

Bamboo charcoal production on Cebu Island, Philippines

Project outline

SUSTAINABILITY REDEFINED.

Using modern carbonization technology, bamboo charcoal will be manufactured in the Philippines. High-quality bamboo, cultivated on a dedicated farm, as well as harvests from sustainably producing local farmers are utilized for the production process.

ECO-NATURE-PRODUCTS PLC pursues the capitalisation of this project.

The project



Bamboo farming on Cebu Island

Integral part of the project is a sustainably managed bamboo farm with an initial size of 45 hectares. Using modern farming methods, bamboo is perennially cultivated and harvested. For that purpose, farmland and species have been carefully selected: The tropical *Bambusa balcooa* (see p. 6) combines a high energy content with fast growth, high crop yields and resilience against various environmental influences and pests.

Following an intensive search for suitable project locations, the vicinity of the provincial capital of Toledo City, located on the west coast of the Philippine island of Cebu, has been selected. In addition to favorable climatic and topographical conditions, numerous economic and sociographic aspects facilitate the excellent suitability of Toledo (more info on p. 7).

The bamboo farm greatly benefits from vast pre-existing experience with *Bambusa balcooa*. Land preparation, planting, farm management and harvesting – every aspect of agricultural operations is carefully adjusted to the species as well as local conditions. Modern technologies and trained experts constantly monitor and optimize growth conditions. These measures ensure efficient, sustainable management and precise projections of harvest times and quantities.

Impressive performance

Only 4-5 years are required for a bamboo culm to be harvest-ready. The plant constantly produces new culm shoots, eliminating costly and time-consuming replanting periods and corresponding latencies. The plants are trimmed several times during the growth phase, i.e. a certain number of culms are deliberately harvested before reaching maturity. This method triggers growth of new shoots and furthermore diversifies the harvest periods - enabling constant, non-seasonal harvests. Generally, a bamboo plant is never harvested completely; only fully matured, woody culms are processed.

The smart way of resource utilization and cooperation

The in-house bamboo farm with its initial size of 45 ha does not yet produce enough raw material to fully cater the capacity of the production facility. However, due to vast local stocks of readily available bamboo in the area, this is in fact not necessary. Local farmers, landowners and unexploited holdings managed by the Philippine Department of Environment and Natural Resources (DENR) provide large amounts of bamboo materials in direct proximity to the project, ensuring constant, sustainable material supply for charcoal production. Certification procedures specifically developed in cooperation with DENR guarantee that only bamboo from sustainably managed sources is acquired and processed.



This strategy allows an eco-friendly, economically reasonable use of pre-existing, unutilized raw material capacities within the province. Furthermore, it purposely pursues a cooperative approach, aiming on an active involvement of local farmers and other stakeholders in the project and their fair share in the project's economic success. Positive side effects of this conception are the active support of the project through these local stakeholders as well as a significant reduction of the required initial investment budget. In a later step, reinvestment of generated profits allow the bamboo farm to expand without the need of further external investments.



Processing and distribution

The bamboo harvest is collected centrally, then sorted, dried, chipped and stored. An automated belt conveyor feeds these bamboo chips into a modern rotary furnace, in which a high-temperature pyrolysis process converts the material into industrial grade charcoal (carbonization). This process takes place in a fully enclosed environment. Resulting by-products such as gases, tar and ash can be fully separated and recycled. The rotary furnace has an average feedstock capacity of 1000 kg of raw material per hour, producing approximately 300-350 kg of bamboo charcoal after the carbonization process. According to the capacity and annual running hours of the furnace, more than 7,000 tons of raw material can be processed into approx. 2,500 tons of charcoal per year. Automatically weighed and packed by a packing machine, the bamboo charcoal is then ready for shipping. Existing regional and international seaports provide the necessary infrastructure for distribution.



Charcoal made from bamboo comes with a high calorific value (over 8,000 kcal / kg), a low ash content and a low level of residual moisture. Compared with conventional charcoal, this results in a longer and more uniform burning process as well as reduced smoke development. Bamboo charcoal is particularly valued throughout Asia and is traded at stable, economically advantageous price ranges.



Further on, it is possible to add a further production step and refine the charcoal to activated carbon. Activated carbon is a high-quality industrial product and a necessary component for filters of all kinds (e.g. exhaust, water and air purification). It is also widely used in medicine and cosmetics. In regards to the project's future economic development opportunities the technical and economic aspects of this refining process are already being assessed.

Why in-house farming pays out

Despite the availability of sufficient bamboo material that can be utilized in the production process, a number of reasons strongly advocate in-house cultivation:

- Compared to external supply, the farm is able to cost-effectively produce superior quality material, both qualitatively (calorific value) and quantitatively (yield per hectare). In particular, the excellent calorific value of *Bambusa balcooa* is an important factor in the overall quality of the produced charcoal, as the farm produces quality bamboo harvests throughout the year and thus constantly incorporates premium material into the production process.
- The farm serves as training ground for local farmers, educating them in modern bamboo farming methods. This is an important contribution to a long-term improvement of yield and quality of externally cultivated bamboo materials.
- Existing farming methods can be further refined and optimized in accordance to local conditions. In addition, new personnel can be trained on-site, providing experienced manpower for future expansion stages of the farm.
- In-house bamboo production increases procurement security and allows a higher level of flexibility during the acquisition of bamboo materials from external sources.



One key target of the project is to achieve and maintain CO²-neutral operations. The planted bamboos permanently convert CO² into oxygen, sequestering emissions caused by transportation, processing and distribution. Provided the required certification, the farm will be able to actively produce carbon credits in the future.



Bamboo factsheet

Bamboo (Bambusoideae) comprises about 116 genera of the grass family Poaceae and enfolds into approx. 1500 different bamboo species. Bamboo can be found on all continents except for Europe and the Antarctic.

Bamboo is one of the fastest growing plants in the world and is valued for its versatility for centuries. Although bendable and flexible, it is a surprisingly resilient material. Concerning tensile strength and hardness bamboo can even compete with steel. Nonetheless it is extremely light and can be machined formidably.

Neglected by modern research and economics for many decades, bamboo has finally received increased attention in the recent years, taking into account numerous mechanical, biochemical, environmental and economic benefits.



Fast growth and constant availability

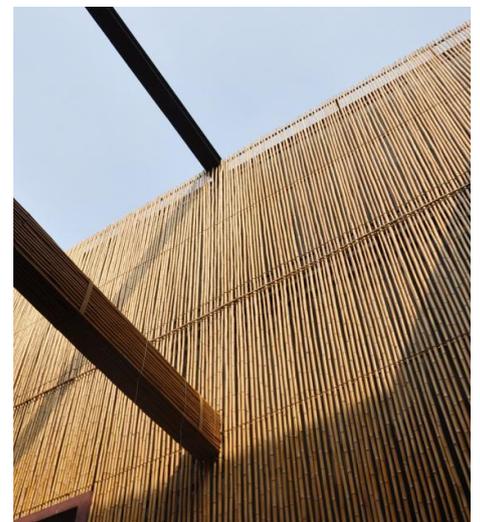
The outstanding economic and environmental value of this raw material results from the unique growth characteristics that distinguish bamboo from other crops. Bamboo culms do not just grow fast, they also regrow regularly after harvest. Depending on the species, replanting is necessary after many decades only.

In addition, bamboo does not require intensive use of chemical fertilizers, pesticides or herbicides. Soils with bamboo vegetation enjoy excellent health, even after numerous years of cultivation. It is reasoned in bamboo's efficient nutrient management as well as effective prevention of erosion by roots and rhizomes. Small animals, insects and microbes appreciating the soil environment of bamboo provide further positive symbiotic effects.

A true multi-talent

Applications of bamboo include, but are not limited to:

- Energy plant for charcoal, pellets and feedstock for biomass power plants
- Construction material for building construction, interior design and scaffolding
- Manufacturing of parquet, furniture, bicycles, boats, etc. v. m.
- Manufacturing of countless consumables (e.g. toothbrushes, straws)
- Textile fibers and paper products
- Arts and instrument building
- Cosmetics and biochemical products
- Technology sector, e.g. activated carbon, memban filters, pipelines
- Reforestation, erosion prevention, riverbank fortification, natural barriers



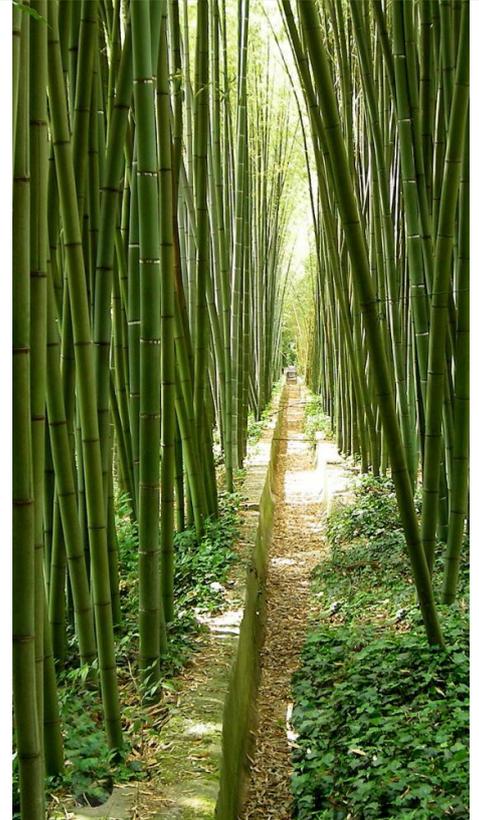
Bamboo and environment

Considering economic and ecological aspects, bamboo certainly stands out among other crops, not only due to its fast growth and continuous reproduction. Combined with ecologically responsible farm management (cultivation without the "chemical mace") that ensures long-term preservation of humans, plants, wildlife, soil and groundwater, bamboo offers unique opportunities in merging economic efficiency and environmental awareness.

Furthermore, bamboo offers a range of other ecological benefits:

- Habitat for countless small animals, insects and microorganisms
- Up to 35% increased oxygen production compared to hardwood
- Highly efficient in erosion-prevention and riverbank fortification
- Resilient to a variety of environmental conditions
- Ideal for rapid reforestation and rehabilitation, even on polluted soils (e.g. mining grounds, fallow land, disaster areas)

The unique growth characteristics of bamboo provide excellent opportunities for mining companies to effectively re-cultivate former mining sites. By rehabilitating such with bamboo, they convert them into sustainable, profit-generating assets.



Bambusa balcooa in a nutshell

Bambusa balcooa is a tropical bamboo, native to northern India and Bangladesh, but successfully introduced to many other countries since decades. It grows sympodially, i.e. new culms only sprout within a narrow radius around the plant center.

A matured bamboo of this species can easily consist of more than 20 culms, each thornless and reaching a height of up to 15 meters and a diameter of 10-12 cm. Within 4-5 years a culm is sufficiently matured and thus ready for harvest. The characteristic cavity inside each bamboo culm is noticeably small (comparable to a 1€ coin). In comparison to most bamboo species, this allows the generation of significantly higher yields.

For an energy project such as charcoal production, *Bambusa balcooa*'s markedly high energy content of more than 4,700 kcal / kg (5.23 kWh) and an ash content of less than 2 percent (air-dried, after harvesting) are further highly advantageous characteristics.



Above: 6 months old *Bambusa balcooa*

Left: Species comparison *Bambusa balcooa* (left) with *Bambusa blumeana*.

Location analysis - Philippines and Cebu

Although the Philippines and its President Rodrigo Duterte with his war against illegal drugs lately received much criticism in Western media, the Southeast Asian archipelago with over 7,000 islands continues to offer attractive business opportunities.

Security and political stability

The country is a stable Western-style democracy with a largely independent judiciary. Although conflicts with the Muslim minority in the southern island of Mindanao remain smoldering, security and stability - esp. on the well-developed tourist island of Cebu and the project site Toledo - are definitely given.

Economy and infrastructure

The country offers a large pool of agricultural workers and well-educated graduates, combined with economically favorable wage levels. The country, still in its development phase, benefits in particular from its geographical proximity to countries such as Japan, China and South Korea. The local economy in Toledo is characterized by agriculture and mining. Especially copper industry is an important industry and employer.

The infrastructure requires further investments, yet does not hinder the economic success of the project. For international distribution, an international container port as well as an international airport in Cebu City (approx. 2 hours drive) provide excellent market access.

Climate and weather

The Philippines have a tropical climate with little seasonal variation in temperature, but periodically large amounts of rain - especially during the rainy season. Tropical bamboo species such as *Bambusa balcooa* thus benefit from excellent climatic conditions. Due to geography and weather dynamics, occasional typhoons rather are a serious threat to islands located further in the East; thanks to the carefully chosen geographical location, they pose in fact no danger.

Location assessments in Cebu

Integral part of the project development was an in-depth assessment of Cebu. As a result, the province of Toledo has been identified as particularly advantageous. More than a dozen agricultural areas have been located and thoroughly inspected by experts. Representative soil samples have been taken to check local soil conditions on its suitability with bamboo. Another precondition was to exclude sites that would require clearance of larger tree populations. Thanks to these efforts, an ideal location for the bamboo farm was finally identified.



The Philippines in numbers:

Population:	104.920.000
Currency:	Philippine Peso (PHP)
GDP in 2017 (in billion USD):	313,6
GDP development (forecast by PEU):	2019: 6,7 % 2020: 6,6 %



With strong partners to success



ECO-NATURE-PRODUCTS PLC and the operating corporation of the project work closely with local partners, providing know-how, many years of experience with the Philippines as a business location, and the benefit of a developed cooperation network.



Asiando Ltd. consults on commercial bamboo projects. The company has been engaged as Project Managing contractor from Phase II of the Cebu project.



The Department of Environment & Natural Resources (DENR) is the institutional partner for all forestry and environmental matters. The authority manages large tracts of land with bamboo vegetation.

Intensive efforts aim on winning local mining companies for the project. Fallow land, mostly former sites of open-pit mining operations, could be re-cultivated with bamboo. This model would pose an active contribution to the long-term recovery of these areas – while the farm could utilize large mounts of land without a costly land acquisition.

Core data and project schedule

- Investment volume: 1.2 million USD
- Begin of investment return: From year 2
- Completion of investment return: 4-5 years
- Raw material consumption / year: 7,000 t
- Production capacity / year: 2,500 t
- Jobs: 50-55



Further information and contact

For further information regarding the current status of the project as well as detailed investment conditions, get in touch with us:

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