Photo: E.Mill, 2016 Ghana

Bioenergy for Ghana:

Charcoal Production with efficient kilns – work experience

International conference:
Sustainable Woodfuel Value Chains in Africa: Governance, Social, Economic and Ecological Dimensions

23-25 NOVEMBER 2021, Kumasi. Ghana

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The use of charcoal made from wood or other* biomass

* coconut shells,
* bamboo from plantations
* shrubs & bushes (unwanted invasive plants)
* agricultural residues

Low charcoal price?
Add additional value
by ECO LABELing

Improved charcoal cookers East Africa (good success)

cooking beans

biochar as a soil amendment

wood vinegar ** for eco agriculture

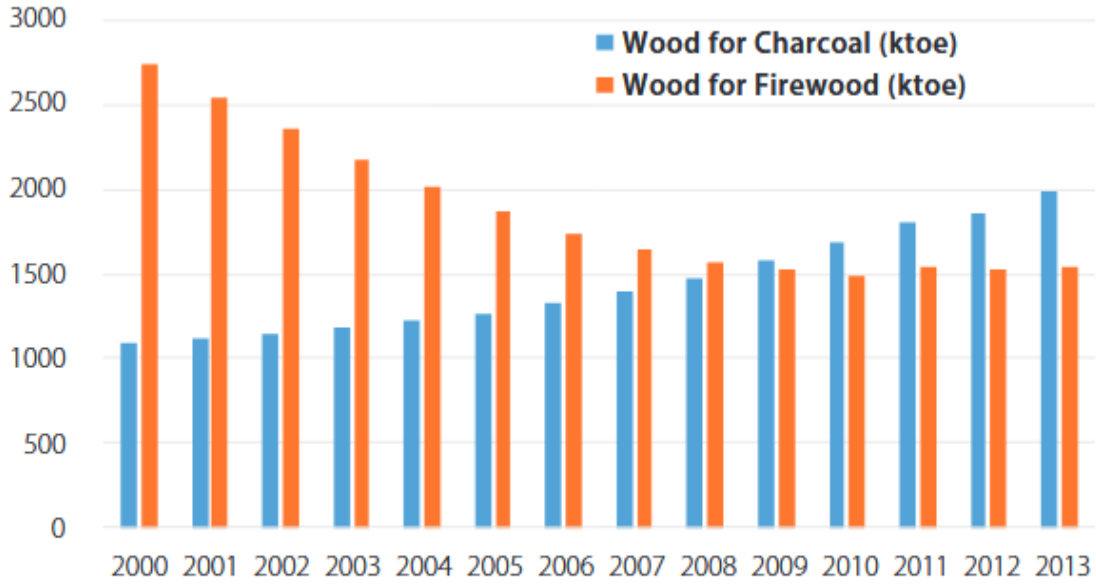
activated **charcoal**

Street advertising in a city of Austria sponsored by the woodworking industry. **1 m³ of wood** that will not be burned or corroded (decayed)- allows the **assimilation of 1 tonne of CO2** - due to the fact that the leaves of a tree during its life metabolize CO2 into oxygen.
A **tree** can be seen as a storage or accumulator of CO2 that would otherwise stay in the atmosphere. If wood replaces a material like plastic that releases additional CO2 during its production, we have a **multiplier** advantage. **www.holzistgenial.at**

About **2 million tons charcoal** or are used per year in Ghana. Ghana's fuelwood consumption is 20.6 million m3. *(NAMA 2014)*
In the West of Ghana, along the Ancobra river, **bambus plantation** from an investment ~60 years ago are available which are not really harvested. **This quickly growing bamboo biomass should be used for energy purpose.**
Its processing could also give an alternative employment for the illegal gold mining in this area which is heavily polluting the Ancobra river.

Nigeria: 2nd largest producer of charcoal after Brazil

Figure 3. Biomass Supply in Ghana (ktoe)

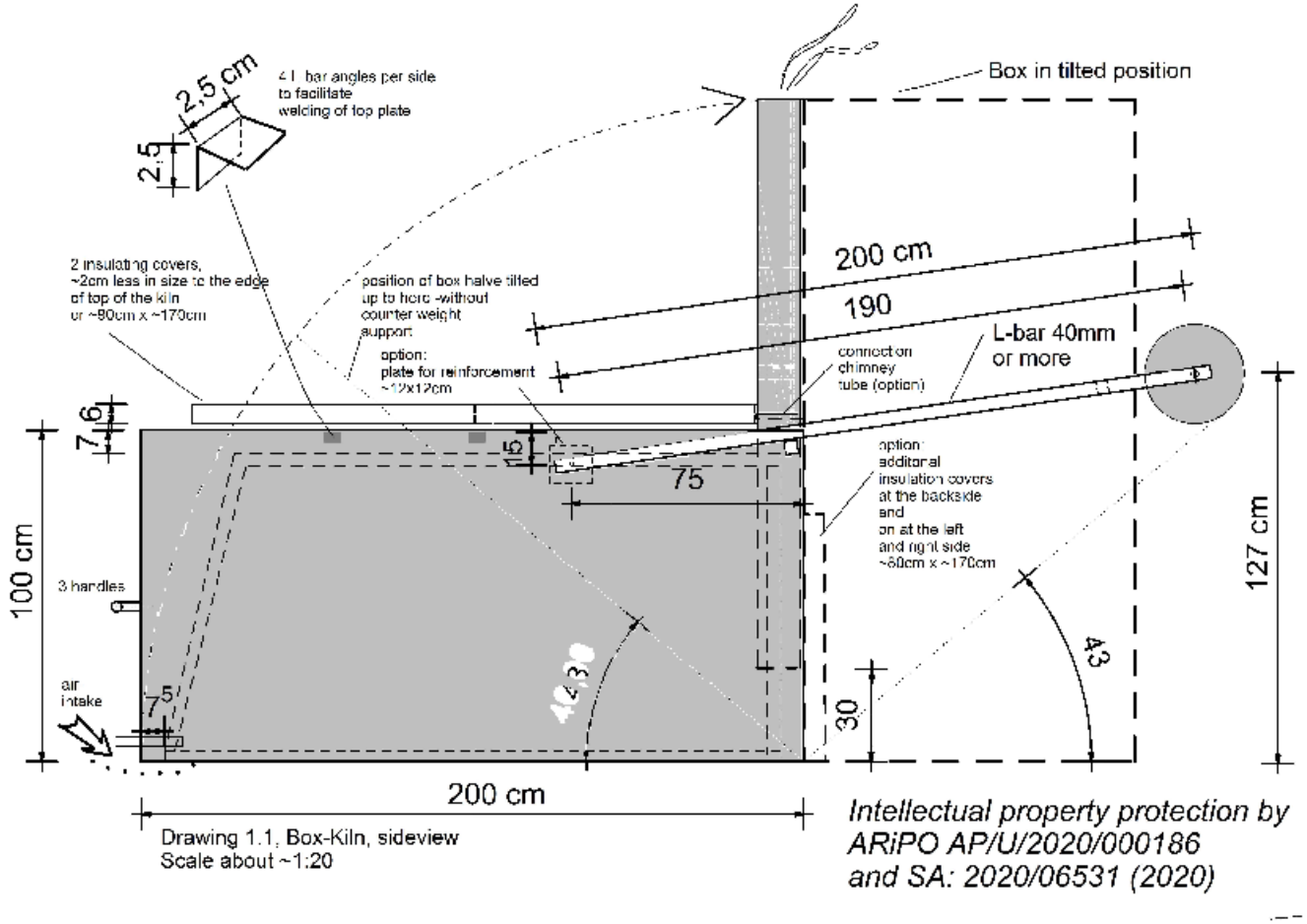


Source: Energy Commission, 2014a.

Box-Kiln, newly developed in 2020.
(protected by Intellectual property protection:
ARiPO AP/U/2020/000186, SA: 2020/06531 (2020) and ET/U/2019/3318)

This newly developed **Box-Kiln** was introduced to Ghana lately this year by the GiZ Project
“FOREST LANDSCAPE RESTORATION BY MEANS OF SUSTAINABLE WOOD ENERGY VALUE CHAINS “
The project is headed by the “*Ministry of Lands and Natural Resources Ghana*”. The project is ongoing and promising results are to be expected.

Round-Kiln (MARK II) Disadvantages	Box-Kiln (adam-design) Advantages
Complicated Construction: needs a sophisticated metal workshop, as a roller-sheet bending machine is needed to bend large metal sheets into a circle shape. Also, a seam is needed to fit the 2 rings together.	**Simple Construction**: simple construction in **any village workshop**, just (extensive) welding and no sheet needs to be cut (option). **No need** to weld a rim which serves as a sealing for a lid.
Operation by more persons: it needs 2 or more persons to lift and remove the lid and upper ring of a round steel ring.	**Operation by a single person:** a single person can tilt the Box-Kiln because of the counterweights to ease tilting.
Biomass (wood) needs **to be cut short into short pieces of different length**- according to the variation of cross-section of the kiln.	Biomass (wood) can be used in **one standard length** (about 1,6 meters).
Medium efficiency which is not really enough to justify and benefit all the investment.	**Higher efficiency** (~30%) because of the top of the Box-Kiln can be easily insulated by a **removable lid/cover**. For a quick cooling, the lid/cover can be removed.
Medium volume (2,5m³) for filling with biomass.	**High volume** for **filling** with **biomass,** about 3,5m² if 1m x 2m metal sheets are used.
Difficult access to recover the charcoal, as the charcoal needs to be taken out from the deep hole if the kiln.	**Easy access** for **loading** the **biomass** and **offloading** of the charcoal, as the box will be tilted upwards to ~90°.
	same	Trials for an **after burner** can be made for a clean combustion of the wood gas.
	same	Box-kiln can be loaded on a pick-up f transport .
	same	Quick construction within a few days.
	same	Workers who are already used to work with a round kiln, will instantly be able to operate a box-kiln .
	none	Already registered under the "**Intellectual Property Law**" to save the project's investment.



Drawing 1.1, Box-Kiln, sideview
Scale about ~1:20

Intellectual property protection by ARiPO AP/U/2020/000186 and SA: 2020/06531 (2020)

- The **Box-kiln** we built in Ghana for the giz does have this dimensions:
- Length: 2 meter
- Width: 1,73 meter
- Height: 1 meter
- Volume: ~3,5m³ ; net Volume actually used: 2,5m³

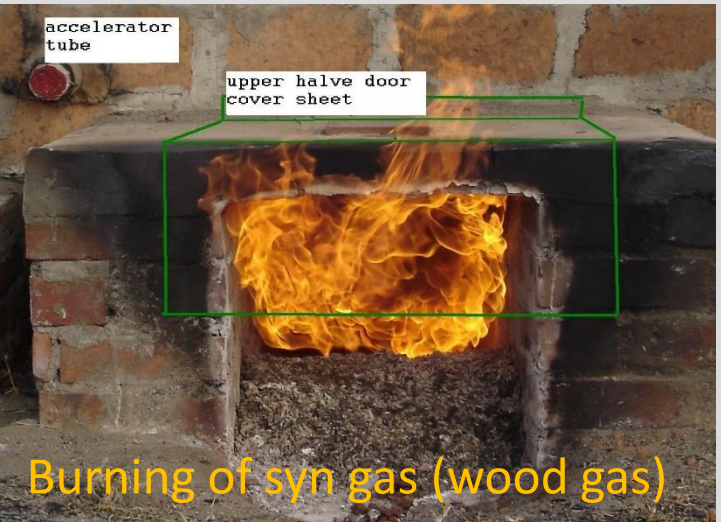
- About ~700kg of wet wood (hard wood) can be loaded.
- Assuming a water content of about 30% (= ~200kg of water)
- About ~**500 kg of wood „oven dry“** can be loaded.
- About ~**130kg of charcoal** can be harvested.
- **Efficiency on dry wood: about ~26%**

- **Operation time** of the Box-Kiln: about 12 hours
- **Cooling time:** about 1 night and ½ day
- **Construction costs:** about 500€ to 900€

Peru
2016

½ (half) number of trees saved !

traditional charcoal production



Burning of syn gas (wood gas)

Only a **Retort Technology** will burn the smoke during production of charcoal
and be herewith much more environmentally friendly.
About a **75% reduction of emission** as compared to trad. Charcoal production.
"ECO-Labeling!" of this charcoal possible!
In a similar project (Eco Consult) methane emissions are around 4.3 kg/t of charcoal produced, which is 5 to 17 times lower than charcoal produced with traditional methods.

A combination of 3 retorts.
A project at the coast near **Axim/ Ghana** for bamboo (www.ankobra-farms.com)

Some of the hot off-gas from the front chimney-2 can be also used for **pre-drying** of wet biomass.

Definition of a **retort**:
it means the smoke and wood gas can be burned, flared thus resulting in **lower** pollution,
Efficiency about 30% on the dry weight.

You don't need trees! Use other kind of biomass

ECO LABEL mandatory for export!

D4S = Design for Sustainability…….
D4S goes beyond how to make a ‘green’ product

- the concept now embraces how best to meet consumer needs – social, economic and environmental -
on a systematic level.

Return on investment? = about one year

“adam-retort”……
Locally built – locally repaired
Local building materials…
Transport? Everything needed for the construction- fits on a pic-up!

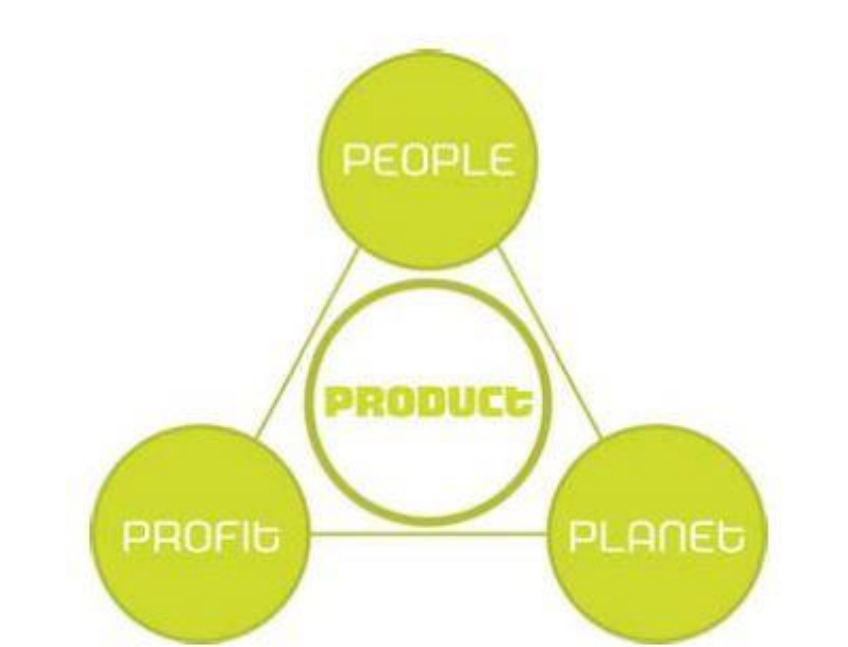


FIGURE 2 ___ PEOPLE, PROFIT, PLANET AND PRODUCT.

Ref.:
“*Design for Sustainability a practical approach for Developing Economies*”
UNEP / University Delft 2005

Alternative biomass: water hyacinth from the lakes ?

About **1 Million ton of charcoal** was used in 2000 (FAO) and about 8 Million of fuelwood.
(**2 Million ton of charcoal** estimated for 2017)

4 main products can be offered from carbonizing bamboo at **Ankobra Frams**:

- High quality **bamboo charcoal** which has export quality
- **Wood Vinegar** which can be used as insecticide and enhancer for ecological & organic farming
- **Biochar** for **soil amendment** (charcoal dust is the base product)
- **Pelleting or briquetting** of bamboo char (household fuel & shisa)

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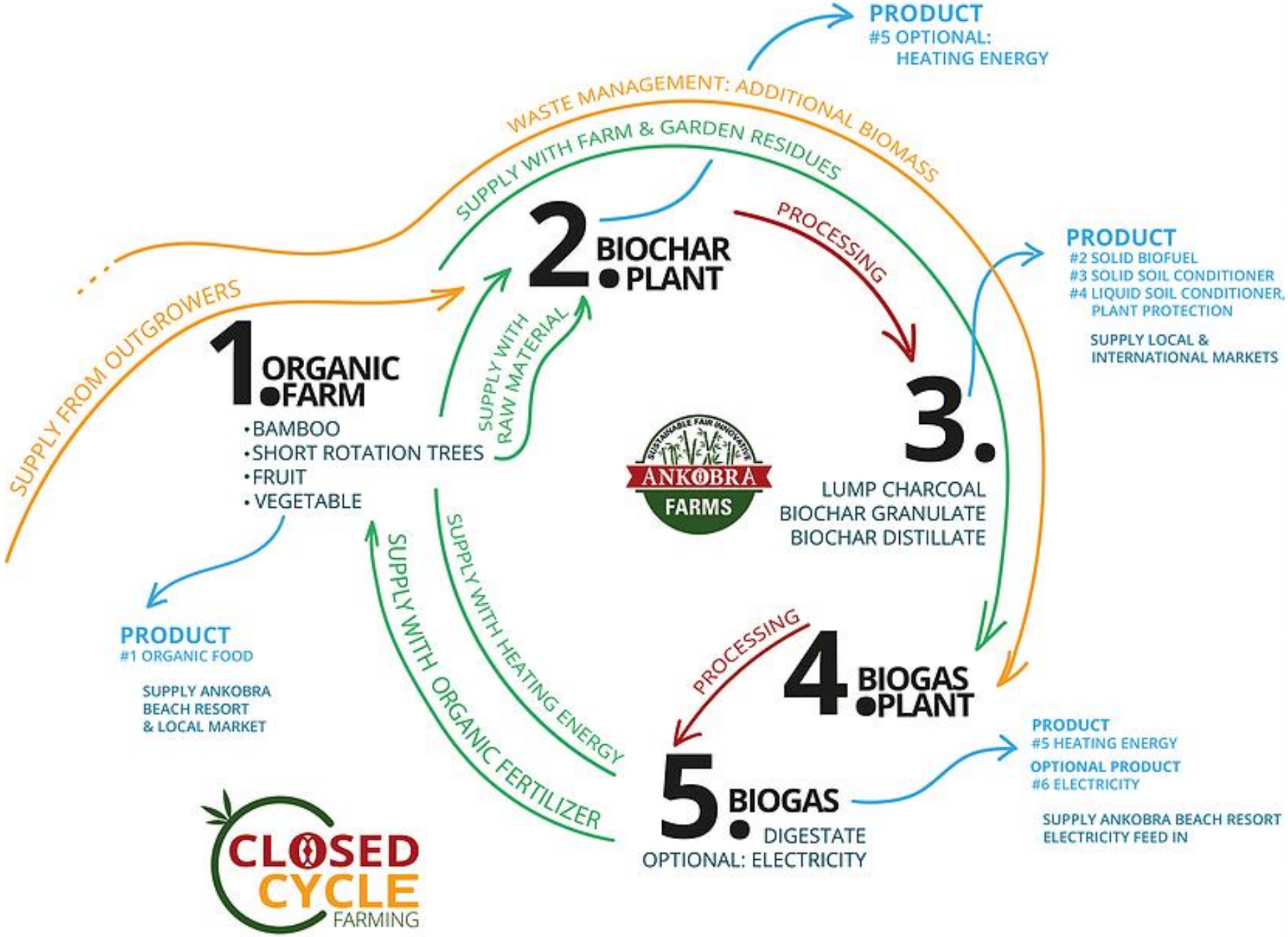
PRODUCT
#5 OPTIONAL:
HEATING ENERGY
WASTE MANAGEMENT: ADDITIONAL BIOMASS
SUPPLY WITH FARM & GARDEN RESIDUES
SUPPLY FROM OUTGROWERS
2 BIOCHAR PLANT
PROCESSING
PRODUCT
#2 SOLID BIOFUEL
#3 SOLID SOIL CONDITIONER
#4 LIQUID SOIL CONDITIONER,
PLANT PROTECTION
SUPPLY LOCAL &
INTERNATIONAL MARKETS
1 ORGANIC FARM
•BAMBOO
•SHORT ROTATION TREES
•FRUIT
•VEGETABLE
SUPPLY WITH
RAW MATERIAL
ANKOBRA FARMS
3.
LUMP CHARCOAL
BIOCHAR GRANULATE
BIOCHAR DISTILLATE
PRODUCT
#1 ORGANIC FOOD
SUPPLY ANKOBRA
BEACH RESORT
& LOCAL MARKET
SUPPLY WITH HEATING ENERGY
SUPPLY WITH ORGANIC FERTILIZER
PROCESSING
4 BIOGAS PLANT
PRODUCT
#5 HEATING ENERGY
OPTIONAL PRODUCT
#6 ELECTRICITY
SUPPLY ANKOBRA BEACH RESORT
ELECTRICITY FEED IN
5 BIOGAS
DIGESTATE
OPTIONAL: ELECTRICITY
CLOSED CYCLE FARMING

DISSEMINATION:
What happened to persons who
got a license (~150) ?

- License to a person for **documentation** (universities) 1/32 (Ugan., Germ., Sowak.)
- License to a person who **never** gave feed back? 1/32 (Israel, Ruan., Mex.)
- License to a person who will build, but did **not yet** build 1/16 (Ken., Philp. Cambo.,)
- License to a person who built- but **abandoned** 1/4 (Indon., S.A., Turk.)

- License to a person **who built and are continuing** **1/2** (Thail., Seneg. Costa R.,)

Spreading to other individuals or communities?

Only Projects are interested in further dissemination to others
(Peru, Mail, Madagascar, Rwanda)

Technology mostly unknown in the country - development of the know-how

Retort kiln technology spreading

Individual who paid for a license, he/she is **not** interested that his/her neighbour gets this technology and becomes a business rival

Network not appreciated!?

Slow spreading of this technology

Peru: too much wood near saw mills, charcoal low value
Mali: civil war
Madagascar: civil war
Rwanda: project finished when retort was ready

Continuous Carbonization System for Bio Mass (CCS)
and
Bio Coal Production Plant (semi-industrial)
and
Continuous Carbonization System-lite (CCS-lite)

Burundi/East Africa 1990

Photo 2: Production hangar, paddle mixer for adding binder left side, roller press (with a staircase for top loading) on the right side, **coffee husks, rice husks** or **wood chips** in front left.

Photo 1 (left): **Moveable hangars** (rain protection) for solar drying of the bio coal briquettes, black heap left backside: peat dust.

Thanking You very much!

- medaase papaapa!

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