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Project Design Document for BOKU Climate Change Mitigation project

SPEEC
Sustainable Brick Production and Energy-Efficient Cooking for Vulnerable Households in South Sudan

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Key project information

Title of the project:	**SPEEC** – **S**ustainable Brick **P**roduction and **E**nergy-**E**fficient **C**ooking for Vulnerable Households in South Sudan
Brief description of the project:	Based on the calculations, the project will reduce 17,312 tons of CO_2 emissions caused by traditional cooking and construction methods throughout project duration of 6 years. During the program, 1,250 vulnerable households (HH) will use fuel-saving stoves (two stoves/HH). Furthermore, the sustainable brick production method will be piloted by constructing one women center and later introduced in the program area (youth groups running brick production businesses). In addition, replanting of mango trees and awareness-raising in the program area will be done throughout the project duration.
Expected implementation date: Expected duration of the project:	01/01/2023 – 31/12/2028 6 years
Project developer:	Caritas Austria
Project representative:	Helene Unterguggenberger Head of Program Unit Africa, Caritas Austria; helene.unterguggenberger@caritas-austria.at Andreas Melcher Institute for Development Research (Deputy Head), BOKU andreas.melcher@boku.ac.at
Project participants and any communities involved:	Caritas Austria, four South Sudanese community-based organizations (CBOs), Makiga company Uganda and BOKU. **Beneficiaries**: 1,250 vulnerable households, ~100 youth, 200 school children.
Host country / location:	South Sudan
Monitoring method:	Simplified methodology for clean and efficient cookstoves (Ver. 3.0 https://globalgoals.goldstandard.org/standards/408_V3.0_EE_ICS_Simplified-methodology-for-efficient-cookstove.pdf); Adaptive Management (AM) and Cause Effect Modelling; Clean Development Mechanism AMS.III.Z. Small-scale Methodology. Fuel Swith, process improvement and energy efficiency in brick production Version 6.
Carbon standard	According to Gold Standard and CDM
SDG impacts:	SDG1 (No Poverty), SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 15 (Life on Land), SDG 17 (Partnerships for the Goals)

Size of the project and planting area:	Yambio region 8,792 km^2
Land-use history and current status of the area:	The project area is Yambio town and some surrounding villages.
Infrastructure (roads/houses etc.):	Basic infrastructure is available in the project area
Socio-economic history of the area:	During the longest liberation war in the history of Africa and the civil war starting in 2013, the social-economic situation in the project area is still weak, and people in Western Equatoria are suffering from war trauma, displacements, fragile health- & education system, and a devastating economic situation characterized by a high inflation rate causing a permanent increase of prices.
Is the site used by indigenous people and local communities, or has its special significance for indigenous people and communities	The activities of the project will not be implemented on communal land - cooking stoves will be used in the private households; community buildings (school and learning center) will be constructed on Church land; houses will be private houses built on family plots
Forest management applied (past and future)	n/a
Forest characteristics (including main tree species planted)	The main parts of Western Equatoria are covered with tropical rainforests (Mahogany-, Teak-, Acacia-, Kapok-, Cassia-, Coffee-, Papaya-, Banana-, Mango trees etc.)
Main social impacts (risks and benefits)	The project will reduce the financial burden on families and contribute to poverty reduction Risks: actors traditionally collecting firewood and burning bricks lose their employment
Main environmental impacts (risks and benefits)	The project will reduce the consumption of firewood for cooking and construction Risks: resistance of the population to apply sustainable methods, low awareness of impacts of using the firewood
Financial structure:	The total project budget is 441.456 €

SECTION A. Description of project

A.1. Purpose and general description of the project

(Provide a brief description of the project, including the description of the scenario that existed before the implementation of the project.)

A.1.1. Background and Problem statement

Work of Caritas Austria in South Sudan

Caritas Austria has been supporting the work of civil society organizations in South Sudan since the country's independence in 2011. Within the Caritas Austria strategy for International Programs, South Sudan is one of the priority countries. Since 2016 Caritas Austria has been registered as an international NGO in South Sudan with a local office located in Yambio in the region of Western Equatoria. The team in Yambio consists of an international Head of office and six South Sudanese staff members.

The primary purpose of Caritas Austria`s work in South Sudan is to support and advise South Sudanese development organizations in their services for the people in the region of Western Equatoria. The total number of beneficiaries reached by Caritas Austria-funded regional projects is about 9.000 households, mainly smallholder families. The cooperation with partner organizations focusses mainly on the support of food security and agriculture activities.

The lessons learnt and experiences made within the implementation of the projects showed the high impact of climate change and environmental degradation on the daily life of the families. That is why the present program was developed to reduce the effects of environmental degradation and respective CO_2 emissions. Furthermore, cooperation with BOKU University will ensure scientific research on the impact of the foreseen measures on the target groups.

General problem statement

South Sudan is one of the least developed countries in the world. According to the United Nations Humanitarian Development Index 2020, South Sudan is the fifth poorest country in the world – ranked 185th out of 189 countries.[1] Around 60% of the population (7.2 million people) is affected by acute food insecurity in South Sudan[2]. Furthermore, political instability in the past, accelerating climate change impacts and mismanagement of land and water ecosystems make South Sudan one of the most vulnerable countries worldwide.

Despite having one of Africa's lowest population densities (less than 13 people per km^2), in South Sudan, forests remain under immense pressure from charcoal and fuelwood production and consumption. A 2015 survey conducted jointly by the UN Environment and the Government of South Sudan estimated that in the capital Juba, 88% of households depend on charcoal energy[3]. Furthermore, 15% of households, 8% of businesses, and 40%of institutions use fuelwood to supplement charcoal for cooking. This demand translates into an estimated five million trees being logged annually to supply Juba with the charcoal it currently consumes, and according to the country's inaugural State of the Environment Outlook Report, launched in June 2018, fuelwood and charcoal account for over 80% of all wood used in South Sudan, with an annual deforestation rate estimated at between 1.5 and 2%. Hence, there is enormous pressure on natural resources,

[1] UN Human Development Index 2020
[2] FAO-WFP. Hunger Hotspots. FAO-WFP early warnings on acute food insecurity 2021 outlook
[3] UN Environment Programme (2015). Charcoal and fuelwood consumption in Juba and the associated impacts on forests. UNEP, Nairobi

especially forests, as over 99% of the population of South Sudan depends on forests as their source of energy[4]. In addition, the people of South Sudan have suffered for decades from war, insecurity, and displacement. Because of war, lack of law enforcement, and missing governmental controlling, natural resources have been exploited, devastated and degraded.

As little as 10-20 percent of the wood used in the traditional charcoal making is marketable as charcoal, while the rest is often wasted in the process. Moreover, illegal logging of tropical timber has deforested a vast forest area leaving behind partly uncovered laterite soil. These factors have undoubtedly contributed to the ongoing climate change at the local level resulting in prolonged dry seasons, increased flooding, strong winds, and increased numbers of wild bushfires. Cognizant of the harm posed to the country's forests by the charcoal trade, South Sudan's Ministry of Trade and Environment announced a restriction on wood charcoal exports in July 2018.

Especially in the greater Equatorian Region, considered the "Breadbasket" of the country, traditional shifting cultivation by cutting and burning forest for food production has degraded vast areas of fertile land. At the same time, the increase in population and the ongoing urbanization are consuming more and more firewood and charcoal for household fuel, as there are no other alternatives. The production of burned bricks for construction adds to the list.


Photo 1: Deforestation around Yambio town (credit: Matthias Fettback)

The project should contribute to a solution to the following problems:

- Extensive firewood and charcoal consumption for cooking purposes

  Firewood and charcoal are the only fuel sources for cooking at the household level in Western Equatoria. Across the country, simple cook stoves using wood or charcoal are predominant, with the traditional open three-stone fires (three stones hold a cooking pot over a fire) commonly used in rural areas and towns.

  With an energy efficiency of only 10%, cooking with an open fire is very inefficient and therefore damages the environment (deforestation) but also involves economic aspects and health consequences. Due to deforestation, soils are eroded, losing their ability to retain water. Searching for firewood costs many hours/day, time that cannot be spent on paid work. Moreover, this activity is mainly carried out by women, representing an enormous additional burden[5]. Because of the increase in population and uncontrolled deforestation, gathering firewood for

[4] UN Environment Programme (2018). South Sudan. First state of environment and outlook report 2018. UNEP, Nairobi
[5] Leonardi, Ch. et al. (2020). Fuelling poverty. The challenges of accessing energy among urban households in Juba, South Sudan. Rift Valley Institute

household consumption and charcoal supply becomes more and more complex and expensive for low-income households. According to interviews conducted with beneficiaries, charcoal prices in urban areas have considerably increased during the last ten years.

Photo 2: Traditional open three-stone fire
(credit: Matthias Fettback)

The above-described factors are also causing an increase in CO_2 emissions. Emission reductions by using efficient cook stoves (instead of the inefficient three-stone method and charcoal stoves) are estimated to be 2.538 tCO_2 per household annually (see section B for emission savings). These savings are due to a decreased demand for fuelwood and charcoal.

- Extensive firewood consumption for informal brick production

The post-war situation has destroyed infrastructure and caused a disastrous economic situation. As a result, most houses in both rural and urban areas are built to this day with baked clay bricks, which are harmful to the environment. For the informal brick-making sectors in Western Equatoria, there are five significant stages of brick production[6]:

- Excavation: mining of ground for suitable soil for brick production. In most cases, ant hills are used, preferably near water sources. Manual tools such as a shovel, wheelbarrow, and bucket are generally employed. Excavation leaves the soil loose, hence prone to flooding during the rainy season and to erosion by wind.
- Preparation: Before moulding, a portion of the excavated soil is gathered together in a heap. Water is manually conveyed from a nearby water source or through the pump to the heap of sand.
- Moulding: Molding transforms the clay soil into wet bricks of the desired shape and size.
- Drying: Successive batches of the wet bricks are aligned in a specified order. Bricks are dried in the open air to save resources. On rainy days, moulded and dried bricks are covered with plastic, and sometimes channels are constructed around the land where the bricks are laid to allow rainwater to flow away from the bricks.
- Burning: Bricks are burnt using firewood to harden them and increase their durability.

The increasing firewood consumption **to burn bricks is causing massive deforestation**, especially around urban centres. Even high-value Mango-trees are cut down for this purpose. According to interviews conducted with beneficiaries, one to two trees are cut to produce 10,000 bricks necessary for constructing one small house.

[6] The description of this process is based on field observations

At the same time, the traditional brick-making industry has dramatically influenced the socio-economic development of Yambio WES. The industry has helped in the creation of jobs either directly or indirectly. In addition, it has absorbed some unemployed youth in the various sections of the brick manufacturing processes. Producing burned clay bricks for local housing is an essential source of income, especially for unemployed youth. This must be considered when introducing a new, more sustainable brick production technology.

Photo 3: A youth group in Yambio is burning clay bricks for construction
(credit: Matthias Fettback)

Photo 4: Brick burning in South Sudan
(credit: Matthias Fettback)

A.1.2. Purpose/ Objective of the project:

This project aims to contribute to the SDG 12 "Promotion of sustainable consumption and production patterns by reducing 17.312 tCO_2 in the Western Equatoria Region of South Sudan. It will provide a solution to the problems described in the previous section, mainly deforestation due to the high need for firewood for cooking and brick burning. The main focus will be on introducing efficient cooking stoves and sustainable brick production (compact earth block method). A deduction from firewood and charcoal consumption will reduce the negative impacts of deforestation and CO_2 emissions. Hence, improved cook-stoves and compact earth block methods will significantly protect the fragile tropical rainforest environment and reduce global warming gases.

The project has the following objectives and results.

The defined indicator to measure the objective of the project are the following:

- Objective Indicator: after 6 years, **17.312** tons of emissions have been saved by the use of **sustainable cooking methods** (16.921 tCO_2) and **sustainable brick production** (391 tCO_2)

Time Schedule	Total Emission Reductions (tCO_2/y)	Total Emission Reductions Stoves (tCO_2/y)	Total Emission Reductions Bricks (tCO_2/y)
Target year 1 (by 31.12.2023)	124	**83**	**41**
Cumulative target year 2 (by 31.12.2024)	2.783	**2.713**	**70**
Cumulative target year 3 (by 31.12.2025)	3.895	**3.825**	**70**
Cumulative target year 4 (by 31.12.2026)	3.727	**3.657**	**70**
Cumulative target year 5 (by 31.12.2027)	3.540	**3.470**	**70**
Cumulative Target year 6 (by 31.12.2028)	3.243	**3.173**	**70**
Total	**17.312**	**16.921**	**391**

During the six-month inception phase of the project from January to June 2023, a Monitoring Guideline will be elaborated to define in detail how the achievement of the defined results and indicators will be measured. The Caritas Austria team will do the surveys on the savings of CO_2 every second year. In addition, surveys on other defined indicators will be done in the middle and the end of the project by the Caritas Austria team with the support of BOKU.

The project has the following expected results:

- Result 1: 1,250 households apply sustainable cooking methods
  - Indicator: after 6 years, 1,250 households use fuel-saving stoves for cooking
  - Indicator: after 6 years, 1,250 households report income savings by use of fuel-saving stoves
- Result 2: Sustainable brick production is piloted/introduced in Yambio town in South Sudan
  - Indicator: after two years, one learning center are constructed with the compact earth brick method
  - Indicator: 28 youth are trained in sustainable brick production
  - Indicator: two groups are employed for the production of the bricks for two community buildings
- Result 3: There is supply and demand on the market in WES for sustainable bricks
  - Indicator: After 6 years, ~100 youth have a regular income from a business for sustainable brick production
- Result 4: A minimum of 1,250 households are aware of the environmental damages and the financial burdens caused by unsustainable cooking and construction methods
  - Indicator: at least 1,250 households report having more knowledge about the impact of unsustainable cooking and construction methods
- Result 5: A minimum of 900 households have successfully planted one grafted mango-tree at their compounds
  - Indicator: 75% survival rate of planted mango trees
- Result 6: Scientific research on the introduction of sustainable cooking and construction methods done
  - Indicator: 2 master theses are done on defined research questions

A 1.3. Target Groups:

The target groups of the project are:

- 1,250 vulnerable households in urban and suburban areas around Yambio Town, Western Equatoria/ South Sudan. Caritas Austria is already working on other projects with most of these households through South Sudanese partner organizations.
- ~100 youth (members of five youth groups) from Yambio town who are already engaged in the informal brick-making production
- 200 primary school children

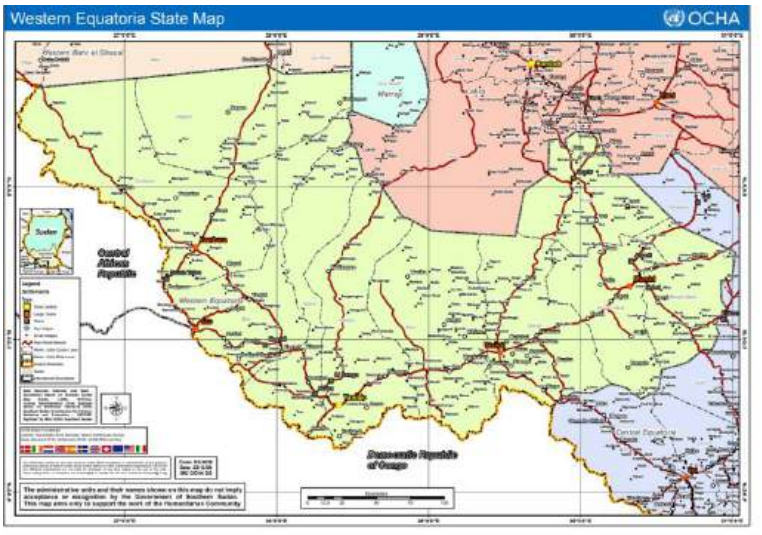
The indirect project target group is the population of Yambio town as potential clients of the brick production business of the youth groups.

A.2. Location of the project.

(Host Country, Region, City/Town/Community, and Physical/Geographical location. Include information allowing the unique identification of this project)

The project takes place in South Sudan, the Region of Western Equatoria, the town of Yambio and its surroundings. The size of the area is about 8.800 km^2.

Map 1: South Sudan7



Map 2: Western Equatoria State and its Counties, Payam and Boma

[7] https://www.alamy.com/stock-photo-south-sudan-political-map-with-capital-juba-national-borders-important-109566817.html?imageid=5D962841-C470-4586-87B9-CB9278BDCCFD&p=183153&pn=1&searchId=c3761923bcfdaf62b5ba20cca07e6db5&searchtype=0

A.3. Technologies and/or measures

(Describe the technologies and measures to be employed and/or implemented by the project, including a list of the facilities, systems, and equipment that will be installed and/or modified by the project.)

Activities ad Result 1 "1,250 households apply sustainable cooking methods."

Result 1 of the project focuses on the promotion of the use of efficient cooking stoves by vulnerable families in Yambio. A first baseline on the recent cooking methods was conducted in February-March 2022, including discussions with women focus groups on their preferences in cooking stoves. This first trial revealed a preference for the combined charcoal-firewood UgaStove or the charcoal UgaStove.

Photo 5: Baseline session in March 2022 comparing UgaStove charcoal, UgaStove firewood, locally made charcoal stove and three-stone method (credit: Laura Oberhuber)

Technology:

The project promotes UgaStoves, a Ugandan fuel-saving stove, to reduce firewood consumption and CO_2 emission and contribute to less pollution during cooking. The Ugandan Company is well known in the region representing 30 years of experience supervised and promoted by GIZ and other international companies.[8]

UgaStoves are affordable and very durable. If well maintained, they last for more than five years. Moreover, compared with other fuel-saving stoves in East Africa, UgaStoves have a high thermal efficiency of 27.3%.[9] Traditional open-fire stoves have an efficiency of only 10%.[10]

[8] For more information on Ugastove see: https://ugastove.net
[9] See: Section B.1.2
[10] See: Section B.1.1

Photo 6: UgaStoves
(credit: UgaStoves https://ugastove.net/ Source of picture: Exhibition of UgaStoves)

The following activities are foreseen under this result:

- Purchase of 100 improved UgaStoves and distribution to 50 households for testing phase

  After the inception phase, the first batch of 100 fuel-saving stoves (50 firewood stoves, 50 charcoal stoves) will be procured by the Caritas Austria Office from UgaStove Company in Kampala/ Uganda. These stoves will be distributed for household-level testing to reconfirm baseline results and the most appropriate types of UgaStoves (Firewood or charcoal stoves, best stove sizes due to standard pot sizes). As a result, 50 households selected by the partner organization "Self-help Women Development Organization" (SHWDO) will get one firewood and one charcoal stove each. Caritas-Austria will assess the field data and negotiate with UgaStove-the company, for the final procurement.

- Purchase of 2,650 subsidized improved stoves and distribution to 1,200 households
  Caritas Austria will procure 2,650 UgaStoves from UgaStove Company in Kampala. The implementing CBO- partner organizations SHWDO and Star Group will be responsible for identifying beneficiary households for the first year (600 households) according to specific criteria like the size of households, the number of fireplaces, mode of preparing the daily dishes, engagement in other business activities demanding firewood (like small scale restaurants and local breweries operated by women). 250 stoves will be purchased as reserve in case of damaged stoves.

  After awareness creation and training in proper usage of UgaStoves, 1,200 stoves will be distributed to 600 selected households (2 stoves per household). The project will ask for a contribution of 20% from each household (3.6 USD per stove). Participants will decide and commit to shifting from the traditional three-stone-open fireplaces to fuel-saving stoves. In 2024, 600 households will be added to the first targeted households.

- Regular accompaniment of families and monitoring of the impact

  The Caritas Austria team, together with the partner organizations, will monitor the fuel consumption and the technical condition of the stoves regularly. Participating households will keep household books to record fuel consumption, cooking time and condition of the stoves.

  Caritas-Austria Office South Sudan will arrange in collaboration with BOKU and the implementing CBO-Partners for mid and final surveys (monitoring) in order to track the project progress

according to the defined result indicators (see section A.1.2.). The project teams will link up with local partners and stakeholders to ensure a participatory approach.

Activities ad Result 2 "Sustainable brick production is piloted/introduced in Yambio town. "

Result 2 of the project focuses on promoting sustainable brick production in Yambio town. The project will introduce the Compressed Earth Block method (CEB), aiming to replace the traditional method of burning clay-brick for local construction, which consumes a tremendous amount of firewood and contributes highly to deforestation and CO_2 emission. The earth blocks are compressed by manual brick press machines producing interlocked blocks. The technique uses a minimum amount of cement for construction.

The advantages of that method have been well-proven in many local housing projects in West Africa. Development agencies, like MISEREOR [11] [12], GIZ [13] and UNHABITAT [14] have successfully implemented low-cost housing projects using the CEB method. In addition, the Compressed Earth Block method has been developed and regularly improved by research institutions, like CRAterre (Centre International de la Construction en Terre, Prof Alexandre Doyline) and the Makarere University of Kampala/ Uganda (Dr Moses Musaazi[15]).

The Compressed Earth Block Method:

Based on the soil analysis results, a special clay, sand, and laterite soil ratio is pressed to blocks and applied to CEB technology. Normally the construction- material consists of 79% laterite- & top-soil; 15% sand and ca. 5% cement for stabilizing only. If correctly done, the compressed earth blocks will achieve nearly the same durability as cement- blocks. They are water-resistant and safe against termites. No additional cement or burning of clay bricks is needed.

This Soil Block Technology uses an ISSB Machine ("Interlocking Stabilizer Soil Block Press") to compress red subsoil, preferably marram, which is free of organic material and is stabilized with water and a small percentage of cement. The Block Machine is purely manual and virtually maintenance-free. It is operated by two people and requires simple greasing and oiling. With one stroke, the prepared soil is compressed by 30%. The second stroke ejects the fresh block from the mould. The fresh blocks are covered with black polythene and water regularly for 24 hours. This "curing" process allows the chemical reaction between the stabilizer (5 % of cement) and soil to be completed. The blocks must be kept wet during this period. Otherwise, the blocks will dry too quickly and weaken. Next, the polythene sheet is removed to allow the blocks to dry in the sun. Once the blocks are dry, they are ready for use on-site or transported to another site.

[11] Mathissen, Herbert, Misereor: „Bauen mit Erde in der Entwicklungsarbeit", 1995
[12] Merschmeyer, Gerhard; Misereor/ AGEH 1982 – 1998: „Bauen mit alternativen Baustoffen"; 1998
[13] Mukerji, Kiran; GTZ / GATE:"Stabilizers and mortars for compressed earth blocks"; 1994
& giz2021-en-climate-and-employment-sustainable-building-materials.pdf
[14] Dan Lewis; UN-HABITAT: "Interlocking Stabilised Soil Blocks Appropriate earth technologies in Uganda"; 2009
[15] 1991, Dr Moses Musaazi; Makarere University /Kampala: "Would you like to know how we are saving tonnes of trees with every classroom we build?"; 1991

Photo 7: Earth Brick Method
(credit: Makiga Company/ Kampala)

Photo 8: Ground floor plan and photo of Tawau residential building using ICEB construction
(credit: Makiga Company/ Kampala)

The following activities are foreseen under this result:

- Contracting of Makiga Company for the supply of block machines, training of youth leaders and masons and regular consultancy and training of six masons

  Makiga Company in Kampala/ Uganda, manufactures appropriate technology for low-cost house construction in Uganda using the compressed earth block method. Caritas Austria visited Makiga Company in Kampala/ Uganda in March 2022 to get more insight into the technology and the machines used. Caritas Austria already procured one block machine in Yambio, and Makiga Company conducted the first training on the compressed earth block method in June 2022 for the staff of the Caritas Austria Office and representatives of five youth groups. Caritas Austria will partner with Makiga Company throughout the project duration.

- Training of 28 youth in compact earth block technology

  28 youth from selected youth groups in Yambio who are already engaged in brick-making will be trained by technical experts of Makiga company on the production of bricks using the compact earth block technology. In addition, five group leaders will also be allowed to participate in a five-day exposure visit to Kampala to learn about CEB and exchange experiences with Ugandan youth groups and construction companies already implementing CEB successfully.

  The content of the three-day training will be the following:
  - Safety precautions while using the ISSB machine.
  - Parts and functions of the machine.
  - Servicing of the machine and its importance.
  - Correct soil selection and sieving for the production of the inter-lock bricks.
  - Calculating the correct ratio of soil, sand, cement, and water-prove cement.
  - The correct way of mixing the soil, sand, cement, water prove cement and water.
  - Correct filling of the machine with the earth, pressing the machine and removing the ready compressed brick from the machine.
  - Correct arrangement of the compressed bricks for drying and curing of the bricks.
  - Constructions of the corners using the inter-lock bricks.
  - Constructions of joint T in the building using the inter-lock bricks.
  - Constructions of double pairs and single pairs using the inter-lock bricks.

- Training of six masons on construction with interlocked bricks

  After the Makiga training, the project personnel should be in the position to train six local masons in construction with interlocked earth bricks. In addition, interested masons should select some leaders who will join the two to three days exposure visit to Uganda to meet with their Ugandan colleagues who have long experience in ISSB construction.

- Construction of one school

  In order to introduce the new technology of sustainable brick production, two “community buildings” (one school and one learning center for young mothers) will be constructed using the earth brick method. The sites of the buildings will also be used for awareness-raising events to introduce the technology in the project area. Both buildings will be built by a local construction company. In addition, the trained youth groups will produce bricks with the earth brick method.

  The community building will be a primary school for children in Gangura village, 17 km outside Yambio town. There is already a primary school in Gangura (St. Peter’s primary school), run by the partner organization ICODO, but this school has a fundamental and semi-permanent structure. The new school would replace this old school and enable about 200 children to get a quality primary education. The school will have three classroom blocks, each one 40 square meters.
  .

  Steps under this activity:

  - Procurement of four brick press machines (block machines): After the training phase, five block machines will be procured from Makiga Company and distributed to the well-trained

and active youth groups to produce the bricks for the two buildings. After setting- up conditions for usage, youth groups will sign a Letter of Understanding (LoU) with Caritas Austria before receiving the machines.

Photo 9: ISSB Block Machine
credit: Makiga Company/ Kampala

- Production of 60,000 bricks for two community buildings: The trained youth groups will be hired by ICODO and CCEWO to produce the bricks for the two community buildings. It is estimated that about 60,000 bricks will be needed for the buildings. The youth groups will use the procured ISSB presses, but the presses will remain the project's property until its end. After the project duration, the ISSB presses will be handed over to the best-performing youth groups.

- Contracting a construction company for the construction of the buildings: The best bidding company for the building will be selected after a transparent procurement process. Contracts will be signed with the partner organizations ICODO and CCEWO.

Activities ad Result 3: "There is supply and demand on the market in WES for sustainable bricks."

- **Training of 72 youth group members on the Compressed Earth Brick Method (CEB)**

  After the construction of the two community buildings introducing the new brick technology in Yambio, the 28 youth that Makiga Company had trained will be considered as ToT ("Trainer of Trainers") and will be in charge of transferring innovative CEB-know-how to their fellow youth group members. It is foreseen that they will train about 72 youth additionally. The training content will be the same as the training they received from Makiga Company.

- **Training of youth groups on essential business aspects** (e.g. business plans, marketing, controlling)

  In order to prepare youth groups well for the running of their brick-making, business training on the main aspects is foreseen. There will be one 1-week training for two representatives of the five groups (about ten persons) around the following contents:
  - Supply and demand.
  - Costs, income, prices and profit.
  - The four Ps of marketing: Product, Price, Promotion and Place.
  - Entrepreneurial spirit.
  - How to set up a business plan for the brick-making business

  A trainer will be hired to conduct the training in Yambio and potentially to consult the groups in the first year of their business.

- **Start-Up Support to youth groups:**

  Depending on the business plans, small start-up support for the youth groups in terms of tools and brick-presses could boost the production of compressed earth blocks for local housing and promote this technology in the markets. Therefore, four additional brick presses will be procured.

- **Production and selling of about 630,000 sustainable bricks**

  It is estimated that in the years 2.5 - 3.5 of the project, youth groups will start their business and supply the bricks for about 63 houses (10,000 bricks per house). This estimation will depend on the demand in the WES market for sustainable bricks. The program manager will monitor and interview the youth groups about their business results. If there is more demand on the market, the CO_2 tons saved throughout the project will be higher.

Activities ad Result 4: "A minimum of 1,250 households are aware of the environmental damages and the financial burdens caused by unsustainable cooking and construction methods.**"**

- Sensitization events on environmental aspects

  The project foresees yearly sensitization workshops creating awareness about the impact of fuel-saving stoves, resource management and sustainable construction: Topics discussed during these events will be: Alternatives to generate locally household fuel (saw-dust-stoves, living hedge for firewood production, appropriated small-scale biogas), sustainable charcoal production, replanting of trees, climate mitigation, principals of sustainable agriculture, sustainable construction and others.

The target groups of these events are the targeted households in the program, but also the population of Yambio town. The location of the events has still to be defined.

During construction, our partner organizations will invite youth leaders, masons, local authorities and the local population to eyewitness the CEB method using the ISSB- technique. These events are meant as a discussion-forum allowing critical questions and –observations. Three events will be conducted, one after each construction phase.

- Radio messages on sustainable cooking and construction methods

  Quarterly radio talk-shows will be organized to sensitize listeners to fuel-saving stoves and environmental protection. The program will also report on the project's progress and success stories. Caritas Austria partner organizations will approach the two local radio stations, Radio Anisa and FM- Yambio. On the national level, we will try to contact “Eye Radio” and “Miraya-FM.”[16]

Activities ad Result 5 “A minimum of 900 households have planted successfully one grafted mango-tree at their compounds.”

- The establishment of 8 community-based nurseries in 4 locations of sub- urban Yambio should promote replanting improved mango trees. This initiative should help replace mango trees that have been cut for firewood to burn bricks for construction.

- The field-extension staff of CARITAS-Austria Office South Sudan will organize 8 ToT training in 4 different locations of Yambio Town to train women- and youth group leaders (20 participants per ToT training) in mango tree grafting and tree-nursery management.

- After the training, the project will procure 1,200 grafted mango seedlings (150 tree seedlings for each of the eight community-based nurseries). The trained nursery attendants will deliver young mango trees to the project beneficiaries and will continue to produce new grafting mango seedlings. Beneficiaries have to sign-up for the first lot of trees and should pay a “protection charge” (half of the market price). Improved mango trees produced by the nurseries will be sold at the local market pries level. This income should help to sustain the community-based nurseries.

Caritas-Office South Sudan will monitor the survival rate of planted mango trees seasonally.
The survival rate of planted trees will be an indicator of the activity's success.

Activities ad Result 6 “Scientific research on the introduction of sustainable cooking and construction methods done.”

See Section D

[16] See https://www.eyeradio.org/ and https://unmiss.unmissions.org/radio-miraya-news.

A.4. Local stakeholder inclusion

(Describe how stakeholders are included in the project)

According to its mission and vision, Caritas Austria pursues a **participative, cooperative and subsidiary approach**. The people we support are not the objects of our aid but, first and foremost, the subjects. Therefore, we organise our support in a participatory way so that the beneficiaries may remain or become the most self-determined subjects they can be and bring their resources and potential to the fore. A fundamental principle of Caritas international work is the partnership with organisations in the partner countries. We always make our contribution in cooperation with organisations in the partner countries. This strengthens civil societies on the ground and ensures the sustainability and relevance of our interventions. A partnership means a long-term obligation to agree on goals based on shared values, strategies and information. Our partner organisations are fully accountable to the people they serve, and all initiatives they propose are based on the needs of the beneficiaries. Participation of beneficiaries is the key to the success of this program.

The Caritas Austria Office South Sudan team will lead the program in cooperation with four South Sudanese partner organizations. Those partner organizations are in regular contact and dialogue with targeted beneficiaries, regularly assess the needs of the target groups, and have processes in place to get regular feedback on the services delivered.

Role of the different stakeholders:

- **Caritas Austria** (one program manager Vienna 5% five years, one project officer in Caritas Austria Office South Sudan 20% 5.5 years, one logistics officer in Caritas Austria Office South Sudan two years 20%)

  Role in the project:
  - Overall coordination and program management
  - Monitoring
  - Regular consultancy and accompaniment of partner organizations (CBOs)
  - Procurement of fuel-saving stoves, brick machines, and constructors
  - Organization of training for youth groups for the production of bricks
  - Organization of training for youth groups on business skills
  - Procurement of 1,200 mango tree seedlings
  - Organization of training for mango-tree grafting and community-based tree-nursery management
  - Support of CBOs for awareness-raising activities

- **Star Support Group (SSG)**

  SSG is an initiative of the Congregation of Christian Brothers located within the premises of St. Mary Parish Catholic Diocese of Tambura-Yambio in Yambio. The project's target beneficiaries are people living with HIV/ AIDS, orphans and vulnerable children, their caregivers, and people affected by HIV/AIDS in the Yambio community. Star Support Group has about 1,924 registered members living with HIV/AIDS. Most of them are women, followed by men and children. All registered members have access to care and a support services center. The larger community also benefits from the program through education and awareness creation.

  Role and tasks in the project:
  - Distribution of stoves to target groups and
  - Regular visits to the households

- **Self-help Women Development Organization (SHWDO)**

  SHWDO is Yambio-based women lead organization established in 2009. SHWDO primarily focuses on engaging the local communities in areas of gender equality, empowering women through vocational skills and income-generating activities. SHWDO is offering leadership training to its members. Moreover, SHWDO creates awareness about Gender-Based Violence and offers trauma healing courses. Currently, SHWDO supports ten women groups representing on average of 250 families (Households)

  Role and tasks in the project:
  - Distribution of stoves to target groups
  - Regular visits to the households

- **CCEWO:**

  CCEWO supports illiterate young mothers and youth groups in adult education, training of vocational skills, and income-generating activities to develop self-employment sustaining their families for better livelihood conditions. CCEWO tends to address the high illiteracy rate among women, and limited opportunities for economic growth, especially among women and youth and children below three years. CCEWO works in urban and sub-urban areas of Yambio, Nzara, and Gangura, supporting 450 youth (250 women & 150 men). Youth are organized groups supervised by locally elected youth leaders.

  Role in the project:
  - Distribution of stoves to target groups and
  - Regular visits to the households
  - Contact targeted youth groups for brick-making

- **ICODO:**

  ICODO is a community-based organization located in Western Equatoria and is registered with the National Relief and Rehabilitation Commission in Juba, South Sudan. It was registered on 31/07/2018 with registration number 1,573 under Chapter 3, Section 10 of the NGOs Act, 2016. Since its establishment, ICODO has carried out several activities in nutrition, women empowerment, psychosocial support, trauma healing, peacebuilding, and primary education for orphans and vulnerable children.

  Role in the project:
  - Distribution of stoves to target groups and
  - Regular visits to the households
  - Construction of a primary school in Gangura

It is foreseen that the involved CBOs will increase the number of the targeted households in the course of the project

- **Makiga Company:**

  Makiga Company manufactures appropriate technology for low-cost house construction in Uganda using the compressed earth block method. The earth blocks are compressed by manual brick press machines producing interlocked blocks. The technique uses a minimum amount of cement for construction. [17] In order to promote its products, Makiga is offering training to constructors and local masons using the compressed earth block method. Makiga Company collaborates with Makarere- University Kampala and is supported by UNHABITAT.[18]

  - Role in the project:
    - Training for youth for sustainable brick production
    - Training of masons for building constructions with interlocked bricks
    - Supply of brick press machines
    - Supervision/Advise for the construction of two community buildings

- **BOKU university**
  - Support in overall monitoring of the program
  - Promotion of the project on the website of its climate change mitigation project platform
  - Scientific research during the whole program duration

All project activities will be coordinated together with the Relief and Rehabilitation Commission (RRC)[19] and the concerned State Ministries.

[17] See for more information: https://makiga-engineering.com/
[18] Interlocking Stabilised Soil Blocks, Appropriate earth technologies in Uganda, https://unhabitat.org/interlocking-stabilised-soil-blocks-appropriate-earth-technologies-in-uganda
[19] https://southsudanrrc.org/

A.5. Funding sources of the project

(Provide the public and private funding sources for the project. Confidential information need not be provided.)

The cost per ton of CO_2 in the project amounts to 30 €. It includes a surcharge of 10% for the quality testing, verification and fundraising services provided by BOKU . Furthermore, the cost per ton is calculated based on the subtraction of a 15% “ton buffer” amounting to 2.597 t of the total of 17,312 t CO_2 expected to be avoided through the project). Program developer Caritas Austria can pre-finance the necessary funds for the implementation of the project. In case BOKU cannot raise enough funds via its climate change mitigation project platform, Caritas Austria will cover the remaining costs.

A.6. Demonstration of additionality

The project has been designed specifically as a climate mitigation project to reduce CO2 /GHG emissions. Without the investment, this project would not exist, and no GHG reduction would be achieved. Furthermore, without the reduction of GHG-Emission, there is no added value in context with mitigation (additionality), and therefore it would not qualify for the BOKU climate change mitigation project platform.

A.7. Start date and expected operational lifetime of the project

*(Specify also the start and length of c*rediting period) of the project *start date, in the format of DD/MM/YYYY.)*

Start date: 1 January 2023
Duration of the program: 6 years until 31 December 2028

SECTION B. Carbon mitigation/sequestration calculation

B.1. Reference and applicability of the methodology

This project is based on Gold Standard (GS) methods for calculating emission reductions and monitoring:

- Fuel-efficient cookstoves:
  Simplified methodology for clean and efficient cookstoves (Vers. 3.0)[20]
- Compact Earth Brick Technology:
  CDM Methodolocy CDM AMS-III.Z. Small-scale Methodology: Fuel Switch, process improvement and energy efficiency in brick manufacture Version 06.0 Sectoral scope(s): 04[21]

B.1.1. Data and parameters fixed ex-ante for monitoring contribution

(Include a compilation of information on the data and parameters that are not monitored during the crediting period but are determined before the design certification and remain fixed throughout the crediting period, like IPCC defaults and other methodology defaults. Copy this table for each piece of data and parameter.)

Fuel-efficient stoves:

Data/parameter	$EF_{b,fuel,CO2\_firewood}$
Unit	tCO_2/tonne of fuel
Description	CO_2 emission factor arising from the use of firewood in the baseline scenario (see also section A.1.1)
Source of data	Simplified methodology for clean and efficient cookstoves (Vers. 3.0)
Value(s) applied	1.747 tCO_2/tonne of fuel
Choice of data or Measurement methods and procedures	This is a default value
Purpose of data	Calculation of ERs
Additional comment	

Data/parameter	$EF_{b,fuel,CO2\_charcoal}$
Unit	tCO_2/tonne of fuel
Description	CO_2 emission factor arising from the use of charcoal in the baseline scenario (see also section A.1.1)
Source of data	Simplified methodology for clean and efficient cookstoves (Vers. 3.0)
Value(s) applied	3.304 tCO_2/tonne of fuel
Choice of data or Measurement methods and procedures	This is a default value
Purpose of data	Calculation of ERs

[20] https://globalgoals.goldstandard.org/408-ee-ics-simplified-methodology-for-efficient-cookstoves/

[21] https://cdm.unfccc.int/methodologies/DB/VLZZ1DVT1QI3KHZKSM6QECOAKNSCXZ

Additional comment	
Data/parameter	$EF_{fuel,non\text{-}CO2\_firewood}$
Unit	tCO_2/tonne of fuel
Description	Non-CO_2 emission factor arising from the use of firewood in the baseline scenario (see also section A.1.1)
Source of data	Simplified methodology for clean and efficient cookstoves (Vers. 3.0)
Value(s) applied	0.148 tCO_2/tonne of fuel
Choice of data or Measurement methods and procedures	This is a default value
Purpose of data	Calculation of ERs
Additional comment	

Data/parameter	$EF_{fuel,non\text{-}CO2\_charcoal}$
Unit	tCO_2/tonne of fuel
Description	Non-CO_2 emission factor arising from the use of charcoal in the baseline scenario (see also section A.1.1)
Source of data	Simplified methodology for clean and efficient cookstoves (Vers. 3.0)
Value(s) applied	0.173 tCO_2/tonne of fuel
Choice of data or Measurement methods and procedures	This is a default value
Purpose of data	Calculation of ERs
Additional comment	

Data/parameter	n_b
Unit	Fraction
Description	The efficiency of the cookstove being used in the baseline scenario (see also section A.1.1)
Source of data	Simplified methodology for clean and efficient cookstoves (Vers. 3.0)
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	This is a default value
Purpose of data	Calculation of reduction of fuelwood consumption and thus ERs
Additional comment	Since people in South Sudan mainly cook with an open fire, this value can be applied. After the midterm monitoring, this factor might need to be adapted to 0.2 depending on if there are also beneficiaries involved using inefficient charcoal stoves

Data/parameter	f_{NRB}
Unit	Fraction
Description	Fraction of biomass used during year y for the considered scenario that can be established as non-renewable biomass
Source of data	There is no specific value for South Sudan available. Since this project is in the south of South Sudan and therefore close to Uganda, the default country-specific fraction of Uganda will be taken and is available on the CDM website: https://cdm.unfccc.int/filestorage/e/x/t/extfile-20171103152130273-EB97_repan02_ASB0002_2017_Charcoal_Uganda.pdf/EB97_repan02_ASB0002_2017_Charcoal_Uganda.pdf?t=aXh8cXUwdnI1fDB-xic1X7zOvNBzjMdT0qyK
Value(s) applied	0.88
Choice of data or Measurement methods and procedures	The NRB is assessed by one of the approaches given in the methodology; here, the default country-specific fraction available on the CDM website is used
Purpose of data	Calculation of ERs
Additional comment	This value is fixed for the entire crediting period, although the project proponent may choose to re-examine the assessment at any time. For any possible renewal of the crediting period this value must be reassessed.

Compact Earth Brick Technology:

Data/parameter	$EF_{b,fuel,CO2\_firewood}$
Unit	tCO_2/tonne of fuel
Description	CO_2 emission factor arising from the use of firewood in the baseline scenario (see also section A.1.1)
Source of data	Simplified methodology for clean and efficient cookstoves (Vers. 3.0)
Value(s) applied	1.747 tCO_2/tonne of fuel
Choice of data or Measurement methods and procedures	This is a default value
Purpose of data	Calculation of ERs
Additional comment	Since there is no Gold Standard or CDM methodology to calculate emission savings from using the compact earth brick technology instead of burning bricks using firewood, values from “Simplified methodology for clean and efficient cookstoves” are applied

Data/parameter	$EF_{fuel,non\text{-}CO2\_firewood}$
Unit	tCO_2/tonne of fuel
Description	Non-CO_2 emission factor arising from the use of firewood in the baseline scenario
Source of data	Simplified methodology for clean and efficient cookstoves (Vers. 3.0)
Value(s) applied	0.148 tCO_2/tonne of fuel

Choice of data or Measurement methods and procedures	This is a default value
Purpose of data	Calculation of ERs
Additional comment	Since there is no Gold Standard or CDM methodology to calculate emission savings from using the compact earth brick technology instead of burning bricks using firewood, values from "Simplified methodology for clean and efficient cookstoves" are applied

Data/parameter	f_{NRB}
Unit	Fraction
Description	Fraction of biomass used during year y for the considered scenario that can be established as non-renewable biomass
Source of data	There is no specific value for South Sudan available. Since this project is in the south of South Sudan and therefore close to Uganda, the default country-specific fraction of Uganda will be taken and is available on the CDM website: https://cdm.unfccc.int/filestorage/e/x/t/extfile-20171103152130273-EB97_repan02_ASB0002_2017_Charcoal_Uganda.pdf/EB97_repan02_ASB0002_2017_Charcoal_Uganda.pdf?t=aXh8cXUwdnI1fDB-xic1X7zOvNBzjMdT0qyK
Value(s) applied	0.88
Choice of data or Measurement methods and procedures	The NRB is assessed by one of the approaches given in the methodology; here, the default country-specific fraction available on the CDM website is used
Purpose of data	Calculation of ERs
Additional comment	This value is fixed for the entire crediting period, although the project proponent may choose to re-examine the assessment at any time. For any possible renewal of the crediting period this value must be reassessed.

B.1.2. Ex-ante estimation of carbon mitigation/sequestration

(Provide a transparent ex-ante calculation of baseline and project outcomes (or, where applicable, direct calculation of net benefit) during the crediting period, applying all relevant equations provided in the selected methodology(ies) or as per the proposed approach.

Data/parameter	$B_{b,y\_firewood}$
Unit	t/hh/y
Description	Quantity of firewood that is consumed in baseline scenario b (see also section A.1.1) during year y per household
Source of data	Baseline / Midterm survey with 48 households and 78 weighted bundles of firewood
Value(s) applied	3.88
Choice of data or Measurement methods and procedures	Value was taken from a baseline and midterm survey of another climate change mitigation project called GEN – Green Energy and Nutrition by Caritas Carinthia in northern Uganda, which is also part of the BOKU climate change mitigation project platform: https://xn--klimaneutralitt-elb.boku.ac.at/projects/gemeinschaftliche-biogasanlagen-in-gulu-uganda/ Those two surveys include 48 households and 78 weighted bundles of firewood

Purpose of data	The basis for calculating fuel savings and thus ER calculations on a per household basis. Since this project is in the south of South Sudan and therefore close to northern Uganda, for the beginning, the applied value will be a good guide
Additional comment	A proper baseline study in South Sudan needs to be conducted. It is expected that results will be very similar to the survey in northern Uganda

Data/parameter	$B_{b,y\_charcoal}$
Unit	t/hh/y
Description	Quantity of charcoal that is consumed in baseline scenario b (see also section A.1.1) during year y per household
Source of data	Small baseline survey with 24 households
Value(s) applied	0.56
Choice of data or Measurement methods and procedures	This value was taken from a first small baseline survey with 24 households in the project region
Purpose of data	The basis for calculating fuel savings and thus ER calculations on a per-household basis
Additional comment	Of course, a proper baseline study with more households needs to be conducted

Data/parameter	$P_{b,y\_firewood}$
Unit	t/hh/day
Description	Specific fuel consumption (firewood) for an individual technology in baseline scenario b during year y converted to tons/day
Source of data	Calculations
Value(s) applied	0.0064
Choice of data or Measurement methods and procedures	This value is calculated with already mentioned values and parameters. This value will be multiplied by the number of technology days. Since it is 365 days within this project, it will be the same value as $B_{b,y\_firewood}$ in the end
Purpose of data	Calculation of ERs
Additional comment	This value is very likely to change a bit since it is calculated with values that need to be established within surveys and tests

Data/parameter	$P_{b,y\_charcoal}$
Unit	t/hh/day
Description	Specific fuel consumption (charcoal) for an individual technology in baseline scenario b during year y converted to tons/day
Source of data	Calculations
Value(s) applied	0.0019
Choice of data or Measurement methods and procedures	This value is calculated with already mentioned values and parameters. This value will be multiplied by the number of technology days. Since it is 365 days within this project, it will be the same value as $B_{b,y\_charcoal}$ in the end
Purpose of data	Calculation of ERs

Additional comment	This value is very likely to change a bit since it is calculated with values that need to be established within surveys and tests

Data/parameter	n_p
Unit	Fraction
Description	The efficiency of the efficient cookstove at the start of the project (%)
Source of data	This value was taken from a certified Gold Standard project https://platform.sustain-cert.com/public-project/843
Value(s) applied	27.23
Choice of data or Measurement methods and procedures	Water Boiling Test protocol
Purpose of data	Calculation of reduction of fuelwood consumption and thus ERs
Additional comment	This value is multiplied with a discount factor DF_n

Data/parameter	DF_n
Unit	Fraction
Description	Discount factor to account for efficiency loss of project cookstoves
Source of data	Simplified methodology for clean and efficient cookstoves (Vers. 3.0)
Value(s) applied	0.975
Choice of data or Measurement methods and procedures	Default value. Since the project runs for 5.5 years and an efficiency loss of 1% per year is default by the methodology, an average efficiency over the 5.5 years of 97.5% is applied. This value will be adapted after the first monitoring and tests
Purpose of data	Calculation of the efficiency of the project cookstove and thus ERs
Additional comment	According to the older version 1.0 from 2020, an efficiency decrease of 1% can be accounted for. Though, according to the newer version 3.0 methodology, efficiency decreases need to be tested and proven by the project developer. Therefore, a discount factor of 1% per year is used. Furthermore, during annual surveys, if it is found that the project cookstoves are not in working condition, their proportionate population should be excluded from the project database until they are replaced with new cookstoves.

Data/parameter	$n_{p,y}$
Unit	Fraction
Description	The average efficiency of the efficient cookstove while being used in the project scenario p (%); see also section A.1.3
Source of data	Calculations of $n_p * DF_n$
Value(s) applied	26.55
Choice of data or Measurement methods and procedures	WBT protocol
Purpose of data	Calculation of reduction of fuelwood consumption and thus ERs

Additional comment	Water Boiling Tests will most likely be done according to GS methodology. According to the methodology, this value was discounted with the factor of 97,5% (1% of efficiency loss per year)

Data/parameter	$U_{p,y}$
Unit	Fraction
Description	Usage rate in project scenario p (see also section A.1.3) during year y
Source of data	Assumed value
Value(s) applied	0.80
Choice of data or Measurement methods and procedures	Annual monitoring and a midterm survey will be conducted according to GS methodologies
Purpose of data	Calculation of ERs
Additional comment	This value is very likely to change. For example, good training for beneficiaries will likely have a higher value in the end. Still, the applied value is seen as conservative.

Data/parameter	$N_{p,y}$
Unit	Number of project cookstoves credited (units)
Description	Cookstove for project scenario p (see also section A.1.3) through year y
Source of data	Total distribution record
Value(s) applied	2,500 (but for 1,250 households)
Choice of data or Measurement methods and procedures	Transparent data analysis and reporting
Purpose of data	Calculation of ERs
Additional comment	The number of cookstoves might change during the project. Each household will get two fuel-efficient cookstoves

Data/parameter	$DF_{p,stove,y}$
Unit	Fraction
Description	Discount factor to account for the baseline stove use in project scenario p (see also section A.1.3) during the year y
Source of data	Assumed value
Value(s) applied	0.10
Choice of data or Measurement methods and procedures	Annual survey with transparent data analysis and reporting
Purpose of data	Calculation of ERs
Additional comment	The discount factor for baseline-stove use may be determined based on several meals cooked using the baseline stove. The required information will be gathered through surveys with a random sampling approach. A minimum sample size shall be selected following the guidelines of GS Simplified methodology for clean and efficient cookstoves (Vers. 3.0).

Data/parameter	LE_y
Unit	Fraction
Description	Leakage
Source of data	Assumed value
Value(s) applied	0.05
Choice of data or Measurement methods and procedures	Even though the GS Simplified methodology for clean and efficient cookstoves (Vers. 3.0) does allow for the neglect of any leakages, due to conservative reasons, 5% of all calculated emission reductions will be deducted.
Purpose of data	
Additional comment	This value might be close to zero

Data/parameter	$ER_{y,\ firewood}$
Unit	tCO_2e
Description	Emission reductions of project device during year y in tCO_2e for firewood
Source of data	Calculation
Value(s) applied	2.25
Choice of data or Measurement methods and procedures	
Purpose of data	
Additional comment	

Data/parameter	$ER_{y,\ charcoal}$
Unit	tCO_2e
Description	Emission reductions of project device during year y in tCO_2e for charcoal
Source of data	Calculation
Value(s) applied	0.21
Choice of data or Measurement methods and procedures	
Purpose of data	
Additional comment	

Since some parameters need to be established from baseline surveys and tests, emission reductions will likely change depending on gained data. Again, though, used values are considered to be conservative. Emission reductions are calculated as follows:

Step 1:
$n_{p,y} = n_p * (DF_n)$

Step 2:
$B_{b,y\_firewood} = N_{p,y} * P_{b,y\_firewood}$

$B_{b,y\_charcoal} = N_{p,y} * P_{b,y\_charcoal}$

Step 3:

$P_{y\_firewood} = B_{b,y\_firewood} * (1-n_b/n_{p,y})$

$P_{y\_charcoal} = B_{b,y\_charcoal} * (1-n_b/n_{p,y})$

Step 4:

$ER_{y\_firewood} = (\sum N_{p,y} * P_y * U_{p,y} * (f_{NRB} * EF_{b,fuel\ CO2\_firewood} + EF_{b,fuel\ non\_CO2}) * (1-DF_{b,Stove,y})) - (LE_y * ER_y)$
$= 1.639\ tCO_2e$

$ER_{y\_charcoal} = (\sum N_{p,y} * P_y * U_{p,y} * (f_{NRB} * EF_{b,fuel\ CO2\_charcoal} + EF_{b,fuel\ non\_CO2}) * (1-DF_{b,Stove,y})) - (LE_y * ER_y)$
$= 0.899\ tCO_2e$

$ER_y = ER_{y\_firewood} + ER_{y\_charcoal} = 2.46\ tCO_2e/hh/year$

Compact Earth Brick Technology (AMS-III.Z):

$$ER_y = BE_y - PE_y - LE_y$$ Equation (5)

Where:

ER_y = Emission reductions in year *y* (t CO_2e)

BE_y = Baseline emissions in year *y* (t CO_2e)

PE_y = Project emissions in year *y* (t CO_2)

LE_y = Leakage emissions in year *y* (t CO_2)

$$BE_y = SEC_{BL} \times EF_{BL} \times P_{PJ,y}$$ Equation (1)

$$EF_{BL} = \frac{\sum_{j,i}\left(FC_{BL,i,j} \times NCV_j \times EF_{CO_2,j}\right)}{\sum_{j,i}\left(FC_{BL,i,j} \times NCV_j\right)}$$ Equation (2)

$$SEC_{BL} = \frac{\sum_{j,i}\left(FC_{BL,i,j} \times NCV_j\right)}{P_{Hy}}$$ Equation (3)

$$PE_y = PE_{elec,y} + PE_{fuel,y} + PE_{cultivation,y} + PE_{CH4,y}$$ Equation (4)

Data/parameter	BE_y

Unit	t CO2
Description	The annual baseline emissions from fossil fuels or NRB displaced by the project activity in t CO2e in year y (of the crediting period)
Source of data	Calculation
Value(s) applied	74,034
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation of ERs
Additional comment	

Data/parameter	SEC_{BL}
Unit	Tj/kg
Description	Specific energy consumption of brick production in the baseline, TJ per unit volume or mass unit (kg or m3)
Source of data	Calculations
Value(s) applied	0.000045144
Choice of data or Measurement methods and procedures	Determined in baseline
Purpose of data	Calculation of ERs
Additional comment	

Data/parameter	EF_{BL}
Unit	$tCO_{2/Tj}$
Description	The emission factor of baseline fuel(s), in t CO2/TJ
Source of data	Default
Value(s) applied	81,6
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	

Data/parameter	$P_{PJ, y}$
Unit	kg
Description	The annual net production of the facility in year y, in kg or m3
Source of data	Monitoring
Value(s) applied	20100
Choice of data or Measurement methods and procedures	

Purpose of data	Calculation auf ERs
Additional comment	

Data/parameter	LE_y
Unit	Fraction
Description	Leakage
Source of data	Assumed value
Value(s) applied	0,05
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	

Data/parameter	$FC_{BL, i, j}$
Unit	kg
Description	Average annual baseline fossil fuel or NRB consumption value for fuel type j combusted in the process i, using volume or weight units (kg or m3). In the case of NRB, it is determined by the total woody biomass consumption multiplied with the fraction of the NRB (fNRB)
Source of data	Baseline
Value(s) applied	60492,96
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	

Data/parameter	P_{hy}
Unit	kg
Description	Average annual historical brick production in kg
Source of data	Baseline
Value(s) applied	20100
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation
Additional comment	

Data/parameter	$EF_{CO2, j}$
Unit	tCO2/TJ
Description	CO2 emission factor of fuel type j combusted in the process i in t CO2/TJ9. In the case of NRB, a default value of 81.6 t CO2/TJ is used, i.e. the emission factor for the fossil fuels projected to be used for substitution of NRB by similar consumers
Source of data	Default
Value(s) applied	81.6
Choice of data or Measurement methods and procedures	
Purpose of data	ER Calculation
Additional comment	

Data/parameter	NCV_j
Unit	TJ/kg
Description	Average net calorific value of fuel type j combusted, TJ per unit volume or mass unit (kg or m3). In the case of NRB, the IPCC default for wood fuel, 1.5x10-5 TJ/kg based on the gross weight of the wood that is 'air-dried', shall be used
Source of data	Default
Value(s) applied	0,000015
Choice of data or Measurement methods and procedures	
Purpose of data	ER Calculation
Additional comment	

Data/parameter	$PE_{elec,y}$
Unit	tCO2
Description	Project emission due to electricity use
Source of data	Assumed value
Value(s) applied	0
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	The brick presses are operated manually. No electricity or fuel is needed or used.

Data/parameter	$PE_{fuel, y}$
Unit	tCO2
Description	Project emission due to fossil use

Source of data	Assumed value
Value(s) applied	0
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	The brick presses are operated manually. No electricity or fuel is needed or used.

Data/parameter	$PE_{cultivation, y}$
Unit	tCO2
Description	Project emission due to fossil use
Source of data	Assumed value
Value(s) applied	0
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	The brick presses are operated manually. No electricity or fuel is needed or used. There are also no additional emissions from cultivation or production of charcoal

Data/parameter	$PE_{CH4, y}$
Unit	tCO2
Description	Project emission due to fossil use
Source of data	Assumed value
Value(s) applied	0
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	The brick presses are operated manually. No electricity or fuel is needed or used. There are also no additional emissions from cultivation or production of charcoal

Since many parameters need to be established from baseline surveys and tests, emission reductions will likely change depending on gained data. Therefore, emission reductions are calculated as follows:

Step 1:
$BE_y = 74$
$PE_y = 0$
$LE_y = BE_y * 0,05 = 4$

Step 2:
$ER_y = BE_y – PE_y - LE_y =$ 70 tCO_2e/year

B.1.3. Summary of ex-ante estimates

Fuel-efficient cookstoves:

Since not all selected households will receive the cookstoves simultaneously, some distribution delay is considered in the emission calculation. However, until the end of 2023, a total of 1,300 cookstoves for 650 households and in the year 2024 additionally 1,200 cookstoves for 600 households will be distributed. In the third project year, all beneficiaries are able to cook with fuel-efficient cookstoves.

Time Schedule	Distributed stoves	Beneficiary households	Emission Reductions (tCO_2/y)
Target y1 (by 31.12.2023)	100	50	**83**
Cumulative Target y2 (by 31.12.2024)	2,500	1,250	**2,713**
Cumulative Target y3 (by 31.12.2025)	2,500	1,250	**3,825**
Cumulative Target y4 (by 31.12.2026)	2,500	1,250	**3,657**
Cumulative Target y5 (by 31.12.2027)	2,500	1,250	**3,470**
Cumulative Target y6 (by 30.06.2028)	2,500	1,250	**3,173**
TOTAL	**2,500**	**1,250**	**16,921**

Total Emission Reductions y1- y6 from using efficient cookstoves = 16,921 tCO_2

Compact Earth Brick Technology:

Since not all compact earth brick machines will be bought and used simultaneously, some distribution delay is considered in the emission calculation. However, in the middle of 2023 and the beginning of 2024 four machines (a total of eight) will be bought and ready to use for youth groups.

Time Schedule	Machines bought /used	Emission Reductions (tCO_2/y)
Target y1 (by 31.12.2023)	4	41
Cumulative Target y2 (by 31.12.2024)	8	70
Cumulative Target y3 (by 31.12.2025)	8	70
Cumulative Target y4 (by 31.12.2026)	8	70
Cumulative Target y5 (by 31.12.2027)	8	70
Cumulative Target y6 (by 30.06.2028)	8	70
TOTAL	**8**	**391**

Total Emission Reductions y1- y6 from sustainable brick production = 391 tCO_2

Total emission savings of the fuel-efficient cookstoves and the earth brick machines in 6 project years are:

16,921 + 391 = 17,312 tCO_2e

B.2. Establishment and description of a baseline scenario

Most people in South Sudan are still cooking with an open fire, the so-called three-stone fire. This system consists of three stones holding a cooking pot over a fire.
With an energy efficiency of only 10%, cooking with an open fire is not only very inefficient but also generates environmental ecosystem damage (i.e. deforestation) and has other negative socio-economic and health impacts: i.e. deforestation leads to erosion, loss of ecosystem function, and biodiversity. Furthermore, it reduces the capacity of soils to retain water. Additionally, searching for firewood costs many hours/day, time that cannot be spent on paid work. In addition, firewood collection and cooking activities are mainly carried out by women, which places additional burdens on them and the children. All of these factors make poverty in South Sudan even worse.

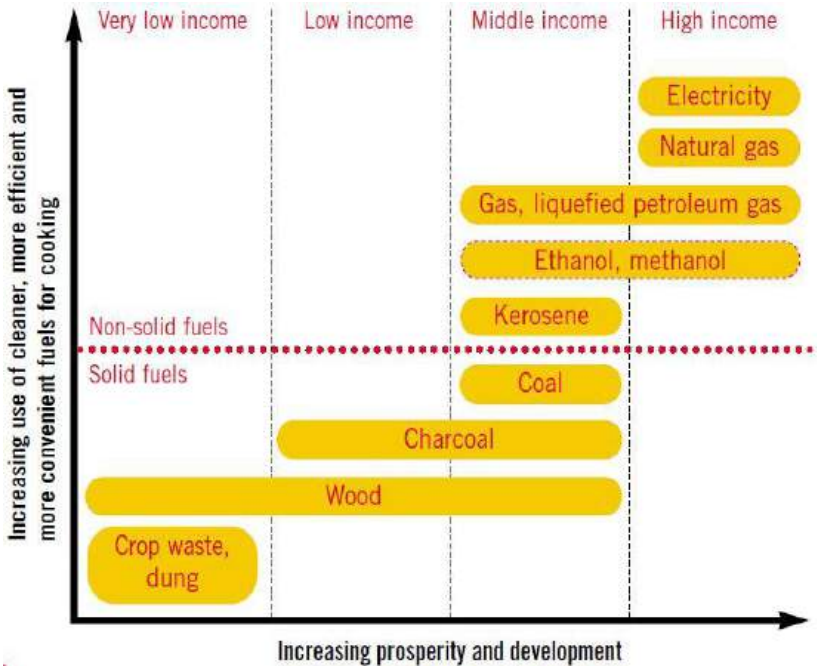


Figure 1: The positive effect of increasing the use of cleaner fuels for cooking and prosperity

The diagram above[22] shows that increasing the use of cleaner fuels for cooking means more prosperity. That is why the proposed project will benefit the environment and have a positive socio-economic impact.

According to the "Africa progress report 2015" nearly 600,000 Africans die each year because of indoor pollution through cooking with solid biomass.

Until recently, the use of biomass for cooking was not regarded as climate-damaging as biomass is primarily considered a renewable energy source; but the harvest of biomass on a non-sustainable level is very likely a burden on the climate. In all developing countries, about 730 mil tons of biomass were burned to generate energy for their household. This is equivalent to more than one billion tons of CO_2e. Thus, the climate debate should also focus on household energy generation. A switch to more sustainable firewood and coal production would save between 33 and 66% of emissions. A sustainable scenario would reduce the output of all sub-Saharan African countries from 7-17% to 5-10%[23].

To establish a proper baseline for emission calculations, a baseline study will be carried out by the field-staff of CARITAS Austria Office South Sudan in conjunction with the concerned national partners at the beginning of the project. Some data and parameters are already available in different documents, and other similar climate projects are also based upon Gold Standard principles, but some need to be gained from a baseline survey, like the fuelwood consumption per capita/household in a year. In the frame of a Kitchen Performance Test, several households will be visited daily over some time to weight the firewood to be used with a hand scale. According to GS Simplified methodology for clean and efficient cookstoves (Vers. 3.0.),[24] it is necessary to have a random sampling approach with the following determined guidelines:

[22] https://www.researchgate.net/figure/Energy-ladder-hypothesis-Source-Rehfuess-2006_fig1_265922433
[23] https://static1.squarespace.com/static/5d66dec735d37400012579cb/t/5e90f8a5eebce132c0b645%2007/1586559147265/household-cookstoves.pdf
[24] Simplified methodology for clean and efficient cookstoves (Vers. 3.0)

- Project target population <300: Minimum sample size 30
- Project target population 300 to 1000: Minimum sample size 10% of group size
- Project target population >1000: Minimum sample size 100

Since this project will target 1,250 households, the sample size will be at least 100. With this data, the project can analyse fuel savings in kilograms per household per day after distributing fuel-efficient stoves.

B.2.1. Data and parameters to be monitored

(Include specific information on how the data and parameters that need to be monitored in the selected methodology(ies) or proposed approaches or as per mitigation measures from safeguarding principles assessment or as per feedback from stakeholder consultations would be collected during monitoring. Copy this table for each piece of data and parameter.)

Fuel-efficient stoves:

Parameters and data will be monitored through Kitchen Performance Tests, Water Boiling Tests[25], and other surveys during the project. There will be a baseline-, a midterm- and an end-term survey which will include more questions and data collection with a significant number of beneficiaries. Quarterly monitoring will gather basic information about the ongoing projects, reduce problems, and increase the utilization of project devices.

The following parameters need to be monitored continuously during this project:

Data/parameter	$B_{b,y\_firewood}$
Unit	t/hh/y
Description	Quantity of firewood that is consumed in baseline scenario b (see also section A.1.1) during year y per household
Source of data	Baseline / Midterm survey with 48 households and 78 weighted bundles of firewood
Value(s) applied	3.88
Choice of data or Measurement methods and procedures	Value was taken from a baseline and midterm survey of another climate change mitigation project called GEN – Green Energy and Nutrition by Caritas Carinthia in northern Uganda, which is also part of the BOKU climate change mitigation project platform: https://xn--klimaneutralitt-elb.boku.ac.at/projects/gemeinschaftliche-biogasanlagen-in-gulu-uganda/ Those two surveys include 48 households and 78 weighted bundles of firewood
Purpose of data	The basis for calculating fuel savings and thus ER calculations on a per household basis. Since this project is in the south of South Sudan and therefore close to northern Uganda, for the beginning, the applied value will be a good guide
Additional comment	A proper baseline study in South Sudan needs to be conducted. It is expected that results will be very similar to the survey in northern Uganda

[25] Kitchen Performance Tests and Water Boiling Tests will be done in the beginning of the project within the baseline survey.

Data/parameter	$B_{b,y\_charcoal}$
Unit	t/hh/y
Description	Quantity of charcoal that is consumed in baseline scenario b (see also section A.1.1) during year y per household
Source of data	Small baseline survey with 24 households
Value(s) applied	0.56
Choice of data or Measurement methods and procedures	This value was taken from a first small baseline survey with 24 households in the project region
Purpose of data	The basis for calculating fuel savings and thus ER calculations on a per-household basis
Additional comment	Of course, a proper baseline study with more households needs to be conducted

Data/parameter	$P_{b,y\_firewood}$
Unit	t/hh/day
Description	Specific fuel consumption (firewood) for an individual technology in baseline scenario b during year y converted to tons/day
Source of data	Calculations
Value(s) applied	0.0064
Choice of data or Measurement methods and procedures	This value is calculated with already mentioned values and parameters. This value will be multiplied by the number of technology days. Since it is 365 days within this project, it will be the same value as $B_{b,y\_firewood}$ in the end
Purpose of data	Calculation of ERs
Additional comment	This value is very likely to change a bit since it is calculated with values that need to be established within surveys and tests

Data/parameter	$P_{b,y\_charcoal}$
Unit	t/hh/day
Description	Specific fuel consumption (charcoal) for an individual technology in baseline scenario b during year y converted to tons/day
Source of data	Calculations
Value(s) applied	0.0019
Choice of data or Measurement methods and procedures	This value is calculated with already mentioned values and parameters. This value will be multiplied by the number of technology days. Since it is 365 days within this project, it will be the same value as $B_{b,y\_charcoal}$ in the end
Purpose of data	Calculation of ERs
Additional comment	This value is very likely to change a bit since it is calculated with values that need to be established within surveys and tests

Data/parameter	n_p
Unit	Fraction
Description	The efficiency of the efficient cookstove at the start of the project (%)

Source of data	This value was taken from a certified Gold Standard project https://platform.sustain-cert.com/public-project/843
Value(s) applied	27.23
Choice of data or Measurement methods and procedures	Water Boiling Test protocol
Purpose of data	Calculation of reduction of fuelwood consumption and thus ERs
Additional comment	This value is multiplied with a discount factor DF_n

Data/parameter	DF_n
Unit	Fraction
Description	Discount factor to account for efficiency loss of project cookstoves
Source of data	Simplified methodology for clean and efficient cookstoves (Vers. 3.0)
Value(s) applied	0.975
Choice of data or Measurement methods and procedures	Default value. Since the project runs for 5.5 years and an efficiency loss of 1% per year is default by the methodology, an average efficiency over the 5.5 years of 97.5% is applied. This value will be adapted after the first monitoring and tests
Purpose of data	Calculation of the efficiency of the project cookstove and thus ERs
Additional comment	According to the older version 1.0 from 2020, an efficiency decrease of 1% can be accounted for. Though, according to the newer version 3.0 methodology, efficiency decreases need to be tested and proven by the project developer. Therefore, a discount factor of 1% per year is used. Furthermore, during annual surveys, if it is found that the project cookstoves are not in working condition, their proportionate population should be excluded from the project database until they are replaced with new cookstoves.

Data/parameter	$n_{p,y}$
Unit	Fraction
Description	The average efficiency of the efficient cookstove while being used in the project scenario p (%); see also section A.1.3
Source of data	Calculations of $n_p * DF_n$
Value(s) applied	26.55
Choice of data or Measurement methods and procedures	WBT protocol
Purpose of data	Calculation of reduction of fuelwood consumption and thus ERs
Additional comment	Water Boiling Tests will most likely be done according to GS methodology. According to the methodology, this value was discounted with the factor of 97.5% (1% of efficiency loss per year)

Data/parameter	$U_{p,y}$
Unit	Fraction
Description	Usage rate in project scenario p (see also section A.1.3) during year y

Source of data	Assumed value
Value(s) applied	0.80
Choice of data or Measurement methods and procedures	Annual monitoring and a midterm survey will be conducted according to GS methodologies
Purpose of data	Calculation of ERs
Additional comment	This value is very likely to change. For example, good training for beneficiaries will likely have a higher value in the end. Still, the applied value is seen as conservative.

Data/parameter	$N_{p,y}$
Unit	Number of project cookstoves credited (units)
Description	Cookstove for project scenario p (see also section A.1.3) through year y
Source of data	Total distribution record
Value(s) applied	2,500 (but for 1,250 households)
Choice of data or Measurement methods and procedures	Transparent data analysis and reporting
Purpose of data	Calculation of ERs
Additional comment	The number of cookstoves might change during the project. Each household will get two fuel-efficient cookstoves

Data/parameter	$DF_{p,stove,y}$
Unit	Fraction
Description	Discount factor to account for the baseline stove use in project scenario p (see also section A.1.3) during the year y
Source of data	Assumed value
Value(s) applied	0.10
Choice of data or Measurement methods and procedures	Annual survey with transparent data analysis and reporting
Purpose of data	Calculation of ERs
Additional comment	The discount factor for baseline-stove use may be determined based on several meals cooked using the baseline stove. The required information will be gathered through surveys with a random sampling approach. A minimum sample size shall be selected following the guidelines of GS Simplified methodology for clean and efficient cookstoves (Vers. 3.0).

Data/parameter	LE_y
Unit	Fraction
Description	Leakage
Source of data	Assumed value
Value(s) applied	0.05

Choice of data or Measurement methods and procedures	Even though the GS Simplified methodology for clean and efficient cookstoves (Vers. 3.0) does allow for the neglect of any leakages, due to conservative reasons, 5% of all calculated emission reductions will be deducted.
Purpose of data	
Additional comment	This value might be close to zero

For further information, see also section B.1.1, B.1.2. and B.1.3.

Compact Earth Brick Technology (AMS-III.Z):

$$ER_y = BE_y - PE_y - LE_y$$ Equation (5)

Where:

ER_y = Emission reductions in year *y* (t CO_2e)

BE_y = Baseline emissions in year *y* (t CO_2e)

PE_y = Project emissions in year *y* (t CO_2)

LE_y = Leakage emissions in year *y* (t CO_2)

$$BE_y = SEC_{BL} \times EF_{BL} \times P_{PJ,y}$$ Equation (1)

$$EF_{BL} = \frac{\sum_{j,i}\left(FC_{BL,i,j} \times NCV_j \times EF_{CO_2,j}\right)}{\sum_{j,i}\left(FC_{BL,i,j} \times NCV_j\right)}$$ Equation (2)

$$SEC_{BL} = \frac{\sum_{j,i}\left(FC_{BL,i,j} \times NCV_j\right)}{P_{Hy}}$$ Equation (3)

$$PE_y = PE_{elec,y} + PE_{fuel,y} + PE_{cultivation,y} + PE_{CH4,y}$$ Equation (4)

Data/parameter	BE_y
Unit	t CO2
Description	The annual baseline emissions from fossil fuels or NRB displaced by the project activity in t CO2e in year y (of the crediting period)
Source of data	Calculation
Value(s) applied	74,034

Choice of data or Measurement methods and procedures	
Purpose of data	Calculation of ERs
Additional comment	

Data/parameter	SEC_{BL}
Unit	Tj/kg
Description	Specific energy consumption of brick production in the baseline, TJ per unit volume or mass unit (kg or m3)
Source of data	Calculations
Value(s) applied	0.000045144
Choice of data or Measurement methods and procedures	Determined in baseline
Purpose of data	Calculation of ERs
Additional comment	

Data/parameter	EF_{BL}
Unit	$tCO_{2/Tj}$
Description	The emission factor of baseline fuel(s), in t CO2/TJ
Source of data	Default
Value(s) applied	81,6
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	

Data/parameter	$P_{PJ, y}$
Unit	kg
Description	The annual net production of the facility in year y, in kg or m3
Source of data	Monitoring
Value(s) applied	20100
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	

Data/parameter	LE_y
Unit	Fraction

Description	Leakage
Source of data	Assumed value
Value(s) applied	0,05
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	

Data/parameter	$FC_{BL, i, j}$
Unit	kg
Description	Average annual baseline fossil fuel or NRB consumption value for fuel type j combusted in the process i, using volume or weight units (kg or m3). In the case of NRB, it is determined by the total woody biomass consumption multiplied with the fraction of the NRB (fNRB)
Source of data	Baseline
Value(s) applied	60492,96
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	

Data/parameter	P_{hy}
Unit	kg
Description	Average annual historical brick production in kg
Source of data	Baseline
Value(s) applied	20100
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation
Additional comment	

Data/parameter	$EF_{CO2, j}$
Unit	tCO2/TJ
Description	CO2 emission factor of fuel type j combusted in the process i in t CO2/TJ9. In the case of NRB, a default value of 81.6 t CO2/TJ is used, i.e. the emission factor for the fossil fuels projected to be used for substitution of NRB by similar consumers

Source of data	Default
Value(s) applied	81.6
Choice of data or Measurement methods and procedures	
Purpose of data	ER Calculation
Additional comment	

Data/parameter	NCV_j
Unit	TJ/kg
Description	Average net calorific value of fuel type j combusted, TJ per unit volume or mass unit (kg or m3). In the case of NRB, the IPCC default for wood fuel, 1.5x10-5 TJ/kg based on the gross weight of the wood that is 'air-dried', shall be used
Source of data	Default
Value(s) applied	0,000015
Choice of data or Measurement methods and procedures	
Purpose of data	ER Calculation
Additional comment	

Data/parameter	$PE_{elec,y}$
Unit	tCO2
Description	Project emission due to electricity use
Source of data	Assumed value
Value(s) applied	0
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	The brick presses are operated manually. No electricity or fuel is needed or used.

Data/parameter	$PE_{fuel, y}$
Unit	tCO2
Description	Project emission due to fossil use
Source of data	Assumed value
Value(s) applied	0
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs

Additional comment	The brick presses are operated manually. No electricity or fuel is needed or used.

Data/parameter	$PE_{cultivation, y}$
Unit	tCO2
Description	Project emission due to fossil use
Source of data	Assumed value
Value(s) applied	0
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	The brick presses are operated manually. No electricity or fuel is needed or used. There are also no additional emissions from cultivation or production of charcoal

Data/parameter	$PE_{CH4, y}$
Unit	tCO2
Description	Project emission due to fossil use
Source of data	Assumed value
Value(s) applied	0
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation auf ERs
Additional comment	The brick presses are operated manually. No electricity or fuel is needed or used. There are also no additional emissions from cultivation or production of charcoal

For further information, see also section B.1.1, B.1.2. and B.1.3.

SECTION C Safeguarding principles assessment

C.1. Analysis of social, economic, and environmental impacts

(If possible refer to the Gold Standard Safeguarding Principles and Requirements document for detailed guidance on carrying out this assessment.)

Gold Standard Safeguarding Principles	**Social, economic, and environmental impacts of the project**
Principle 1: Human Rights	The project upholds the principles of accountability and the rule of law, participation and inclusion, and equality and non-discrimination. The project beneficiaries (including all diversity criteria like race, ethnicity, gender, age, language, disability, sexual orientation, religion, political or another opinion, or origin) have equal access to the project activities
Principle 2: Gender Equality and Women's Rights	The project promotes gender equality and women's rights. Women have a considerable burden ensuring the availability of firewood and charcoal for cooking. The project reduces the workload for collecting firewood for women, reduces health risks caused by traditional cooking methods, and reduces the financial burden for single mothers to provide charcoal for cooking activities. Furthermore, the project empowers women by promoting good conditions for literacy courses by constructing a solid and sustainable learning center.
Principle 3: Community Health, Safety, and Working Conditions	The project will not adversely impact the health and safety of affected communities.
Principle 4: Cultural Heritage, Indigenous Peoples, Displacement and Resettlement	n/a
Principle 5: Corruption	Caritas Austria has an anticorruption policy binding for all implementing partner organizations. This policy will be obligatory for the project partner organizations and will be monitored by the Caritas Austria Office
Principle 6: Economic Impacts	The project promotes equitable, sustainable economic growth, decent work, and local employment and procurement: - By the use of fuel-saving stoves, the burden on the incomes of beneficiary households caused by high charcoal prices will be reduced. - By contracting, income and job opportunities for youth in a poor rural environment will be promoted. - The project promotes local employment and procurement by using locally constructed fuel-saving stoves and employment of local youth groups for brick production and house construction.
Principle 7: Climate and Energy	The project promotes climate-friendly solutions and sustainable development: - The project reduces greenhouse gas emissions over the baseline scenario (see baseline scenario and project objectives)

	- The project does not affect the availability and reliability of energy supply to other users
Principle 8: Water	Water resources are not affected by the project
Principle 9: Environment, ecology, and land use	The project ensures a precautionary approach to natural resource conservation and avoids negative environmental impacts: - By the use of fuel-saving stoves and the innovative approach to sustainable brick production, deforestation around the town of Yambio will be reduced - Replanting of mango trees will be promoted to replace trees which have been cut down because of burned brick production for local housing

C.2. Sustainable Development Goals (SDGs) outcomes

(Specify relevant SDGs targets and how they could be measured) Explanation of methodological choices/approaches for estimating the SDG outcome

All SDGs are indivisible and interlinked. Therefore, the project will contribute mainly to the following SDGs goals and targets. Furthermore, the interaction of the SDGs and possibilities for implementation and mitigation will be an essential part of the BOKU scientific and research monitoring and master thesis; see Section D further below.

Goal 1: End poverty in all its forms everywhere

Target: 1.1 "By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day"

The project increases the income of 100 youths and reduces the financial burden for 1,250 households. The increase in income and reduction of financial burden will be measured in the program's final monitoring (survey).

Goal 5: Achieve gender equality and empower all women and girls

Target 5.4.: "Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate."

The project promotes the use of fuel-saving stoves, reducing the burden of women to collect firewood and thereby reducing the time spent by women on unpaid domestic work. In the final survey, women cooking with fuel-saving stoves will be asked about the estimated time reduction for firewood collection.

Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Target 8.3 "Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services."

The project creates entrepreneurship in the business of sustainable brick-making, enabling five youth groups to start small-sized enterprises.

Goal 12: Ensure sustainable consumption and production patterns

Target 12.2 "By 2030, achieve the sustainable management and efficient use of natural resources."

By reduction of necessary charcoal and wood, the project reduces the inefficient use of natural resources, especially firewood. The reduction will be measured every year.

Goal 13: Take urgent action to combat climate change and its impacts

Target 13.2 "Integrate climate change measures into national policies, strategies and planning."
Target 13.3 "Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning."

Through measures for efficient cooking and sustainable brick production, the project contributes to reducing greenhouse gas emissions caused by traditional brick-making and cooking. Furthermore, the project foresees measures for awareness raising on the impact of climate change. Calculations on savings of CO_2 will be done annually.

Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Target 15.2 "By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally."

A deduction of firewood and charcoal consumption will reduce the negative impacts of deforestation. Hence improved cook-stoves and compact earth block methods will positively impact protecting the fragile tropical rainforest environment.

Goal 17: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

Target 17.3 "Mobilize additional financial resources for developing countries from multiple sources."
Target 17.7 "Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed."

The project will be promoted through the BOKU climate change mitigation project platform mobilizing additional financial resources for developing countries. In addition, through scientific research done by BOKU, there will be a knowledge transfer on sustainable technologies.

SECTION D Inclusion of BOKU research and teaching

Specifically, in developing countries, there is a need for adaptive, multilevel, collaborative research to improve and apply governance to achieve integrative management of land and water resources. Agriculture, forestry and fishery are closely related systems. Management of catchments is the sum of single management plans, but always in the context of others. Soil and water are the communicating media between the three systems. Knowledge of functioning ecosystem services needs to be improved and applied to protect, sustain, and restore the health of crucial natural habitats and ecosystems.

As explained above, this project will look at many aspects of ecosystem management concerning climate change and socioecology. However, the focus will be on sustainable land ecosystem use and construction. Furthermore, the needs for this project are also given in the SDGs, which will be an essential part of our scientific monitoring. Therefore, this part will integrate and reflect all project activities and results.

Scientific activities will be carried out by BOKU staff and students and will be integrated into all other project activities and resources. Each activity necessary for the implementation of the project is meticulously described and accounted for in the budget and LogFrame. It is planned that 2 Bachelor/Master students will work on-site with colleagues from Caritas on two main research and teaching topics:

A) ecosystem management and human-induced stressors
B) sustainable construction and cooking

The main elements of the project that play a role in scientific activities, including teaching, are explained below.
The proposed BOKU research aims to strengthen community-based research for human-end ecosystem health and climate change mitigation in the study area. The specific objectives to achieve this are:

1. To **improve the knowledge** of ecosystem health via conceptual modelling on ecological impacts and bioindicators.
2. To **enhance the skills and capability to research and manage** ecosystems through sustainable construction and cooking.
3. To **contribute to management frameworks** and alternatives for ecosystems and land use via community-based management
4. To **contribute to knowledge development**, dissemination synthesis and impact evaluation through adaptive management **knowledge integration**

Research monitoring activities (e.g. surveys) follow the principle concept of Adaptive Management (AM), which is often used to understand, implement and evaluate projects in several phases of a project (see below).
Crucial for a successful and sustainable project implementation is (1) the understanding of ongoing human impacts on the local ecosystems and (2), as a consequence, the implementation of sustainable construction and cooking systems.

Establishment and description of a baseline scenario

Establishing **a project baseline** represents an activity that modifies **socio-ecological stressors affecting the local ecosystems.** Caritas has worked in the region and is well established, enabling participatory approaches from the beginning.
Existing data from previous and ongoing Caritas projects, literature reviews, **inception meeting workshops**, primary stakeholders' interviews, and strategic simulations will be used and validated by data from the field.

Such workshops provide an opportunity to discuss in a participatory way with the local population the disadvantages generated by traditional three-stone fires and ways to avoid them. However, it is unclear whether they can be carried out in practice.

A) Ecosystem management and conceptual modelling of human-induced stressors (see B2)
We introduce selected elements and characteristics of ecosystem management into the project design and methodology in order to make it possible to answer scientific questions about this perspective in and around Yambio.

- What impacts does climate change impact on the local population, and what adaptation (mitigation) strategies can be developed?
- Which habitats and bioindicators are threatened by human interventions and climate change and require special protection?
- What contribution can afforestation and agroforestry make to CO_2 reduction and adaptation to climate change?
- What is the quantitative and qualitative importance of using firewood in the region?
- Suggest planting mango trees and other species in the project to counteract the felling of trees in recent years and to promote the positive ecological, economic and socio-cultural effects of trees.
- What strategies, tools and opportunities (early warning systems) for sustainable land use are needed to achieve a better life for the population?
- How can this project contribute to SDGs, ecosystem management policies and practices?

B) Sustainable construction and cooking

- How is sustainable construction, cooking and building accepted by the local population?
- How much firewood is used in the region, and what are the quantitative and qualitative differences?
- Which indicators are necessary to establish an improved stove technology and scientific elaboration of state-of-the-art under local adaptation
- Establishment of the Compressed Earth Block Method and scientific elaboration of state-of-the-art under local adaptation
- How can sustainable construction contribute to SDGs, ecosystem management policies and practices?

For the community-based research, BOKU students will have access and cooperation with local administrations, 1,250 households and youth groups via Caritas Austria. Furthermore, integrating community members, experts, governmental and non-governmental organizations, and service providers will enhance environmental protection and adaptive ecosystem management".

Synthesis and dissemination: The research results will benefit local managers, national advisories and communities. Ecosystem management policies and practices will require a substantial increase in knowledge about what influences these trends of biophysical and socio-cultural factors of ecosystems.

We suggest conducting interviews in the project's frame with local stakeholders and administrations regarding the impact of human activities on the ecosystems around Yambio[26]. Proposals for conceptual DPSIR models for understanding and improving the state of the local ecosystems will be collected and elaborated.

This information will then be combined with the cartographic material generated from the satellite images. The spatial representation of impacts and management proposals is the basis for applying the ecosystem management perspective. Finally, this practical mapping approach will strengthen the project:

The main activity representing an actual practical intervention in the ecosystems (see proposal below) includes planting mango and other tree species. In addition, also concerning ecosystem management, it is suggested that project proponents might consider the perspective of *political ecology*, which has proven to be very fruitful in research carried out in developing countries[27].

Methodology

1. Conceptual modelling of Socio-Ecological Stressors affecting the Ecosystems

Qualitative data from literature reviews, inception meeting workshops, primary stakeholder interviews, and strategic simulations will be used. In the literature review, the project will identify the main adverse effects of climatic variabilities (climate change), biodiversity and land use, especially forest resources. This will assist in formulating relevant questions for the interview and research as a whole. Over 60 people will be consulted during the interview, including local council chairpersons, water supply agencies, regional NGOs, experts, environmental officers and other relevant government officials. The interviews will focus on local human-induced pressures, the current health status of the ecosystems, climate-driven factors, their potential and impacts, constraints for water resource development and the way forward toward sustainable development of the river resources. We shall develop, assemble, and use multiple lines of evidence across the Drivers–Pressure–State–Impact–Response (DPSIR) framework. The DPSIR framework, which elaborates the cause-effect relationships between interacting components of social, economic and environmental systems, had barely been used in East Africa (Sonan, 2020). It will be employed to identify the significant land use quality issues, adopt standardised (bio-) indicators and pave ways for improved ecosystem management and sustainable construction resources in East Africa. The current situation will be characterised during workshops by relating the identified challenges, risks and opportunities surrounding the region.

2. Land use and ecosystems' vulnerability to climate change

To assess the ecosystems' vulnerability to climate change effect, delineation of the habitat sensitivity at different spatial scales using land use resources models (e.g. SWAT) will be done. Through analysis of the concept of vulnerability, we propose a response-based quantitative method to assess ecosystem vulnerability, integrating the concepts of sensitivity and adaptability for 30 years. Climate change (mainly changes in hydrothermal conditions) is an essential external driver in the regional ecosystem response process. Changes in temperature and precipitation can affect the ecosystem variable such as water levels, flooding regimes, algal photosynthetic rate and other organism activity. Both satellite and regional meteorological centre climate data will be used to determine the variation

[26] Ideas for ecosystem management research can be found, for instance, in: Meffe, G. K. et a. (2002). Ecosystem management. Adaptive, community-based conservation. Island Press

[27] For instance: Robbins, P. (2012). Political ecology. A critical introduction (2nd edition). Wiley-Blackwell; Bryant, R. L. et al. (1997). Third World political ecology. Routledge

in flooding regime and temperature over the region on a small scale. Human activities will be analysed using land sat images under Arc GIS software.

3. Innovation, a community-based approach to land use and sustainable construction quality monitoring

This is a trans- interdisciplinary innovation pathway to transform the management of ecosystems and sustainable construction; political and policy economics for enhanced resources management. This research will develop a sensitivity matrix of selected indicators which will later be used to develop a user-friendly pictorial manual of sustainable land use and construction. Local community women and youth groups from the region will be mobilized and trained to use the manuals for river quality monitoring. Other stakeholders will be consulted on the manual and how the monitoring data will be used.

A Memorandum of understanding will be developed between the local communities and their corresponding resource developers. Consultation with the local leaders, district environmental officers, NGOs, and national managers on quality monitoring and community involvement will be done. Detailed knowledge of the current activities related to the projects and priority actions for sustainable land use and construction resource use will be gathered. Through this community environment action plan, communities will be empowered to reflect upon the status of their region, identify issues and causes lobby for action from duty bearers - concerned citizens, construction companies and policymakers.

4. Systems science for participatory management (teaching)

In addition, we will focus intensively on systems science for participatory management of socio-ecosystems is used for understanding and managing socio-ecosystems (SES), e.g. systems whose development path is influenced by interactions within and between nature and society. This involves building on an understanding of the structure and dynamics of aquatic and terrestrial ecosystems and then expanding inquiry to address how ecosystems interact with anthropogenic processes (social, political, economic). The project examines theory (Systems, Hierarchy, Resilience, Cultural) that deals with the structure and dynamics of socio-ecosystems, establishing the need for flexible and adaptive management to address surprising and irreversible dynamics. It also examines practice (modelling, serious gaming, social simulation) that supports the development and application of science and policy in the adaptive management of SES. Furthermore, it explores explicitly how to manage SES in a participatory partnership between public (academic) and private actors by describing barriers and bridges to establishing a recursive, iterative learning process. Finally, it enhances learning the skills needed to design and lead the participatory process by replacing lectures with a 'learning-by-doing' laboratory. Literature search & review concerning systems science theory and participatory science applications; experience in learning the skills and concepts needed to design and carry out participatory science in support of ecosystem management:

- we introduce the theory and practice of participatory science in support of decision-making about environmental issues.
- Concepts and Theory: we introduce Resilience Theory, Hierarchy Theory, Cultural Theory, and Systems Thinking.
- Tools and Skills: we use Conceptual modelling, Group decision-making (Adaptive Management).
- Practical applications of Theory and Methods for Adaptive Management of Socio-Ecosystems
- Strategic Social simulation and severe gaming application (SSG)

Strategic social simulations or policy exercises combine interactive scenarios, role-playing, and game-like mechanisms to provide a more realistic environment to study and understand specific stakeholders' challenges. Through this, SSG can also offer potential solutions or show new forms of collaboration necessary for problem analysis and is also a learning possibility for all actors involved or observing. In addition, SSG can provide an opportunity to retain information quickly and gain intuition about actual decision-making. Variations of such exercises have been used in such issues as international climate change management (Parson, 1995), European climate policy (Haug et al. 2011) or the social aspects of river-floodplain management (Stefanska et al., 2011). The simulations were designed to 1) create an overview of the current situation, identifying essential factors and challenges of socio-enviro-economic situation in the river basin and, based on this, 2) develop ‘business as usual and 3) desired potential pathways in the future. Parallel to the simulations, observers were tasked with noting the extent and quality of the discussions in the discussions. In a final step, the game-based social simulation was adapted concerning the feedback of stakeholder participation. It will be an open-source tool for actors and policymakers in the Burkinabe fisheries and water management sector.

The SDGs 2030 Agenda is universal, integrated and indivisible (United Nations, 2015). Universal refers to the validity of the 2030 Agenda for all 193 UN member states. Integrated, i.e. the characteristic of being such that "different, diverse things are connected, united" (Duden, 2015), describes the comprehensive nature of the 17 goals and 169 targets, while "indivisible" indicates that the agenda is to be addressed and achieved in its entirety. This is to avoid the possible tendency to selectively address only individual goals in silos, which would stand in the way of progress toward achieving the "transformation of the world for the better" (United Nations, 2015, #37) envisioned in the 2030 Agenda. To bring about transformation-a "deep and deliberate shift away from business as usual" - the interactions of goals, targets, and options must be considered. Not only can this mitigate the harmful effects of actions to achieve one goal on another, but more importantly, it can leverage synergies. These linkages will lead to the desired transformative change if adequately addressed. The study of these linkages and the resulting interactions has generated great scientific interest since adopting the 2030 Agenda. For example, in the Austrian UniNEtZ project, a sub-working group for “ SDGs Assessment Methods Development” has reviewed the scientific literature on this topic, extracted the methods used and subjected them to an assessment. (https://www.uninetz.at/) This evaluation aims at facilitating a sound and transparent method of development to be used in this project

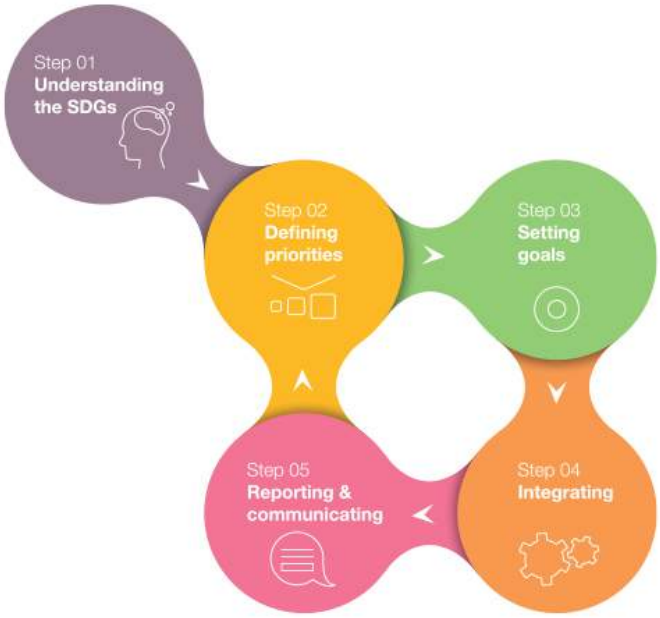


Figure 1: SDGs – Five steps adaptive management approach for assessment and implementation. Adapted from https://sdgcompass.org/.

A consistent and structured approach is essential for several reasons. First, the participation of numerous partners and stakeholders leads to various considerations for implementing the SDGs. Accordingly, the options' interactions (synergies, trade-offs) are a crucial building block of the project report. In order to be able to analyze the interactions of the different options, the options should have a uniform "form" and description to which one can dock with the method for assessing the effectiveness of the options and their interactions (Figure 2).

By assessing the potential impact of all options and their measures on the respective targets, our project complies with the principles of the 2030 Agenda. In this step, synergies and potential trade-offs are identified and made visible. In doing so, our team experts leave their disciplinary boundaries and the boundaries of the individual SDGs and interact with all other SDGs. These interactions will also include topics and options whose relevance to their "own" targets may not have been anticipated. This can also generate new knowledge that, beyond making expected synergies and trade-offs visible, can contribute to the envisioned "transformation of the world for the better." At the same time, this approach can bring conflicts and immanent, possibly hidden, contradictions within the agenda or the proposed options, thus promoting transparent negotiation of priorities and positions.

5. Knowledge integration

Dissemination synthesis and impact evaluation will evaluate current and future impacts, design communication avenues, and engage with academia for further project cooperation. In addition, two regional workshops/ local seminars will be organized by Caritas Austria and will involve students, experts, stakeholders and policymakers in land use sustainable construction management and natural resource sectors.

Annex

List of photos:

List of maps:

List of figures: