



RoCC kilns on

X-Frame Support:

Initial Experiences Kenya 2021-04

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Foreword:

Although almost ten barrel-size rotatable covered cavity (RoCC) kilns have been made, none have been made with the simple X-Frame design. The first draft document of its fabrication was created by Paul S. Anderson, PhD on 8th April 2021.

We fabricated the first two units of the RoCC X-Frame kilns on 15th April 2021 at Kisii University workshop in Kenya using two 55-gallon (200 l) barrels and salvaged metal pieces from shock absorbers, metal seat frames, wheel burrow wheels, metal sheets and square tubes.



NB.

The provided information is covered by a patent (pending) for rotatable kilns. (RoCC™ kilns are not rotary kilns). There are no fees until the person / entity is making a "meaningful" cash flow, at which time some modest but reasonable amount is due to the inventor of the device that is making the income possible.

Field tests:

Biochar for long term sequestration and significant climate benefits

*** On a dry weight basis, each ton of wood or similar biomass can yield about 200 kg of solid carbon (biochar) which represents the removal of 730 kg of atmospheric CO₂. Of that, ~80% (580kg) can be sequestered for many hundreds of years by placing biochar into soils. Every 1.7 thousand tons of biomass can yield enough biochar for the long-term removal of 1000 t CO_{2e}. And there would be potential for up to 7 Gt CO_{2e} removal per year derived from the world's estimated 15 Gt of accessible available biomass.

1. Kisii University.

The first firings were on 16th April 2021 at the University grounds to burn out any old contents and to burn off paints on the barrels. In the afternoon we decided to conduct experimental trials on two locally available feedstocks.

- a) Rice straw.
- b) Underbrush clearings.





From left:

James Ochieku (PhD), Maurice, Zabron, Mika, Dickson and Gilbert.

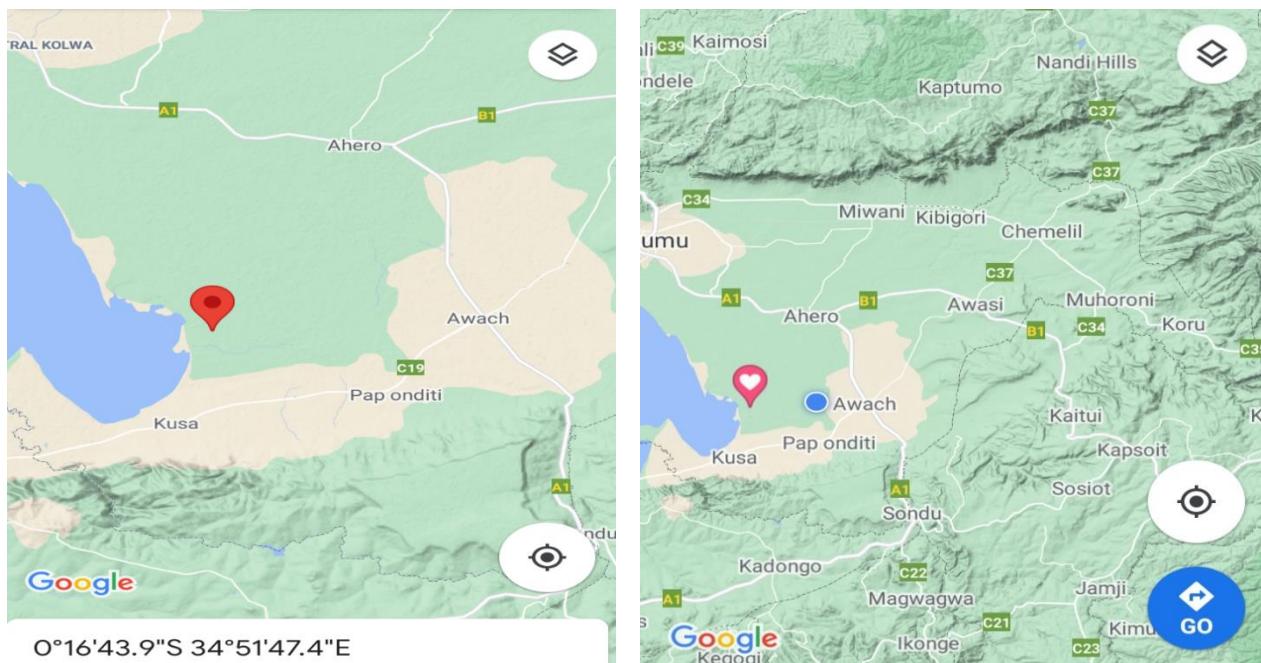


Char from underbrush



Char from Rice straws

2. Lower Nyakach.



We conducted our field tests at the farm of Mr. Zephania Ochiel on two days. His farm is near Kanyalwal Primary School at Wasare Sub-Location, Rangul Location, Lower Nyakach Division, Nyakach Sub-County, Kisumu County in Kenya, on the eastern edge of Lake Victoria.

Our principal feedstock was an invasive Acacia shrub that forms thickets or scrambles over other plants. It has small, single prickles, mostly hooked and scattered along the stems. Its fragrant yellow-white flowers make the shrub very conspicuous during flowering. Locals call it Osiri (*Acacia brevissipa*). The locals have been cutting and burning it to create planting fields.



- Day 1 (20th April 2021)

We travelled from Kisii to Mr. Zephania's farm on 20th April 2021. He has two farms within the area with the most accessible having his home and the other sandwiched between River Nyando and Lake Victoria. The latter was our principal focus because of availability of feedstock of both Acacia brevipes and soya beans stalks. After a courtesy call at Zephania's home we had to take our RoCC kiln to the other farm to make biochar.

Unfortunately though the land was dry, the roads were impassable and our 4×4 track could only make it up to Miruka Primary School which is 2 Km from the farm. The ability that the RoCC kiln can be pushed or pulled like a wheel barrow was a great help especially on this environment. We arrived at the farm 14:00 hrs having travelled on cattle tracks and over River Nyando by a footbridge and worked for two hours leaving our kilns there to get back to spend our night at Katitu.



- Day 2 (21st April 2021)

There had been some rain during the night necessitating a need for gumboots on this day. We were accompanied by two members of staff from Kenya Marine and Fisheries Research Institute who had come to take soil samples at our target plots of land at Lower Nyakach and Ahero for soil analysis prior to biochar application. To our surprise, fields we had passed through the previous day were now flooded and on a certain stretch we had to seek services of a canoe. It's surprising that the stretch of watermass flows perpendicular to River Nyando leaving a dryland between them 200-700 meters wide. Across River Nyando where the farm is situated is never affected by floods and was formerly a rice plantation. There are times when floods force locals to be ferried by boats from Miruka Primary School. That's why there are no homesteads built on the affected parcels of land on this stretch.





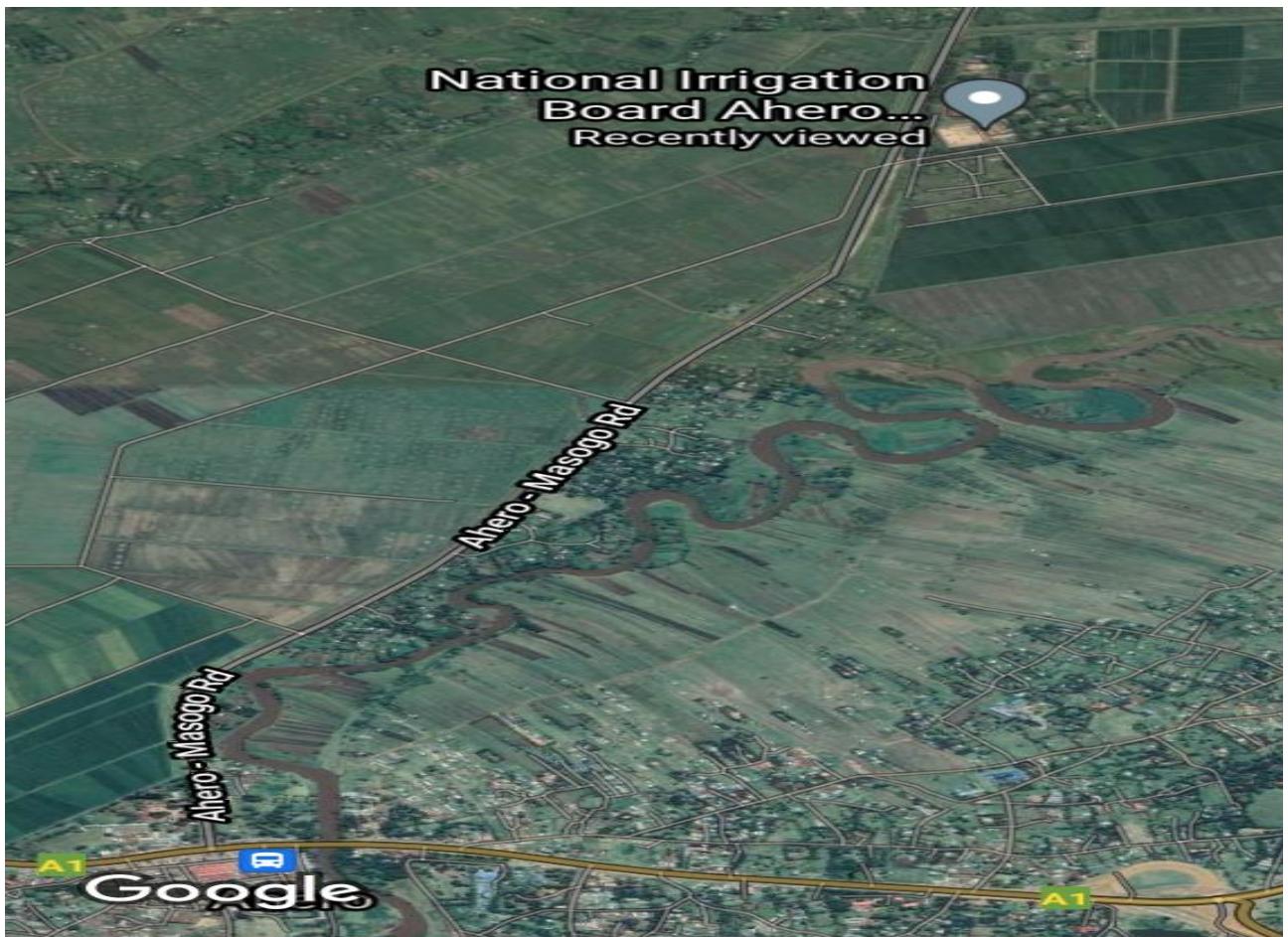


Our conclusions

- 3 people can produce 100kgs of biochar from *Acacia brevispica* in a day using a RoCC kiln. One person collects / sources the brush that was cut previously and left to dry, the second chops to manageable sizes and the last one feeds the kiln. A larger RoCC kiln would result in less size reduction needed.
- Where the *Acacia brevispica* has been cut and chopped to size while still green and then left to dry, the production of biochar by two persons is expected to be above 200Kgs in a day, in part because the RoCC kiln can be rolled closer to the biomass even while pyrolyzing the biomass.
- Our production average with the RoCC kiln was 12kgs of *Acacia brevispica* biochar in 45 minutes which depends on sourcing, chopping and feeding.
- Two persons can produce 5 Kgs of Soyabean biochar in an hour.
- Two persons can produce 40KG of Soyabean biochar in a day.
- 1-5 kg of soya bean biochar can be applied on an area of 1 m square.
- 2 people in 30min produce 12kg of Osiri biochar.



3. Ahero



The Ahero Irrigation Scheme is located in Kano Plains between Nandi Escarpment and Nyabondo Plateau. It is managed by the National Irrigation Authority and situated in Muhoroni Sub-County of Kisumu County in Kenya. It was established in 1966 on a gazette area of 4,176 acres with 2,586 acres under basin irrigation from River Nyando. It has 570 farm holders, 2,000 farmers and 20,000 dependents. In addition to rice, crops like soybeans, tomatoes, watermelon, maize, cowpeas and sorghum are grown.

The National Irrigation Authority through a Community Based Organization (CBO) named Arise and Shine Community Centre had offered a plot of land to train and make biochar for soil amendment. We performed these tasks on 22nd & 23rd April 2021 with rice husks obtained from milled rice at the Western Kenya Millers premises which is a subsidiary of the National Irrigation Authority and rice straws from the neighboring Ahero Irrigation Scheme.

a) Rice straws.



Results:

- On average 30Kgs of dry rice straws produced 8Kgs of biochar in 30 minutes.
- One person could produce 100Kgs of biochar using the RoCC X-Frame kiln in a day.



b) Rice husks



Results:

- Lighting a fire directly on a mound of rice husks is not successful because it takes a lot of time for them to carbonize.
- Its possible to produce biochar from rice husks by starting a fire with dry firewood in a RoCC kiln and then controlling the steady feed of rice husks into the kiln.
- For feeding the rice husks, use a piece of sheet metal as a fuel-holding shelf at the portal of the RoCC kiln. Continually push moderate amounts of rice husks from the shelf into the RoCC kiln, allowing the air and the flame cap to pyrolyze the rice husks quickly. Note: A mechanical means to feed the fuel would be possible.



- The initial experience with 42 kgs of rice husks produced 18 kgs of biochar in 36 minutes [30 kg/hr] where a fire is lit and sustained in the RoCC kiln.
- The biochar obtained from rice husks is very dense.
- Note: The RoCC kiln use in this experiment and seen in these photos was the initial (November 2019) RoCC kiln built with a rack with roller wheels and discussed in the report available at: <https://woodgas.energy/wp-content/uploads/2020/12/4C-Kiln-Char-Production-Notes-Kenya-2019-11-20.pdf>





