

2023 Call for research proposals

“Biochar based fertilizer: challenges and opportunities for a widespread uptake of the technology by Ethiopian smallscale farmers for increased grain productivity”

(1) Call brief

Strengthening the production and use of biochar based fertilizer (BBF) for increased grain crop productivity on degraded or acidic agricultural soils in Oromia, Sidama, Central, Southern and South-Western Ethiopia.

(2) Eligible applicants

Proposals are accepted from individuals and teams employed at institutes of higher education or at public agricultural research institutes in Oromia, Sidama, Central Ethiopia, South-West Ethiopian Peoples Regional State and Southern Ethiopia Regional State who fulfil the following criteria:

(a) Proven capacity to involve farmers/farming communities in agricultural development projects and/or proven expertise in addressing agricultural development challenges especially concerning soil quality amendement. Supporting evidence shall be presented by a list of projects of the employing institution covering a period of 3 to 7 years, indicating the sponsoring body or donor agency, the region (Regional state, Zone, Woreda) of project implementation and the financial volume of the project as adequate. Supporting evidence can also be provided by a list of relevant publications or supporting letters from relevant Ethiopian or international authorities.

(b) Documented practical knowledge of the applicant(s) on farmers' common practices to maintain or improve soil fertility by organic fertilizer and/or other methods of climate-smart agriculture. Experience with prior reseach on biochar-based fertilizer, its production and application is an asset. Supporting evidence shall be presented by the submission of CVs of the applying researchers and agricultural development experts.

(3) Introduction and background of the call

Sustainability is innate to agriculture. However, growing population leads to high land use pressure and diminishing resources. The resulting resource competition tends to break the circular use of farm and crop residues, diverting them to seemingly better uses than for the indispensable replenishment of soil fertility. Hence soils are degrading - also because mineral fertilizer is no cure for nutrient depleted soils. On top, tropical climate is a strong force to accelerate soil erosion wherever it finds a leverage.

Across the world and disciplines, science has re-discovered, consented on, and refined agricultural methods that can sustainably recover soil fertility. Among these is the application of biochar-based fertilizer (BBF), which increases and stabilizes soil organic carbon (SOC), microbial activity, nutrient status, water retention capacity, and soil pH. BBF has been introduced by various national and international collaboration projects, and its use has seen an increasing trend in Ethiopia.

The Ethiopian-German project ETH-Soil **aims** at increased food security of smallholder farmers. We build capacities with new knowledge and technologies. Jointly with project partners, we develop convincing solutions that make use of underutilized biomasses and biogenic residues like coffee husk, saw dust, invasive plants or food waste. Joint engineering, chemical and agricultural competencies of the project partners will showcase the value of modern bioenergy and pyrolysis plants. These will provide digestates and biochar that shall be used for biofertilizer production. Thus, higher economic value and new income-earning opportunities will evolve while project activities serve to push back - farm by farm - soil degradation and below average crop yields.

(4) Objective

Compliant to overall **aim** of the ETH-Soil project, this call for research proposals serves to (a) engage farmers in BBF production and application while providing scope for their practical ingenuity, (b) mold BBF use into evolved farm practices of grain crop cultivation and (c) document the results (soil amelioration, crop yields, households' food security). To gain momentum in the dissemination and spread of sustainable agricultural practices, this call emphasises the aims to build on farmers' knowledge, practices, creativity and also learn a lesson on economic trade-offs and challenges from smallholder perspectives.

(5) Scope and contents of research proposals

Applicants shall select and specify a methodological approach with special attention to a participatory research with members of the target group (smallholder households) and field testing of BBF. A high degree of interaction with farmers and documentation and evaluation of their perspectives on challenges and opportunities of increased BBF production and application is expected. This includes identification of

- the farmers' strategy to improve grain crop productivity,
- the available feedstock for (vermi-)compost and biochar production at the farmers' compounds,
- perceived trade-offs (like e.g. less feed), challenges (like e.g. seasonal workforce shortages, risks or knowledge gaps) and physical obstacles to increased BBF application.

6-A) Structural benchmarks for proposals

- a. This tender calls specifically for participatory field experiments with and related to BBF production and application at smallholder farms. .

- b. Proposals should outline the applicant's capacity to produce, or collaboratively produce together with farmers, the amounts of high quality (low PAH content) biochar sufficient to fertilize between 25 to 40 sqm with BBF. For requirements of biochar production refer to **Appendix 1**.
- c. Applicants shall select a minimum of 20 and a maximum of 40 farmers. Inclusion of female participants/female farmers will be especially valued.
- d. Selected farmers may work on different soil types, at different landscape positions/elevation (midlands or highlands), with different agricultural practices (rainfed or irrigated, agro-forestry, and else), and may grow different types of crops alongside maize, sorghum, teff, wheat, and barley. While there is seasonal crop rotation anyway, the focus of this call is to gain better understanding of the use and effect of biochar based fertilizer on the grain crops.

6-B) Content benchmarks for proposals

- a. Applicants should describe the problems of soil fertility in their area, i.e., where the project would be implemented. If adequate, prior projects on soil fertility can be outlined. The proposal should also include the applicant's own concept/understanding of how different biobased/organic fertilization methods integrate in sustainable land management. In other words "which arguments are likely to motivate a farmer asking, whether he/she should use BBF?"
- b. The applicants' proposal should present clear understanding of the meaning and goal of transformative research. Applicants should, therefore, provide a methodological approach of how they suggest to explore the determinants of farmers' participation and willingness to change established practices. This may include information collection on critical issues and limitations these farmers are facing in their agricultural practice related to soil fertility (interviews, questionnaires, workshop round tables, etc.).
- c. ETH-Soil project has developed a soil monitoring protocol for collection of evidence showing the effects of BBF on soil quality and yield. It is expected that the proposed project will follow the soil monitoring protocol, i.e. plan for measurement of soil quality and fertility as well as crop yield. Thus, applicants are required to analyse at least pH, organic carbon, plant available nitrogen, phosphorous and potassium, and to quantify above and below ground biomass (AGB/BGB) and grain yield. In addition, applicants are free to select and analyse additional parameters from the Table 1 in **Appendix 2** based on the listed priority.

(7) Documentation of results

Grant holders are requested to submit an interim report (3,000 to max 5,000 words, annexes permitted) by the 15th August 2024 via the same channels as used for proposal submission. Grant holders are expected to submit a final report of max. 8,000 words (annexes permitted) by the 15th December 2024. If results are to be published (preferably in Open Access Media) due acknowledgement of the sponsorship of the German Federal Ministry for Economic Cooperation and Development and the employing Ethiopian institution is mandatory.

(8) Budget and duration of grants

Grants are awarded for convincing research proposals envisaging field testing in 2024. ETH-Soil project will award a maximum of four convincing research proposals with a cost estimation up to 40.000 € each. The research contract shall be completed and end on the 31st December 2024.

For consideration of an award the proposal needs to include a budget outline in line with the attached format that pays attention to the budget limit (40 k€).

(9) Timelines and proposal evaluation procedure

The research proposals should be submitted until 3rd December 2023 by e-mail to Virginie.Bellmann@DBFZ.de. Cover pages (max 2 pages) with information on the applicant (team) and her/his/their expertise shall be separated from the technical and financial proposal text (max 20 pages) in such a way that double-blind review is possible.

Applicants shall also submit a (signed and stamped) statement of their institutions (employer) that guarantees the (cost-free) availability of infrastructures (working space, data sources, literature, lab facilities, organic fertilizer production plants, etc.), equipment and vehicles as required for the implementation of the research project. The statement will also commit the employing institution to (a) verify the deployment of grant funds for the intended use, (b) submit a financial report on actual expenditures by the 15th December 2024 at the latest, and (c) indicate a bank and account number for money transfer. To send attachments, please use the following upload platform <https://upload.dbfz.de/Start?1> (without using a password). Recipient of the data is Virginie Bellmann with the e-mail address indicated above.

✓ By the 16th November 2023, a sample of the biochar intended for use shall be sent to the ETH-SOIL project coordinator, Dr. Getachew Eshete Beyene, at:

GIZ International Services Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Gabon Street, Meskel Flower Square
Aster Plaza (Building), 4th Floor
P.O. Box 28127; Code 1000
Addis Ababa, Ethiopia

✓ There is no entitlement to a grant resulting from proposal submission.

✓ The evaluation of research proposals will take place on the 12th of December 2023.

✓ The evaluation committee will include representatives from the following organisations:

- Oromia Agricultural Research Institute IQQO
- Jimma University
- DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH
- 2-3 Selected soil science experts from Germany/Ethiopia

✓ The results will be communicated to the applicants on the 13th January 2024. The successful applicants are expected to present their research concept during the Soil Symposium that will take place in Addis Abeba on the 13th of February 2024.

Evaluation grid

| Criteria | Score (%) |
|--|-----------|
| Importance and appropriateness of the topic and its coherence with the objective of the research call | 10 |
| Clarity of the research proposal and its objectives | 20 |
| Soundness of the proposed methodology, including the underlying concepts, models, assumptions, appropriate consideration of the gender dimension, and the quality of target group engagement | 30 |
| Quality and effectiveness of the work plan and assessment of risks | 25 |
| Appropriateness of the budget plan and limit, and the details of resources allocation | 15 |
| Total | 100 |

APPENDICES

Appendix 1.

1.1 Biochar itself is not considered being a fertilizer. Hence, biochar is to be loaded with nutrient through co-composting resulting in a mixture called biochar based fertilizer (BBF). The BBF shall consist of a plant-based biochar which is nutrient loaded by co-composting with fresh organic matter. The fertilizing effect can be augmented by bone char or urea.

1.2 The biochar must be produced by pyrolysis of – preferentially – crop residues such as corn cobs, husks, kernels, shells, and hulls. Wood cuttings, saw dust, and else can constitute up to 25% of the input material.

1.3 Applicant should be aware that in compliance with international soil health standards, biochar will be examined specifically for its content of Polycyclic aromatic hydrocarbons (PAHs).

1.4 Biochar provided by the applicant or produced together with the farmer is to be loaded with nutrients at the farmers site through co-composting/vermicomposting with nutrient rich components such as animal manure/urine (cattle, horse, donkey, chicken etc), agroindustrial byproducts (sluges, liquid or solid digestate) and green wastes including agricultural residues available at the farm sites.

1.5. The applicants are expected to record all biochar input and production data (feedstock types and quantities, pyrolysis time and temperature). In addition, the weight to weight ratio (compost/biochar) shall be recorded. A measurement of the content of plant available N, P, K (at least) is required for the final BBF applied on 20 farms.

1.6 Cow dung, other animal excrements and bioslurry can add much more nutrients to the biochar than similar volumes of most green wastes/compostes. Their use is encouraged.

1.7 The BBF application rate is given as biochar based amount. Applicants shall plan for a rate of 1 kg or 2 kg biochar per square meter (this may result in something between 2–5 kg BBF depending of the type of organic matter used to nutrient-load the biochar). Applicants are free to choose either 1 kg or 2 kg per square meter.

Appendix 2.

2.1 Measurement Protocol for Soil Quality and Yield

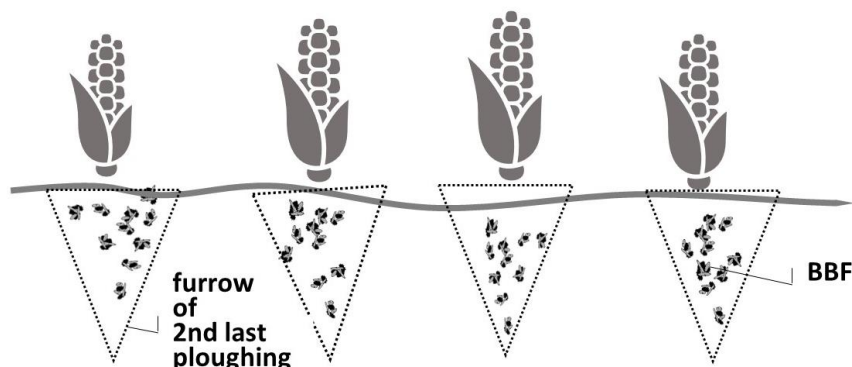
Within the ETH-Soil project, the effect of BBF application is always compared to a “business as usual” (BAU) reference. The latter refers to the area where the farmer uses the same fertilizer he/she has applied so far. This implies that fields chosen to be included in this call’s experiment have not received any specific biochar treatment before.

2.2 Soil sampling

ETH-Soil protocol for soil monitoring samples assumes that BBF is applied to the second last furrow during ploughing with the traditional Maresha plough. Based on this assumption, BBF will be distributed somewhere between 0-25 or 30 cm soil depths (see Figure 1). Soil samples should be collected when crop has been established (i.e. seedlings have reached the height

of 10–20 cm). They are to be taken from soil cores of depths -5 cm to -20 cm beneath soil surface. This means the core above 5 cm and below 20 cm is to be discarded from each soil sample.

Figure 1 Illustrating the distribution of BBF applied to the furrows of the second last ploughing



From within each BBF treated area, three random samples are to be taken. Each of these individual samples consists of a mixture of three cores taken around a sampling center point. Mixing samples from three cores is considered to increase the representativity of the samples towards the area’s mean. Samples from the BAU reference area are collected in exactly the same manner.

2.3. ETH-Soil monitoring protocol adapted to the call’s one sampling in the year

Table 1. Parameters of the ETH-Soil Soil Monitoring

| i | ii. Monitoring parameter | iii. | iv. Possible method |
|---|--------------------------------|------|-------------------------------|
| 1 | Soil pH | a | pH in soil/water slurry |
| 1 | Soil organic carbon (SOC) | a | Walkley-Black method |
| 1 | Total Nitrogen | a | Kjeldahl method |
| 1 | Plant available Phosphorus (P) | a | Bray I extraction method |
| 1 | Potassium (K) | a | |
| 2 | Cation exchange capacity (CEC) | a | Compulsive exchange method |
| 3 | C/N ratio | a | C/N analyser |
| 4 | Micro nutrient status | d | |
| 5 | Water holding capacity (WHC) | c | from undisturbed soil core |
| 6 | Infiltration rate | b | infiltrimeter |
| 7 | Soil moisture retention | c | pF/WC curve w/ pressure plate |

Table Notes:

i. Indicates “1” compulsory parameters, and 2-7 as further parameters of choice

iii. Indicates distinct physical samples (a to d) for different parameter analyses

iv. Indicates possible methods, but note that scientific validity of methods need to be referenced by applicant.

2.4 Monitoring of biomass/crop yield

Important evidence of interest in the ETH-Soil project results from the correlation of soil quality parameters with biomass growth and crop yield. Biomass and crop samples must be collected for each crop growing on BBF and its respective BAU. The total above- and belowground biomass must be collected from a predefined sampling plot within the areas of BBF treatment and BAU reference. From these plots, the whole above- and belowground fresh weight must be determined. Only a representative portion of biomass and crop yield needs to be carried to the lab to obtain oven-dry weight (12h 105°C) from which the overall AGB, BGB and crop yield can be inferred.