Deutsches Biomasseforschungszentrum
gemeinnützige GmbH

DBFZ

ETH-SOIL

Call for Research Proposals No 1

„Development of an evidence basis for the application of nutrient-loaded biochar on smallholder farms to enhance soil regeneration, increase productivity, strengthen food security, and mitigate climate change"

(1) Introduction and background of the call

Agricultural cultivation in Ethiopia takes place primarily on highly fragmented land - with average farm sizes ranging from 0.2 to 2 hectares. Due to overuse, erratic rainfall and soil erosion, food security is one of the country's greatest challenges. Soil acidification occurs with eroded topsoil and depleted soil organic carbon (SOC) stocks, depleted nutrients, alternating drought stress and high rainfall. Many areas are experiencing productivity declines for main staple foods and cash crops. Rather few farmers use agricultural residues for soil improvement - mainly due to strong competition for the use of these residues as animal feed or fuel. However, several Woredas have already been advancing composting and vermicomposting efforts without or alongside other measures targeted to reduce soil erosion and improve soil fertility (intercropping, agro-forestry, etc.). Due to high and currently increasing prices of synthetic fertilizers in Ethiopia, the local production of organic fertilizers gains increasing attention.

Research on plant-based biochar and organic fertilizers has already seen an increasing trend in Ethiopia during the past decade. However, relevant knowledge is still rather fragmented and incomplete:

(1) Renowned Ethiopian researchers published in international journals but often do not find the time to share their knowledge widely;
(2) Some results remain hidden in project reports and are not easily accessible;
(3) Limited exchange between agricultural research institutes, university-based experts and agricultural extension services hinders synthesis and limits the impact of research efforts.

The challenges of climate change require increased efforts in the development of evidence-based adaptation strategies. Smallholder farmers can benefit from the substantial potential embedded in the application of high-quality organic fertilizer with regard to augmented food security and resilience.

(2) Objective

The ETH-Soil project funded by the German Federal Ministry for Economic Cooperation and Development focuses on the use of residual biomass in pyrolysis, biogas and composting plants to produce charcoal, nutrient-rich fermentation products and compost as biofertilizers. In order to address the above-mentioned challenges, this call for research proposals serves to

a) synthesize available knowledge on the formulation and use of high-quality organic fertilizer with plant-based biochar;
b) prioritize knowledge gaps (with regard to the impact on plant growth, soil properties and CO2 sequestration), and
c) start field testing for the development of evidence-based receipts that farmers can use for an optimized cultivation of selected crops alongside gradual soil regeneration.

Insights from pre-tests in pilot zones 2023 under this call shall be discussed with all parties involved and used to complement and focus further efforts in the period 2024 to 2026 (second call).

(3) Scope and content of research proposals

Applicants shall identify and clearly specify an existing knowledge gap pertinent to biochar use as an ingredient of organic fertilizer and its application on smallholder farms' degraded soils in ETH-Soil pilot zones (located in the following Woredas: Jimma, East Shoa, Arsi, and Sidama). Applicants shall propose a research concept that can contribute to the closing of knowledge gaps preferably by participatory research/with target group involvement on smallholder farms. The envisaged testing of (a) specific biofertilizer formulation(s) shall be justified on the basis of

1. prior documented or published research on the impact of biochar application in Ethiopia;
2. the relevant soil characteristics and farming pattern in the regions concerned, and
3. existing capabilities of the host organization / employer of the applicant.

Convincing research concepts shall clearly define the research objective. They shall propose research on an organic fertilizer deemed fit for one or several (intercropping pattern) specific crops usually cultivated by smallholders in Oromia, Sidama or in the Southern Nations, Nationalities, and Peoples' Region (SNNPR).

- The fertilizer shall consist of a mixture of plant-based biochar (produced by pyrolysis with due attention to PAHs) and a) compost, b) vermicompost and/or c) biogas digestates. The biomass used for composting or biogas production shall be agricultural residues and waste material from agricultural or food processing.
- For biochar production, the use of wood is still allowed under this call but should be reduced by the use of residues (wood cuts, saw dust, husks, kernels, shells, hulls, etc.) as far as possible. Biomass sources and quantities shall be specified as well as the pyrolysis process and temperature.
- The biofertilizer formulation shall be adapted to the (degraded) soil conditions and the requirements of specific crops. Different grain sizes of the organic fertilizer are possible

as well as differences in physical (e.g. density, water content), biological (e.g. degree of rotting) and chemical properties (e.g. pH value, nutrients, trace elements). The research efforts shall aim to specify (C target values) and quantify the soil fertilizing effects (before and after C:N ratios, SOC, etc.),

- The fertilizing effect may or may not be augmented with bone char, rhiazobium bacteria or inorganic supplements. The formulation of ingredients and any mixing or co-composting methods shall be specified, including (pre-application) testing results as deemed adequate or necessary.
- The mixing ratio of fertilizer components (biochar, compost, fermentation products, supplements) shall be justified. Co-composting shall be implemented with 0%, 5% or 10% biochar.
- The test field sizes should be not smaller than 4m x 4m.

Applicants shall select and specify a methodological approach with special attention to participatory research with members of the target group (smallholder households) and field testing of organic fertilizer. This includes:

a) A characterisation of the agro-climatic conditions (temperature, precipitation), topography, farming pattern and soil type;
b) A method for smallholder farming household mobilisation and selection (e.g. based on households' perceived opportunities and constraints),
c) Criteria to select the test fields, including e.g. the fertilization history, irrigation, planned test field sizes for perennial or annual crops, intercropped farming pattern or agroforestry - as applicable, envisaged subfield trenching or safety distances,
d) soil sampling method (grid soil sampling, composite sampling with adequate safety distances and repetitions, etc.);
e) Agreements to be reached on (male and female) farmers' participation in test field selection (with and without biochar comparison), uniform soil pre-treatment (annual crops), uniform fertilizer application to existing (multi-annual) crops, seedlings or fields (identical seed varieties), uniform cropping pattern, uniform care-procedures during the crop's growth phase, as well as monitoring and result evaluation,
f) Provisions to be made for test fields' (re-)identification and protection against damage (if applicable),
g) Methodological approach for yield measurement;
h) Instrumentation of test fields for monitoring soil moisture, temperature, and emissions (if applicable),
i) Specification of (before & after) soil testing protocols, equipment used and method of analysis as applicable.

Lastly, convincing research concepts shall propose a structure for the result report.

(4) Budget and duration of grants

Grants are awarded for convincing research proposals envisaging field testing with at least 10 and a maximum of 20 smallholder farmers[1] per applicant in 2023 which may or may not be accompanied by trials on dedicated test fields of the employing research organisation. (Efforts shall be expanded in 2024/25/26 on the basis of refined research concepts in such a way that at least 450 smallholder farmers are involved in extended field trials on biofertilizer formulation and application, and at least 50 ha of degraded soils are covered by ETH Soil project activities.)

A maximum of five research proposals with a cost estimation of up to 40,000€ each are accepted in 2023.

Budget proposals shall include the following specifications

No	*Cost category*	*Price per Unit & other specifications*	*Total costs*
1	*Personnel (including social insurance provisions) for the implementation of the envisaged research* • *Scientific staff (with Master degree or PhD)* • *Student assistant(s)* • *Other:*	*Person/Month*	
2	*(Non-personnel) Costs of biomass for biochar production and (co-)composting in a "raw" status or pre-processed (shredded, washed, pelleted, briquetted, or other)*	*Price / ton*	
3	*(Non-personnel) Costs of biomass preprocessing (if deemed necessary, might include energy or depreciation costs of equipment used) for biochar production*	*Price / ton*	
4	*(Non-personnel) Costs of biomass processing (if deemed necessary, might include energy, water or depreciation costs of equipment used) for (vermi)compost production*	*Price / ton*	
5	*Cost of other fertilizer ingredients to be included in the formulation for field testing* • *…* • *…*	*Price / ton*	
6	*(Non-personnel) Costs of mobilizing and selecting smallholder farming households for participation in field testing, monitoring and yield result evaluation* • *Transportation* • *Compensation of smallholder households for test field protection and monitoring duties …* • *…*	*No. of planned field visits times no of km;* *No of smallholder households to be included;* *…*	
7	*Costs of soil, biochar and biofertilizer analysis – as necessary or applicable*	*Price/piece*	
8	*(Non-personnel) Costs of biofertilizer transportation to pilot region / smallholders*	*Tones of material times km*	
9	*Costs of biofertilizer application (if applicable)*	*Price/ton*	

[1] Smallholder household is defined as a (male or female-headed) household with less than 2ha of arable land at its disposal

10	*Costs of consumables during soil sampling, testing, or analysis* *…* *…*	*Price/piece*	
11	*Miscellaneous:* *…*		
	Total		

(5) Submission and evaluation procedure

- Applicants shall submit their proposals by the 15th of February 2023 by Email to Virginie.Bellmann@DBFZ.de (or via https://cryptshare.dbfz.de/Start?0).
- Applicants shall also submit a (signed and stamped) statement of the 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 verify the deployment of grant funds for the intended use, submit a financial report on actual expenditures by the 1st of March 2024 at the latest and indicate a bank and account number for money transfer from Germany.
- By the 15th of February 2023, a sample of the biochar intended for use shall be sent to the ETH SOIL project manager 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 28th of February 2023.
- The results will be communicated to the applicants on the 1st of March 2023.
- The evaluation committee will include representatives from the following organisations:
  - Oromio Agricultural Research Institute IQQO
  - Jimma University
  - DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH
  - 2-3 Selected soil science experts from Germany / Ethiopia

(6) Evaluation grid

	Criterium	Weight
1	Relevance of the research proposal for a widespread reduction of food insecurity	*10*
2	Clarity and pertinence of the research objective	*20*

3	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*
4	Quality and effectiveness of the work plan and assessment of risks	*25*
5	Appropriateness of the resource input	*15*
Total		*100*

(7) Documentation of results

Grant holders are requested to submit an interims report (3,000 to max 5,000 words, annexes permitted) by the 30th of August 2023 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 of December 2023.

Results are to be published in Open Access Media with due acknowledgement of the sponsorship of the German Federal Ministry for Economic Cooperation and Development and the employing Ethiopian institution.

(8) Eligible applicants

Research proposals are accepted from individuals employed at institutes of higher education or at public agricultural research institutes in Oromia, Sidama and in the Southern Nations, Nationalities, and Peoples' Region (SNNPR) who fulfil the following criteria:

a) Own contribution to at least one peer-reviewed publication on biofertilizer application during the past 10 years or
Evidence of support (recommendation letter) by a scientific supervisor who fulfills the above-mentioned precondition;

b) Documented practical knowledge within the employer organization on organic fertilizer and/or biochar production.

Literatur

Gross, A., Bromm, T., & Glaser, B. (2021). Soil organic carbon sequestration after biochar application: A global meta-analysis. *Agronomy*, *11*(12), 2474.

Techen, A. K., Helming, K., Brüggemann, N., Veldkamp, E., Reinhold-Hurek, B., Lorenz, M., ... & Vogel, H. J. (2020). Soil research challenges in response to emerging agricultural soil management practices. *Advances in agronomy*, *161*, 179-240.