



## Result Assessment of the Biogas, Biomass and Solar Trilateral Cooperation Project

### Project/Programme Information

**Project/Programme Title:** Biogas, Biomass and Solar Trilateral Cooperation (Transitioning to Sustainable Energy Uses in the Agro-Industry)

**Implementing Partner:** Ministry of Water and Energy (MoWE)

**Responsible Parties:** Ministry of Science and Technology of China; China Agriculture University; Administrative Centre for China's Agenda 21

**UN Agency:** UNDP (Ethiopia and China Country Offices)

### Strategic Objectives

Under the South-South and Triangular Cooperation Programme (SSTC), the overarching objective of the project is to establish a sustainable trilateral cooperation mechanism to address sustainable development challenges related to international cooperation, access to sustainable energy for improved service delivery, and integrated sustainable farming practices. The Project takes a point of departure between the need for renewable energy technology dissemination and scale-up of Ethiopia's climate-resilient growth and supports access to renewable energy and sustainable resource consumption through trial and demonstration of biogas and solar energy for productive use of energy. The Project is implemented under the South-South and Trilateral Cooperation Framework and as such presents itself as a learning platform for both China and Ethiopia to engage and cooperate at the international level in renewable energy technology and related green skill transfer.

### Project's Interventions Strategies

1. Developing the capacity of stakeholders in the energy sector to assess the potential of RET in meeting energy needs in productive sectors such as public service delivery and the agro-industry.
2. Sharing Chinese knowledge and experience in biogas and solar energy for productive uses.

3. Strengthening trilateral cooperation through conducting implemented renewable energy project site visits.
4. Determining suitable business models through South-South knowledge and experience-sharing platforms.
5. Providing support to Chinese institutions on carrying relevant capacity development in South partner countries.

### **Project/Programme UNDSCF linkage**

**UNSDCF Pillar:** Pillar 6 Building a Climate Resilient Economy.

**UNSDCF Outcome:** Outcome 4: All people in Ethiopia live in a society resilient to environmental risks and adapted to climate change.

### **Project Result Assessment of the Year 2023 under Planned Outcome and Outputs**

The project has planned to identify the demonstration sites of biogas and solar technologies for productive use. To achieve the project goal, the project is actively installing solar PV systems and biogas plant at four specific demonstration sites located in Ethiopia's Amhara, Harari, and SNNPR regions in order to enhance access to electricity while also promoting integrated agricultural and farming practices. In the reporting year of 2023, the project has achieved the following results:

#### **1. Result indicators related to the biogas project**

As part of this initiative, the Wolaita Sodo University (WSU) has been selected to benefit from a 300 m<sup>3</sup> institutional biogas plant. This biogas plant, in addition to its primary purpose, also has the co-benefit of generating a peak electricity capacity of 20 Kw.

- **Social Impact:** The biogas plant reduces the work overload burden/drudgery of 60 women and girls working as cooks in the Wolaita Sodo University main campus student service cafeteria. Furthermore, the biogas plant reduces indoor air outdoor pollution (IAP) of the cafeteria environment and reduces air pollution-related diseases including pneumonia and lung complexity that affect the health of women and children. The WSU provides service to 46,558 students and staffs on an annual basis.
- **Economic impact:** The presence of the biogas plant reduces the electricity bill and fuel Wood Consumption of the Wolaita Sodo University student cafeteria related to unsustainable

utilization of traditional biomass. In the traditional scenario, Wolaita Sodo University's annual electricity consumption is 2,000,000 ETB and its annual fuel wood consumption amounts to 10,950,000 ETB. Therefore, the access to the institutional biogas plants off-set the annual total energy bill (Power+cooking) of the university by 12,950,000ETB.

- **Environmental Impact:** The biogas plant reduces fuel wood consumption and contributes to biodiversity conservation and reducing degradation and deforestation (REDD<sup>+</sup>) by reducing. The annual fuel wood consumption of the Wolaita Sodo University under traditional/unsustainable biomass consumption is 5,840 m<sup>3</sup>/year. Therefore, the equivalent GHG emission under the unsustainable biomass consumption scenario is mounted to **4,958.160TCO<sub>2</sub>eq.** On the other hand, under the biogas application (300 m<sup>3</sup>) the life cycle emission is Zero. Therefore, the annual GHG emission reduction is **4,958.160TCO<sub>2</sub>eq.** On the other hand, the fuel wood saving because of biogas application has carbon sequestration potential. Therefore, the Total emission abatement benefit of the biogas plant over economic lifecycle of 30 years is **148,744.8t CO<sub>2</sub>eq.**
- **Carbon Market benefit:** Wolaita Sodo University can benefit from the global carbon credit due to carbon savings related to the installation of biogas.

## 2. Result indicators related to solar PV projects

The implementation of solar technology intervention has benefitted three regions, namely Amhara, Harari, and the Southern Nations, Nationalities, and Peoples (SNNP) regions, in Ethiopia.

- **Social Impact:** In the Amhara region, a total installed capacity of 107 kW has been provided for the purpose of utilizing solar-powered irrigation systems in the production of cash crops or high-value crops. This intervention has benefitted approximately 300 households in the region. In a similar fashion, the Harari region has been equipped with a solar power system with a peak capacity of 13.4 kW. This system has been installed in Kara Primary school, benefiting a student population of 642, as well as in Kebbele Primary School, benefiting a student population of 400. Furthermore, in the SNNP region, a solar power system with a capacity of 6.7 kW has been installed in Newasea Secondary School. This intervention has provided electricity to a student population of 1,067.
- **Economic Impact Solar Irrigation North Wollo:** Amhara region, North Wollo is privileged to get access to 107Kw in Solar Powered pump which can irrigate 53.5 hectare of land in one

cropping season of high value crop. In the North Wollo Agroecology a hectare of tomato planted land requires 96 irrigation calendar days in three months cropping season. Each irrigation day requires a 6 liters of diesel fuel and therefore 576 liters are required.

- Therefore, the total fuel requirement of a hectare of tomato plot in area 5,761 in one cropping season. There are four cropping seasons and therefore the total fuel requirement of hectare plot of tomato is 23,041. Therefore, total estimate, fuel requirement of 53.5 hectare of land is 123,264 liters. The current market price of a liter of diesel is 80ETB. Therefore the total financial cost to irrigate 53.5 hectare of tomato land, which is the total price of 123,264 liters is 9,861,120ETB.
- Therefore, the adaption of the solar powered irrigation has potential benefit of off-setting **9,861,120ETB** in fuel cost.
- **Environmental Impact:** The total diesel fuel requirement of the 53.5 hectare of land from the above economic assessment is **123,264 liters**.
- Therefore, The total GHG emission of diesel fuel in a year with diesel emission factor of 2.67KgCO<sub>2eq</sub>/litre (2.67KgCO<sub>2eq</sub>/litre\*123,264 Litre=329,114.88KgCO<sub>2eq</sub>/year). This is equivalent with 329.115tCO<sub>2eq</sub>/year. Therefore, the adoption of Solar powered pump has GHG abatement benefit equal to 329.115tCO<sub>2eq</sub>/year. Therefore, total GHG emission reduction benefit over 25 years of the solar powered pump is **8,227.872tCO<sub>2eq</sub>**.
- **Environmental Impact of the roof-integrated solar panels in Harar schools:** According to the study by National Renewable Energy Laboratory, 10 Kw Peak Solar PV has potential of GHG emission reduction/abatement in the order 37Kg/per day in Ethiopia. Therefore the 13.4 Kw peak has potential abatement of 13,505kg/year which is in the order of **13.505tCO<sub>2eq</sub>/year**. Over its 25-year lifespan, the solar mini-grid has a total greenhouse gas abatement potential of approximately **337.625 tCO<sub>2eq</sub>**.

### **Outcome-level Results: (i) Successes, (ii) Challenges, (iii) Moonshots**

#### **Integrated Work Plan (IWP) Organizational Result/Energy Component**

**IWP Output Name:** Proportion of population with primary reliance on clean fuels and technology. (SP 1.7) Baseline (2019): 37% Target: 55%; Output 3.3 Solutions adopted to increase access to clean, affordable, and sustainable energy. [modified IRRF 1.5.1]

**IWP Organizational Result Success:** Under the Project, UNDP has supported the innovation of institutional biogas, productive use of energy in solar powered irrigation, and rural and semi-urban school solar electrification. The innovation of institutional biogas, solar-powered irrigation and school solar integration has resulted in emission reduction of **157,310.297tCO<sub>2</sub>eq**. The Project enabled 50,319 people gained access to clean, affordable, and sustainable energy services through trials and demonstrations of biogas and solar energy solutions in schools, universities, and solar-powered irrigation farm in rural areas of Amhara, Harari, and SNNP regions. Of which, 3,609 people gained access to clean, affordable, and sustainable energy and 10,033 households benefiting from solutions applied at scale to accelerate transition to improved energy efficiency and clean energy. As a valuable benefit package, the solar-powered irrigation system spans a vast expanse of 53.5 hectares of fertile land in North Wollo of Amhara region, allowing for the cultivation of high-value, revenue-generating cash crops.

**IWP Organizational Result Challenges:** The institutional capacity of implementing partners and local responsible parties has been a key bottleneck in advancing the projects. For instance, implementing partners have limited expertise and experience in international energy product supply and procurement processing.

**Organizational Result Corrective Measures:** UNDP supported government through international bid process and procurement supply chain and engaged suppliers of institutional biogas and solar products from chain. The other measure of experience and empirical evidence sharing from China through the South-South Cooperation Framework. Green House Gas (GHG) emission estimation method for Wolaita Sodo University Biogas Plant and Solar Powered Irrigation.

### **Further Data, References/Resources**

The number of cooks(chefs) in the university is 60 WOMEN.

Fuel wood Consumption per day and year respectively (16 m<sup>3</sup>; 5,840 m<sup>3</sup>).

Financial expenditure related to fuel consumption per day and year(30,000ETB; 10,950,000ETB).

Estimated Financial expenditure related to electricity per year is 2,000,000ETB.

Number of students served by the University cafeteria is 30,000.