Biochar

CCARDESA
Centre for Coordination of Agricultural Research and Development for Southern Africa

Technical Brief 03

Biochar refers to a fine-grained charcoal, rich in organic carbon compounds, used to improve soil quality through enhanced nutrient and water holding capacity of soil, reducing total fertiliser needs. Biochar is a stable solid produced from the controlled burning of plant and waste feedstock, including wood chips and pellets, tree bark, crop residues (straw, maize stovers, nut shells and rice hulls), grain, sugarcane bagasse, chicken litter, diary manure, sewage and paper sludge. Biochar is used as a soil conditioner as part of soil amendment strategies, improving the workability of soil, particularly those with heavy clay components.. The application of biochar to soil is a strategy to minimise the climate and environmental impact of cropland systems, such as the application of synthetic fertilisers, and improve soil quality through enhancing its physical-chemical characteristics. This agricultural practice improves soil structure, nutrient cycling and water retention, and the high stability of biochar carbon compounds contributes to the reduction of green-house gas emissions by increasing carbon sequestering in soils. Biochar is shown to be effective in improving soil conditions in acidic, sandy and clay-rich soils, improving the physical characteristics, and is classified by the FAO classifies as an adaptation strategy and contributes to mitigation of climate change as the processes captures and stores carbon in soils create other secondary socio-economic benefits, through additional fuel sources, and economic opportunities for production. Biochar can either be purchased or produced on-farm on a small or large scale. Collective action may benefit communities, so discussion with neighbours and community leadership may be necessary, especially if a biochar.

MOST SUITABLE AGRO-ECOLOGICAL CONDITIONS

Value chain
- ● Maize
- ● Sorghum
- ○ Rice
- ○ Livestock
- ● Other

Soil texture
- ● Light
- ● Medium
- ● Heavy

Climatic zone
- ○ Arid
- ○ Semi-arid
- ● Sub-humid
- ● Humid

Water source
- ● Rainfed
- ● Partly irrigated
- ● Irrigated

Annual average rainfall (mm)
- ○ < 250
- ● 250 - 500
- ● 500 - 750
- ● 750 - 1000
- ○ 1000 - 1500
- ○ > 1500

Topography
- ● Flat to gentle slope (0 – 5 %)
- ● Moderate to rolling slope (6 – 15 %)
- ● Hilly slope (16 – 30 %)
- ● Steep slope (> 30 %)

MOST APPROPRIATE CONDITIONS AND REQUIRED INPUTS

Farming system

Does it require collective action
- ○ Yes
- ● No

Characteristics
- ● Subsistence
- ● Commercial Small
- ○ Commercial Medium
- ○ Commercial Large

Farm size (ha)
- ● < 2
- ● 2 to 5
- ○ 5 to 10
- ○ > 10

Mechanisation
- ● Manual
- ○ Animal
- ○ Mechanised

Human resources

Labour intensity – level of effort
- ○ Low (household)
- ○ Medium (seasonal)
- ● High (outside labour)

Gender/youth smart (low investment/low labour requirements)
- ● Yes
- ○ No

Financial resources

Initial investment
- ● Low
- ○ Medium
- ○ High

Maintenance Costs
- ● Low
- ○ Medium
- ○ High

Access to finance capital or credit required
- ○ Yes
- ● No

Enabling Environment

Extension support
- ○ Yes
- ● No

Access to inputs
- ○ Yes
- ● No

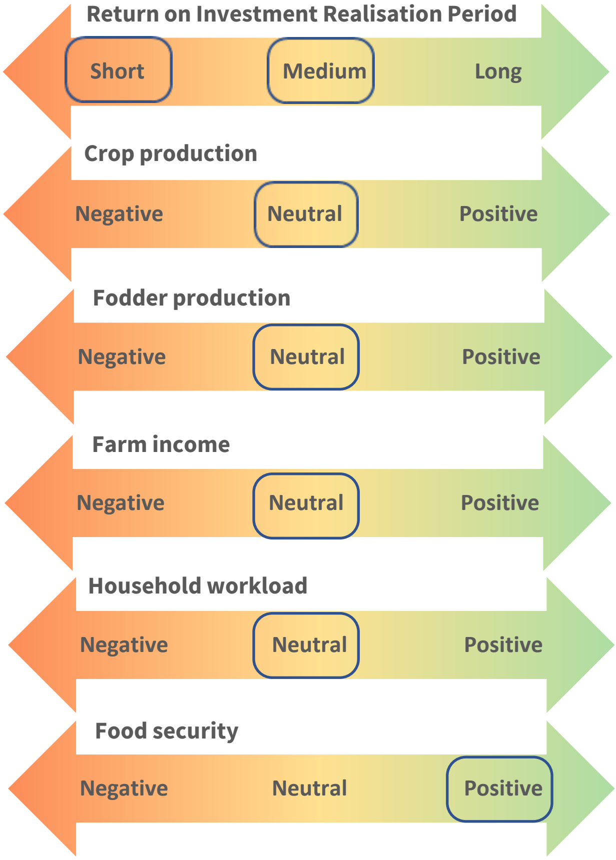
Market access
- ○ Yes
- ● No

The purpose of this technical brief is to guide where this **practice, technology or strategy** could be applied. It may be applicable in other circumstances, but this brief focuses on where it is possibly **most suitable**. Content is general, and should be contextualised depending upon locality. The brief provides an overview, details of appropriate agroecological characteristics, appropriate conditions and inputs, possible outcomes and impacts, how the **practice, technology or strategy** should be applied, potential benefits and drawbacks, and provides suggestions for further reading in terms of CCARDESA materials and other sources, including those used to develop this technical brief.

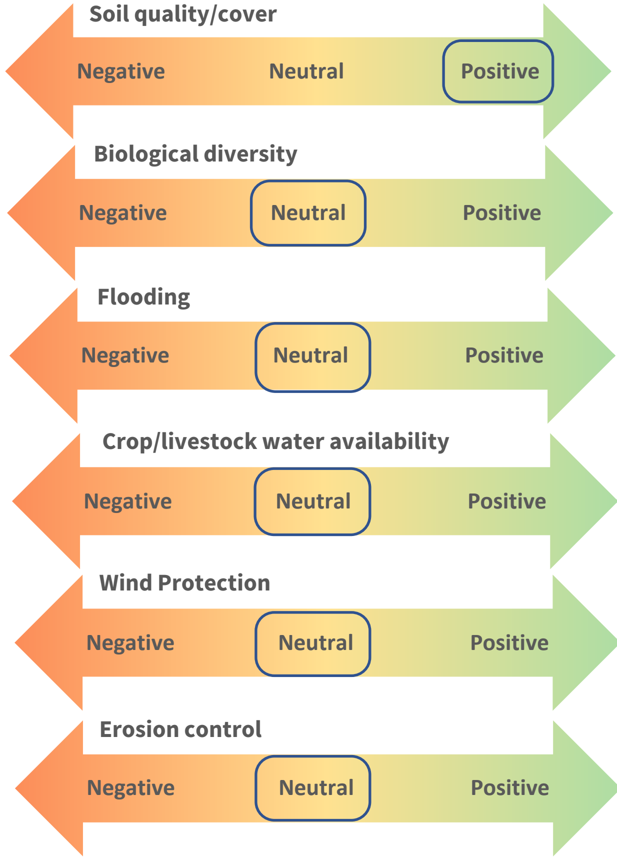
CCARDESA is a subsidiary of SADC, coordinating and harmonising agricultural research and development in Southern Africa.
This ***Technical Brief*** *is part of a series of materials designed to support* ***Knowledge Products on climate smart agriculture*** *available here: www.ccardesa.org/saaiks-knowledge-hub*

POSSIBLE IMPACT/OUTCOMES

Socio-Economic Impacts Positive or Negative



Ecological Impacts Positive or Negative



These descriptors indicate whether the practice, technology or strategy has a positive, neutral , or negative impact or outcome
Those with no box are deemed not-applicable

TECHNICAL APPLICATION

To effectively implement biochar the following should be carried out. Tools required – shovel and a metal sieve.

Step 1: Acquire charcoal from local vendor, and sieve or grate the charcoal into fine material in a pile. Biochar should not be applied to soil directly after production. It should be allowed to 'rest' for one to two months.
Step 2: Rotate the pile every 2-days for a period of up to 10-days (total).
Step 3: Prior to application, aim to wet (but not waterlog) biochar stock with water or preferably urine. If done when still warm, it will fracture the charcoal, increasing surface area for absorption.
Step 4: Spread the biochar evenly across soil prior to planting and let it settle or mix with the top layer of soil. One to three kg/m2 is recommended, depending on the degree of soil required.
Step 5: Regularly monitor soil pH, water retention and soil texture, keeping records if relevant to ensure that improvements are realised, and negative impacts do not arise.

Biochar can be produced on-farm, but will require collection of plant and waste feedstock (see above). Biochar can be produced on-farm using a trench. A biochar trench is a dug recess where crop residues are burned to create charcoal. Tools required are a shovel and one or more roofing sheets (one-metre long).

Step 1: Dig trench 50 to 70 cm deep, and one to two metres long, ensuring that roofing sheets fully cover the trench void.
Step 2: Start a fire in one end of the trench, throwing in loose crop residue or other organic waste, keeping the fire under control (not creating large flames and smoke).
Step 3: Keep fire burning until trench is full of char.
Step 4: When the trench is full, and flames have burned-out, cover the trench with the roofing sheet, sealing edges with loose soil, trampling it down to ensure closure.
Step 5: Leave the covered trench for five to six hours to extinguish.

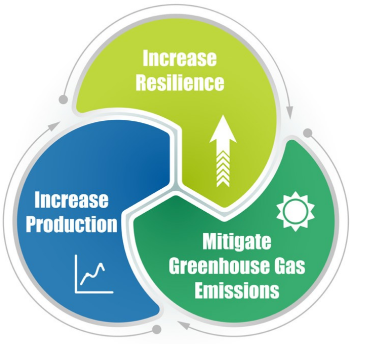
CLIMATE SMART AGRICULTURE OUTCOME(S)

Reflecting how this **practice, technology or strategy** contributes to Climate Smart Agriculture outcomes

Makes nutrients more available to plants and increases water retention. Can increase pH.

Improves water retention.
Remains in the soil for a long time.

Capturing carbon in soils thereby reducing emissions.



SUMMARY/KEY ISSUES

Benefits

- The production and application of biochar reduces GHG emissions of cropland systems due to the properties of the biochar itself, and reduction in the application of synthetic fertiliser.
- Can improve physical and chemical composition of soil, especially in acidic, sandy and clay-rich soils; soil nutrient cycling and water retention.
- Can reduce fertiliser and irrigation requirements.
- Potential socio-economic opportunities for biochar producers, if not produced on-farm.
- Improved food security from production of secondary fuel source.
- Provides an appropriate and sustainable mechanism for dealing with crop residues and biomass.
- Can be mixed with compost during application to increase performance of soil amendments.

Drawbacks

- Requires sustainable non-wood supply of organic matter for production so as not to increase deforestation.
- Long-term impacts not fully understood.

REFERENCE MATERIAL

CCARDESA Related Content

- CCARDESA 2019. KP06 Climate Smart Soil Amendment Options for Maize and Sorghum. Gaborone, Botswana.

Additional Information

- Department of Environmental Affairs (South Africa) 2015. Assessment of the potential to produce biochar and its application to South African soils as a mitigation measure. Department of Environmental Affairs, Pretoria, South Africa.
- Echo 2013. Biochar – An Organic Note #Technical Note No. 75 House for Soil Microbes. Echo Community.
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- FAO 2009. Biochar.A Strategy to Adapt/Mitigate Climate Change? Technical Factsheet. Rome, Italy
- Govindarajan, Dr & Ch, Srinivasrao & K.A., Gopinath & Reddy, Kotha. (2015). Low-Cost Portable Kiln for Biochar Production from On-Farm Crop Residue. Indian Farming. 64. 9-12,18.
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