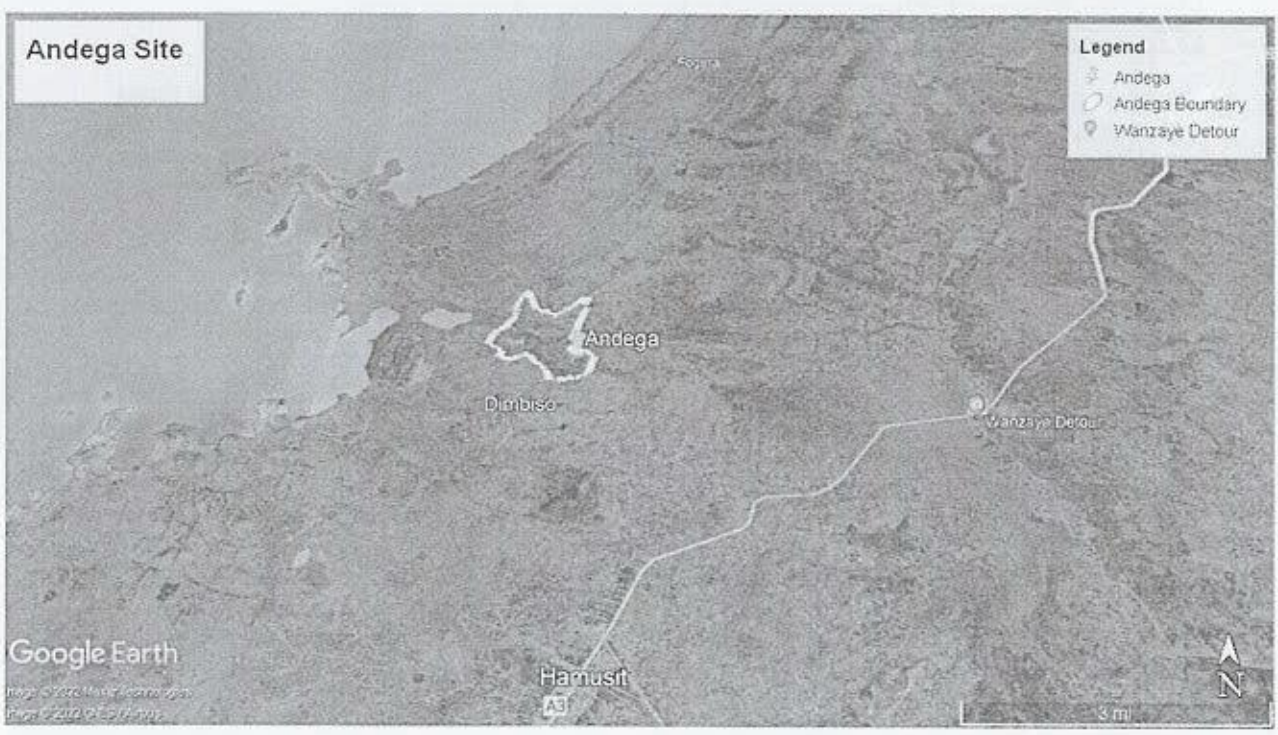
Several project options were examined to select feasible alternatives considering biophysical, socioeconomic, and technical factors. The alternatives considered were;

- no project alternative,
- project location alternatives,
- other sources of power (Hydro, Fuel, and Wind): and
- Project implementation option.

All the above-mentioned alternatives were analyzed based on technical feasibility, economic viability, and environmental acceptability. After comparing the above-mentioned alternatives based on technical feasibility, economic viability, and environmental acceptability, the project implementation option using solar energy was selected because of the numerous project advantages to the local community, low negative impacts of the project on the social and biophysical environment.

3. Project location

The project site is in South Gonder zone, Amhara regional state. Andega is found in Dera woreda and can be accessed through the Bahir Dar - Gonder asphalted road. Andega site is 10km west of Hamusit, but it can only be accessed during the dry season.



Baseline conditions

The Andega site is characterized by bimodal rainfall distribution with a main rainy season from June to October and a small rainy season from February to March. In situ measurement of temperature was taken from 06/10-

09/10/2021, and the temperature records were 26-27oC for Andega site. The proposed project site (Andega) is part of the tertiary and quaternary volcanic rocks, and lakeshore unconsolidated recent alluvial-lacustrine deposits of the quaternary age. The topography of Andega is part of the Fogera plain.

The soil in Andega is weathering product of alluvial lacustrine sediments and quaternary and tertiary volcanic and organic humus. Soil samples were taken from the site and analyzed to determine nutrient availability. The results of exchangeable Na, K, Ca and Mg are 300mg/kg (1.3 meq/100g), 105mg/kg (0.27 meq/100g), 1520mg/kg (7.6 meq/100g) and 130mg/kg (1.1 meq/100g), respectively. The concentration of Ca and Mg are medium in the target area. Similarly, sulfate and sulfur in the Andega area are 110mg/kg and 40mg/kg, respectively. FAO recommends the standard concentration of sulfur in soil ranges from 500mg/to kg-5000mg/kg. Therefore, laboratory results reveal that the concentration of elemental sulfur and sulfate (SO42-) in the target area is low and less than the recommended FAO values. Similarly, the concentration of total Fe and Mn is 0.5mg/kg and 13.6mg/kg, respectively. Based on FAO classification, healthy and productive soils should contain 50 to 1000mg/kg iron and 20-200mg/kg Manganese. Thus, the soils have low Fe and Mn falling below FAO-recommended essential micronutrient concentration in the soil.

The major river in the project area is Gumera. Gumera flows towards the west and finally joins Lake Tana. The groundwater potential appears to be high at all sites. The main sources of water for drinking are hands dug and shallow wells. Water quality investigations were also conducted during the ESIA baseline studies. The water quality test for the Andega site indicates a slight level of acidity and a slightly higher concentration of Manganese.

No	parameters	Unit	Andega	WHO maximum limit	Remark
1	Turbidity	NTU	1.85	5	
2	EC	uS/cm	177.6	2000	
3	PH	log10	6.4	6.5- 8.5	Unacceptable
4	TDS	ppm	88.9	1000	
5	Nitrate, NO3	mg/l	6.25	10	
6	Total hardness	mg/l CaCo3	45	300	
7	Manganese	mg/l	0.02	0.1	Unacceptable

Trees are grown scattered within and around farmlands, and homesteads. Indigenous trees such as *Cordia Africana*, *Juniperus* procera, *Croton macrostachyus,* and *Vachellia tortilis* were seen in the area, but Eucalyptus trees are commonly found around the villages. The common domestic animals are cattle, sheep, goats, and donkeys. The common wild animals in the Andega site include *Corcorous* (spotted Hyena), Porcupine, common fox, crocodiles, apes, and vervet monkeys.

The population in target kebele: Tanadinbiso (Andega site) is densely settled and lives in closely packed nucleated village houses. The farmers practice both rainfed and irrigation activities. The main crops grown include cereals (e.g., wheat, teff, etc.) and vegetables, the latter mainly for urban markets.

In the proposed project area (Andega) only health posts are available, a health center and primary hospital are found in Woreda capital town. Concerning education services, access is quite good for the primary level (Grades 1-8). For example, primary level education coverage is 90.48%, whereas it was only 33.81% for secondary level (Grades 9-12). Andega site doesn't have access to electricity from the main grid, however, in some areas the community uses solar energy for home lighting. Regarding physical cultural resources, there are several churches and monasteries in Dera Woreda. Most of these are found outside the potential irrigation areas and solar power plants will provide them with a potential source of power. The ESIA team did not observe any evidence of archaeological/historical heritages that would potentially be affected by the project implementations. Nevertheless, there is a risk that cultural heritage objects are unexpectedly uncovered during construction activities. Hence, excavation works should be done carefully as per World Bank Guidelines - OP 4.11, and chance finds procedures would need to be prepared.

4. Institutional and Legal frameworks

As part of the ESIA study, a review of the policies, laws, and institutional arrangements that govern environmental protection and the ESIA system in Ethiopia has been carried out. The ESIA study also considered the African Development Bank Integrated Safeguard System and applicable Safeguard Policies.

Regarding institutional arrangements for the implementation of ESIA, the Ethiopian Environmental Authority (EPA) is mandated to formulate or initiate and coordinate the formulation of strategies, policies, laws, and standards as well as procedures and upon approval monitor and enforce their implementation. It is also responsible for the synergistic implementation and follow-up of international and regional environmental agreements. EPA is mandated to review and approve ESIA reports and issue environmental authorization. The EPA also undertakes the role of certification of ESIA practitioners. The EPA has its tentacle office at regional levels as well. Moreover, the regional bureau of Agriculture, irrigation and pastoral development, Women's office, and mines and energy were reviewed.

Regarding the policies, proclamations, regulations, and guidelines issued by the government of Ethiopia and the AfDB, the ones outlined below, *inter alia*, are relevant to the proposed projects:
Constitution of The FDRE, the National Energy Policy of Ethiopia, the Water Resources Management Policy, the National Conservation Strategy of Ethiopia (CSE, 1997), the Environmental Policy of Ethiopia (1997), the Ethiopian Women's Policy, the Health Policy of Ethiopia, Environmental Impact Assessment (Proclamation No. 299/2002): Environmental Pollution Control (Proclamation No. 300/2002), Public Health Policy (Proclamation No. 200/2000): in addition, the ESIA team has also reviewed the African Development Bank Operational Safeguards Policy.

Concerning the AfDB safeguard policies, five Operational Safeguards (OS) were established and are summarized here as extracted from the AfDB ISS Policy Statement 2013.
2013.

- **OS1 Environmental and Social Assessment**: This overarching safeguard governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements. The proposed projects are Category 3 projects as they are less likely to have site-specific environmental and/or social impacts. Likely negative impacts are site-specific, largely reversible, and readily minimized by applying appropriate management and mitigation measures or incorporating internationally recognized design criteria and standards.

- **OS2: Involuntary Resettlement: Land Acquisition, Population Displacement, and Compensation:** This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement, and it incorporates refinements designed to improve the operational effectiveness of those requirements. As the risk category of the project falls under category 3 the project does not trigger OS 2 and hence resettlement action plan and livelihood restorations are not needed.

- **OS3: Biodiversity and Ecosystem Services**: The overarching objective of this safeguard is to conserve biological diversity and promote the sustainable use of natural resources. This safeguard could be triggered due to trade-offs of ecosystem services where the availability of solar energy may result in increased withdrawal of water for irrigation (to increase agricultural production) at the cost of regulatory services such as draining wetlands which are carbon sinks and biodiversity hotspots.

- **OS4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials, and Resource Efficiency**: This safeguard covers the range of impacts of pollution, waste, and hazardous materials for which there are agreed on international conventions and comprehensive industry-specific standards that other multilateral development banks follow. The solar mini-grid power plants are meant to curb pollution which is already underway through diesel pumps for irrigation.

- **OS5 Labour Conditions, Health, and Safety**: This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights, and protection from abuse or exploitation. It

covers working conditions, workers' organizations, occupational health and safety, and avoidance of child or forced labor. Construction and decommission of mini-grid power plants facilities may temporarily attract a medium labor force. Unfortunately, workers may not be properly informed of their rights and work conditions.

5. Project impacts

Solar mini grid power plants are generally considered to have low environmental and social risks and impacts compared to many other energy or industrial developments due to their short construction phases and insignificant emissions to air, water, and soil during operations. The major positive impacts of the mini grid projects include:

- Employment opportunities for skilled and non-skilled Labour,
- Provision of reliable electric power supply to farmers,
- Reducing greenhouse emissions to the atmosphere by replacing diesel pumps,
- Enhancing agricultural production and productivity,
- Improving local livelihoods by supplying electricity to communities.
- Enhance women's empowerment and gender equality

The project's main negative impacts on the bio-physical environment on the Andega selected site include clearing of vegetation for the solar power plant installation, risks of contamination of water and soil from the disposal of hazardous wastes (including PV panels), and increased water consumption for cleaning the solar panels. However, most of these potential impacts are minor or insignificant, and their impacts could be avoided or mitigated through proper implementations of the proposed Environmental and Social Management and Monitoring Plans (ESMMP).

The project's adverse impacts on the socio-economic environment may include increased prevalence of HIV/AIDS and other infections/diseases and Covid 19 due to the influx of workers. Similarly, temporary Labour influx, especially during the construction phase, may result in gender-based violence (GBV) and sexual exploitation risks for women and girls. In addition, the employment of children below 15 years of age could be an issue requiring monitoring protocols and administrative mechanisms. However, GBV and associated impacts will likely be minor during the operation phase since the minigrid will only be providing electricity to clients and does not involved an external labor force. In the meantime, water resource competition could potentially arise in the three proposed sites, which would eventually call for formal and informal conflict resolution mechanisms.

Finally, fire hazards, workplace accidents, injuries, and traffic accidents to workers and local communities were among the identified negative impacts of the proposed mini-grid solar power projects during the construction and decommissioning phases of the project.

6. Public consultation

The consultation was conducted with woreda officials and local people in the project area. Public Consultation meeting was undertaken in the project kebele during which the attitude of the community was assessed. It was very helpful to obtain basic information on the socio-economic, socio-cultural, and biophysical impacts of the project, and the associated measures to be taken. The discussion was participatory in that the participants expressed their views, concerns, and suggestions without any reservations about the proposed solar project. The Minute of public consultation is annexed to the main report of this document.

Date of meeting: 09/10/2011

Place of meeting: At Tana Dinbiso kebele meeting place in Andega site (Figure 12)

Number of participants: Male (29) & female (18)

Name of participant	Issues raised by the participants	Summary of responses to the issue by ESIA experts
Ato Kindeneh Belete (M)	He expressed there is a high hope among us that this project will provide access for transportation of agricultural goods to the market. In addition, the lesson this community learned from the Shina Dam is important on how these kinds of projects especially combining electricity to irrigation would give us a boost to our economy and social cohesion of the community. So, the project is much welcomed, to say the least.	Thanks for your view and support for the project idea. It is well recorded.
Ato Moges Engidaw (M)	Land shortage is one of the serious problems here and what if it takes a sizeable amount of land for mini-grid solar power plants and distribution lines.	Actually, the purpose of this discussion is to get important feedback, comment and information directly from project affected people like you. Land take will be minimal and will duly be compensated according to the legal provisions of the country.
Ato Turneh Tege (M)	He presented his comments, in short, stating that we heard about this project before and it is good for us and we are ready to support it.	It is known that the site has been investigated by others and you have got information from them and your support to the project is well noted.
Ato Kindeneh Belete (second round question) (M)	The community is ready to support in terms of labor, money, or other means to see the success of this project.	Your intention to support the project in labor and money is much appreciated.
W/r Temognehu Taho (F)	She stated that she wants to see a sustainable project, not something that starts and ends shortly.	We expect that the project will not be interrupted once it is started unless it is not feasible at the beginning. The final decision will be made after ESIA and other technical and financial reports evaluation.
Priest (Aba) Worku Alemu (M)	He stated that most of the community members are frustrated with irrigation activities because of fuel shortage and its soaring prices. This is good news not only for irrigation but also to provide spiritual and community services to our community.	The ESIA team thanked for the comments and promised to include all views aired during the meeting.
The Kebele representative (M)	He stated that the project is very useful, and we are glad to see it in a short period of time.	The ESIA team expressed their gratitude and promised to incorporate all the comments.
All participants (M & F)	All the above respondents raised any potential source of gender-based violence including sexual exploitation of women for short term benefits	The ESIA team responded that gender-based violence is a serious offense and the potential project proponent will have a protocol including training manuals to sensitize and monitor it. If it happens in some way there will be administrative and disciplinary mechanism to address the offenses

7. Environmental and Social Management Plan

The minigrid power plant, generation and distribution, and customer connections will be managed by the Minigrid Developer, with construction done by the Minigrid Contractor. The local government and municipality bodies will be involved as well as and where appropriate.

This ESIA seeks to address all potential impacts and risk mitigation activities that any of the above entities may be involved in. The following table seeks to delineate which entity will be responsible for impacts and mitigation.

The cost estimates provided in the below reflect expected costs over the 20-year estimated lifetime of the minigrid project.

Phases	Category of impacts	Main Identified Impacts	Impact Significance	Mitigation Measures/enhancement	Responsible bodies	Estimated cost
Construction		Loss of land or property	Low Negative	Compensation should be paid following the relevant government compensation proclamation. Timely communication with the affected people before the commencement of the project and if any disputes arise grievance redress management should be put in place	Minigrid Developer/Regional government	Exact siting for solar panels is not identified yet

Phases	Category of Impacts	Main Identified Impacts	Impact Significance	Mitigation Measures/enhancement	Responsible bodies	Estimated cost
		Traffic Accident	Medium Negative	Ensure all drivers follow mandatory speed limits not exceeding 30km per hour Educate all drivers and construction site workers on applicable laws and road safety practices	Minigrid Contractor, in collaboration with Woreda traffic office	Internal safety training and traffic signposts 40,000Birr
		Noise Pollution	Low Negative	Noisy activities shall be scheduled to daytime hours Personal protective equipment such as ear mufflers/plugs should be used during construction works	Minigrid Contractor	PPE 30,000 Birr
		Gender- based violence / Potential child labour	Medium negative	Community sensitization, regular monitoring for compliance	Community /woreda labour and women affairs office	Costs for GBV training (manual, etc) 100,000 Birr
		Impact on public health including Covid 19	Medium Negative	Conduct public health awareness campaigns addressing issues of behavioural change on HIV/AIDS and STDs etc. Provision of materials useful for the prevention of HIV/AIDS.	Woreda health office	Costs for awareness campaign, PPE etc 25,000 Birr
		Public health and safety training for day labourers	Medium Negative	Provision of training for workers on sexual harassment and GBV policies Workers should follow strictly Covid19 prevention protocols	Minigrid Contractor	Cost for half day internal training 30,000 Birr
	Biophysical environment	Generation of solid and liquid Wastes	Medium Negative	Hazardous waste should be disposed of in accordance with best industry practices. Any heaps of sand and concrete aggregates in the compound should be cleared to keep the area neat and clean. The wastewater from sanitary and construction works should be collected through a channel in a plastered pond or reservoir and can be recycled for construction, green area, and other purposes after proper filtering and treatment	Minigrid Contractor	Cost for waste disposal 150,000 Birr
		Air pollution	Low Negative	Workers assigned in the construction should wear a dust mask. Water shall be sprayed on all internal roads to minimize dust dispersion when necessary	Minigrid Contractor	Cost for PPE already included above, for water spray 30,000 Birr
		Soil erosion	Medium Negative	Avoid excavation during the rainy seasons Heap the excavated soil in the selected area and reuse it to fill undulating areas	Minigrid Contractor	Labour cost to pile up soil is 60,000 Birr
		Impacts on cultural, historical and archaeological site	Medium	If, in case, during excavation works a religious or historical site is found or suspected to be found , Chance Find Procedure for physical and cultural resources will be prepared as per World Bank Guidelines - OP 4.11 and will be part of the construction procedure manual	Minigrid Contractor, supervised by Oromia regional state culture and tourism office	Supervision cost 20,000 birr contingency
Operation Phase	**Human Environment**	Employment opportunity	Medium Positive	Hire workers from local people	Minigrid Developer	No separate cost is implied

Phases	Category of impacts	Main Identified Impacts	Impact Significance	Mitigation Measures/enhancement	Responsible bodies	Estimated cost
		Knowledge transfer	Medium Positive	Provide training to local workers	Minigrid Developer	No separate cost is implied
		Electric supply	High positive	Provide electric for local people	Minigrid Developer	No separate cost is implied
		Fire hazards	High Negative	The solar PV plant should be equipped with proper extinguishers for firefighting The technician should regularly inspect Solar PV and power plant components	Minigrid Developer	Cost for fire extinguishers 80,000 birr
		Occupational health and safety	Low Negative	Use of appropriate PPE during maintenance The solar PV plant shall be equipped with fire-extinguishers Ensuring all electrical equipment and machinery are properly grounded Maintenance should be conducted by trained professionals only	Minigrid Developer	Costs for PPE, maintenance over project lifetime 60,000 Birr
	Biophysical Environment	Liquid waste	Low Negative	Construct a toilet inside the power site premise and collect sanitary waste and finally dispose it off at permitted area when needed	Minigrid Contractor	No cost implied here since toilets/septic tank will be constructed during the construction phase
		Employment opportunity	Low Positive	Hire workers from local people	Minigrid Developer	No major cost is implied – this is within the business model operation costs
Decommissioning phase	Human Environment	GBV/Child labour	Low Negative	Provide training for families/ communities	Community/Woreda labour and women's affairs office	Training cost 20,000 Birr
		Loss of employment	Low Negative	Transfer permanent workers to other active projects or be absorbed into other government offices Pay compensation (severance) fee for permanent workers to be done in accordance with company contracts and applicable labour law	Minigrid Developer /Regional government	Compensation payment for workers should be paid by project proponent
		Solid Waste	Low Negative	Hazardous waste, including broken PV panels, used batteries, shall be disposed of in accordance with best industrial practices	Minigrid Developer	Waste disposal cost 150,000 Birr
	Biophysical Environment	Air Pollution	Low Negative	Workers assigned to the demolition should wear dust masks. Spray water during demolish work	Minigrid Developer	PPE for workers 40,000 Birr

Phases	Category of impacts	Main Identified Impacts	Impact Significance	Mitigation Measures/enhancement	Responsible bodies	Estimated cost
		Air Pollution	Low Negative	Workers assigned to the demolition should wear dust masks. Spray water during demolish work	Minigrid Developer	PPE for workers 40,000 Birr
Monitoring Costs						150,000
Total Minigrid Developer / Contractor						720,000 Birr
Total other parties/ multiple parties combined Only						245,000 Birr
Total Combined Cost						965,000 Birr

Environmental and Social Management and Monitoring Plans (ESMMP)

ESMMP has been prepared for addressing all adverse impacts of the implementation of the mini-grid projects. The ESMMP presents in detail impact categories, their mitigation measures, institutional responsibility, and indicative budget. The proposed management and monitoring measures can easily be implemented with available resources and expertise. The proponent is responsible for financing and coordination of the ESMP for the solar project. The contractor and all project employees should be among the main actors, especially during the construction phase when they are required to act as agreed on the contract document and this ESIA study. The Amhara Region Environmental Authorities are the regulatory body responsible to review EIA, monitoring, auditing, enforce and guide its implementations.

Parameters to be monitored	Mitigation measures	Responsible	Monitoring schedule	Monitoring indicators	Monitoring cost (Birr)
Contract management	Make sure the contractor has prepared ESMP for approval by the client	Proponent	Pre-construction and construction phases	Copy of the approved ESMP and implementation of it	Cost internal to developer to get approvals
Social support to vulnerable people	Job opportunities for project-affected people (loss land), Landowners should be compensated as per proclamation No. 1161/2019	Proponent	Throughout operation phase Note: selected land is expected to be community land, not individual	Interview vulnerable people, field visit, Check the amount of money paid out from finance	Supervision cost 5,000 birr
Employment opportunity	Hire workers from local people depending on their education preparedness and skill level	Proponent & Woreda	At the beginning and annually months	Number of local workers from company human resource office	Supervision cost 5,000
Solid waste	Hazardous waste, including broken PV panels or panels at the end of their use-life, shall be disposed of in accordance with best industry practice Any heaps of sand and concrete aggregates in the compound should be cleared to keep the area neat and clean	Proponent	Quarterly during construction and annually in operation	Annual site visit to determine if any hazardous waste is on site Disposal of hazardous waste in compliance with waste management procedures	Supervision cost 10,000

Parameters to be monitored	Mitigation measures	Responsible	Monitoring schedule	Monitoring indicators	Monitoring cost (Birr)
Liquid waste	Storage areas for fuel and hazardous materials shall be roofed and have a concrete floor with a bund for secondary containment and collection of spills The wastewater from sanitary and construction works should be collected through channels in a plastered pond or reservoir and should be recycled for reuse during construction	proponent	Beginning of construction and annually each year of Operation	Annual check that the necessary are in place Constructed plastered pond/ reservoir if required Amount of water recycled	Supervision cost 10,000
Noise pollution	Noisy activities shall be scheduled to daytime hours personal protective equipment such as ear mufflers/plugs will be used	Proponent in collabouration with Woreda health experts	Weekly during the construction phase	Noise level should not exceed the world bank standard (55dBA and 45 dBA during the day and night times, respectively)	Cost for regular checking of noise level 5,000
Air pollution	Workers assigned in the construction should wear dust masks. The supervisor should strictly follow and make sure this procedure is in place before starting their job; and Water should be sprayed on all internal roads to minimize dust dispersion when necessary	proponent collabouration with Woreda health experts	Periodically during the construction and operation phase	Check air quality measurement, Air emission shouldn't exceed WHO standards Supervise workers proper use of PPE's Complaints from the local governor, community	Expert cost for regular check emission level 5,000
Loss of farm and grazing lands	Landowners should be compensated as per the new proclamation No. 1161/2019 before the construction activities started Provide priority to a job opportunity for those projects affected people (PAP) during construction and implementation phases	Proponent	Before commencement of construction work	Check the amount of money paid for PAP Contractor's personnel office documentation	No cost
Traffic accident	Emphasizing safety aspects among drivers (putting up signposts and other precautionary messages) Mandatory speed limits not exceeding 40km per hour Collabourating with local communities on education about traffic and pedestrian safety (e.g., school education campaigns)	Proponent collabouration with Woreda traffic police	Every three months during construction, annually during operations	Number of accidents on the site Speed limits put at appropriate places Erected traffic sign	Supervision cost 5,000
Sexually transmitted diseases like HIV	Health promotion: sensitization of both community and workforce Provision of materials useful for the prevention of HIV/AIDS Having in place an appropriate signpost to educate the workforce and community about the Project's HIV policy	Woreda health office	Every month during the construction and operation phase	Number of distributed condoms Check the number of trainings conducted	Training cost 100,000
Covid 19	Train workers to follow strictly Covid-19 prevention mechanisms Temperature measurement check-up each day at the gate of the compound Provision of materials necessary for prevention and detection of COVID 19	Proponent in collabouration with Woreda health experts	Regularly during construction and operation	Number of Covid-19 infected	Expense already included in construction and operations No cost to report # of cases
Occupational Health and safety	Use of appropriate PPE during installation and maintenance The solar PV plant shall be equipped with a fire-fighting system Ensuring all electrical equipment and machinery are properly grounded;	Proponent	Regularly during construction and operation	Total recorded incidence rates	for provision of first aid a lump sum of 5,000
Fire hazards	The solar PV plant should be equipped with a fire-fighting system The technician should regularly inspect Solar PV components	Proponent	Every three months during the construction and operation phase	Number of incidents and reported cases	Part of project and operation cost
Impacts on historical, cultural heritage	Excavation work should be done carefully as per World Bank Guidelines - OP 4.11 and prepared chance find procedures	Contractor	During construction work	Number of discovered heritage site or artifacts	Part of supervision cost

Grievance redresses mechanisms:

X

It is expected that no major grievance issue will arise. However, to ensure that stakeholders have avenues for redressing their grievances related to any aspect that may result from the project, procedures of redress of grievances have been established. They are as follows:

- The community will be informed about the procedures in their local language. All information about grievance mechanisms will be available in public areas and with the community leaders
- The client/contractor will accept all comments and complaints associated with the project from any stakeholder either in person, via email, post, telephone, or any other appropriate communication channel. The client/contractor will then arrange for an officer to further listen to the complaints, then summarize the grievances in a complaints/comments logbook which would contain the name of the commenter, date of receipt, brief description of issue, proposed corrective actions, and date of response sent to the complainant
- All grievances will be registered and acknowledged within 6 working days then responded to within 15 days. All responses will be done either in writing or verbally, according to the preferred method of communication of the complainant.

Roles and responsibilities

- Project proponent- manage and monitor the environmental and social impacts
- Environmental Protection agency- is responsible for evaluating and approving ESIA study reports as well as for providing environmental approval licenses
- Environmental protection Agency of the Amhara is expected to be involved in monitoring the environmental performance of the solar power PV project in the region
- Community water use associations/ cooperatives are responsible to oversee fair water sharing among farmers

The estimated overall budget for the implementation of all environmental and social measures, which includes the cost for ESMP and ESMMP, is 835,000 birr or 15,587 USD (assuming 1 USD = 53.6 Birr).

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AC	Alternative Currents
AfDB	Africa Development Bank
ADLI	Agricultural Development Led Industrialization
AIDS	Acquired Immunodeficiency Diseases
dB	decibels
CBD	Convention on Biological Diversity
CEP	Community Engagement Plan
Covid-19	Coronavirus Disease 2019
CRGE	Climate Resilient Green Economy
CSA	Central Statistical Agency
CSE	Conservation Strategy of Ethiopia
DC	Direct Currents
EFCCC	Environment, Forest, and Climate Change Commission
EHS	Environment, Health, and Safety
EPA	Environment Protection Authority
EIA	Environmental Impact Assessment
ESIA	Environmental & Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards
FDRE	Federal Democratic Republic of Ethiopia
GTP	Growth and Transformation Plan
GHG	Green House Gas
IFC	International Finance Corporation
ILO	International Labour Organization
ISS	Integrated Safeguards System
IUCN	International Union for Conservation of Nature
HIV	Human Immunodeficiency Diseases
PHCU	Primary Health Care Unit
PPE	Personal protective Equipment
PPM	Parts per million
PV	Photo Voltaic
STDs	Sexually Transmitted Diseases
STI	Sexually Transmitted Infection
TDS	Total Dissolved solids
WB	World Bank
WHO	World Health Organization

1. Introduction

1.1. Background of ESIA study

Ethiopia has shown impressive two digits GDP growth in the last couple of decades. This economic growth brings with it an enormous demand for energy for households and industries. Nevertheless, the country depends largely on hydropower-generated energy to propel its economic growth and provide energy for domestic uses. To meet the rising demands of energy for development and meet the challenges of climate change, Ethiopia designed the Climate Resilient Green Economy strategy (CRGE). This strategy was well aligned with Ethiopia's ambitious plan to become a lower-middle-income country by 2025 (GTP II). The alignment of the two policies (GTP II and CRGE) is instrumental for Ethiopia's broad economic planning and has proven to be particularly central in the design of Ethiopia's power development strategy (Veritas, 2020).

The same document stipulates that mini-grids powered by renewable energy directly address two NDC [Nationally Determined Contribution] components: (i) reduction of greenhouse gas (GHG) emissions and (ii) reduction of the impact of climate change on Ethiopia's population, environment, and economy. Mini-grid development also helps to deliver on key CRGE objectives viz: (i) ensuring economic development is sustainable by limiting GHG emissions, (ii) creating green job opportunities, and (iii) protecting the economy and people from the adverse effects of climate change" (Veritas, 2020, p. 7).

Given this, solar-powered mini-grids are favorably considered for small-scale projects in different regions of Ethiopia; namely, Amhara, Oromia, Sidama, and SNNP. According to the Environmental Impact Assessment (EIA) proclamation 299/2002, projects that may likely have adverse environmental and social impacts are required to carry out a full impact assessment. In response, this ESIA has been conducted for the proposed DREAM mini-grid solar power projects. The purpose of the ESIA study is therefore to identify, predict and analyze the nature and magnitude of environmental impacts and propose enhancement and/or mitigation measures for environmental impacts that are likely to arise from the various activities of the project implementation.

In the study process, various ESIA tools were employed for the identification, prediction, and analysis of impacts. To this end, a biophysical resources survey (vegetation, soils, air, and water quality measurements) was conducted to establish baseline conditions and socioeconomic assessments were carried out. In addition, secondary data sources were consulted to augment field observations and measurements. The assessment followed the national and international guidelines to comply with the best ESIA practices such as the environmental impact assessment procedural guidelines of Ethiopia and that of AfDB's operational safeguards. The potential positive and negative project impacts have been identified for the construction, operation, and decommissioning phases. On top of this, environmentally sound and socially acceptable impact enhancement and management options were also suggested.

1.2. Objectives of ESIA Study

The main objective of carrying out the Environmental and Social Impact Assessment for the proposed mini-grid solar power plant is to improve project planning by ensuring that environmental and social considerations are taken care of in all stages of project planning and implementation – these phases include construction, operations and decommissioning. The ESIA study is particularly aimed at ensuring the environmental and social impacts of the proposed solar mini-grid projects' potential impacts are clearly identified and the corresponding mitigation measures are appropriately addressed before decisions are made to implement the project.

Specifically, the ESIA study is to:

- Establish the baseline conditions of the project area.
- Assess and report on the likely magnitude and significance of impacts, both positive and negative
- Conduct stakeholders and community consultations.
- Propose mitigation actions to reduce negative impacts and enhancement mechanisms for positive impacts
- Propose ESMP and a monitoring plan for significant impacts.

1.3. Approaches and Methods

1.3.1. General

The Environmental and Social Impact Assessment (ESIA) was conducted between September and October 2021. The data used for the ESIA were collected from both primary and secondary sources. Primary data were collected through a field survey, expert interviews, and focus group discussion with the communities, while secondary data were obtained from relevant sources, including literature and archives from project area government offices. The assessment process incorporates several key steps and constitutes a systematic approach to evaluate the proposed project in the context of the natural and socio-economic environment of the mini-grid pilot site. In addition, the ESIA team has reviewed compliance with the relevant national and international policies, laws, standards, and guidelines.

1.3.2. Review of relevant documents

Policies, legislation, and guidelines pertinent to environmental and social protections were reviewed to assess the relevant laws and regulations related to the expected environmental and social impact of the proposed project. In addition, existing documents on previous studies related to mini-grid solar power plants projects were obtained and reviewed to get insights into important data for the baseline description and background information for the proposed projects (FDRE constitution, 1994; EPA, 1997; CSE, 1997; EPA/EIA, 2002; 2003).

1.3.3. Field Survey

Field surveys and observations are critical to understanding the likely impact of a given project on the environment. The ESIA study team conducted a field survey of the project site in October 2021. The team made observations in and around the project site and gathered essential field data. During site observations, information on physical, biological, and socioeconomic environments has been collected. In addition, noise level, air quality, carbon monoxide, and ambient temperature measurements were conducted. Moreover, the team has also collected soil and water samples and subjected them to Physio-chemical analysis in the laboratory to establish baseline conditions.

1.3.4. Stakeholders and community consultations

To elicit the views of stakeholders about the potential impacts and effects of the project, stakeholders and public consultations were conducted. The ESIA team followed two stages for public and stakeholder consultations. First, we identified and mapped potential stakeholders (details are provided in section 5.2) based on the nature of the projects (off-grid solar power plant) and the end users or communities. The stakeholders were identified by segmenting across the following groups: directly indirectly affected persons, institutional stakeholders including government, and organizations likely to be involved in project implementation, regulation, and monitoring.

Following stakeholder identification, we separately engaged the relevant government offices. Official letter communications were made to all the identified government offices, then key informant interviews or focus group discussions were conducted as appropriate. For community (public) consultations, we conducted a public meeting including all the community members and social influences (e.g., clergymen, and elders) who could potentially be affected by the proposed off-grid solar power plant in the three selected project sites.

The local government administrations at Dera Woreda and other appropriate government offices (Agriculture, Health, Education, water and energy, culture and tourism, bureau, etc.) were consulted to obtain their concerns and inputs for the success of the proposed project. Community consultations were conducted with local communities in Amharic language (following AfDB's requirement to conduct consultation in a language the communities are comfortable with) at Andega localities. The community-level stakeholder engagement activities targeted entire communities within the project's area of influence, including the indirect impact zones. Two approaches were adopted at this level. The first was to have general community meetings targeting residents of Andega communities, and thereafter to conduct interviews with community representatives such as community leaders and social

influencers. During the consultation, the ESIA team disclosed the project and presented project objectives, project benefits, and adverse impacts. Then, participants were allowed to express their concerns and expectations regarding the project and social and environmental impacts that would likely arise during the construction and operation phases of the mini-grid solar power plant project.

1.4. ESIA report structure

The ESIA report is structured into ten chapters. Chapter 1 introduces the projects' background, scope, and objectives; whereas Chapter 2 reviews relevant national policies and strategies, international conventions, lenders' guidelines, and safeguard standards. Project descriptions, such as proposed project locations, justifications, power, and material requirements are presented in Chapter 3. In Chapter 4, details of baseline environmental and social conditions are provided. Chapter 5 presents stakeholder and community consultation findings. Potential environmental and social impacts of the proposed mini-grid solar power plants activities are highlighted in Chapter 6. This is followed by discussions of project alternatives in Chapter 7. Chapters 8 and 9 present the proposed ESMP and monitoring plans, respectively. Conclusions and recommendations are written in Chapter 10 based on the findings of the ESIA study. Finally, references and annexes are provided at the end of the report.

1.5. Limitations

The data collected (particularly secondary data) at kebele and woreda levels may often be incomplete and fragmented. In some instances, data were not compiled in organized form (e.g., yield per year, land under farming or grazing, etc.). To rectify the constraints and limitations the study team conducted key informant interviews with concerned stakeholders and further substantiated them through community consultations.

2. Policy, Legal and Administrative Frameworks

This chapter provides an overview of the relevant legislation, policies, standards, and guidelines applicable to the proposed DREAM mini-grid solar power plants and associated irrigation projects. Thus, the chapter reviews applicable national legislation, policies, strategies, and proclamations particularly related to water resources, energy, environmental protection, and others. In addition, the chapter provides a brief discussion of African Development Bank Operational Safeguard, which are pertinent to the proposed project.

2.1. National Laws, Policies and Strategies

2.1.1. The Constitution of the Federal Democratic Republic of Ethiopia (FDRE)

The constitution of the Federal Democratic Republic of Ethiopia, Proclamation No. 1/1995 is the supreme law of the land. Article 40 sub-article 3 states that "The right to ownership of rural and urban land, as well as of all natural resources, is exclusively vested in the State and the peoples of Ethiopia. The land is a common property of the Nations, Nationalities, and Peoples of Ethiopia and shall not be subject to sale or other means of exchange."

Article 44 stipulates in sub-article 1 that "All persons have the right to a clean and healthy environment." Sub article 2 of article 44 informs on resettlement action planning. It states that; "All persons who have been displaced or whose livelihoods have been adversely affected as a result of State programs have the right to commensurate monetary or alternative means of compensation, including relocation with adequate State assistance."

Article 36 on children's rights states that every child has the right not to be subject to exploitative practices, not to be necessary, neither permitted to perform work that may be hazardous or harmful to their education, health, or well-being.

The right of the public and the community to full consultation and participation as well as to the manifestation of their views in the planning and implementation of Environmental Policies and development projects that affect them is enshrined in the constitution (Articles 92.3 and 43.2).

2.1.2. National Energy Policy of Ethiopia

The Federal government of Ethiopia has formulated an energy policy in 1994, which was the first ever comprehensive energy policy in Ethiopia. The main objectives of the policy are:

- To provide reliable, timely, and affordable energy to foster the nation's agricultural and industrial development
- To ensure and encourage gradual shift from traditional energy sources to modern ones
- To remove institutional and other bottlenecks for energy development and utilization and streamline toward the development of indigenous energy sources for self sufficiency
- To increase energy use efficiency and reduce wastages, and
- To ensure that development and utilization of energy is not detrimental to the environment

The policy document has indicated many options of energy development (in chapter 4 of the policy document) in order to attain the national energy policy objectives. Among them the most relevant for this mini-grid solar project are provided below:

- To provide alternative energy sources for the household, industry, agriculture, transport, and others
- To ensure the compatibility of energy resource development which promotes ecological and environmental sustainability
- To facilitate and encourage the participation of the private sector in energy development
- Encourage women's participation in planning, development, and utilization of energy

Even though the energy development plan is heavily reliant on hydro-power development other sources of energy are also being considered. The main among them is geo-thermal, solar, wind, and other energy sources and exploration of fossil fuels (e.g., natural gas), afforestation, and increasing efficiency of agro-residues as sources of energy.

2.1.3. National Conservation Strategy of Ethiopia (CSE, 1997)

The Federal Government of Ethiopia has undertaken several initiatives that aim to develop regional, national, and sectoral strategies to conserve and protect the environment. One of these strategies was the conservation strategy of Ethiopia (CSE, 1996). This document provides a strategic framework for integrating the environment into new and existing policies, programs, and projects. It is also an important policy document, which views environmental management as an important component of development. It recognizes the importance of incorporating environmental factors into development activities from the outset.

The major environmental and natural resources management issues facing Ethiopia are well documented in the CSE (FDRE, 1997). The CSE sets out detailed strategies and action plans as well as the institutional arrangements required for the implementation of sect oral as well as cross-sectoral interventions for the management of Ethiopia's natural, man-made and cultural resources.

The most important areas that are addressed by the CSE include the following:

- Management of forest and woodland resources
- Land resource use policy and strategies; physical land use planning.
- Integration of social, cultural, and issues in sustainable resources and environmental management
- Promotion of participation in the sustainable development of natural, artificial, and cultural resources, and environmental protection
- Development of environmental education, public awareness, and human resources

2.1.4. Environmental Policy of Ethiopia (1997)

The Environmental Policy of Ethiopia (EPE) was approved by the Council of Ministers in April 1997 (EPA/MEDAC 1997). It is based on the Conservation Strategy of Ethiopia (CSE), which was developed through a consultation process over the period 1989-1995. The policy has the broad aim of rectifying previous policy failures and deficiencies, which in the past have led to serious environmental degradation. It is fully integrated and compatible with the overall long term economic development strategy of the country, known as Agricultural Development Led Industrialization (ADLI), and other key national policies like the National Population Policy and the National Policy on Women.

EPE's overall policy goals may be summarized in terms of the improvement and enhancement of the health and quality of life of all Ethiopians and the promotion of sustainable social and economic development through the adoption of sound environmental management principles.

Specific policy objectives and key guiding principles are set out clearly in the EPE and expand on various aspects of the overall goal. The policy contains sectoral and cross-sectoral policies and has provisions required for the appropriate implementation of the policy itself.

2.1.5. Ethiopia's Climate Resilient Green Economy (CRGE) Strategy

The Climate Resilient Green Economy (CRGE) is Ethiopia's overarching framework and a national strategy toward a green economy with the main objective to protect the country from the adverse effects of climate change and to build a green economy that will help realize Ethiopia's ambition to reach middle-income status before 2025. This strategy was highly synchronized with Ethiopian Growth and Transformation Plan II (2015/2020) which was aimed to bring about structural transformation in Ethiopia's major economic sectors. The objective of the strategy is to identify green economy opportunities that could help Ethiopia reach its ambitious growth targets while keeping

greenhouse gas emissions low. The CRGE strategy has identified four pillars: Agriculture and forestry, power and industry, transportation, and buildings as instrumental in supporting Ethiopia's developing green economy and for reaching middle-income status by 2025. The CRGE strategy had designed specific objectives to address issues related to water and energy sectors to climate. These objectives include:

- To identify the economic and social impacts of current climate variability and future climate change on water and energy in Ethiopia.
- To identify priority ways that the water and energy sectors can build climate resilience and reduce the impact of climate variability and climate change.
- To map the necessary steps to finance and implement measures in the water and energy sectors to build climate resilience in Ethiopia and deliver an integrated climate resilient green economy

2.1.6. Ethiopian National Energy Policy 2012

Policy Objective in relation to Environmental Impact is to ensure energy production, delivery, and utilization which poses minimum threats on the environment and society. One of the Policy Instruments in this respect is the introduction of mandatory environmental and social impact assessment on new energy and non-energy investment projects to assess the level of emissions of pollutions and determine whether the project will have to be realized and on the type of necessary mitigation measures to be adapted.

2.1.7. National Social Protection Policy of Ethiopia

The main objectives of the Social Protection Policy of Ethiopia are the following:

- Protect poor and vulnerable individuals, households, and communities from the adverse effects of shock and destitution
- Increase the scope of social insurance
- Increase access to equitable and quality health, education, and social welfare services to build human capital thus breaking the intergenerational transmission of poverty
- Guarantee a minimum level of employment for the long-term unemployed and under-employed
- Enhance social status and progressively realize the social and economic rights of the excluded and marginalized
- Ensure the different levels of society are taking appropriate responsibility for the implementation of social protection policy; and
- To make practical the above-listed objectives social protection policy, the project proponent or developer should abide by the policy prescriptions

2.1.8. Ethiopian Women's Policy

The then transitional government of Ethiopia in 1993 adopted the first National Policy on Ethiopian Women (NPEW). This was the first such move to give an institutional approach to address gender equality and enhance women's development aspirations through policy measures. Indeed, it was a great stride in focus moving away from the welfare approach to that of realization/recognition of women's role and contribution to the national socio-economic development. The policy has a three-fold objective. The first one is to ensure women's access to basic services such as health, education, and employment opportunities and avoid barriers such as social norms, and cultural and traditional practices, which may hinder women's full participation in the socio-economic development of the nation. Second, the policy gives special attention to eliminating all forms of discrimination against women and creating awareness of women's legal rights. Finally, it was intended to create the appropriate structures within the government offices to establish and monitor the implementation of different gender-sensitive and equitable public policies. Following the policy recommendations of creating an appropriate institutional structure at the various tiers of government, there is now a ministry of Gender and Social Affairs /regional bureaus/district offices of women's and children's affairs. At the federal level, one of the duties and responsibilities of the Ministry of Gender and Social

Affairs is conducting and monitoring gender-related issues and activities at the national level and creating an environment for the implementation of the NPEW in different sectors (even though the policy needs to be updated to match with the current institutional set up). At regional, zonal, Woreda, and Kebele levels, there are respective offices (at the Kebele level, usually individuals are assigned in place of an office). Those situated in line sectors/ministries are mandated to identify issues of gender gaps and develop strategies to address inequalities in the respective line ministries and their sub-sectors. The Gender and Social Affairs Offices are formally accountable to their respective councils, many of which have women's affairs or social affairs committees engaged in oversight activities. The plans included steps to enhance rural women's access to and control over productive resources like land, extension, and credit services.

2.1.9. Violence against Women

A declaration on the Elimination of Violence against Women Proclaimed by General Assembly resolution 48/104 of 20 December 1993 is talking about recognizing the urgent need for the universal application to women of the rights and principles concerning equality, security, liberty, integrity, and dignity of all human beings. This under this declaration article 2 states that battering, sexual abuse of female children in the household, dowry-related violence, marital rape, female genital mutilation and other traditional practices harmful to women, non-spousal violence and violence related to exploitation; psychological violence occurring within the general community, including rape, sexual abuse, sexual harassment and intimidation at work, in educational institutions and elsewhere, trafficking in women and forced prostitution; and Physical, sexual and psychological violence perpetrated or condoned by the State, wherever it occurs. In this same declaration it is stated that women are entitled to the equal enjoyment and protection of all human rights and fundamental freedoms in the political, economic, social, cultural, civil, or any other field.

2.2. National Proclamations

2.2.1. Environmental Impact Assessment Proclamation No.299/2002

This proclamation made Environmental Assessment a mandatory legal prerequisite for the implementation of major development projects, programs, and plans. The proclamation also provides a legal base for the effective means of harmonizing and integrating environmental, economic, cultural, and social considerations into the planning and decision-making processes thereby promoting sustainable development. Moreover, it serves as a basic instrument in bringing about administrative transparency and accountability, to involve the public and the communities, in the planning and execution of development programs that may affect them and their environment.

2.2.2. Environmental Pollution Control Proclamation No.300/2002 and Industrial Pollution Control Regulation No.159/2008

This proclamation aims at eliminating or, when not possible, mitigating pollution as an undesirable consequence of social and economic development activities. Additionally, it emphasizes that all citizens have a duty and obligation to conserve the environment, human health, biological diversity, and aesthetic worth of the natural world. It further considers other important issues such as control of pollution, management of hazardous waste, chemical and radioactive substances, the importance and need to respect environmental standards, and punitive and incentive measures. The Ethiopian regulatory body such as the former Environment, forest, and climate commission (now reconstituted as Environmental Protection Agency) may make surprise monitoring visits without any prior notice to ensure that the environment is protected from any serious pollution effects.

2.2.3. FDRE Rural Land Administration and Land Use Proclamation No. 456/2005

The Rural Land Administration and Use Proclamation (Proclamation No. 456/2005) provides entitlement to property produced on the land of the occupant rights of intergenerational transfer and limited leasing rights. Provisions are

made for the registration and certification of tenure rights. Part Three of the Proclamation presents regulations relating to the use of rural land, particularly as it relates to soil and water conservation and watershed management. The rural land administration and land use laws that are to be implemented by the regional states. Landholding right gives the right to use the land for agricultural purposes as well as to lease it and, while the right remains in effect, bequeath it to family members.

Article 7 sub-article 3 of the proclamation reinforces the rights of land users to compensation for the development they have made on the land. It also states that when the landholder is evicted by the federal government, the rate of compensation would be determined based on the federal land administration law. When the rural landholder is evicted by regional governments, the rate of compensation would be determined based on the rural land administration laws of regions. It is envisaged that the proclamation will create a sense of ownership among much of the rural population and enable them to take initiatives and collectively engage in environmental management activities.

2.2.4. Expropriation of Land Holdings for Public Purposes and Payment of Compensation Proclamation No. 1161/2019

The federal proclamation on expropriation of landholding for a public purpose, payments of compensation, and resettlement (Proclamation No.1161/2019) replaced "Expropriation of Land holdings for Public Purposes and Payment of Compensation, Proclamation No. 455/2005". This new proclamation has been formulated to address, *inter alia*, the fast-growing urban population in major cities of Ethiopia and associated land acquisition for residential and infrastructure development needs. For rural areas also it defines the powers and responsibilities of authorities, which are in charge of property valuation, payment of compensation, and resettlement. This proclamation was made to correct past misgivings due to gaps seen during the implementation of the previous proclamation 455/2005. In light of these gaps, it envisions to provide fair compensation and expedite decision making for those whose land has been expropriated for development purposes. Moreover, it envisions putting in place a grievance redress mechanism to address complaints related to land appropriation and compensation. The proclamation states that the landholder whose land has been expropriated shall be paid compensation for the property on the land and the permanent improvement made on the land. The amount of compensation for the property on the land shall cover the cost of replacing the property anew. The proclamation requires compensation and resettlement for land expropriation to sustainably restore and improve the livelihood of displaced people.

2.2.5. Payment of Compensation for Properties Situated on Landholdings Expropriate for Public Purposes (Regulation No.472/2020)

This regulation repealed the Council of Ministers Regulation on Payment of Compensation for Property Situated on Landholdings Expropriated for Public Purposes (Regulation No. 135/2007). This regulation contains property valuation and compensation methods and formulae that should be used in calculating compensation for various properties. It also contains lump sum compensation to be paid for severed social relationships and moral damages. The regulation also sets the provision of land expropriation procedure, proprietary right to develop the land to be expropriated, provision of substitution of land, housing and resettlement, and shareholder rights of the displaced. This regulation was issued for the purpose of not only paying compensation but also assisting displaced persons to restore their livelihoods. The Council of Ministers Regulation No. 472/2020 was issued to facilitate the proper implementation of proclamation No. 1161/2019.

2.2.6. Labour Proclamation No.1156/2019

The Labor proclamation states requirements regarding employer-employee relationships including requirements for the provision of contracts of employment (article 6 & 7) and the need for employers to take all the necessary

occupational safety and health measures and to abide by the standards and directives to be given by the appropriate authorities in respect to Occupational Safety and Health (OSH) measures.

2.2.7. FDRE federal Civil Servants Proclamation No. 1064/2017

Article 8 states that states that all positions of equal value shall have equal base salary and any Government office shall, at the end of every month, make payments of salary to civil servants or their legal representatives.

Article 14 presents that civil servant shall not be civil servant:

a) Person is under the age of 18years
b) Any person who has been convicted by a court of competent jurisdiction for offences of corruption, breach of trust, theft, fraud, or rape unless five years have lapsed from the date the penalty is served or is barred by limitation or remitted by pardon
c) A person is having no certificate of competence; and
d) Any person who is unwilling to take oath of fidelity in accordance with Article 17 of this Proclamation

2.2.8. Proclamation for the Establishment of Environmental Protection Organs No. 295/2002

This proclamation established a system that fosters coordinated but differentiated responsibilities among environmental protection agencies at federal and regional levels. It clarifies the mandate and responsibilities of the Federal EPA and the Regional Environmental Authorities (REAs) within the governments of the regional states. The proclamation stipulates that each sector office shall establish an environmental unit to assess and evaluate environmental performance by the sector.

2.2.9. Other Strategies and Legislations

Other legislation and strategies that may be of relevance to the proposed projects include but are not limited to:

2.2.9.1. Research and Conservation of Cultural Heritage (ARCCH) Proclamation

Proclamation No. 374/2003 (Proclamation to Ratify the Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property) requires developers to conduct a cultural resources survey to identify and assess cultural sites that may be affected by the development activities. The Proclamation defines cultural heritage broadly as "anything tangible or intangible which is the product of creativity and labor of man in the pre-history and history times, that describes and witnesses to the evolution of nature and which has a major value in its scientific, historical, cultural, artistic and handcraft content." Prior approval from the Authority for Research and Conservation of Cultural Heritage (ARCCH) is required to remove immovable (Article 21/1) and movable cultural heritage (Article 21/2) from its original site during the execution of the project. Proclamation No. 209/2000 (Research and Conservation of Cultural Heritage Proclamation) allows the use of cultural heritage sites for economic and other purposes if and only if such use is not detrimental to its preservation and does not impair its historical, scientific, and artistic values (Article 22). It specifies that the protection and conservation of cultural heritage is the duty and responsibility of the Authority for Research and Conservation of Cultural Heritage (ARCCH). Proclamation No. 484/2006 (Proclamation to Ratify the Convention for Safeguarding of the Intangible Cultural Heritage) formalizes the adoption of the Convention for the Safeguarding of the Intangible Cultural Heritage in Ethiopia at the General Conference of the United Nations Educational, Scientific and Cultural Organization in Paris on 17 October 2003. The Ethiopian Government ratified the said Convention on 24 January 2006.

2.2.9.2. Hazardous Waste Management and Disposal Control Proclamation No.1090/2018

This Proclamation shall have the following objectives:

- Create a system for the environmentally sound management and disposal of hazardous Wastes
- Prevent the damage to the human or animal health, the environment, biodiversity, and property due to the mismanagement of hazardous waste

2.2.9.3. National Health Policy

Ethiopia issued its first-ever health sector policy in 1993. The policy was intended to reorganize the health services delivery system to contribute positively to the overall socio-economic development effort of the country. Major aspects of this policy focus on fiscal and political decentralization, expanding the primary health care system, and encouraging partnerships and the participation of non-governmental actors. The policy and other health-related programs of the country highly promote the preventive approach to health services. Hence, the project proponent is also required to act in conformity with this strategy for the occupational health and safety of its workers and the environmental health of the community in the area.

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2.2.9.4. National HIV/AIDS Policy 1998

The overall objective of the policy is to provide an enabling environment for the prevention and control of HIV/AIDS in the country. The specific objectives are:

- To establish effective HIV/AIDS preventive and control strategies to curb the spread of epidemic
- To promote a broad multi-sectoral response to HIV/AIDS epidemic, coordination of the activities of different sectors and mobilization of resources for the control of epidemic
- To encourage government sectors, NGO, and communities to take measures to alleviate the social and economic impacts of HIV/AIDS
- To safeguard the human rights of people living with HIV/AIDS
- To empower women, youth, and other vulnerable groups to take action to protect themselves

2.2.9.5. Proclamation for Wildlife Development Conservation and Utilization proclamation 541/2007

This Proclamation has the following major objectives:

- To conserve, manage, develop, and properly utilize the wildlife resources of Ethiopia.
- To create conditions necessary for discharging government obligations assumed under treaties regarding the conservation, development, and utilization of wildlife
- To promote wildlife-based tourism and to encourage private investment

This proclamation clearly stated that under article 8" no person, other than the Ministry or the concerned regional organ in the discharge of their duties, may hunt any game animal unless he is in possession of a hunting permit".

2.2.10. FDRE, Pesticide Registration and Control Proclamation No.674 /2010

The purpose of this proclamation is to enact comprehensive legislation to regulate the manufacture, formulation, import, export, transport, storage, distribution, sale, use, and disposal of pesticides and other matters by laying down a scheme of control that would minimize the adverse effects that pesticide use might cause to human beings, animals, plants, and the environment. The detailed legislation of pesticides is presented in this proclamation under 37 articles. To mention article 14 of this proclamation states about pesticides registration and the Ministry shall maintain a separate central database or archive containing the inventory of all pesticides to track the movement and use of pesticides according to each stage of the pesticide life cycle within the country and containing other relevant information ads, etc.

In this article under No. 1 and 5, it is stated that no person shall make any import or export of any pesticide without obtaining an import or export permit issued by the Ministry; and under No. 3 (a) of this article, no pesticide consignment shall be imported if it has been manufactured six months from its date of entry into the country. The disposal rule of pesticides is articulated in Article 21 and No 1 of this article states that no person shall dispose of any pesticide or pesticide waste in a manner that may harm human or animal health or the environment".

2.3. International Treaties Ratified by Ethiopia

2.3.1. The United Nations Framework Convention on Climate change (UNFCCC), 1992

Article 3(1) of the Convention states that Parties should act to protect the climate system based on "common but differentiated responsibilities", and that developed country Parties should "take the lead" in addressing climate change. Under Article 4, all Parties make general commitments to address climate change through, for example, climate change mitigation and adapting to the impacts of climate change. Ethiopia, being a member state of the United Nations, therefore, ratified the convention and must abide by the principles of the convention.

2.3.2. Convention for the Safeguarding of the Intangible Cultural Heritage, 2003

The convention sets out the duties of States Parties in identifying potential sites and their role in protecting and preserving them. Each member country pledges to conserve not only the World Heritage sites situated on its territory, but also to protect its national heritage. The States Parties are encouraged to integrate the protection of the cultural and natural heritage into regional planning programs, undertake scientific and technical conservation research and adopt measures that give this heritage a function in the day-to-day life of the community.

2.3.3. International Labour Organization Core Labour Standards

Labor, working conditions, health, and safety are the subject of numerous international agreements, conventions, policies, and standards. Core labor standards formulated by the International Labor Organization (ILO) include forced labor, child labor, and workmen's compensation among others.

2.3.4. The Stockholm Convention

The Stockholm Convention is a global treaty to protect human health and the environment from persistent organic pollutants (POPs). POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms, and are toxic to humans and wildlife. POPs circulate globally and can cause damage wherever they travel. In implementing the Convention, Governments will take measures to eliminate or reduce the release of POPs into the environment. Inclusive of Ethiopia, over 150 countries signed the convention. Concerning the proposed mini-grid solar power plant projects, POPs could arise from open-air combustion of waste, disposal of electronic waste such as used batteries, and degradation of components within the storage.

2.3.5. The Convention on Biological Diversity (CBD)

A major objective of this convention is in-situ and ex-situ conservation of biological diversity. Parties to this convention are required to undertake ESIA for projects likely to have significant adverse effects on biodiversity and are required to develop national plans and programs for the conservation and sustainable use of biodiversity.

2.3.6. African Convention on the Conservation of Nature and Natural Resources-1982

This convention was signed by the Heads of State and Governments of independent African States, assembled at Algiers, Algeria on 15th September 1968. Under this convention in Article II, the contracting States shall undertake to adopt the measures necessary to ensure conservation, utilization, and development of soil, water, flora, and fauna resources in accordance with scientific principles and with due regard to the best interests of the people.

2.4. African Development Bank Operational Safeguards

The African Development Bank (AfDB) has an Integrated Safeguards System (ISS). The ISS consists of an Integrated Safeguards Policy Statement, Operational Safeguards (OSs), a set of Environmental and Social Assessment Procedures (ESAPs), and Integrated Environmental and Social Impacts Assessment (IESIA) Guidance Notes.

The Bank's Integrated Safeguards Policy Statement sets out the Bank's commitments to and responsibilities for delivering the ISS while Operational Safeguards establish operational parameters, delineates the roles and responsibilities of the Bank and its borrowers or clients in implementing projects, achieving sustainable outcomes, and promoting local participation. Operational Safeguards are also intended to prevent projects from adversely affecting the environment and local communities or, where prevention is not possible, minimize, mitigate and/or compensate for adverse effects and maximize development benefits.

Five Operational Safeguards are established and are summarized here as extracted from the AfDB ISS Policy Statement 2013:

- **OS 1: Environmental and Social Assessment** This overarching safeguard governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements.

  The proposed projects are Category 3 projects as they are less likely to have serious site-specific environmental and/or social impacts. Likely impacts are very few, site-specific, largely reversible, and readily minimized by applying appropriate management and mitigation measures or incorporating internationally recognized design criteria and standards.

  Category 3 investment projects do not require a RAP but may have an ESMP plan to manage and mitigate minor environmental and social risks of projects in compliance with the African Development Bank's safeguards.

- **OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement, and Compensation** This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement, and it incorporates refinements designed to improve the operational effectiveness of those requirements. As the risk category of the project falls under category 3 the project does not trigger OS 2 and hence resettlement action plan and livelihood restorations are not needed.

- **OS 3: Biodiversity and Ecosystem Services** The overarching objective of this safeguard is to conserve biological diversity and promote the sustainable use of natural resources. This safeguard could be triggered due to trade-offs of ecosystem services where the availability of solar energy may result in increased withdrawal of water for irrigation (increased production) at the cost of regulatory services such as draining wetlands which are carbon sinks and biodiversity hotspots.

- **OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials, and Resource Efficiency** This safeguard covers the range of impacts of pollution, waste, and hazardous materials for which there are agreed on international conventions and comprehensive industry-specific standards that other multilateral development banks follow. The solar mini-grids power plants are meant to curb pollution which is already underway through diesel pumps for irrigation. These operational safeguards are triggered because irrigation activities, especially the use of pesticides, may result in water and air pollution. It is noted that pesticide-related activities are pre-existing within the baseline of farmer activities at these sites. Irrigation activities, especially the use of pesticides will result in air pollution.

- **OS 5: Labour Conditions, Health, and Safety** This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights, and protection from abuse or exploitation. It covers working conditions, workers' organizations, occupational health and safety, and avoidance of child or forced labour

2.5. Institutional Framework

2.5.1. Institutional Arrangements for Environmental Protection

The definition of powers and duties of the executive organs of the Ethiopian Environmental Protection Authority (EPA) was established by proclamation 295/2002. The EPA has been subsumed under the former 'Environment, Forest & Climate Change Commission until 2021. However, recently the commission was dissolved and renamed EPA (where the forest sector) was merged into the ministry of Agriculture). The objective of the newly re-established Environmental Protection Authority is to formulate policies, strategies, laws, and standards which foster social and economic development in a manner that enhances the welfare of humans and the safety of the environment and to spearhead ensuring the effectiveness of the process of their implementation.

Part three of Proclamation No. 295/2002 states that every competent agency shall establish or designate an environmental unit that shall be responsible for coordination and follow-up so that activities of the competent agency are in harmony with the proclamation and other environmental protection requirements. Each national regional state is also required to establish an independent regional environmental agency or designate an existing agency for coordinating the formulation, implementation review, and revision of regional conservation strategies and environmental monitoring, protection, and regulation.

2.5.2. Environmental Protection Authority of Ethiopia (EPA)

The former Environment, Forest, and Climate Change Commission (EFCCC) are renamed the Environmental Protection Authority. This federal institution is entrusted with managing the Environment of Ethiopia. The EPA is responsible to ensure the realization of the environmental rights, goals, objectives, and basic principles enshrined in the Constitution. The Environment Policy of Ethiopia coordinates appropriate measures, establishes systems, and develops programs and mechanisms for the welfare of humans and the safety of the environment.

It is mandated to formulate or initiate and coordinate the formulation of strategies, policies, laws, standards, and procedures, and, upon approval, monitor and enforce their implementation. It is also responsible for the synergistic implementation and follow-up of international and regional environmental agreements. EPA is mandated to review and approve ESIA reports and issue environmental authorization. The EPA also undertakes the role of certification of ESIA practitioners.

2.6. Regional Government Offices

The regional governments based on the constitution of the federal republic of Ethiopia established relevant executive organs. The following executive organs will be relevant for the proposed project.

2.6.1. Amhara Bureau of Agriculture

The Amhara region bureau of agriculture has a wide range of duties to improve agriculture activities in the Region. The most relevant to the proposed project include the following:

- Provides agricultural training and extension services. They are responsible for agronomic issues and agriculture conservation practices that improve agronomic practices in the proposed project area such as crop rotation, intercropping, land preparation, planting method, and planting materials
- Provides agriculture information and extension services to the community as well as supports training and scaling up best practices to all farmers. For such cases, a farmer's training center (FTC) is mandated to train farmers on different agricultural technologies
- Administers land resources of the region and prepares land use plan
- Encourages farmers to undertake crop protection to control crop damage or yield reduction caused by insects, diseases, weeds, and other destructive animals

- Follows up the implementation of recommended fertilizer and time of fertilizer application for the proposed crops of this project

2.6.2. Amhara Bureau of Water, Irrigation, and Energy

The Bureau of Water, Irrigation and Energy Development was established as the Bureau of Water, Minerals and Energy Resources Development in accordance with Proclamation No. 4/1988 of the Amhara National Regional State Council.

The bureau is entitled to a wide range of duties related to irrigation activities in the region. The most relevant to the proposed activities include:

- Assign irrigation experts in the project area to advise and assist irrigation users
- Provide training for irrigation users for the wise use of the water resource
- Form and follow irrigation water user associations to facilitate and manage fair distribution of waters for irrigation.

2.6.3. The Amhara Environmental Protection Authority

The Amhara Environmental Authority acts as a regional environmental regulator (with its respective offices at lower levels) and is responsible for the following activities:

- Reviewing or evaluating the ESIA documents prepared by the consultant of the proponent. Based on the assessment results, the authority sets the overall direction for a project's environmental performance
- Enforces and guides land compensation payment issues as per land proclamation and rules
- Regulates and follows up that any development shall conduct ESIA prior to the project implementation
- Undertakes environmental auditing of establishments for the safe disposal and management of liquid and toxic wastes.

3. Project Description

3.1. Project location

The project site is in South Gonder zone, Amhara regional state. Andega is found in Dera woreda (Figure 1) and can be accessed through the Bahir Dar - Gonder asphalted road. Andega site is 10km west of Hamusit, but it can only be accessed during the dry season.

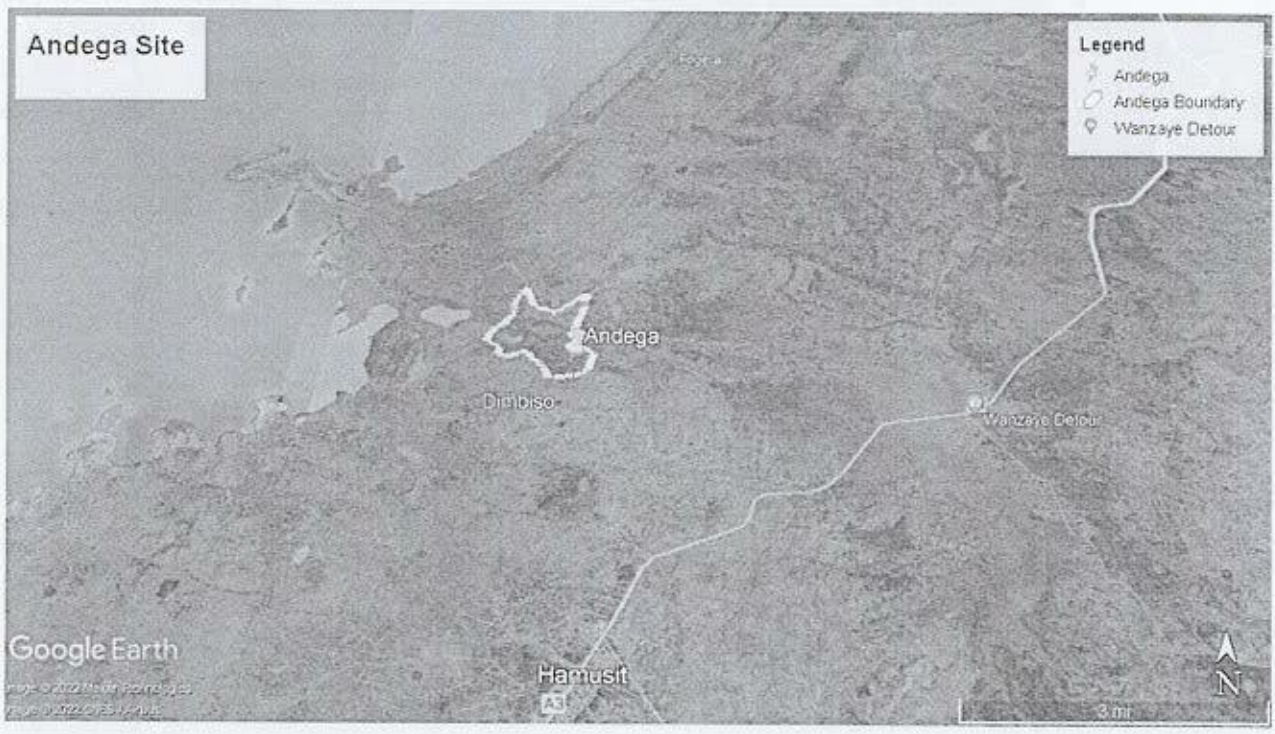

FIGURE 1 LOCATION MAP OF PROJECT SITE

3.2. Project Justifications

Solar mini-grids have proven to be more environmentally friendly compared to other sources of energy and other types of power generation projects. The importance of renewable energy, including solar power technology, is also highlighted in the national Growth and Transformation Plan (GTP) II and compliant with Ethiopia's Climate Resilient Green Economy Strategy (CRGE). The purpose of the planned solar mini-grid project is mainly to substitute diesel irrigation pumps with electric-powered irrigation, which would intensify the existing irrigation activities at the project site. Consequently, farmers will have access to reliable water, which would help them increase agricultural production/productivity, ensure food security, and help to mitigate and adapt to climate change. In addition, the households, social institutions, and businesses in the community will also get access to electricity.

3.3. Project Components

The major project components are discussed hereunder. However, this section is expected to be revised and updated once the project feasibility report is completed.

- **Mounting system:** PV modules will be mounted on structures made of aluminum or hot-dip galvanized steel. Footing design and type will be decided during design work.

- **PV Modules:** PV modules absorb the sun's rays as a source of energy to generate electricity.
- **Inverters:** Inverters convert the Direct Currents (DC) produced by PV modules to grid-exploitable Alternative Currents (AC)
- **Transformers:** Transformers will change voltage levels from low voltage (230V) to medium voltage (15kV or 33kV) and vice versa
- **Distribution grid:** overhead distribution lines mounted on wooden poles will be used to transfer power from the solar power plant to households, businesses, and irrigation pump customers

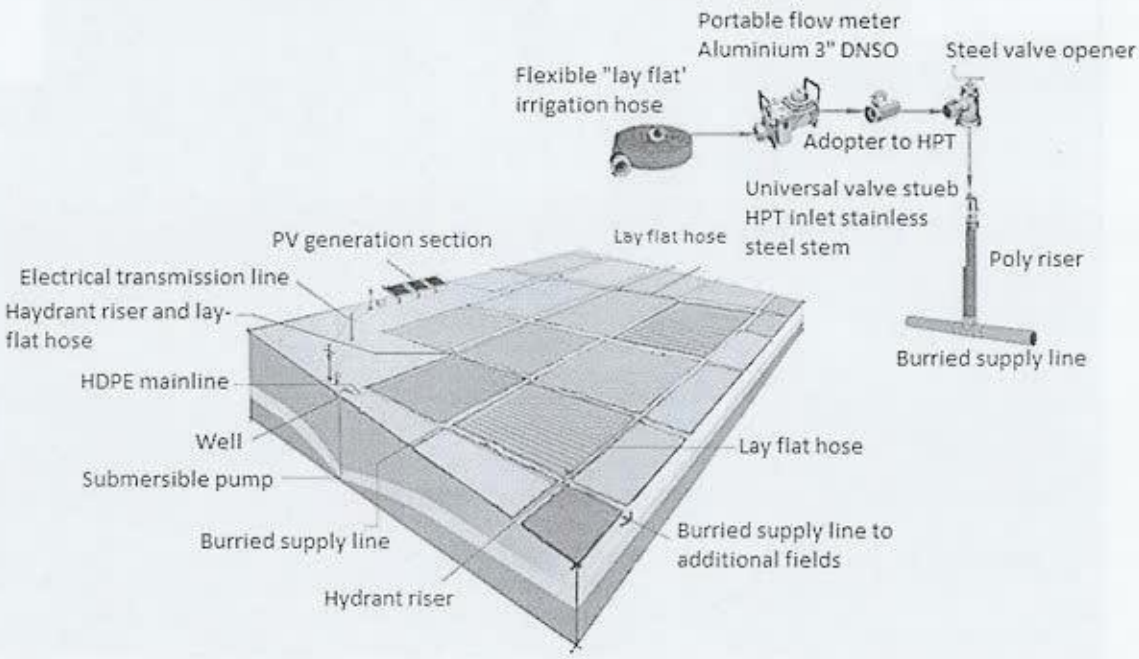

FIGURE 2 IRRIGATION SCHEME DESIGN

3.4. Civil works

Civil works related to the solar PV construction will include land excavation and leveling, foundations for the installation of the mounting system for the PV modules, the building of access roads, and fencing, as well as the construction of the light buildings (operation and administration building, security posts, storage, etc.) The project intends to use the existing irrigation canal at Andega site.

3.5. Manpower requirements

Installation of solar PVs, and installation of distribution grids are labor-intensive works during the construction phase and are expected to hire 75 skilled and non-skilled workers. However, during the implementation phase, manpower requirement is minimal, and it's expected to create 5-7 jobs in the proposed site. Similarly, during the decommissioning phase, about 6 skilled manpower and about 50 laborers are required to dismantle solar panels and other equipment.

The non-skilled workers should be hired from the nearby communities and some skilled manpower may come from other parts of the country and will rent houses in the nearby towns. Therefore, there is no need to construct camps during construction or house for temporary workers.

During the construction phase, construction machinery such as an excavator, dump trucks, a mixer, and Rollers will be used.

3.6. Land requirement

The land required for Solar PV modules installations is 0.42 hectares for Andega site. The total area required, including internal roads, and light buildings, are estimated to be 0.504 hectares.

The area stated was calculated based on an assumption of 12 sqm per kW.

3.7. Implementation schedule

Following submission of the final ESIA report, the major activities are tentatively scheduled as follows:

- Construction starts in July 2023
- Construction lasts for 6 months for Minigrid
- Operation will start in December 2023

4. Baseline Information for the Proposed Project site

Conducting base line survey before the commencement of a project is important to understand the socio-environmental situation of the target area very well and to plan where to focus. Therefore, base line survey is conducted through interviews, stakeholders and community consultations, and expert field surveys, and the results are summarized in the following sub-sections.

4.1. Physical and biological Baseline Information

4.1.1. Climate: temperature and rainfall

The Lake Tana basin, including the Andega site, is characterized by bimodal rainfall distribution with a main rainy season from June to October and a small rainy season from February to March (Asmare et al., 2020). The long-term (1951–2013) average rainfall of Bahir Dar, Debre Tabor, and Gondar meteorological stations ranges from 680 to

2400 mm (Lemma et al., 2017). The mean annual rainfall (2006–2013) was 1250–1500 mm in the east where the current project site is located (Lemma et al. 2017), while the air temperature varies between 12 and 28°C in Bahir Dar and 9–24°C in Debre Tabor. In situ measurement of temperature in the field from 06/10-09/102021 was in the range of 26-27 for Andega site.

4.1.2. Geology

In In general, the proposed project site is a volcanic rock of tertiary and quaternary age as well as a lake that share unconsolidated recent alluvial-lacustrine deposits of quaternary age. The tertiary volcanics are found in the highlands to the east, south, and north of the proposed site while the recent quaternary alluvial lacustrine, volcanic, and pyro clasts are found within Andega.

The geology of Andega site is exposed in many places especially following peculiar cinder conic hills which are made up of pyro clast of scoria and ignimbrites. The main features are pyro clasts, vesicular to aphantic basalts, and unconsolidated alluvial lacustrine sediments (Figure 3). The geological features of the area indicate the potential for a good aquifer for underground water sources.

FIGURE 3 THE GEOLOGY OF APHANATIC AND JOINTED BASALT, VESICULAR LAVA FLOW, LACUSTRINE DEPOSITS, AND PYROCLASTIC FLOWS

4.1.3. Topography and drainage

The project area lies to the southeastern fringe of Lake Tana. The topography of the target area is part of the Fogera plain (Figure 4). Andega site is flat with randomly distributed cinder conical hills (Figure 4). Field measurements of elevation using GPS at Andega centers is 1840m. This flat land is used for cultivation and animals grazing. Gumera River is a Perennial River that crosses Andega. This river is used for irrigation, fishing as well as for domestic uses. It originates from the Gunna mountains and drain towards lake Tana.

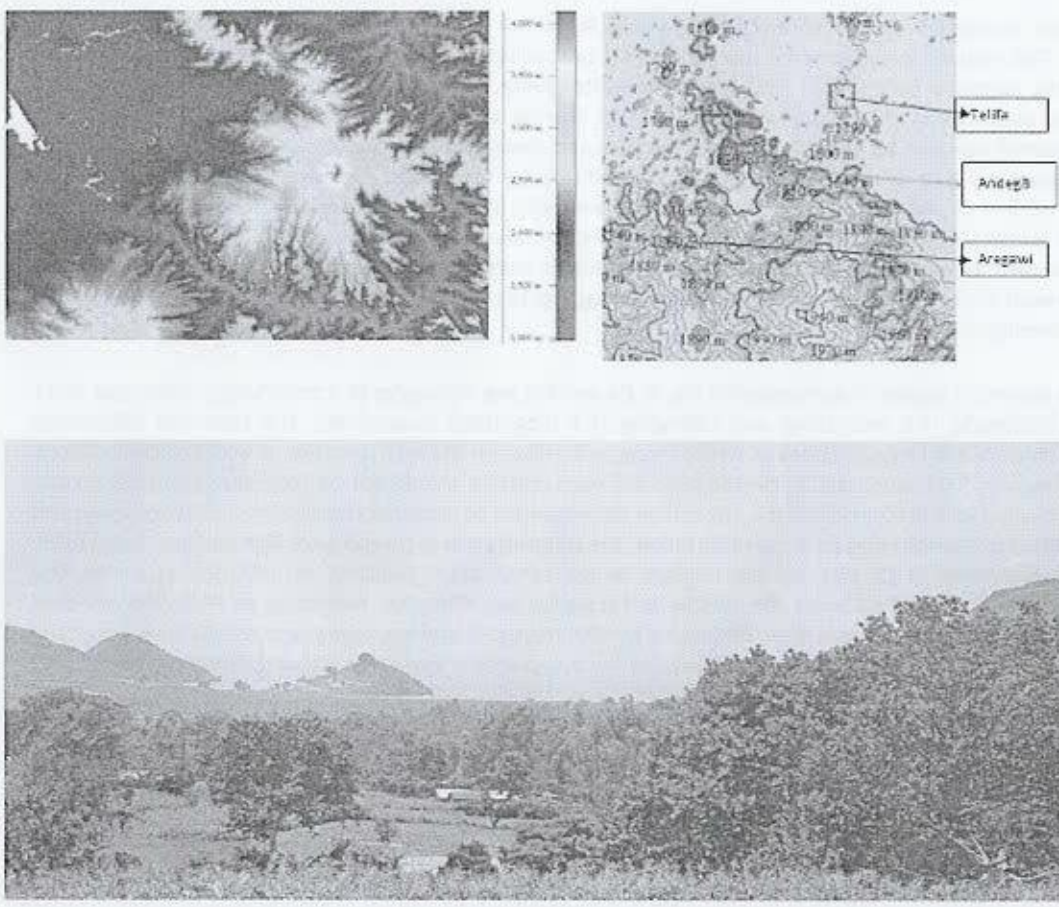

FIGURE 4 PARTIAL VIEW OF THE TOPOGRAPHIC FEATURES OF THE PROJECT AREA, DIGITAL ELEVATION MODEL (ABOVE) PANORAMA VIEW OF ANDEGA KEBELE (BELOW)

4.1.4. Soils

Soil forming factors such as parent material, climate, topography, organisms (macro-and micro-organisms), and time plays important roles in determining the physical and chemical properties of soils. Among the soil forming factors climate and organisms are active agents acting upon parent materials, and these are again modified by the topography over an extended period. Hence, the soils of a given area are a product of the interactions of soil-forming factors. Consequently, the soil in the Andega area (Dera Woreda) is a weathering product of alluvial lacustrine sediments and quaternary and tertiary volcanic (parent material) and organic materials that developed over millennia in the wetlands of the Tana basin. The soil in the Andega area is largely reddish brown in areas of steep and gentle slopes to dark in color with large content of clay due to the deposition of fine soil particles from the highlands see figure below. The types of soils generally vary with the topographic positions predominantly vertisols and luvisols in flat and gentle slopes, whereas in some pockets Leptosols are found in steeper slopes. Generally, the soils are very suitable for annual and perennial cropping. A soil sample was taken from an agriculture field to determine the physical and chemical properties of soils in the laboratory. The soil sample was collected from the surface (0-30cm depth), which was actively by roots of annual crops.

The sample was analyzed in Addis Environmental Services for Water & Wastewater Quality Testing Laboratory in Addis Ababa. The analysis included some macronutrients and micronutrients, and the results were provided in Annex. The PH, electrical conductivity (EC), macronutrients (Sulfur, Potassium, Calcium, and Magnesium), and micronutrients such as Iron and Manganese are indicated. The PH value of the soil in this site is 7.46, which is a suitable medium of reaction for the availability of primary and secondary macronutrients for plant nutrition. The electrical conductivity (EC), which is a measure of the soil's ability to conduct electrical currents, is seen as an indicator of nutrient availability or low concentrations. Generally, elevated electrical conductivity indicates the availability of excess nutrients in the soil. While too small, EC indicates a low concentration of nutrients in the soil. The FAO recommended optimal range of electrical conductivity in the soil is 1100µs/cm to 5700µs/cm. The electrical conductivity result of the current soil is 369µs/cm, which suggests the low concentration of nutrients in the soil due to intensive farming for centuries.

Similarly, the analytical results of exchangeable Na, K, Ca and Mg are 300mg/kg (1.3 meq/100g), 105mg/kg (0.27 meq/100g), 1520mg/kg (7.6 meq/100g) and 130mg/kg (1.1 meq/100g) respectively. The food and Agriculture Organization (FAO) of the United Nations provided a range of values for the interpretation of exchangeable cations in the soil. However, FAO cautioned its classification for each nutrient should not be considered in isolation but concerning the other ions present in the soil, the rate of its movement to the plant roots which is determined by soil texture, soil Based on the information in the table below, the concentration of Na and K are high and low respectively while the concentration of Ca and Mg are medium in the target area. Similarly, as indicated in Annex, the concentration of sulfate and sulfur in the sample is 110mg/kg and 40mg/kg. According to FAO, the standard concentration of sulfur in soil ranges from 500mg/to kg-5000mg/kg. Therefore, laboratory results reveal that the concentration of elemental sulfur and sulfate (SO42-) in the target area is low and less than the recommended FAO values.

Similarly, the concentration of total Fe and Mn is 0.5mg/kg and 13.6mg/kg, respectively. Based on FAO classification, healthy and productive soils should contain 50 to 1000mg/kg iron and 20-200mg/kg Manganese. Therefore, the concentration of Fe and Mn in the target area is lower than the range of FAO essential micronutrient concentration in soil.

TABLE 1: RANGES OF EXCHANGEABLE CATION (CMOL/KG=MEQ/100G) IN SOIL FOR INTERPRETATION OF CATION EXCHANGE DATA (TAKEN FROM FAO BULLETIN, 2006)

Rating	Exch. Ca	Exch. Mg	Exch. K	Exch. Na
Very high	>20	>8	>1.2	>2
High	10-20	3-8	0.6-1.2	0.7-2
Medium	5-10	1-3	0.3-0.6	0.3.-0.7
Low	2-5	0.3-1	0.2-0.3	0.1.-0.3
very low	<2	<0.3	<0.1	<0.1

FIGURE 5 SOIL PROFILE AT ANDEGA SITE

4.1.5. Water Resources

4.1.5.1. Surface water resources

The major river in the project area is Gumera. It flows east to west and finally join Lake Tana. It is a perennial river flowing throughout the year and has about 50-meter width. The majority of Andega village uses Gumera River for irrigation in addition to boreholes. There are seasonal streams with a dendritic pattern joining Gumera river. During the rainy season, Gumera overflows its banks and inundates the Andega areas (Figure 6).

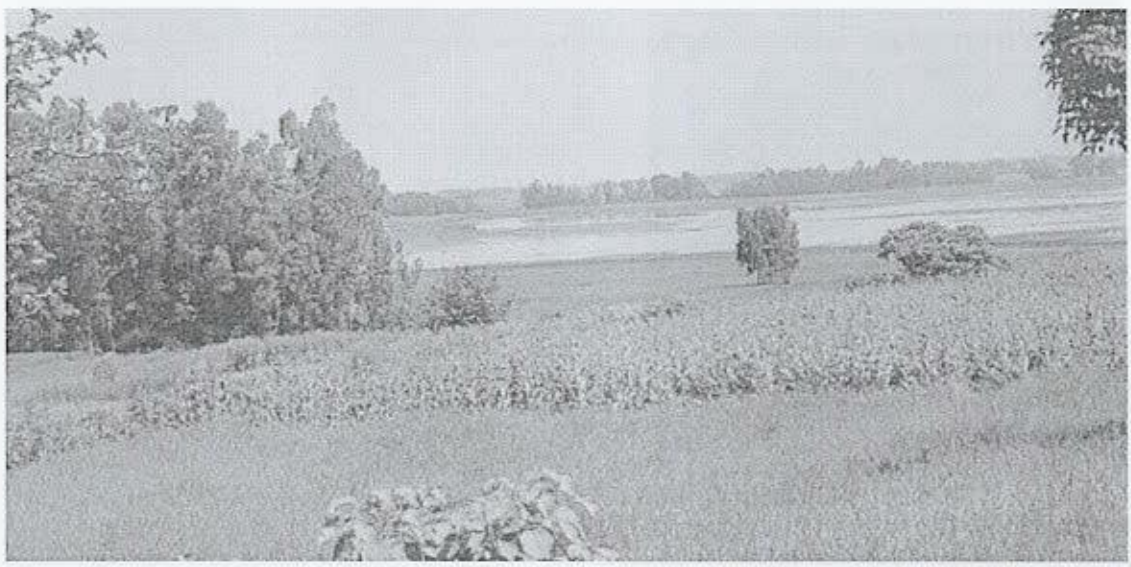

FIGURE 6 THE OVERFLOW OF GUMERA RIVER AND INUNDATED AREAS IN THE LOWER COURSE AROUND THE ANDEGA SITE

Water quality investigations were conducted during the ESIA baseline studies. Water quality test for the Andega site indicates a slight level of acidity and concentration of Manganese.

TABLE 2: SELECTED PARAMETERS OF WATER QUALITY TESTS FOR ANDEGA SITE

No	parameters	Unit	Andega	WHO maximum limit	Remark
1	Turbidity	NTU	1.85	5	
2	EC	uS/cm	177.6	2000	
3	PH	log10	6.4	6.5- 8.5	Unacceptable
4	TDS	ppm	88.9	1000	
5	Nitrate, NO3	mg/l	6.25	10	
6	Total hardness	mg/l CaCo3	45	300	
7	Manganese	mg/l	0.02	0.1	Unacceptable

4.1.5.2. Ground water

The groundwater potential appears to be high at the site. Interviews with the local communities and woreda level experts reported in Andega site water levels range from 8 to 10 meters. The community uses hand-dug wells for irrigation and more than 170 boreholes are available. Dera Woreda largely depends on the groundwater source for domestic and irrigation water supply. As information obtained from the woreda water office, the discharge capacity of deep wells varies from place-to-place ranging from 8 lit/sec to 30 lit/sec. The depth of deep wells drilled for drinking water for the community's ranges from 130 to 408m.

4.1.6. Noise baseline condition

During the construction phase, some noises could be generated from construction machinery (like excavator, loader, bulldozer, mixers, dump trucks, compactors, generators, etc.) movements. This may disturb workers of the project and the nearby villagers to some extent. Accordingly, two locations were selected; settlement area (considered as sensitive receptors) and actual project area (irrigation/farm area). See Figure 7. Noise by nature is a nuisance and may bring about annoyance, sleep disturbance and interference with communication and cause ear disease if the

level is beyond the acceptable limit (WHO prescribes 55dB for residential areas). However, the construction noise will last for a short period of time and is not expected to cause a significant nuisance to the public, at least not with standard mitigation measures in place (see Table 3) for baseline conditions).

TABLE 3: NOISES AND TEMPERATURE MEASUREMENT RESULTS AT ANDEGA SITE

Site	Location UTM	Elevation in m	Tepm in C0	Noise in dB			Date	Time
				Max	Min	Av		
Andega	341929E 1308479N	1837	25	78.1	45	61.55	09-10-21	9:30
Andega	341904E 1309126N	1807	27	64.2	48.5	56.35	09-10-21	11:40

4.1.7. Baseline air condition

Ambient air quality measurements are essential to provide a description of the existing conditions, to provide a baseline against which changes can be measured and to assist in the determination of potential impacts of the proposed project on air quality conditions. Accordingly, two locations were selected: (1) settlement area (considered as sensitive receptors) and (2) actual project area (irrigation/farm area) Figure 7. Air pollution is one of the serious environmental and social problems which create a number of adverse effects on human health due to their nature and residence time in the atmosphere. In addition to their negative effect on human health, they exert a strong effect on local and global climate change. Air pollution is often intensified in connection with development activities such as agriculture (irrigation) and industry. Hence, the source of air pollution and its mitigation measures should be understood and analyzed in advance of the commencement of any project development and implementations.

Particulate matter concentration for Andega is not of concern since both fine and coarse matters are below 0.075 ppm.

TABLE 4: AIR QUALITY MEASUREMENTS RESULT AT ANDEGA SITE

Site	Location UTM	Elevation in m	Unit	CO	PM2.5			Pm10			Time	Date
					Min	Max	Av	Min	Max	Av		
Andega	341929E 1308479N	1837	ppm	0	0.002	0.037	0.02	0.002	0.041	0.025	9:05	09-10-21
Andega	341904E 1309126N	1807	ppm	0	0.008	0.029	0.019	0.008	0.037	0.03	11:30	09-10-21

Generally, PM2.5 ranges from 0.002 to 0.032 which are not beyond the WHO required standards. Moreover, CO concentration was nil in the proposed site (Table 4).

In summary, the implementation of the proposed solar power plant for irrigation and electrification does not involve any release of greenhouse gases (GHG). Rather it is expected to offset or avoid minor emissions from diesel pumps. Nonetheless, chemical effluents due to irrigation activities especially during aerial spray of pesticides will have localized pollution impact. This impact is very much localized and can be managed to mitigate its effects on human health.

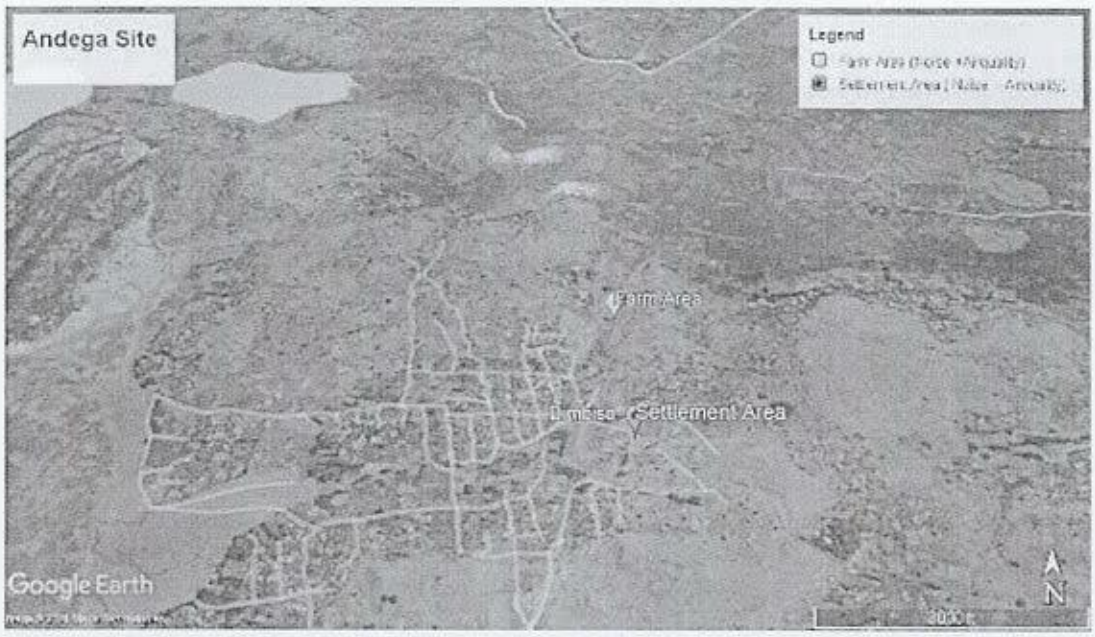

FIGURE 7 NOISE AND AIR QUALITY SAMPLE COLLECTION SITE

4.1.8. Flora

4.1.8.1. Andega site

Trees and bushes are found within the cultivated and grazing lands and around homes. Particularly, elevated topography and hills are covered by different types of trees, bushes, and scrubs. Indigenous trees such as Cordia Africana, Acacia nilotica, Juniperus genus, Piptademiastrum Africanum, Croton macrostachyus, Olea europaea (Olive) and Vachellia tortilis (Accacia) are sparsely distributed in many places of the target area. Eucalyptus tree is commonly grown around houses and churches (Figure 8). The common available bush and scrub species include Carissa spinarum edulis, Rosa abyssinica, Dodonaea viscosa, Balanites aegyptica, Vachellia sp., Hypericum sp.

FIGURE 8 BUSHES AND PIPTADENIASTRUM AFRICANUM AND SENNA DIDYMOBOTRYA IN ANDEGA SITE

4.1.9. Fauna

4.1.9.1. Domestic animal

As with any highland farming community, the Dera woreda farmers follow mixed farming, where cattle rearing is an integral part of farm activities. In addition, small livestock such as sheep, goats, and poultry are reared for protein sources as well as markets since they fetch a good deal of money from the increasing market demand from Bahir Dar city. Donkeys and horses are used for the transportation of goods.

TABLE 5: DOMESTIC ANIMALS IN DERA WOREDAS (DATA OBTAINED FROM AGRICULTURE OFFICES OF THE RESPECTIVE WOREDAS), 2013 E.C (2020/2021)

SN	Domestic animals	Woreda
		Dera
1	Cattle	277191
2	Sheep & Goat	150146
3	Pack animals	44499
4	Hen	250532
5	Bee colony	16004
6	Fish	-
7	Red- fish	-

Main problems in livestock production and fishing

Livestock and fishing are the main sources of livelihoods and dietary protein for rural and urban populations in the project area. Fish, however, are consumed mainly by urban populations rather than rural areas due to food traditions in northern Ethiopia. Some studies (e.g., Amare et al., 2018) suggest that L. Tana has low diversity of fish as compared to other lakes in Ethiopia, but some species are quite abundant in their distributions. The three most abundant fish species are Nile tilapia and Labeobarbus spp and catfish. Recently, fishery is under pressure due to overfishing by ever increasing population around the lake and habitat degradation owing to the invasive species, Eichhornia crassipes.

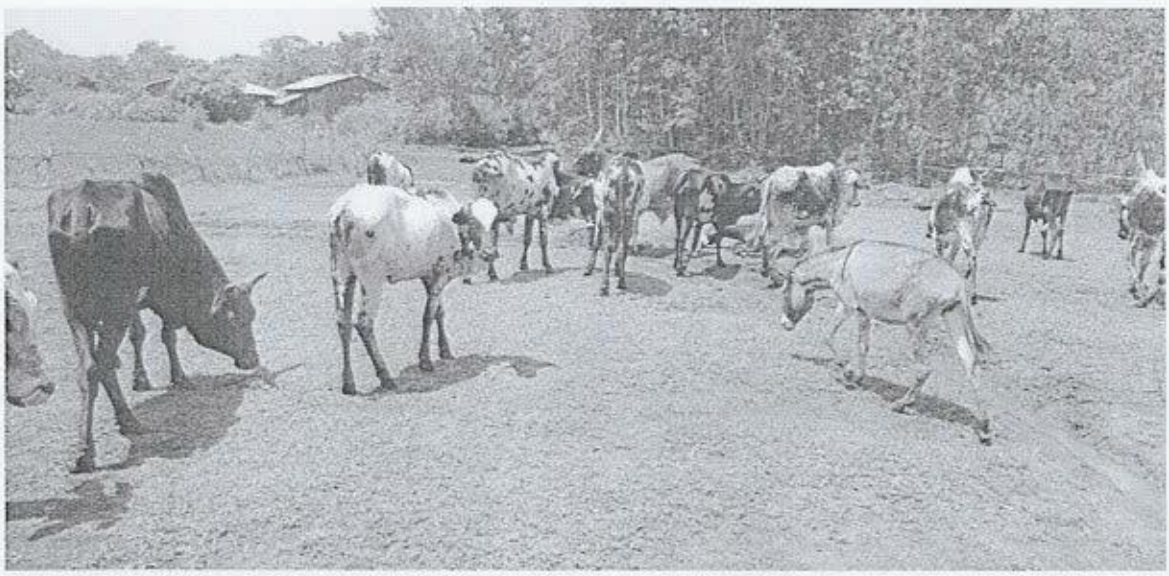

Figure 9 Domestic animals at the site

4.1.9.2. Wild animals

Local people and the regional wildlife experts have reported the presence of different wild animals in the Andega site. The common wild animals in the area include Corchorus (spotted Hyena), Porcupine, common fox, Crocodiles, Apes, and vervet monkey, Tragelaphus seriptus (Dikula), Hippopotamus, Dik-Dik and several bird species such as vultures, Eagle, Duck, Dove, Crow and so on.

4.2. Socio-Economic Baseline Information

4.2.1. Population

Based on the 2007 Central Statistical Agency (CSA), the population of south Gondar is 2,051,738, with a population density of over 145 people per km^2. It is one of the highest population density areas for grain complex farming systems of northern Ethiopia. However, Dera Woredas has slightly higher densities than the Zonal crude density over 163. The population in the target kebele Tanadinbiso (Andega site) is also densely populated and live in closely packed nucleated village houses. Almost all the houses are built of Eucalyptus poles and mud, with a ceiling of corrugated iron sheet. The population of the Tana dinbiso (Andega site) is presented in the Table 6 below. All the people in the proposed project site are farmers.

TABLE 6: POPULATION AND CULTIVATED LANDS IN TANADINBISO/ANDEGA KEBELES

Kebele	Population	Total House holds	Female headed household	Cultivated land (ha)	Irrigation participant	
					Men	Women
Tanadinbiso/	10,295	1,814	245	1,271	1,812	237

4.2.2. Agriculture activities

Land use is largely dominated by cereal crops. Traditionally the most important cereals were teff, and maize (Figure 10). This has, however, changed in the last two decades with the advent of rice. Rice has overtaken the primacy because of the availability of paddy fields. Nonetheless, increased incidences of crop diseases (common rust and bacterial wilt) particularly for rice have withheld the potential of it to secure farm households' food security. The ESIA team probed questions to agriculture office experts and the local communities on the challenges during farming and harvest seasons. The experts reported that farmers' low capacity to absorb new technologies such as new crop varieties, fertilizer uses, land degradation, and climate change as the main challenges. Whereas the farmers mentioned that prices for fertilizers, lack of market for their products, shortage of manpower during harvesting, post-harvest loss due to rodents, etc.

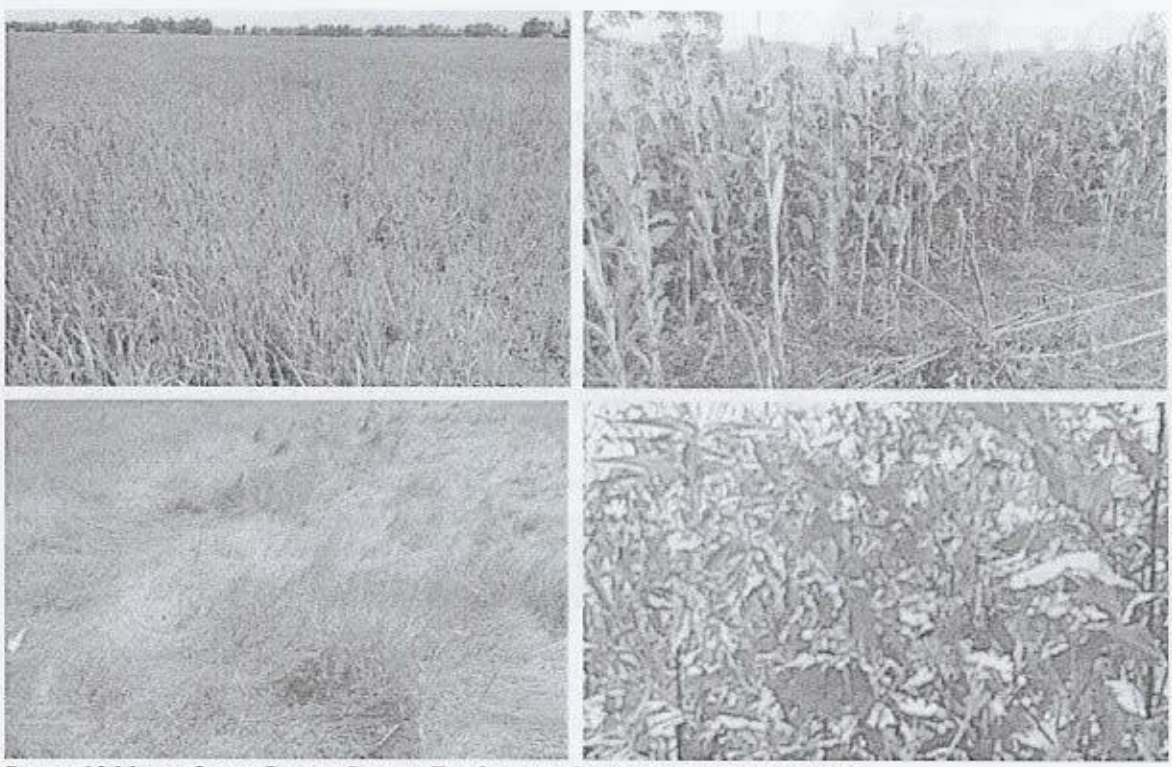

FIGURE 10 MAJOR CROPS GROWN DURING THE SUMMER SEASON IN THE PROJECT AREA

4.2.3. Health Facilities

Reports from the Dera Woreda indicated that over 80% of the health services are covered by publicly owned health posts and health centers. There is one primary hospital in Dera Woreda while for critical medical services they either travel to Bahir Dar or Gonder cities.

The top ten diseases reported by the woreda are provided in Figure (11). Malaria falciparum and respiratory infections are the two causes of morbidity in Dera woredas in addition to Fever and Helminites where seriously affecting people in Dera Woreda (Figure 11).

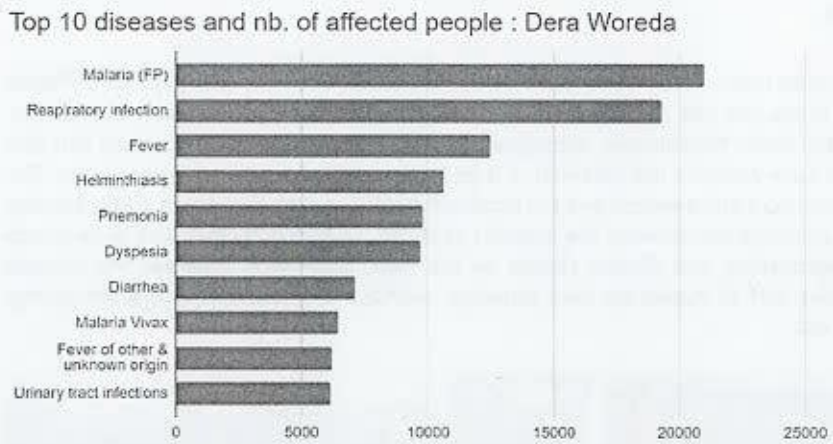

FIGURE 11 TOP TEN DISEASES IN A NUMBER OF PEOPLE AFFECTED IN DERA WOREDA

As most people during the ESIA study informed us that health centers are located far from the village and there are no good road networks to reach to them. Thus, people carry sick person with "Hessansa" to reach to the nearest health center. The available health centers are also poorly staffed and lack medical equipment and medicines.

4.2.4. Education

Concerning educational services, there is access for the primary level and secondary level, Dera Woreda did not provide us with quality data except to mention that education coverage was 84% for both primary and secondary in 2020 G.C. At Andega kebele there is one primary school which is equipped with limited teaching materials and the number of teachers is also not as required.

TABLE 7: NUMBER OF SCHOOLS AND STUDENTS IN DERA WOREDA (JUNE 2020 TO JUNE 2021)

SN	Level of school	Dera	
		No of student	Coverage
1	Prim (1-8)	No data	84.4%.
2	Sec (9-12)	No data	

4.2.5. Electric Supply

The main grid power supply is accessible for few who are located along the medium voltage transmission lines. The ESIA team learned that the woreda administrations were planning to invest in alternative sources such as biogas from Eichhornia crassipes, solar energy, etc.

Similarly, according to information obtained from the Woreda Water and Energy resources development office, there is no solar energy application for water abstraction for irrigation purposes. Some households are using solar powerhouse lights and mobile charging.

4.2.6. Road Infrastructure

Road network is poor in Dera Woreda. The only asphalted road is Bahir Dar Gonder highway. Most of the roads are functioning only during dry seasons and are also poorly maintained. One has to use a 4WD vehicle to access the

proposed site during rainy seasons. However, the site can easily be accessed by road during dry seasons (November to May).

4.2.7. Utility Service

Mobile telephone and 4G network services are available in most parts of Dera Woreda. These services are available in Tanadinbiso kebele (Andega locality) of the project area. So, communications in the project area can easily be done through email, telegram, WhatsApp, etc. as well as on phone calls using smart mobile. Bank, Fuel stations, Postal office, Hotel, Supermarkets, and other shopping services are available at the nearest towns such as Hamusit, Wereta, or Bahir-Dar.

4.2.8. Physical cultural, religious, and archaeological resources

Churches and monasteries are the most common religion-related heritages in Amhara Region. There are several churches and monasteries in Dera Woreda (Table 8). Some of the notable cultural sites are documented by the culture and tourism offices of the woredas (Table 8). Most of these are found outside the potential irrigation areas and solar power plants will provide them with a potential source of power.

TABLE 8: HISTORICAL AND CULTURAL SITES IN DERA WOREDA

SNo	Tourist attracting historical and natural places
	Dera Woreda
1	Kirkos male & women Monastery
2	Wanzaye Natural Hot water
3	Wekishet Saint Gebrial Monastery
4	Korata Welete Petros Historical Monastery
5	Saint Gelawdiwos Monastery
6	Egyptian Natural Cave
7	Wendbeser Historical Monastery
8	Rema Medihanialem Monastery
9	Monastery of Eyesus Historical Cave

4.2.9. Gender Equality

Gender relationships have always been dominated by men in rural Ethiopia, especially productive assets such as land and oxen are owned by men yet animal products such as dairy products are owned by women. The main sources of income for the families are agriculture both irrigation and rainfed. According to locals, poor people are defined as those people who have no fixed assets such as farmland. According to our discussion with the local people in the proposed area, widow or divorced women are more vulnerable to poverty compared to men-headed households. Poor people in the locality have community-based social support such as the contribution of a small number of grains from each household, lineage, and family support. Malnutrition is prevalent and poor people especially women and children are the most vulnerable.

5. Public consultations and stakeholder's engagements

5.1. Objective of stakeholder consultation

Public consultation and stakeholders' engagement are crucial components of environmental and social impact assessment. Such efforts are believed to provide opportunities for people who are potentially affected by the intended solar power plant project and help contribute to improving the design and implementation of the project activities. In addition, public consultation will enable project proponents in close cooperation to identify or mitigate any potential adverse impact that might arise due to project implementations. Furthermore, public consultation ensures the enhancement of positive impacts of projects and contributes towards sustainable development of the target area and beyond.

A stakeholder is defined as "any individual or group who is potentially affected by the proposed initiative or can themselves affect the proposed initiative".

Stakeholder engagement is a crucial component of environmental and social impact assessment.

The main objectives of public consultations and stakeholder engagement are to:

- **Identify** all those affected by or interested in the project to ensure that they are included in the engagement process.
- **Understand** the views of the key stakeholders and make sure that stakeholders adequately understand the positive and negative impacts of the project
- **Inform** the ESIA including local benefits and partner opportunities
- **Build relationships and trust** through supporting open dialogue and engagement with stakeholders. Establish transparency in activities being undertaken and build trust with stakeholders
- **Engage with all stakeholders** by having an inclusive approach to consultation and participation. This may include the use of differential measures to maximize the effective participation of stakeholders that might not be easily reached through conventional methods
- **Manage expectations and concerns** by providing a mechanism for stakeholders to engage with the Project about their concerns and expectations and provide a mechanism for receiving, documenting, and addressing comments received
- **Comply** with both national regulations and international best practice

Project details were disclosed to all stakeholders and the host community. The team also undertook to consult with administrative stakeholders to identify their views on the proposed project and perceived impacts.

5.2. Stakeholders Mapping and Analysis

The ESIA is considered to have engagement with the community; directly affected and indirectly affected persons, institutional stakeholders including government and organizations likely to be involved in project implementation, regulation, and monitoring.

List of stakeholders consulted to date are included in the appendices section attached to this report. The input from stakeholders obtained during the ESIA has informed the identification of important issues and potential sensitivities that merit further stakeholder engagement.

TABLE 9: STAKEHOLDERS IDENTIFIED, THEIR ROLES AND STATUS OF CONSULTATION IN THE AMHARA REGION

Stakeholder	Role and Interest/ influence	Status of consultation	Outcomes of consultations
Amhara region water, mine and energy office	Regional government	Letter sent, meeting conducted to introduce the project and project team.	Project disclosure was made, data and information were collected
Dera woreda Water, Mine and Energy Office	Local governments	Letter sent from the zone and meeting was conducted to introduce the project and project team.	Project disclosure was made, data and information were collected
Community from Andega village	Host community, all have interest in power for domestic consumption and irrigation and some have an interest in new employment opportunities	Meetings were conducted to disclose the project to community	PAPs may be identified later when the exact location of the project is known, and the developer identified
Dera Woreda Culture and tourism offices	Local governments	Meetings were conducted to disclose the project and identify any known cultural and archaeological sites in the proposed project area	Discussions were made, data were obtained regarding culture and tourism sites
Dera Woreda Agriculture and Natural Resources Offices	Local governments	Letter sent, meetings were held to introduce project and request data	Project disclosure was made, data were obtained

5.3. Outcomes from Community and major institutional stakeholders' consultations

5.3.1. Public consultation at Andega site

TABLE 10: PUBLIC CONSULTATION AT ANDEGA SITE

Date of meeting: 09/10/2011
Place of meeting: At Tana Dinbiso kebele meeting place in Andega site (Figure 12)
Number of participants: Male (29) & female (18)

Name of participant	Issues raised by the participants	Summary of responses to the issue by ESIA experts
Ato Kindeneh Belete (M)	He expressed there is a high hope among us that this project will provide access for transportation of agricultural goods to the market. In addition, the lesson this community learned from the Shina Dam is important on how these kinds of projects especially combining electricity to irrigation would give us a boost to our economy and social cohesion of the community. So, the project is much welcomed, to say the least.	Thanks for your view and support for the project idea. It is well recorded.
Ato Moges Engidaw (M)	Land shortage is one of the serious problems here and what if it takes a sizeable amount of land for mini-grid solar power plants and distribution lines.	Actually, the purpose of this discussion is to get important feedback, comment and information directly from project affected people like you. Land take will be minimal and will duly be compensated according to the legal provisions of the country.
Ato Turneh Tege (M)	He presented his comments, in short, stating that we heard about this project before and it is good for us and we are ready to support it.	It is known that the site has been investigated by others and you have got information from them and your support to the project is well noted.
Ato Kindeneh Belete (second round question) (M)	The community is ready to support in terms of labor, money, or other means to see the success of this project.	Your intention to support the project in labor and money is much appreciated.
W/r Temognehu Taho (F)	She stated that she wants to see a sustainable project, not something that starts and ends shortly.	We expect that the project will not be interrupted once it is started unless it is not feasible at the beginning. The final decision will be made after ESIA and other technical and financial reports evaluation.

Priest (Aba) Worku Alemu (M)	He stated that most of the community members are frustrated with irrigation activities because of fuel shortage and its soaring prices. This is good news not only for irrigation but also to provide spiritual and community services to our community.	The ESIA team thanked for the comments and promised to include all views aired during the meeting.
The Kebele representative (M)	He stated that the project is very useful and we are glad to see it in a short period of time.	The ESIA team expressed their gratitude and promised to incorporate all the comments.
All participants (M & F)	All the above respondents raised any potential source of gender-based violence including sexual exploitation of women for short term benefits	The ESIA team responded that gender-based violence is a serious offense and the potential project proponent will have a protocol including training manuals to sensitize and monitor it. If it happens in some way, there will be administrative and disciplinary mechanism to address the offenses

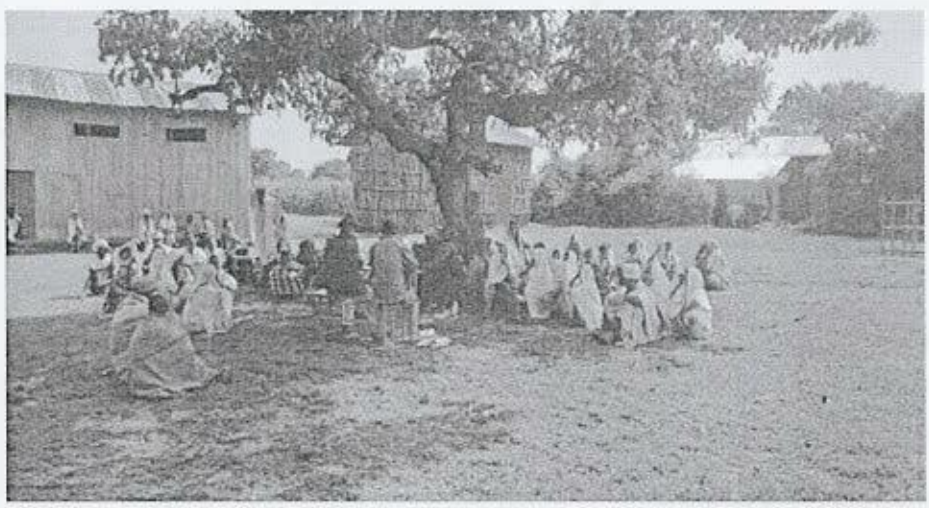

FIGURE 12: LOCAL PEOPLE PARTICIPATING IN PUBLIC CONSULTATION AT ANDEGA SITE

5.4. Grievances Redress Mechanism

The mitigation and management plans will be carried out properly. Thus, it is expected that no major grievance issues will arise. However, to ensure that stakeholders have avenues for redressing their grievances related to any aspect that may result from the project, detailed procedures for the redress of grievances have been established. The objective is to respond to the complaints of stakeholders in a timely and transparent manner without resorting to complicated formal channels to the extent possible. The procedure covers stakeholder grievances generated during construction and operation activities. Anyone will be eligible to submit a grievance to the project if they believe the practice is harming the community, the environment, or on their quality of life.

5.4.1. Grievance Handling Procedure

Disclosure of the grievance and redressing Mechanism (GRM): The Community will be fully informed about the Grievance procedures in their local language. Information about the grievance mechanism will be tailored according to the community for ease of communication. Community leaders, social entities and the governmental units will be informed about the GRM. All information about grievance mechanisms will be made available in public areas and with the community leaders in the proposed project site.

5.4.2. Mode of Grievance Reporting

The client or contract will accept all comments and complaints associated with the project from any stakeholders. Comments can be made in person or via emails, post, telephone, or any other appropriate communication channel. The client or contractor will arrange an officer to entertain complaints for those who want to report in person within

the project compound. The comments and complaints will be summarized and listed in a complaints/ comment logbook, containing the name/group of commenter/complainant, date the comment was received, brief description of the issues, information on the proposed corrective actions to be implemented (if appropriate), and the date of response sent to the complainant.

5.4.3. Registration and Response to Grievances

All grievances will be registered and acknowledged within 6 working days, and we generally anticipate it will be responded to within 15 days. The project management will keep a grievance log and report on the progress of grievance management as part of the annual project progress reports which will be available on the company website. All comments and complaints will be responded to, either verbally or in writing, in accordance with the preferred method of communication specified by the complainant.

6. Potential Environmental and Social Impact Identification and Significance

6.1. General Overview

Identification of all project-induced impacts is an essential output of environmental and social impact assessment (ESIA). ESIA is a process of addressing potential positive and negative impacts of a project to design a management action plan before the project construction, development, and implementation phases. As part of the project planning process, it helps to prevent and/or mitigate adverse impacts and enhances a project's beneficial outcomes. In addition, ESIA provides information for decision makers for better planning and resource management and helps them avoid the negative consequences of the project.

To this end, the potential impacts of the proposed projects were identified in this document and categorized as biological, physical, and socio-economic. The main impacts and their likelihoods as well as their levels of impact and severity were identified based on the projects' main activities.

The ESIA team addressed some of the identified impacts based on:

- Identification of the main environmental and social resources and receptors from the baseline data collection from the project site
- Literature review of impacts of solar generation project
- Results of the stakeholders and community consultations

During the ESIA study, in addition to including some more impacts (based on additional information from the site), a brief description and analysis were made for each impact identified. Accordingly, the proposed project's potential impacts (positive and negative, large, or small, direct or indirect, reversible and irreversible, and significant and insignificant) on the existing bio-physical and socio-economic environment and significance are outlined in the next section. Parameters such as land environment, water environment, air environment, noise environment, and socio-economic environment are of significance in the environmental impact assessment and are being discussed in detail in the following subsection below.

6.2. Beneficial Impacts

6.2.1. Economic and environmental benefits

The main purpose of this project is to provide electricity to the community and large irrigation pumps from PV power plants. The project will have several beneficial impacts both at national and regional levels. Some of the major positive impacts include the replacement of diesel pumps with electric pumps, which will reduce dependence on diesel and, thus, the reduction of greenhouse gases emission to the atmosphere. In addition, the project will also increase agricultural yield/production, create an employment opportunity for skilled and semi-skilled workers, create an opportunity for knowledge transfer in utilizing best irrigation and agricultural practices, improve social infrastructures, and economic development to the nation at large. The following are some of the positive impacts of the developing project.

6.2.1.1. Increasing agriculture production

During the field visit, it was observed that the selected project area is favorable for modern irrigation activities. However, the farmers are dependent on imported fuel, and its cost has been rising over time. Apart from the rise in fuel prices, its availability has been a challenge for farmers. The planned project, generating energy from solar power, is expected to solve many of the farmers' problems. It will provide and/or increase access to water for many farmers and can have significant effects on agricultural productivity and generated income. There will be a sustainable and

diverse food supply throughout the year. Furthermore, the project will increase opportunities to produce market-oriented or high-value horticulture crops for urban centers.

6.2.1.2. Employment opportunity

Unemployment is a huge problem in many developing countries including Ethiopia. The development and implementation of this project will undoubtedly be very significant in creating job opportunities for trained, semi-trained local youths during the construction and implementation phases. During the public consultation, one of the community's concerns was about hiring technicians for maintenance not to interrupt the middle of cultivation. The project developer will hire trained experts for repair and maintenance. This proposed project is expected to generate employment opportunities for over 150 people operating at full capacity. This will be a significant impact since unemployment is currently quite high in the city and the country at large. Moreover, unemployed youths in the community will form associations and participate in irrigation activities.

6.2.1.3. Alternative source of energy

Solar energy is friendly to the environment, clean, and requires limited maintenance. It can be used as a useful renewable energy source, especially for countries like Ethiopia which have a high amount of annual solar irradiation. Among the various forms of renewable energy technologies, solar photovoltaic (PV) technology is perhaps the most used one to generate electricity, especially in rural areas. Currently, in Ethiopia, some people in rural areas use solar energy for household uses. During field visits at the project area, it is observed people using solar for charging mobiles and lights at home. From information obtained from the Dera woreda water and energy office, 16 deep wells work using solar energy to pump water to distribute to the community water supply.

6.2.1.4. Electricity supply for the nearby community

The planned solar mini-grid solar power plant provides multiple opportunities for the community; it will likely save the environment through avoiding deforestation and pollution; reducing women's burden from household chores; enhance community safety and security through provision of stable and affordable energy (light); improved health and education services and enhance the general well-being of the community.

6.2.2. Social Benefits

6.2.2.1. Gender equality

Irrigation interventions can also affect women's empowerment (or disempowerment) depending on gender roles in agriculture, which vary from case to case. Improved access to the water supply may release women from water-collection chores and might allow women to invest more time in income-generating activities, such as agricultural production. If women are farming their own plots and have access to irrigation technologies, then the productivity of female-managed plots may increase, and income from the increase in productivity may also grow.

6.2.2.2. Knowledge Transfer

The project will play a great role in transferring (development) knowledge and skills in utilizing the best irrigation agricultural practices. Here, the irrigation users will be organized in the irrigation user's association (cooperative) which can help to disseminate information effectively and efficiently. People from other parts of the country will visit the pilot project and initiate them to implement it in their localities.

6.3. Potential Adverse Impacts and Mitigation measure

6.3.1. Adverse impacts during the preconstruction phase

Before the commencement of construction, only data collection for feasibility study and environmental and social impacts assessment study were conducted. Baseline data collection and public consultation have been conducted at the site. These activities don't have any significant impact on the environment.

6.3.2. Adverse impacts during construction

6.3.2.1. Generation of solid waste

The major solid waste expected from this project is damaged solar PV modules during construction. These modules can contain potentially hazardous materials and result in soil and water contamination. Other wastes from the construction site will be mainly residues of the construction material. These include pieces of concrete, heaps of sand and aggregates, bits and pieces of various pipe types, pieces of electrical materials, cans and bags of paint and plastering, packing materials, pieces of timber, scrap, and pieces of metals sheet and iron bar (metals) among others within the project site.

These waste materials create adverse impacts on the biophysical environments of the area if proper avoidance and mitigation measures have not been taken in place and on time.

Mitigation measures:

- Hazardous waste, including broken PV panels, shall be disposed of in accordance with best industry practice
- Wastes will be kept in a dedicated storage container until the recycled materials are sold and the unwanted materials to be transported to a designated disposal site
- Any heaps of sand and concrete aggregates in the compound should be cleared in order to keep the area neat and clean

6.3.2.2. Generation of liquid waste

During the construction phase, liquid wastes like oil spills from machinery, grease, and petrol in the garage from vehicles are expected to pollute the environment in addition to water wastes from concrete rationing and water sprinkling water wastes from different sanitary uses are expected to increase. Moreover, accidental release of other hazardous materials from equipment used in the solar panel installation process will likely create liquid wastes. If these wastes are not properly managed and mitigated can seep into the soil, kill plants, pollute surface and subsurface water, destroy natural habitats and cause biodiversity loss (especially the microbes and small invertebrates) in the area. Furthermore, such continued spill and seepage into the ground will result in the contamination of surface and groundwater sources. These all will further affect human health and wellbeing in the project command area and beyond.

Mitigation measure

- Storage areas for fuel and hazardous materials shall be roofed and have a concrete floor with a bund for secondary containment and collection of spills
- The wastewater from sanitary and construction works should be collected through a channel in a plastered pond or reservoir and can be recycled for construction, green area, and other purposes after proper filtering and treatment

6.3.2.3. Soil erosion

During construction work, a considerable volume of soil will be excavated for the leveling site and solar mounting foundation. In the construction area, soils will be impacted due to clearing of vegetation, mounting of the PV modules, construction of internal roads, etc. Exposure of the ground and removal of vegetation cover will make the soil vulnerable to erosion by wind and running water. However, due to the site's flat topography and the relatively limited earthworks associated with solar PV installations, these impacts are manageable through ensuring good international industry practice in construction works.

Mitigation measure

- Topsoil shall be set aside and reserved where possible
- Avoid excavation during the rainy season
- Heap the excavated soil in the selected area and reuse it to fill undulating areas
- Drainage measures shall be provided, prior to construction works, to reduce stormwater run-off and flash floods

6.3.2.4. Noise pollution

During the construction phase, some noises could be generated by construction machinery (like excavators, loaders, bulldozers, mixers, dump trucks, compactors, generators, etc.) movements. This may disturb the workers of the project and the nearby villagers to some extent. Noise by nature is a nuisance and may bring about annoyance, sleep disturbance, and interference with communication and cause ear disease if the level is beyond the acceptable limit (WHO prescribes 55dB for residential areas). However, the construction noise will last for a short period and is not expected to cause a significant nuisance to the public, at least not with standard mitigation measures in place.

Mitigation measure

- Noisy activities shall be scheduled for daytime hours
- Noise disturbance and impact can be reduced by also administration and management decisions to work on a shift basis, work rotation, and work time reduction for workers to reduce their exposure to noise, moving away the workers from the source of noise by restricting area and shutting or turning off noisy equipment or machinery when not needed
- Noise levels at sensitive receptors shall be measured regularly and whenever complaints arise
- In instances where workers will be exposed to elevated sound levels, personal protective equipment (PPE) such as ear mufflers/plugs should be used

6.3.2.5. Air pollution

The main impact on air quality during construction will be from increased dust levels arising from the movement of vehicles and construction machinery, land clearing and leveling, cement mixing (fugitive dust, Pm2.5 microgram per litter), internal road construction, etc. In addition to emissions of particles, there will be minor emissions of CO from construction machinery, vehicles, and diesel power generators. However, due to the relatively long distance between the main PV installation areas and the settlements the impacts are very minor. Principally it is essential to keep control of dust particles during construction since dust particles contribute to air pollution that might limit visibility and affect human and animal health (It adversely and seriously affects human respiratory systems, particularly bronchitis and lung).

Mitigation measure

- Workers assigned in the construction machinery operation should wear a dust mask. The supervisor should strictly follow and make sure this procedure is in place before starting their job
- Water shall be sprayed on all internal roads to minimize dust dispersion when necessary

6.3.2.6. Impact on public health

In the construction phase, solar PV installation involves a high number of workers from other parts of the region. The influx of workers may contribute to a breakdown in social fabrics, norms, and practices, including sexual behavior. Many workers both male & female are expected to be involved in the different stages of the construction activities as envisaged in the project feasibility study. Along the process, workers may have a chance to interaction within themselves or with any nearby, which might lead to behavioral change. This could result in the transmission of contagious diseases such as HIV/AIDS and other STIs. Such incidences may further strain rural health infrastructure and become community health concerns. In addition, ponds and stored water may result in malaria risks and other diseases such as bilharzia.

Mitigation Measures:

Prevention will be the key intervention measure and therefore sensitization and awareness measures on HIV/AIDS should be carried out on a regular basis among workers and the host community during the construction phase.

- Conduct public health campaigns addressing issues of behavioral change, HIV/AIDS, etc.
- Putting in place appropriate signage to educate the workforce and community about the project's HIV policy
- Provision of materials useful for the prevention of HIV/AIDS
- A code of conduct shall be in place to manage workers' behavior
- Conducting malaria awareness raising campaign, using mosquito bite prevention methods such as mosquito nets
- Avoid drinking contaminated water (raising communities' awareness to boil and drink water) to reduce bilharzia infection

6.3.2.7. Spread of Covid-19

The influx of labor is associated not only with the spread of HIV/AIDS and other sexually transmitted diseases but also with other pandemics such as Covid 19. Coronavirus is a novel contagious disease that is spread through crowding and from the person-to-person transmission of the virus. During construction work, many workers will be involved and work in close contact, and this will aggravate the spread of Covid-19 from person to person and also within the surrounding communities.

Mitigation Measures:

- Workers shall follow strictly Covid-19 prevention mechanisms
- Temperature measurement checkup each day at the gate of the compound
- Workers should clean their hands with soap and water, or sanitizers or alcohol many times as much as possible each day
- Keep a safe distance (2 meters) from anyone who is coughing or sneezing
- Workers keep proper physical distance from others (2meter) and always wear a mask and avoid handshake or other physical contacts
- Workers do not touch their eyes, nose, or mouth
- Cover their nose and mouth with their bent elbow or a tissue when they cough or sneeze
- Stay home if workers feel unwell
- If workers have a fever, cough, and difficulty breathing, seek a doctor on time

6.3.2.8. Traffic accident

During the construction phase, there could be traffic accidents associated with the construction of the solar minigrid facility. Specifically, some large trucks, rollers and perhaps excavators will be used. In addition, the roads leading to the project area are not accessible for all vehicles except tracks during the dry season to transport agricultural products. Furthermore, the community awareness regarding the traffic system is also limited. Therefore, unless traffic safety is promoted among workers and the community, traffic accidents could increase during the construction phase

Mitigation Measures:

- Emphasizing safety aspects among drivers (putting up signposts and other precautionary messages)
- Collaborating with local communities on education about traffic and pedestrian safety (e.g., school education campaigns)
- Mandatory speed limits not exceeding 40km per hour

6.3.2.9. Impacts on flora

The construction work is only limited for solar panel construction site, since there is no plan to construct irrigation components as seen from design (Figure 1). The selected solar mini grid project site consists of areas that are sparsely vegetated or have no vegetative covers, and hence no trees will need to be removed as part of construction. However, a limited amount of vegetation will be cleared at the solar panel erection site during construction.

Mitigation Measures:

- Replantation in other part of the area to compensate amount of vegetation cleared

6.3.2.10. Landscape change and visual impacts

During the construction phase the existing relatively flat topography may change due to excavation and levelling. In addition, the excavated overburden materials and construction materials leftover inside the site and surrounding area may create visual impacts.

Mitigation Measures:

- Use the excavated soil for backfill during site restoration phase
- Properly store and finally clear construction leftover materials

6.3.2.11. Gender based violence (GBV)

Gender-based violence involves power imbalances where, most often, men are the perpetrators and women the victims. While women are usually the immediate victims of gender violence, the consequences of gender violence extend beyond the victim to society. Experience from other projects indicates that among the most serious and invisible risks is the increase in gender-based violence (GBV) in the populations in which a project is carried out. For this specific project during the construction phase, there will be a very small, temporary labour influx which may result in gender-based violence (GBV) and sexual exploitation risks for women and girls, although unlikely this issue should have modest monitoring.

Mitigation measures

The main measures to minimize these cases in the context of development projects include preventive measures such as codes of conduct, worker training, and specific complaint mechanisms to address sexual violence. The proponent should work closely with local women's support groups, organizations, and institutions that can provide the timely and immediate support that girls and women require.

6.3.2.12. Child labour abuse

In most parts of the country in Ethiopia including this specific project area, the culture encourages children to work to develop skills. Children are considered assets to generate income in a time of poverty. Children should, therefore, be given work at home early in life and be obliged to assist parents in the farming area. During the construction phase, children may become involved in construction activities by running errands or doing simple tasks. These activities could keep the children away from school in addition to the risk of being exposed to accidental and other injuries.

Mitigation measures

Continuous monitoring of contractor's compliance to national labour laws and AfDB's OS5

6.3.3. Adverse impact during Operational or implementation phase

6.3.3.1. Impacts on bio- physical environment

6.3.3.1.1. SOIL CONTAMINATION AND SOIL FERTILITY DECLINE

Solar mini-grid power plant facilities do not involve significant risks of pollution spills or the release of other hazardous materials during the operation phase. However, as mentioned earlier, solar PV modules and batteries contain potentially hazardous materials and need to be disposed of safely at the end of their use and when they are damaged during the operation phase.

Mitigation measures

- PV panels and batteries at the end of their useful life, and other potentially hazardous waste generated during the operation phase, shall be disposed of in accordance with best industry practices

6.3.3.1.2. SOIL EROSION

The proposed solar mini-grid plants at the site have flat laying topography, and the expected soil erosion during the operation phase is very minimal. However, there will be a need to provide drainage around the solar mini-grid plant to prevent localized flooding and erosion. This will be considered in the detailed engineering phase as a measure to safeguard the solar PV installations as well as for environmental protection

Mitigation Measures:

- Plant trees in areas exposed to flooding
- Provide permanent drainage at the project site to prevent flooding and soil erosion
- Construct terrace at sloppy areas (some places of Andega site)
- Avoid discharging excess water over in the irrigable site

6.3.3.1.3. WATER CONTAMINATION

The project area is rich in surface and groundwater; therefore, any improper discharge of pollutants may contaminate the water bodies significantly. The major river Gumera and other tributaries drain to Lake Tana, the contamination may go beyond the farmland and could impact the lake unless proper waste management is practiced. The impact of water pollution from solar PV plants during the operation phase is very minimal. The expected potential source of water pollution is from the permanent workers (e.g., Guard, technician) facilities, therefore, sources from these facilities may generate sanitary effluents

Mitigation Measures:

- Ensure proper facilities and disposal processes exist for waste and water at the minigrid site and toilet/guardhouse facilities.

6.3.3.1.4. IMPACTS ON BIODIVERSITY (FLORA AND FAUNA)

The planned solar PV installation area is sparsely covered with bushes and grasses. Clearing of vegetation will be conducted at the start of construction, once the solar PV installation is completed impact on flora will be minor.

Risk of bird fatalities: during the site visits, a variety of bird species were observed, this is maybe due to the proximity of site to Lake Tana and availability of food on the lake and surroundings. Recent studies have demonstrated that utility-scale solar developments represent a source of fatality for wildlife such as birds (e.g., Kagan et al. 2014). However, the risk is highly dependent on the type of technology with several impacts confined only to concentrating solar power (CSP) and power tower technologies (Walston et al. 2016). The impacts may also not be greater than for any other facility with above-ground structures including window strikes on buildings and bird collisions and electrocution with distribution lines.

Mitigation Measures:

- Select PV panels with minimal light reflection to protect birds from collision and remove weeds manually and avoid using pesticides.
- Rehabilitation of trees through planting
- Stakeholders should work hand in hand with demographic pressure on diminishing natural resources rather than starving to meet their own individual interests at the expense of the park and its objectives

6.3.3.2. Impacts on socio-economic environment

6.3.3.2.1. LOSS OF FARMLAND

Though the implementation of the irrigation project has numerous benefits for most of the local communities, the construction of the solar PV will occupy a sizable amount of land not more than 0.5 hectare per site. Hence, land take will result in permanent loss of agricultural and grazing lands. However, the area needed for solar is so small and also there is a chance to construct on communal land. Therefore, it does not result in economic displacement for farmers

In project area Kebele (Andega localities), a public consultation was conducted, and the communities agreed to hand over land for solar panel installation if compensation payment is made as per the provision of the law (proclamation no. 1161/2019).

Mitigation Measures:

- Landowners shall be compensated as per the new proclamation No. 1161/2019 before the construction activities start
- Provide job opportunity priority for those projects affected people (PAP) during construction and implementation phases

6.3.3.2.2. Noise pollution

Both the irrigation activities and solar PV facilities emit insignificant sound pollution. Therefore, noise impact will likely be insignificant and may not need mitigation measures.

6.3.3.2.3. Air pollution

Air pollution is one of the serious environmental and social problems which creates several adverse effects on human health due to their nature and residence time in the atmosphere. In addition to its negative effect on human health, it exerts a strong effect on local and global climate change. Air pollution is often intensified in connection with development activities such as agriculture (irrigation) and industry. Hence, the source of air pollution and its mitigation measures should be understood and analyzed in advance prior to the commencement of any project development and implementation. Upon commissioning, the solar PV plant will supply renewable energy using a technology that does not involve the release of greenhouse gases (GHG) during operation. Compared to diesel generators or other thermal power plants, solar PV facilities can thus contribute to reducing air pollution.

Mitigation Measures:

- Measure levels throughout lifetime of project and address as needed

6.3.3.2.4. Generation of liquid waste

During the operation phase, the generation of liquid waste from the solar PV plant is very limited. The major source of liquid waste emanates from sanitary wastewater from restrooms.

Mitigation Measures:

- Construct a septic tank inside the premise and collect sanitary waste and finally dispose of it at permitted area

6.3.3.2.5. OCCUPATIONAL HEALTH AND SAFETY

The health and safety risks during the operation phase will be limited to the solar PV site worker. Technicians will be exposed to electric shock, burns, and body damage as they undertake routine operations and maintenance tasks.

Mitigation measures

- Use of appropriate PPE during installation and maintenance
- The solar PV plant shall be equipped with a fire-fighting system

6.3.3.2.6. CONTAGIOUS DISEASES (STDS, HIV, TB) AND COVID-19

The operation phase of the solar PV project involves a limited number of workers; The influx of labor is often associated with the spread of communicable diseases such as HIV/AIDS and other sexually transmitted diseases. Coronavirus disease is also a new and potentially dangerous contagious disease that is spread through crowding and from person-to-person contacts. In addition, it is expected that a disproportionate percentage of the labor force will be constituted of the young population in their sexually active age hence exposure to STDs (e.g., HIV) would be expected.

Mitigation measures:

- Health promotion: sensitization of both community and workforce
- Provision of materials necessary for prevention and detection of COVID 19
- Provision of materials useful for the prevention of HIV/AIDS
- Having in place appropriate signpost to educate the workforce and community about the Project's HIV policy and project COVID management and prevention policies

6.3.3.2.7. FIRE HAZARD

During the operation phase of the project, there could be different activities that may lead to a fire outbreak. Poor handling of Solar PV components like AC and DC converters, and transformer & electricity systems, faulty electrical equipment, carelessness, etc. are some of the possible causes for a fire outbreak. The effects may result in total damage from fire hazards which could permanently affect the project and may result in loss of property and life.

Mitigation Measures:

- The solar PV plant shall be equipped with a fire-fighting system
- The technician should regularly inspect Solar PV components,

6.3.3.2.8. IMPACTS ON TOURISM AND CULTURAL HERITAGE

As described earlier in this document Dera woreda is rich in different cultures and tourist attraction areas. However, the information obtained from public consultation, woreda's culture and tourism office and field visits conform to the absence of known cultural heritage resources at the project site. However, as always, there is a risk that cultural heritage objects are unexpectedly uncovered during construction activities. The project area is situated about 7km far from the main road to Bahir Dar and Gonder, both cities are known tourist destinations in Ethiopia. The establishment of this project adds a positive impact on tourism activity. Government representatives from different parts of the country, researchers, students, etc., might be attracted to visit the solar PV facility for educational purposes and to implement in other parts of the country.

Mitigation Measures: Prepare chance finds procedure based on World Bank

6.3.3.2.9. CHILD LABOR ABUSE

In most parts of Ethiopia, including this specific project area, the culture encourages children to work to develop skills. Children are considered assets to generate income in times of poverty. Children should, therefore, be given work at home early in life and be obliged to assist parents in farming areas. During the operation phase, the minigrid developer will not have any role to hire children in to, so this is a highly unlikely risk for the operation of a solar energy power plant.

Mitigation measures

- Provide training for families not to participate children underage
- Strictly monitor compliance to national labour law and AfDB's OS 5

6.3.4. Impact during Decommission Phase

Information from different literature reviews reveals that power PV plants are expected to have an economic life span of 25 to 30 years and are more likely above with proper maintenance and interim replacement of major equipment (National Renewable Energy Laboratory 2012). Once the power generation ceases, it is mandatory to decommission the solar modules and all associated equipment and facilities to return the affected area to the natural environment.

6.3.4.1. AIR POLLUTION

Similarly, during the construction phase, during the dismantling of the solar PV equipment and unwanted constructed structures will create dust emissions. The dust results in respiratory problems and other health impacts on decommissioning workers.

6.3.4.2. GENERATION OF SOLID WASTE

During the decommissioning phase, solid waste will be generated after the use-life of solar modules, cables, substructures, demolished civil structures, etc. Solar modules can contain potentially hazardous materials, so consideration should be given at the start of a solar PV project as to how units will be disposed of at the end of their use-life.

Mitigation Measures:

- Workers should wear dust masks
- Spray water on demolishing areas
- hazardous wastes should be dumped in specified protected site

6.3.4.3. LOSS OF EMPLOYMENT

The solar PV project will create jobs for a limited number of workers during the implementation phase. When the project phases out, permanent workers will be jobless and will likely be negatively affected.

Mitigation Measures:

- Transfer permanent workers to other active projects
- Pay compensation (severance) for permanent workers

6.3.4.4. NOISE POLLUTION

The decommissioning activities of dismantling the solar power plant and removing the ancillary facilities are associated with potential increased noise levels. The receptors of the increased noise level will be only the workers of decommissioning activities.

Mitigation Measures:

- As the only receptors will be the workers at the site and within the proposed facilities within the vicinity of the solar power plant, these increased noise levels are considered occupational noises that require occupational health and safety measures, like wearing air plugs

6.3.4.5. LABOR INFLUX AND GBV

The activities associated with decommissioning will involve dismantling of the solar power plant, irrigation pipes and removal of its facilities. These activities involve a limited number of workers. Hence it may have a temporary effect. We don't anticipate any insignificant impact on gender related violence and spreading of communicable disease like HIV, Covid 19, etc. Similarly, the participation of underaged workers will be unlikely since the number of workers required for the decommissioning phase is very limited.

6.4. Significance of impacts

Identification of impact significance and analysis is a core element in an ESIA process. It involves impact identification, prediction, and evaluation. The most possible potential impacts associated with this project were identified using professional exposure to similar projects, from collected baseline data, community consultation, and professional judgments.

Based on these factors, the identified impacts of the project on the biophysical and socio-economic environment of the area were evaluated and predicted. The identified impacts were evaluated to determine their significance by using typical parameters; type, duration, nature, magnitude, and significance through the project development periods as indicated in Table 11.

The parameters used in evaluating the magnitude and likelihood of the impacts are briefly addressed in the table. Spatial and temporal extent, the natural resources carrying capacity and possible potential environmental sustainability because of the impacts of the identified parameters were done. Based on these factors, the most possible impacts of the project on the biophysical and socio-economic conditions of the project area were evaluated.

TABLE 11: IMPACT SIGNIFICANCE EVALUATION CRITERIA

S. No	Criteria	Impact rating	Description
1	Extent of the impact	Local	Site specific or confined to project premise
		Regional	Extending beyond the boundaries of the project site and its buffer zone, affecting neighbors, town, local authority, district and even province
		National	Affecting areas beyond the province.
2	Magnitude	Very low	Where the impact affects the environment in such a way that natural, cultural and social functions, and processes are not affected.
		Low	Where the impact affects the environment in such a way that natural, cultural, and social functions and processes continue, albeit in a slightly modified way
		Medium	Where the affected environment is altered, but natural, cultural, and social functions and processes continue, albeit in a modified way.
		High	Where natural, cultural, and social functions or processes are altered to the extent that it will temporarily or permanently cease.
3	Nature	Permanent	When the effect is long-lasting
		Temporary	When the effect is for a short period of time

TABLE 12: POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS EVALUATION

S. No	Main Identified Potential Impacts	Type		Reversibility		Impact Extent		Nature		Magnitude	Significance
		Beneficial	Adverse	Reversible	Irreversible	Local	Trans-Region	Temporary	Permanent		
I.	**Potential positive impacts**										
1.	Employment opportunities	x		x		X		X	x	Medium	Medium
2.	Agriculture productivity	x		x		X	X		x	Very High	Very High
3.	Knowledge transfer	x		x		X	X		x	Medium	Medium
4.	Gender Equity	x		x		X		X	x	Medium	Medium
II	**Potential Adverse Impacts**										
	a. **Construction Phase Impacts**										
1.	Generation of Waste		x	x		X		x		Medium	Medium
2.	Generation of noise		x	x		X		x		low	low
3.	Dust emission		x	x		X		x		low	low
4.	Impact on public health		x	x		X		x		Medium	Medium
5.	Workplace Accidents		x	x		X		x		Medium	Medium
6.	Covid 19		x	x		X	X	x		High	High
7.	Soil erosion		x	x		X		x		Medium	Medium
8.	Traffic Accident		x	x		x		x		Medium	Medium
9.	Landscape change and visual impacts		x	x		x		x		Medium	Medium
10.	GBV		x		x	x			x	High	High
11	Child labor abuse		x		x	x			x	High	High
	b. **Operation Phase Impacts**										
1.	Air emission/pollution		x	x		X			x	low	low
2.	Noise pollution		x	x		X			x	Very low	Very low
3.	Over abstraction		x	x		X			x	Medium	medium
4.	Siltation		x	x		X			x	Medium	medium
5.	Water pollution		x	x		X			x	Medium	Medium
6.	Soil contamination		x	x		X			x	Medium	medium
7.	Impact on fauna		x	x		X			x	low	low
8.	Impact on flora		x	x		X			x	Medium	medium
9.	Covid 19		x		x	X	X		x	High	High
10.	Sexually transmitted disease		x		x	X	X		x	Medium	Medium
11.	Impact on public health		x		x	X			x	Medium	medium
12.	Fire Hazards		x		x	X			x	High	High
13.	Traffic accident		x		x	X			x	low	low
14.	Occupational health and safety		x		x	X			x	Medium	Medium

15.	Impacts on culture, tourism		x		x	X			x	low	low
16.	Loss of land		x		x	X			x	High	High
17.	Child labor abuse		x		x	x			x	High	High
	c. Decommission phase impact										
1.	Pollution		x		x	X			x	low	low
2.	Loss of employment		x		x	X			x	low	low

7. Project Alternatives

1. No project alternative: the "No project or No action" option refers to not implementing the proposed solar power plant projects. The main aim of the intended project is to provide solar energy for irrigation and electric supply to the community. With such no actions the local community will intensify deforestation by extracting wood for fuelwood and cow dung for domestic energy. In addition, the price of fuel/diesel will likely increase due to inflation and other externalities which would result in the decline of agricultural productivity. Consequently, the major benefits such as increasing agricultural production/productivity and income of the people from the project would be missed. Moreover, it contradicts the interest of the people towards the project as well as the socio-economic development needs of the nation by using the available water resources (see water management policy). As a result, this option is not recommended.

2. Other sources of power (Hydro, Fuel, and Wind):
the site is far from the main electric line, and it will be more costly to get power from the main grid sources. The chosen site is not favorable for generating power from the wind as well. Currently, some farmers use fuel for their pumps, but the cost of fuel increases from time to time (40 to 50 birr per liter) and does not make any economic sense to intensify irrigation activities. Environmentally, diesel pumps are also not clean and contribute to greenhouse gas emissions to the atmosphere. The ESIA team measured carbon monoxide (CO) in the field while the pump was working with fuel, a value of 56 ppm whereas in the absence of pumps it was 0 ppm.

3. Project location alternative: the ESIA team has analyzed other site alternatives, based on topography, hydrology, soil, biological and socio-economic parameters. Gumera river is currently serving as a water source for Andega site. The community practicing irrigation activities in the project area suffers from the high price of fuel for their pumps, to alleviate this problem and due to the presence of plenty of water and irrigable lands, the site is recommended for irrigation and electricity to boost the local economy.

4. Project implementation option: the planned project in the selected area has numerous advantages for the local community. The community would get sustainable energy sources for their irrigation activities. This will have a positive consequence to increase agricultural production and enhance local livelihoods. The implementation of solar power plants would help communities obtain a dependable source of electricity for domestic consumption, schools, health posts, and flour mills. Hence, the availability of electricity will further energize other sectors and create employment opportunities, reduce women's' burden from domestic chores, improve social relations and enhance the overall well-being of the communities.
Generally, the above-mentioned alternatives were analyzed based on technical feasibility, economic viability, and environmental soundness. Then, the "No Action" alternative has not been accepted while the project implementation option using solar energy for irrigation and electrification for the community is selected because of the numerous advantages of the project to the local community such as low negative impacts of the project on the social and biophysical environment.

8. Environmental and Social Management Plan

8.1. General Overview

One of the objectives of undertaking an Environmental and Social Impact Assessment (ESIA) is to develop an Environmental and Social Management Plan (ESMP), which outlines the costs, timeframes, and responsibilities for the implementation of the proposed mitigation and enhancement measures. It identified all measures considered to the Mini-grid project in the handling of impacts that were significantly generated by environmental impacts.

These include:

- A mitigation plan with mechanisms and actions to minimize negative environmental impacts during construction, operation, and decommissioning;
- A compensation plan with measures for designing activities to restore the environment;
- A risk-and accident prevention plan linked to the construction, operation, and decommissioning of the mini-grid solar projects;
- A contingency program in response to risk manifestations;
- A public-participation plan that involves stakeholders; and
- A training plan to adequately meet human-resource needs.

The sole responsibility for the implementation and outcome of the ESMP rests with the project proponent. In this case, the developer will be responsible for the implementation of ESMP. The proponent has to incorporate an environmental management system in its daily operations and its ESMP is implemented, maintained, and updated in a manner that is consistent with nationally and internationally recognized standards. The Environmental management issues outlined in this ESMP will be used to manage all environmental and social aspects of the operations activities. The proponent should ensure that it puts in place the essential institutional setup (Environment, Health, and Safety unit) and hires competent, experienced, and qualified person(s) to implement the ESMP.

8.2. Institutional framework

This section assesses institutional issues for implementing the ESMP and its monitoring plan and accordingly recommends a reporting and monitoring framework before discussing the mitigation measures for each identified impact in detail. The implementation of mini-grids in this project will directly involve the project proponent, the duty and responsibility of managing the environmental and social impacts should therefore be the sole responsibility of the project proponent.

For this project, the Amhara regional bureau of agriculture and natural resources, water and energy, Lake Tana, and Other Waters Management Agency, etc., will be responsible for enforcing compliance with national standards in the different areas of specialization. At the national level, the Environmental Protection Authority (former EFCC) is responsible for evaluating and approving ESIA study reports, and for providing environmental approval licenses, which must be obtained before the commencement of project implementation. In addition, the environmental protection Agency of the Amhara regional state is expected to be involved in the monitoring of the environmental performance of the solar power PV project in the Amhara region.

The contractor should maintain adequate control over the project to minimize the extent of impacts during construction, ensure appropriate restoration of areas affected by construction activities and prevent long-term environmental degradation.

8.3. Air Quality and noise management plan

The intended project will have some pollution impacts on air and noise to workers during the construction and operation phases, Therefore, the project proponent must do its best to comply with the performance standard that deals with pollution prevention and abatement.

During the design, construction, and operation of the mini grids, the project proponent has to consider ambient conditions and apply pollution prevention and control technologies and practices (techniques) that are best suited to minimize or reduce adverse impacts on human health and the environment. Noise levels at the nearest sensitive receptors shall not exceed Ethiopian or international standards for daytime and nighttime noise. Regular measurements of noise level (Leq, dBA), using a standard sound level meter, shall be carried out to demonstrate compliance.

8.4. Occupational Health and safety plan

The project proponent provides safety wear, safety equipment, and occupational safety training before replacing and maintaining solar modules. To attain workplace safety, for example, some construction machines and solar PV components shall have protections, warning stickers, automatic stopping, or safety switches. Fire extinguishers should be placed at proper places which are easy to access during an emergency. Depending on the site context of workplaces and the type of types of machinery; workers shall be provided with safety wear such as goggles, hand gloves, work clothes, dust masks, safety shoes, working manuals, etc.
For example:

- Providing information materials, instructions, and regular pieces of training for employees regarding workplace injuries and hazards
- Regular reporting and consultation with employee-elected health and safety representatives and/ or other employees about occupational health, safety, and welfare situations
- Providing adequate personal protective clothing and equipment to ensure safety
- Ensuring all work procedures are undertaken without exposing workers to hazards

8.5. Waste Management Plan

The project site is selected in a rural area where there are no proper waste disposal sites. Therefore, it is the proponent's responsibility to manage hazardous (e.g., accidental leakage of energy storage batteries) and non-hazardous wastes following the guidance included in the General Ethiopian Guidelines.

Management and disposal of hazardous and non-hazardous wastes should be undertaken following guidance included in the "General Ethiopian Guidelines".

8.6. Community Engagement Plan (CEP)

The main objective of this project is to provide a reliable supply of energy for irrigation so that smallholder farmers increase their farm productivity and mitigate climate change impacts. Farmers often use diesel pumps to irrigate their farms, nonetheless, they face multifaceted problems such as rising diesel prices due to inflation, shortage of fuels in the market, and frequent maintenance-related costs of the pumps. During the public consultations, the ESIA team witnessed that the community members of Andega site were eager to see the implementation of this project. Hence such a positive outlook and attendant good relations with the community should be promoted by implementing an action plan that aims to provide timely response to any inquiries, concerns, or complaints about construction or operation activities. The project proponent should consult and disclose any problems during operations, particularly regarding the disclosure of information related to effluents, public health, and safety issues; and reporting results of environmental monitoring. The project should continue to remain in contact with irrigation

user communities, local and regional agriculture offices, energy experts at various levels, and other stakeholders during the period of operation. Ongoing stakeholder consultation will allow the project to receive and respond to community concerns on an ongoing basis.

- The Community Engagement Plan (CEP) should be designed on the following principles:
- A Community Liaison Officer for Andega site needs to be appointed.
- The Community Liaison Officer will initiate the CEP through consultation with key stakeholders identified during community consultation.
- A formal CEP should be produced and documented in consultation with all key stakeholders.
- Through the Community Liaison Officer, the solar PV project proponent will implement a community grievance mechanism allowing community members to raise their concerns about any environmental or social concerns that they may have about the project.
- The project proponent will likely take responsibility for the implementation of the ongoing CEP.

8.7. Community Health and Safety Plan

The proponent will be responsible for safeguarding the health and safety of the public. During the construction phase, an influx of workers was expected from another part of the country. The spread of Covid 19, HIV/AIDS, and other Sexually Transmitted Diseases (STDs) will be expected. In addition, due to the increased movement of construction machinery and dump tracks, traffic accidents will be one of the problems for the residents.

- To mitigate above mentioned potential impacts the following activities should be carried out
- Support the local government in improving access to clean water
- Create awareness between workers and the community to prevent communicable diseases (HIV, Covid19, and other STDs)
- Enforce the drivers to limit speed (not more than 40km/hr.) in the project area and surroundings
- Aware the communities about traffic accidents through campaigns
- Put the traffic and other safety signage in the project site during construction and operation

8.8. Construction phase Environmental Management Plan

TABLE 13: SUMMARY OF CONSTRUCTION PHASE MANAGEMENT PLAN

	Identified Impacts	Mitigation measures	Responsible Body	Estimated cost
Biophysical Environment	Generation of solid Waste	Hazardous waste shall be disposed of in accordance with best industry practices Any heaps of sand and concrete aggregates in the compound should be cleared to keep the area neat and clean	Minigrid Contractor	Estimated cost for disposal of solid waste 50,000 birr
	Generation of liquid Waste	Storage areas for fuel and hazardous materials shall be roofed and have a concrete floor with a bund for secondary containment and collection of spills The wastewater from sanitary and construction works should be collected through a channel in a plastered pond or reservoir and can be recycled for construction, green area, and other purposes after proper filtering and treatment. Very minimal amount of wastewater for Minigrid, very limited amount of fuel or hazardous material	Minigrid Contractor	For construction of plastered pond and other storage structure is 100,000 birr
	Soil erosion	Avoid excavation during the rainy season Heap the excavated soil in the selected area and reuse it to fill undulating areas	Minigrid Contractor	Labour cost to pile up soil is 60,000 birr
	Noise pollution	Noisy activities shall be scheduled to daytime hours Noise disturbance and impact can be reduced by also administration and management deciding to work on a shift basis, work rotation and work time reduction for workers to reduce workers exposure to noise, etc. Personal protective equipment such as ear mufflers/plugs should be used	Minigrid Contractor	For purchasing PPE is 30,000 birr
	Air pollution	Workers assigned in the construction should wear a dust mask. The supervisor should strictly follow and make sure this procedure is in place before starting their job, and Water shall be sprayed on all internal roads to minimize dust dispersion when necessary	Minigrid Contractor	PPE included above, and water spray is 30,000 birr
Human Environment	Public health including Covid 19	Conduct public health awareness campaigns addressing issues of behavioural change, HIV/AIDS, etc. Prepare training manual and conduct regular training about STDs Provision of materials useful for the prevention of HIV/AIDS Workers shall follow strictly Covid19 prevention mechanisms such as temperature measurement at the gate of the compound, washing of hands, wearing of masks, avoid handshake, and keep social distance as much as possible.	Community /woreda labour and women affairs office Internal training by Minigrid Developer	Awareness-raising and training 25,000 birr For internal half day training 30,000 birr
	Gender-based violence/child labour	Provision of training for workers and families, Community sensitization, regular monitoring for EHS compliance	Community/ Woreda labour and women's affairs office	100,000 birr for training, and regular monitoring
	Traffic accidents	Emphasizing safety aspects among drivers (putting up signposts and other precautionary messages) Mandatory speed limits not exceeding 30km per hour Collaborating with local communities on education about traffic and pedestrian safety (e.g., school education campaigns)	Minigrid Contractor in collaboration with Woreda traffic police	Training cost for awareness creation for community and workers 20,000 birr
	Impacts on	If, in case, during excavation works a religious or historical site	Minigrid Contractor supervised	Supervision cost

	Identified Impacts	Mitigation measures	Responsible Body	Estimated cost
	cultural, historical and archaeological site	is found or suspected to be found, Chance Find Procedure for physical and cultural resources will be prepared as per World Bank Guidelines - OP 4.11 and will be part of the construction procedure manual	by Amhara regional state culture and tourism office	20,000 birr
Total Cost				465,000 birr

8.9. Operational phase Environmental and Social Management Plan

TABLE 14: SUMMARY OF OPERATIONAL PHASE MANAGEMENT PLAN

	Identified impacts	Mitigation measures	Responsible body	Estimated cost
	Liquid waste	Construct a toilet inside the premise and collect sanitary waste and finally dispose it off at permitted area	Minigrid Developer	Toilet is expected to be constructed during construction phase
Biophysical Environment	**Loss of farm and grazing land**	Landowners shall be compensated as per the new proclamation No. 1161/2019 before the construction activities started Provide job opportunity priority for those projects affected people (PAP) during construction and implementation phases	Minigrid Developer, Woreda Agriculture offices, Woreda administration	The cost will be estimated later by Woreda experts
Human Environment	**Occupational health and safety**	Use of appropriate PPE during installation and maintenance The solar PV plant shall be equipped with fire-fighting tools Ensuring all electrical equipment and machinery are properly grounded Maintenance should be conducted by trained professionals only	Minigrid Developer	Estimated cost to purchase lifetime PPE is 60,000 birr
	Fire hazards	The solar PV plant should be equipped with proper fire extinguishers The technician should regularly inspect Solar PV components	Minigrid Developer	fire protection systems 80,000 birr
	Impacts on cultural, historical and archaeological site	If, in case, during operation if religious or historical site is found or suspected to be found, Chance Find Procedure for physical and cultural resources will be prepared as per World Bank Guidelines - OP 4.11 and will be part of construction procedure manual	Contractor, supervised by Amhara regional state culture and tourism office	No cost is implied
			Total cost	140,000 birr

8.10. Decommission phase Environmental Management Plan

TABLE 15: SUMMARY OF DECOMMISSION PHASE MANAGEMENT PLAN

	Identified Impacts	Mitigation measures	Responsible Body	Estimated cost
Biophysical Environment	Generation of solid Waste	Hazardous waste, including broken PV panels, used batteries, shall be disposed of in accordance with best industrial practices	Minigrid Contractor	Waste disposal cost 150,000 Birr
	Air pollution	Workers assigned to the demolition should wear dust masks. Spray water on demolishing areas	Minigrid Contractor	PPE purchase and water spray cost 40,000 Birr
Human Environment	Loss of employment	Transfer permanent workers to other active projects Pay compensation (severance) for permanent workers	Minigrid Contractor /Regional government	Compensation payment for workers should be paid by the project proponent
	child labour	Provision of training for workers and families, Community sensitization, regular monitoring for EHS compliance	Community/ Woreda labour and women's affairs office	20,000 Birr for training, and regular monitoring
Total Cost Decommissioning (Birr)				210,000 birr
Total ESMP + ESMMP cost (Construction, Operations, Decommission, Monitoring) with Minigrid + local/government parties combined				965,000 birr

9. Environmental and Social Monitoring Plans

Monitoring usually takes two forms, i) compliance monitoring and ii) effect monitoring. The former is about whether impact mitigation and enhancement measures are implemented in time and to the agreed national and international standards. Whereas the latter refers to the monitoring of project-induced impacts on the social and biophysical receptors. Thus, the compliance aspect is monitored by government authorities at the federal level (EPA) and Amhara regional bureau of environmental protection authority (Figure 13).

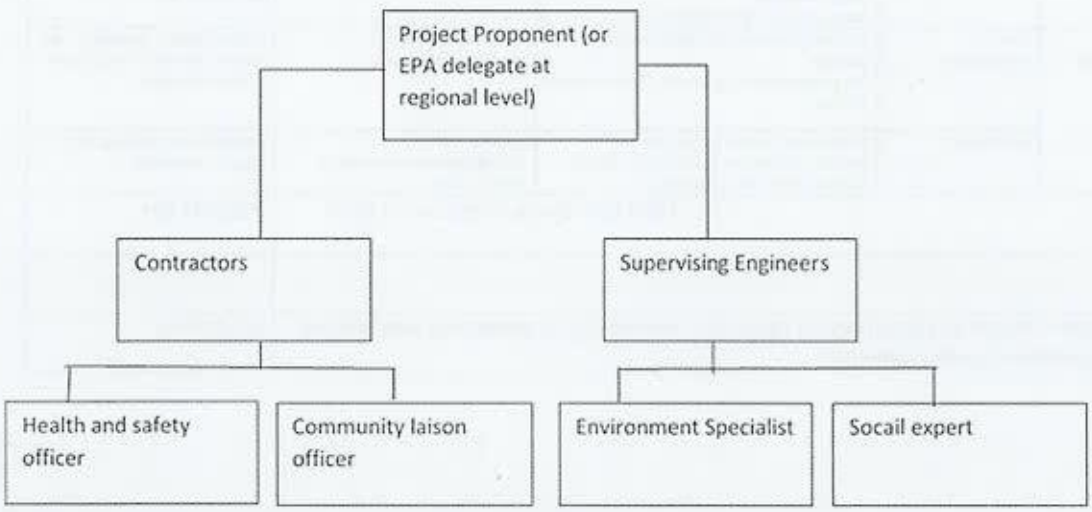

FIGURE 13: ORGANIZATIONAL STRUCTURE FOR COMPLIANCE MONITORING

The main objective of the environmental monitoring plan is to ensure that the predicted outcome of the company is achieved. The overall objective of this EMP is to integrate environmental and social considerations into account to ensure the successful economic and social development of the project. The regular monitoring program will determine whenever changes or operations are required to reduce the negative impacts and enhance the beneficial ones. Therefore, conducting monitoring will be of paramount importance.

Effect (target) Monitoring: Periodical ambient air quality measurement should be conducted at solar PV installed areas and around irrigated farmlands and the quality of the water effluent should be monitored regularly for all critical parameters such as Biochemical Oxygen Demand (BOD), pH, Total Dissolved Solids (TDS), Total Suspended Solids), alkalinity, hardness, and turbidity. In addition, soil samples should be collected from irrigated farms and monitor changes in soil fertility. Dera woreda Environmental protection office should periodically conduct its independent monitoring for compliance with national standards. The project proponent should submit an annual compliance report indicating all the monitoring results to Dera woreda Environmental protection office as well.

TABLE 16: ENVIRONMENTAL MONITORING PLAN

Parameters to be monitored	Mitigation measures	Responsible	Monitoring schedule	Monitoring indicators	Monitoring cost (Birr)
Contract management	Make sure the contractor has prepared ESMP for approval by the client	Proponent	Pre-construction and construction phases	Copy of the approved ESMP and implementation of it	Cost internal to developer to get approvals
Social support to vulnerable people	Job opportunities for project-affected people (loss land), Landowners should be compensated as per proclamation No. 1161/2019	Proponent	Throughout operation phase Note: selected land is expected to be community land, not individual	Interview vulnerable people, field visit, Check the amount of money paid out from finance	Supervision cost 5,000 birr
Employment opportunity	Hire workers from local people depending on their education preparedness and skill level	Proponent & Woreda	At the beginning and annually months	Number of local workers from company human resource office	Supervision cost 5,000
Solid waste	Hazardous waste, including broken PV panels or panels at the end of their use-life, shall be disposed of in accordance with best industry practice Any heaps of sand and concrete aggregates in the compound should be cleared to keep the area neat and clean	Proponent	Quarterly during construction and annually in operation	Annual site visit to determine if any hazardous waste is on site Disposal of hazardous waste in compliance with waste management procedures	Supervision cost 10,000
Liquid waste	Storage areas for fuel and hazardous materials shall be roofed and have a concrete floor with a bund for secondary containment and collection of spills The wastewater from sanitary and construction works should be collected through channels in a plastered pond or reservoir and should be recycled for reuse during construction	proponent	Beginning of construction and annually each year of Operation	Annual check that the necessary are in place Constructed plastered pond/ reservoir if required Amount of water recycled	Supervision cost 10,000
Noise pollution	Noisy activities shall be scheduled to daytime hours personal protective equipment such as ear mufflers/plugs will be used	Proponent in collaboration with Woreda health experts	Weekly during the construction phase	Noise level should not exceed the world bank standard (55dBA and 45 dBA during the day and night times, respectively)	Cost for regular checking of noise level 5,000
Air pollution	Workers assigned in the construction should wear dust masks. The supervisor should strictly follow and make sure this procedure is in place before starting their job; and Water should be sprayed on all internal roads to minimize dust dispersion when necessary	proponent collaboration with Woreda health experts	Periodically during the construction and operation phase	Check air quality measurement, Air emission shouldn't exceed WHO standards Supervise workers proper use of PPE's Complaints from the local governor, community	Expert cost for regular check emission level 5,000
Loss of farm and grazing lands	Landowners should be compensated as per the new proclamation No. 1161/2019 before the construction activities started Provide priority to a job opportunity for those projects affected people (PAP) during construction and implementation phases	Proponent	Before commencement of construction work	Check the amount of money paid for PAP Contractor's personnel office documentation	No cost
Traffic accident	Emphasizing safety aspects among drivers (putting up signposts and other precautionary messages) Mandatory speed limits not exceeding 40km per hour Collabourating with local communities on education about traffic and pedestrian safety (e.g., school education campaigns)	Proponent collaboration with Woreda traffic police	Every three months during construction, annually during operations	Number of accidents on the site Speed limits put at appropriate places Erected traffic sign	Supervision cost 5,000

Parameters to be monitored	Mitigation measures	Responsible	Monitoring schedule	Monitoring indicators	Monitoring cost (Birr)
Sexually transmitted diseases like HIV	Health promotion: sensitization of both community and workforce Provision of materials useful for the prevention of HIV/AIDS Having in place an appropriate signpost to educate the workforce and community about the Project's HIV policy	Woreda health office	Every month during the construction and operation phase	Number of distributed condoms Check the number of trainings conducted	Training cost 100,000
Covid 19	Train workers to follow strictly Covid-19 prevention mechanisms Temperature measurement check-up each day at the gate of the compound Provision of materials necessary for prevention and detection of COVID 19	Proponent in collaboration with Woreda health experts	Regularly during construction and operation	Number of Covid-19 infected	Expense already included in construction and operations No cost to report # of cases
Occupational Health and safety	Use of appropriate PPE during installation and maintenance The solar PV plant shall be equipped with a fire-fighting system Ensuring all electrical equipment and machinery are properly grounded;	Proponent	Regularly during construction and operation	Total recorded incidence rates	for provision of first aid a lump sum of 5,000
Fire hazards	The solar PV plant should be equipped with a fire-fighting system The technician should regularly inspect Solar PV components	Proponent	Every three months during the construction and operation phase	Number of incidents and reported cases	Part of project and operation cost
Impacts on historical, cultural heritage	Excavation work should be done carefully as per World Bank Guidelines - OP 4.11 and prepared chance find procedures	Contractor	During construction work	Number of discovered heritage site or artifacts	Part of supervision cost
Total monitoring cost					**150,000**

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10. Conclusion and Recommendations

The main aims of the environmental and social impact study were to identify, predict and evaluate all the potential environmental and social impacts due to the proposed solar power plant project Andega site in Amhara regional state. The ESIA study is done with the overall intention of integrating environmental and social concerns into the project's planning, design, construction, and operational stages.
Environmental and social impacts have been identified for both components of the project (solar power plants) in the Amhara region Andega site. For all the identified negative impacts mitigation measures were provided alongside the impacts, and in some cases, enhancement for positive impacts was also indicated in chapters (see Chapters 7, 8, and 9).

A review of international safeguard policies reveals that the major policies triggered relate to Environmental and Social Assessment, biodiversity, and ecosystem services (Tana Biosphere Reserve), labor and working conditions, community health and safety, information disclosure, and stakeholder engagement. Management measures have been proposed and most of these can be easily implemented with available local resources and national policy and legal provisions (e.g., proclamation 1161/2019, proclamation 1156/2019).

Recommendations: As soon as the project proponent is identified the project implementation schedule covers all project activities. For example, solar panel installations, time, and modalities for compensation for land take should be communicated ahead of time for the Woreda and Kebele administrations as well as for the potentially affected persons. This should be done at least three months before the commencement of solar power plant installations. To avoid any minor conflicts which might delay the project implementation, the potential developer/project proponent should work in tandem with Kebele administrators to establish grievance-handling committees, which will serve as avenues for community members to channel grievances to the project proponent. The potential contractor should also prepare the grievance handling mechanism for the workforce during the construction phase, and this must be monitored by the client or any other responsible body. There should be continuous monitoring for the biophysical and social impacts of the projects so that the developer or any project proponent could draw a lesson for future investments.

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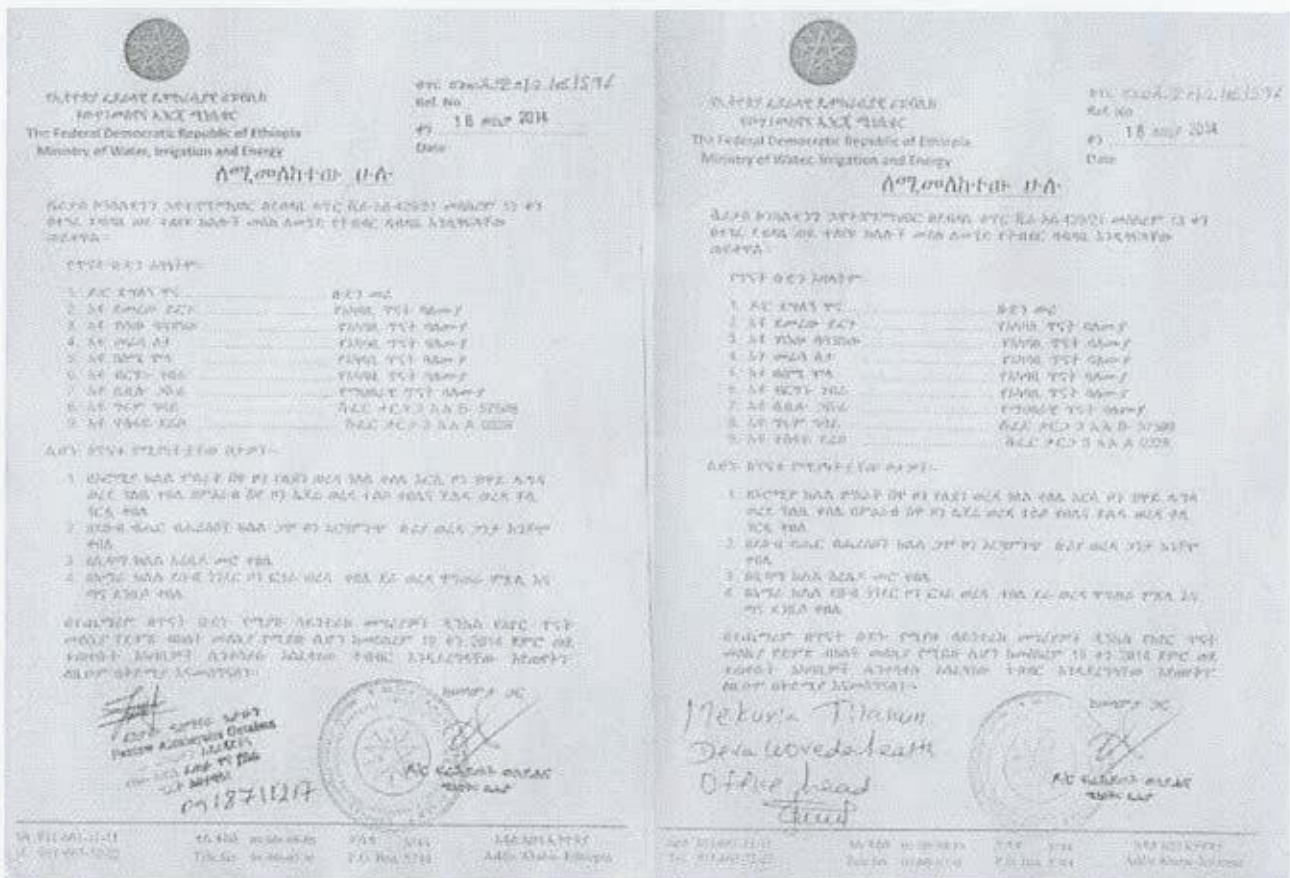
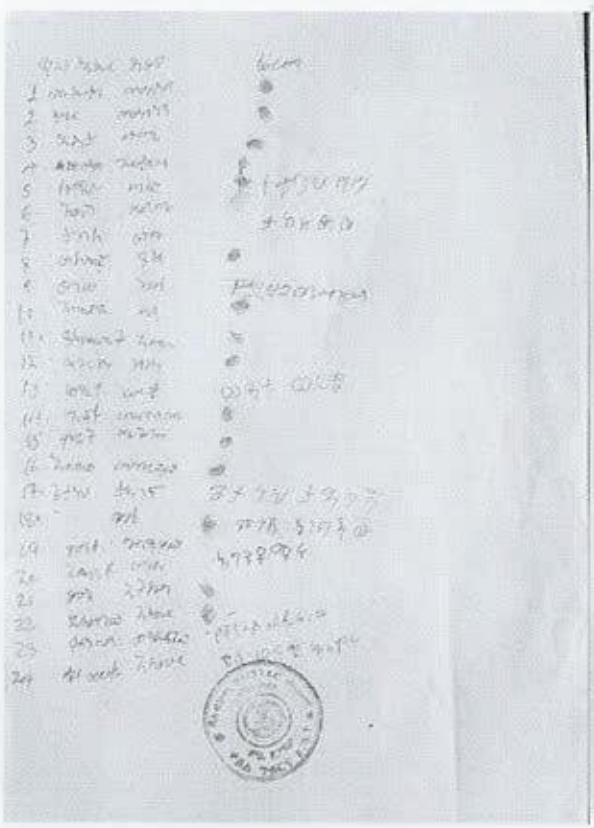
Annexes

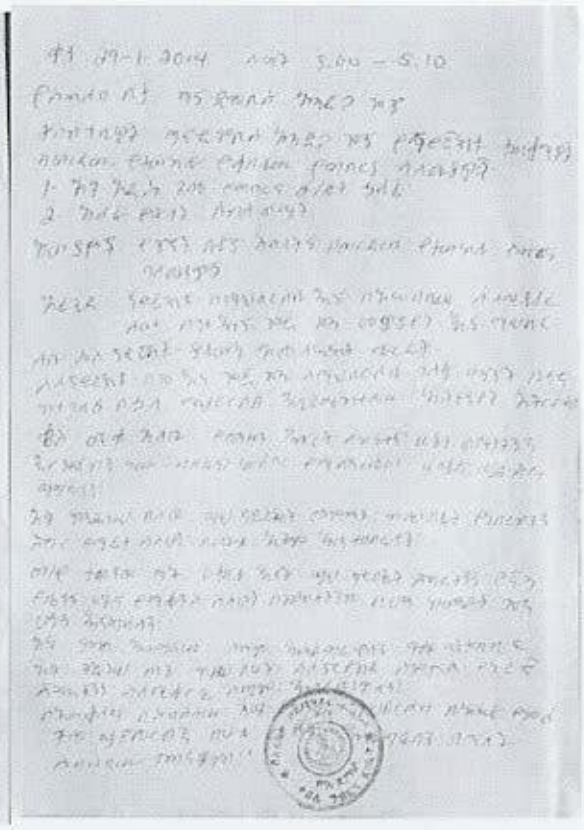
Annex 1: Letter of Communication to Regional and Local Government Offices



Annex 2: List of participant and minutes of meeting

Andega site





Annex 3: Water baseline data (lab report for Andega)

LABORATORY TEST REPORT

Client:	Geoscience Consultancy plc.	Lab Ref	AES/LAB/21/193
Location:	Region: Amhara	Sample No	21/192 3
	Zone/Town: Bahirdar area.		
Project /Institution:	ESIA Study for irrigation.	Water use:	Domestic Use
Source of Water	River	Sample Delivered on:	Oct 21/2021
Sample point (Site):	As-004, Andega.	Test report issued on:	Oct 27/2021
Sapmple Collected by:	Geoscience Consultancy plc.	Sample Delivered by	Geoscience Consultancy plc.

Test Description: Selected Physicochemical Tests

No	Parameters	Unit	Value	WHO Maximum Allowable Concentration for Drinking
1	Odourless		Odourless	Unobjectionable
2	Colour		Colourless	Colourless
3	Turbidity	NTU	1.85	5
4	E.Conductivity	µS/cm	177.6	2000
5	PH	Log 10	6.4	6.5-8.5
6	TDS	Ppm	88.9	1000
7	Total Alkalinity	mg/l $CaCO_3$	80	200
8	Ammonium, NH_4	mg/l	0.07	1.5
9	Bicarbonate, HCO_3	mg/l HCO_3	97.6	-
10	Calcium, Ca	mg/l	68	200
11	Chloride, Cl	mg/l	16	250
12	Carbonate	mg/l	Nil	
13	Fluoride, F	mg/l	0.2	1.5
14	Magnesium, Mg	mg/l	11	150
15	Manganese, Mn	mg/l	0.02	0.1
16	Nitrate, NO_3	mg/l	6.25	10
17	Nitrite, NO_2	mg/l	0.01	1
18	Phosphate, PO_4	mg/l	0.17	-
19	Potassium, K	mg/l	0.1	-
20	Sodium, Na	mg/l	10	200
21	Sulphate, SO_4	mg/l	Nil	250
22	Total hardness	mg/l $CaCO_3$	45	300
23	Total iron, Fe	mg/l	0.05	0.3

Test Performed by: Fasika Berhanu — Signature:
Checked by: Degsit Goshu — Signature:
Approved by: Dr Addis A. Zeleke — Signature:

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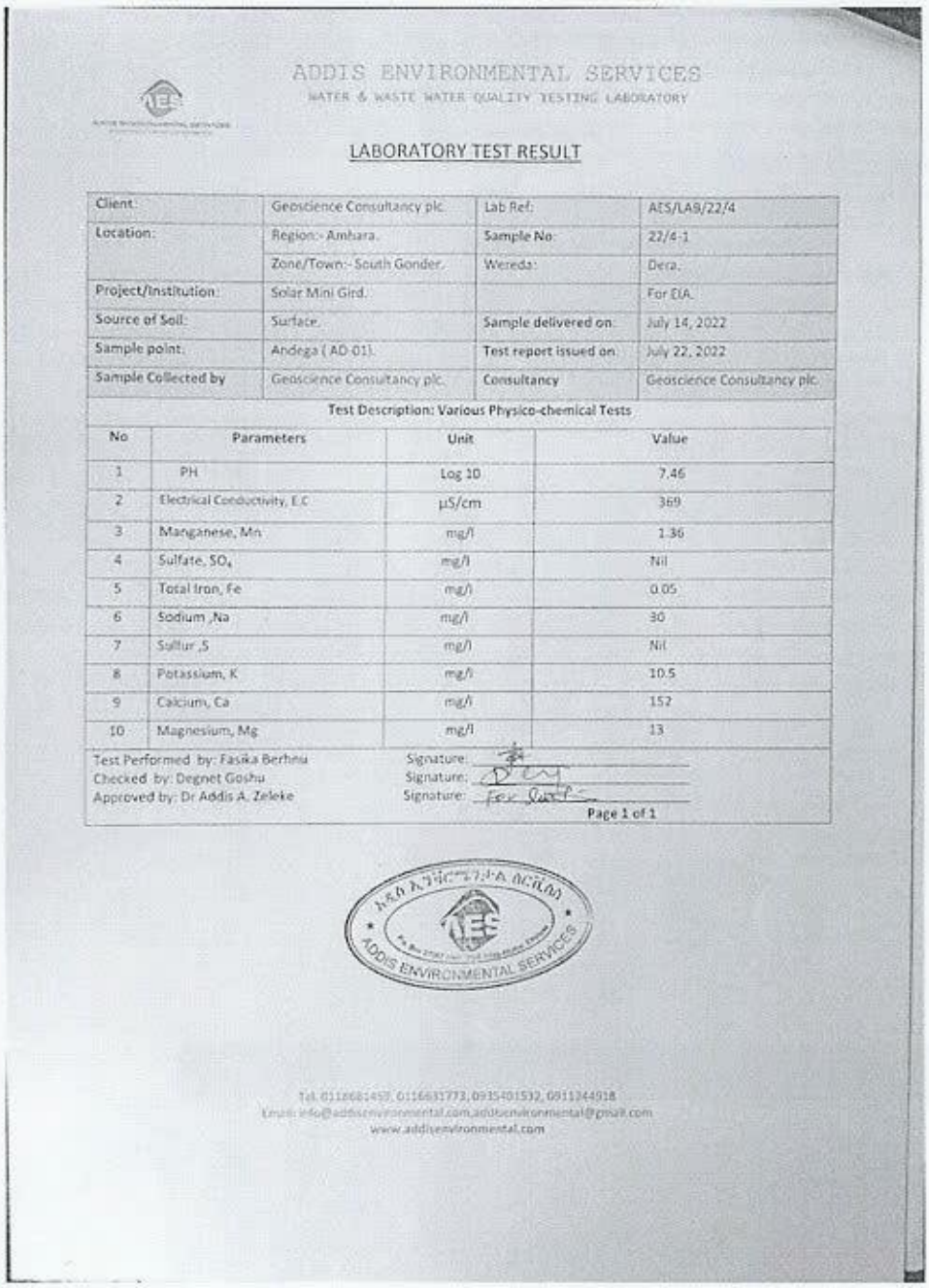
Annex 4: Soil Sample



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WATER & WASTE WATER QUALITY TESTING LABORATORY

LABORATORY TEST RESULT

Client:	Geoscience Consultancy plc.	Lab Ref:	AES/LAB/22/4
Location:	Region:- Amhara.	Sample No:	22/4-1
	Zone/Town:- South Gonder.	Wereda:	Dera.
Project/Institution:	Solar Mini Gird.		For EIA.
Source of Soil:	Surface.	Sample delivered on:	July 14, 2022
Sample point:	Andega (AD 01).	Test report issued on:	July 22, 2022
Sample Collected by	Geoscience Consultancy plc.	Consultancy	Geoscience Consultancy plc.

Test Description: Various Physico-chemical Tests

No	Parameters	Unit	Value
1	PH	Log 10	7.46
2	Electrical Conductivity, E.C	µS/cm	369
3	Manganese, Mn	mg/l	1.36
4	Sulfate, SO_4	mg/l	Nil
5	Total Iron, Fe	mg/l	0.05
6	Sodium ,Na	mg/l	30
7	Sulfur ,S	mg/l	Nil
8	Potassium, K	mg/l	10.5
9	Calcium, Ca	mg/l	152
10	Magnesium, Mg	mg/l	13

Test Performed by: Fasika Berhnu Signature:
Checked by: Degnet Goshu Signature:
Approved by: Dr Addis A. Zeleke Signature:

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Annex 5: List of Registered Pesticides

List of Registered Pesticides (Insecticides) may be used at project site

No	Trade name	Common name	Approved uses	Registrant
1	Ajanta 72% EC (W/V)	profenofos	For the control of onion trips on onion.	28
2	Bravo 5% EC (W/V)	lambda-cyhalothrin	For the control of stalk borer on maize	28
3	Ethiolathion 5% Dust	malathion	For the control of maize Weevil (Sitophilus zeamays) on stored maize.	18
4	Ethiolathion 50% EC	malathion	For the control of sweet potato butterfly (Acraea acerata) on sweet potato.	18
5	Ethiothoate 40% E.C	Dimethoate	1. For the control of Aphids on field pea. 2. For the control of Russian Wheat Aphid (Diuraphis Noxia) on Barley.	18
6	Hondize 60% EC	Diazinon	For the control of African boll worm on tomato.	28

List of Registered Herbicides that may be used at project

No	Trade name	Common name	Approved uses	Registrant
1	Orozole 25 EC	Propiconazole	For the control of yellow rust and stem rust on wheat.	57
2	Ridom 80% WP	Mancozeb	For the control of late blight on potato.	33
3	Mancodex Super 72 WP	Metalaxyl + Mancozeb	For the control of late blight of potato & Tomato	53

List of Registered Fungicide that may be used in the proposed project site

No	Trade name	Common name	Approved uses	Registrant
1	Agro- 2,4-D amine 720g/l A.E	2,4-D 720 g/l A. E	For the control of broadleaf weeds in wheat, barley, teff, maize, sorghum, and sugarcane.	9
2	Abocel 41% SL	Glyphosate	For the control of grass and broad-leaved weeds on wheat.	51
3	Pallas Super Tm 320 WG	Halauxifen-Methyl + Pyroxsulam	For the control of grass & broad leaf weeds in wheat and Teff.	2
4	Richway 750 WDG	Tribenuron Methyl	For the control of broad leaf weeds in wheat.	15

Impacts of pesticides

- **Diazinon** exposure, whether from ingestion, skin contact, or inhalation can result in nervous system health effects. These effects may include **watery eyes, runny nose, drooling, loss of appetite, coughing, urination, diarrhea, stomach pain, and vomiting.**
- **Malathion** is highly toxic to bees and other beneficial insects, some fish, and other aquatic life. Short-term exposures to high levels of malathion can affect the nervous system causing a variety of symptoms,

including **headaches, nausea, dizziness, weakness, cramps, diarrhea**, excessive sweating, blurred vision and increased heart rate

- **Profenofos** can cause cholinesterase inhibition in humans; that is, it can overstimulate the nervous system causing **nausea, dizziness, confusion**, and at very high exposures (e.g., accidents or major spills), respiratory paralysis and death.
- **Dimethoate** can cause **rapid, fatal organophosphate poisoning with headache, sweating, nausea and vomiting, diarrhea, loss of coordination, muscle twitching, and death.**
- **Lambda-cyhalothrin** may cause **irritation to the skin, throat, nose**, and other body parts if exposed. Skin tingling, burning, and prickling feelings, particularly around the face, are unique temporary symptoms of exposure

Impacts of Herbicides

- **2,4-D Effects** that have been reported following oral or dermal exposure to high amounts of 2,4-D include tachypnea, tachycardia, vomiting, leukocytosis, liver and kidney congestion in fatal cases, metabolic acidosis, and neurological effects characterized by sensory and motor abnormalities
- **Glyphosate** has excellent properties of fast sorption in soil, biodegradation, and less toxicity to non-target organisms. However, glyphosate has been reported to increase the risk of cancer, endocrine-disruption, celiac disease, autism, effect on erythrocytes, leaky-gut syndrome
- **Halauxifen-Methyl** - not likely to be carcinogenic to humans
- **Tribenuron Methyl**; Tribenuron methyl has low to moderate acute toxicity via the oral, inhalation, and dermal routes of exposure. It is not a dermal irritant, but was found to be mildly irritating to the eye and is a skin sensitize (*J*

Impacts of Fungicides

- **Propiconazole** is moderately toxic, and it is a skin sensitizer
- **Mancozeb** exerts numerous effects related to the function of the thyroid gland, including **decreases in serum thyroxine (T_4) levels, thyroid peroxidase activity and iodine uptake**, increased production of thyroid stimulating hormone (TSH) and thyroid weight, hyperplasia, and hypotrophy of follicular cells, therefore still be a potential contributor to thyroid disruption in humans and in result adversely affects the developing brain.
- **Metalaxyl** generally is of **low acute toxicity** but is an eye irritant. It has been classified as a Group E carcinogen (, Office of Pesticide Programs (OPP), US EPA,); that is, a chemical showing evidence of non-carcinogenicity for humans.