PRO-NATURA INTERNATIONAL
Innovation towards Sustainable Development
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USING BIOCHAR TO FEED THE GLOBAL SOUTH WHILE MITIGATING CLIMATE CHANGE

Biochar (a form of ecological charcoal) has been called **"The Third Green Revolution"**. When used in fine granular form (less than 2 mm) and combined with organic fertilizers like camel or cow dung, it can be applied to different soil types across a variety of climatic conditions. The poorer the soils, the more the effect of biochar is spectacular.

Our experience under different climates has shown that a single application of approximately 10 tonnes per hectare can **increase crop productivity to levels that range from 50 to 200%.** Just one application provides and maintains long-lasting soil fertility benefits that enhance carbon sequestration in the soil, thus fighting climate change.

Adding biochar to the soil in the South of Algeria

Today, biochar research shows measurable, replicable improvements in soil productivity:

- Enhances the soil biological activity (40% increase in mycorrhizal fungi)
- Improves nutrient retention in soils (50% increase in Cation Exchange Capacity)
- Improves the water retention capacity of soils (up to 18% increase)
- In terms of carbon sequestration, 1 tonne of biochar is equivalent to 2.7 tonnes of CO_2
- Increases the pH of acidic soils (1 point pH increase)
- Increases soil organic matter

Five weeks later a Biochar Super Vegetable Garden

Most biochar-related activity is linked to the International Biochar Initiative based at Cornell University: *www.biochar-international.org*

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It is important to note, however, that the impact of biochar is likely to be much greater on disturbed, degraded or highly weathered soils than on those high in organic matter. Since biochar is particularly relevant for areas with severely depleted soils and water shortages, it could play a major role in improving soil quality and hence food security and human health in tropical agro-ecosystems including desert areas.

CarboChar-1

Pro-Natura won the Altran Foundation's first prize for technological innovation with its pyrolysis unit, the CarboChar-3 is now producing 5 tons of biochar per day. This machine shown on the right produces it's own energy and has proven that it is possible to make high quality biochar from carefully selected and otherwise unused agricultural and/or forestry wastes in a highly ecological and efficient manner.

A biochar-enriched Super Garden of less than 60 m^2 produces up to 1.5 tonnes of vegetables per year with more than 80% water saving

Pro-Natura International has developed the innovative, ecological and highly productive Super Garden, originally designed for Africa. The result of 15 years of research, the Super Garden is a mode of intensive and ecological vegetable cultivation that yields up to one and half tonne per year on only 60 m^2, providing families with a nutritious diet and surplus food crops to sell. The corresponding kit includes non-GMO high-yielding seeds, soil amendments, adapted irrigation devices together with innovative equipment (covering veils, tools, etc.).

The production is constant throughout the year irrespective of seasons in approximately 5 weeks for short cycle vegetables. The system allows a reduction in water consumption by over 80% and reduces the labour required to two hours per day. The Super Gardens can be set up on a large scale by grouping them by hundreds and combining them with fruit trees.

The Super Garden has many innovations notably biochar produced with Pro-Natura's green charcoal technology. Pro-Natura's biochar avoids environmental problems associated with charcoal production since it involves green charcoal produced exclusively from renewable biomass (unused agricultural or forestry residues, invasive plants, etc.).

This technique allows for at least multiplying by five the productivity of agricultural land, once the soil has been enriched by incorporating once and for all one kilogramme of biochar per m^2.

Trees growing in deserts with biochar

In addition to improving soil fertility, biochar also acts as a sustainable carbon sink by sequestering carbon from atmospheric CO_2 (one tonne of biochar being equivalent to at least 2.7 tonnes of CO_2), thus mitigating long-term climate change.

Summary of key scientific publications regarding biochar on main tropical crops

Type of crop	Authors	Location	Type of soils	Quantity of biochar (t/ha)	Yield increases (%)
Rice	Asai et al.	Houay-Khot, Nord du Laos	upland	8	70%
Rice	Steiner et al.	Manuas, Brésil	xanthic ferralsol / laterite	11	73%
Rice	Masulili et al.	Sungai Kakap, Indonesia	acid sulphate soil	10	93%
Rice	Zaitun et al.	Empretring, Indonesia	-	10	57%
Sugarcane	Chen et al.	Okinawa, Japan	shimajiri maji (clay)	7,2	78%
Tomato	Effah et al.	Kade, Ghana	forest ochrosol	7	177%
Cotton	Reddy	Midjil Mandal, Andrha Pradesh, India	alkaline	3,75	100%
Cabbage	Carter et al.	Siam Reap, Cambodia	sandy acidic	100	750%
Maize	Major et al.	Llanos Orientales, Colombia	savanna oxisol	8	71%
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Maize	Kimetu et al.	Vihiga, western Kenya	highly degraded ultisol	6	71%
Peanuts	Islami et al.	Malang, Indonesia	clay loam	15	54%
Cowpea	Tagoe et al.	Gifu, Japan	sandy loam	-	146%
Casava	Islami et al.	Malang, Indonesia	clay loam	15	32%
Onion	Pro-Natura	Senegal	-	10	50%

In Belize biochar-treated cacao tree on the left has started producing pods significantly earlier than the non-biochar treated tree on the right – both are three years old