‘Sustainable alternative fuels from crop for ILC-Calciner Kiln ’

Prof.Dr.Habil: Satyanarayana Narra 1, Prof.Dr: Komi Agboka 2 , PhD.C Essossinam BEGUEDOU 3, Prof.Dr: Mani Kongnine Damgou 4

1,3 Department of Waste and Resource Management at the University of Rostock. - GERMANY
2,4 West African Service Center for Climate Change and Adaptive Land Use (WASCAL) from University of Lomé in Togo.

Abstract:

Togolese clinker green plant is one of west-African Industry who is dealing with high energy costs, about 3,74€/GJ as landed cost, and resources scarcity in Togo, most of the fuels used as heating in pyro-system must be imported from oversea countries. Even if raw material such as oil exist, the countries, like Togo of lacking the processing infrastructure. At the same time, fossil fuels come with negative social and environmental impacts with highest CO2-emissions of about 336 kg CO2/t clinker, making them also less attractive in the local markets.
Therefore, by building sustainable structures around the local production and sourcing of biomass as alternative fuel, the dependency on imports can be substitute by a home-grown energy production sector with this Pennisetum crops trial project for 10 ha give us about 4,25% of daily raw fuel substitution. This given the lower costs of production arrow 1,87€/GJ, the co and pre-processing application and logistics expenses was arrow 0,34€/GJ, the local production has a significant cost advantage. To avoid the CO and NOX interlock tripping, the kiln ID-fan damper and cooler has been increased from 75,9% to 76,5% and the tertial air duct damper also get some change 57%-64%.

KEY WORD: Pennisetum, Co-processing, Pre-processing, ILC-Calciner, crops, clinker plant

Introduction:

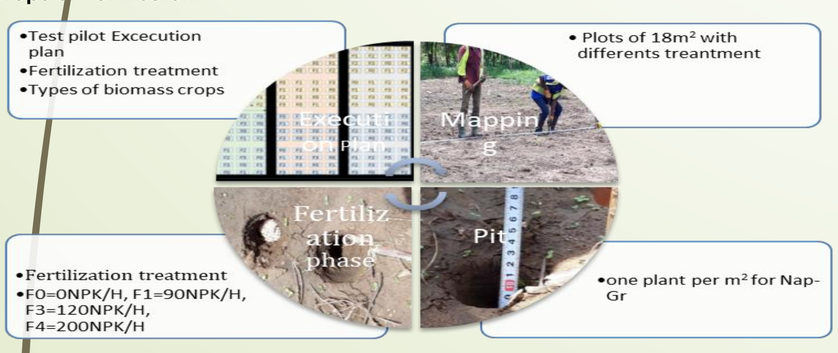
The construction material sector, in Togo, west-Africa and worldwide, has a huge demand for energy. In late 2021, the estimated mass of human-made constructions surpassed the biomass of all living things on earth. One huge tributary to this “anthropogenic mass” is concrete (Elhacham et al., 2020).
Currently, most of the energy demand for cement kilns is being met by energy from fossil fuel sources (coal, diesel, mostly). Innovative concepts for the reductions of this industry sector´s impact on global greenhouse gas emission must be identified, adapted, and implemented. These could range from technical solutions like natural carbon-capture strategies by Pennisetum crops, improvements in the energy efficiency of the clinker plants itself, or by adapting carbon-neutral fuel sources as energy source to replace some of the high carbon-fuels needed for the clinker production process. With the trialing action presented here, we aim integrating of renewable biomass-based energy resources into the value chain for cement kilns co-processing.
By adapting existing crop management schemes, harvest, and post-harvest technologies to the regional background conditions, the clinker green plant demonstrate the adaptability and conception of these biomass-based renewable energy systems to different scales of implementation, from smallholder-based over cooperative to industrial scale. Pennisetum purpureum crops is to offer possibilities to meet peak demand. Management principles from conservation agriculture aim to increase mid-term buildup of topsoil and soil-carbon pools, and measures to identify and protect remaining biodiversity hotspots within the landscape context are considered.
The integration of farmers’ cooperatives and NGOs into the process facilitated the dissemination processes and support the uptake and implementation of this trial project system.

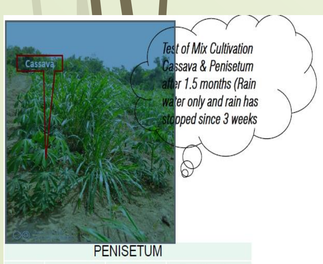
MATERIAL AND METHODES

❖ **PENNISETUM AND CASSAVA CROPS PREPARATION**

❑ Fertilization treatment:
The fertilizer NPK was used in different dosing in the plot of 18m2,
❑ Fertilization Application:
The application of the fertilization was on two way
❑ Irrigation:
The season in the south of have good rain season this was one advantage for no irrigation of the biomass during crops.
Type of biomass crop used:
a) Pennisetum purpureum was crop on 7ha.
b) Mix of Pennisetum purpureum and cassava in 03ha.

❖ **Startup of crops of Pennisetum**





PENISETUM

	Height mm	Diameter mm	Fertilization treatments (NPK/ha)
F0	3400	250	0
F1	3500	230	0
F2	3550	260	0
F3	3700	250	0

Status of Elephant Grass (Penisetum). Stem **diameter** more than 25mm.

PENISETUM

	Height mm	Diameter mm	Fertilization treatments (NPK/ha)
F0	3400	200	0
F1	3500	220	90
F2	3550	300	120
F3	3700	300	200

Status of Elephant Grass (Penisetum). The measuring **diameter** is more than 30mm.

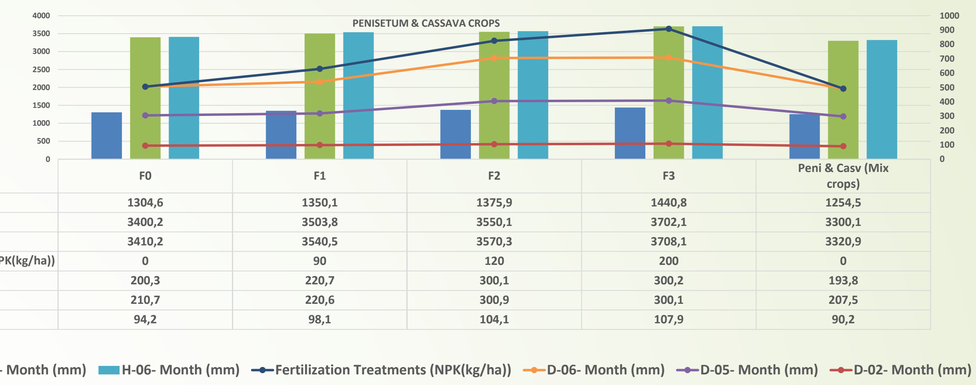
RESULTS AND DISCUSSIONS

• CROPS DEVELOPMENT PROCESS

The data collection shows the fast growth of F3 plots, the length in deux month was 1440,8 mm the diameter is 107,9 mm in average, with only with the rain as others.
The mix crops Pennisetum and cassava plots have the slowest growth H=1254,5 mm as length and D=90,2 mm as diameter.
The F0 growth was H=1304,6mm as length and D=94,2mm diameter, from this deux types of plots we can conclude that the fertilization treatments have an impact on the Pennisetum crops.

• COST ANALYSES

The different treatment of the sol let us have a variation in expenses.
F0=2,39 euro/Gj is the lowest expenses because of no treatment of the sol with fertilizer and no mix growth.
The mix culture is the highest expenses, 4,48 euro/Gj, by considering the cassava ou tput which is about 3,7kg/m2 the mix plot crops was lowest expenses. Considering our data, the growth of the mix crops (Pennisetum and cassava) is the suitable for scarcity of the food in Togo.
The tree types of plots F1, F2, F3 expenses are 2,55euro/Gj, 2,40euro/Gj, 2,92euro/Gj all plots have good output due to soil fertilization with no combination, this let us have a scarcity of food in the society, same as F0 plots



	F0	F1	F2	F3	Peni & Casv (Mix crops)
H-02- Month (mm)	1304,6	1350,1	1375,9	1440,8	1254,5
H-05- Month (mm)	3400,2	3503,8	3550,1	3702,1	3300,1
H-06- Month (mm)	3410,2	3540,5	3570,3	3708,1	3320,9
Fertilization Treatments (NPK(kg/ha))	0	90	120	200	0
D-06- Month (mm)	200,3	220,7	300,1	300,2	193,8
D-05- Month (mm)	210,7	220,6	300,9	300,1	207,5
D-02- Month (mm)	94,2	98,1	104,1	107,9	90,2

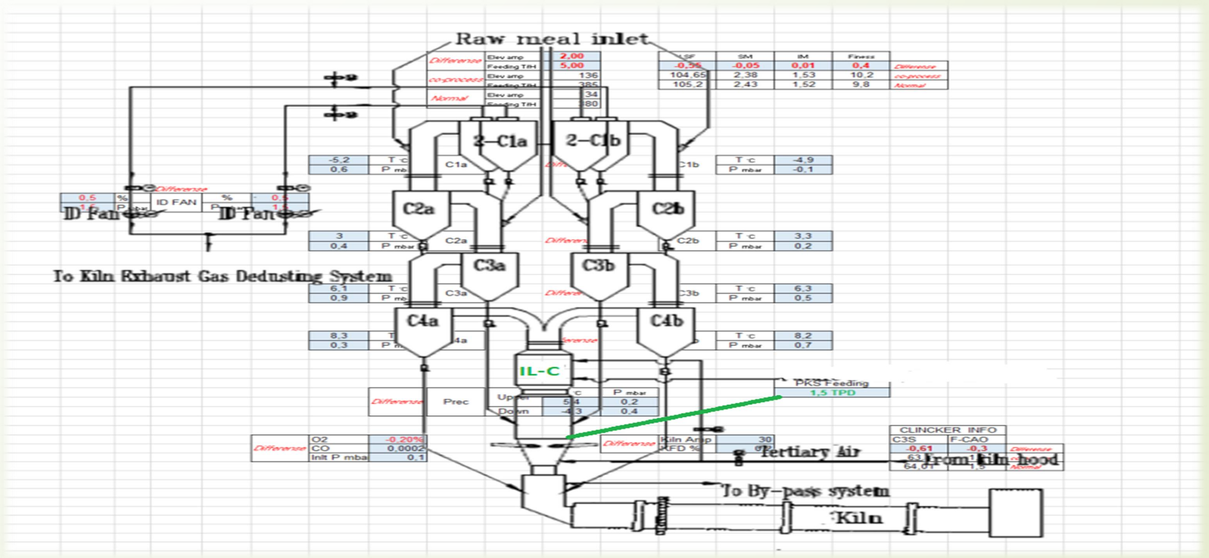
H-02- Month (mm) H-05- Month (mm) H-06- Month (mm) Fertilization Treatments (NPK(kg/ha)) D-06- Month (mm) D-05- Month (mm) D-02- Month (mm)

COST ANALYSES FIGERS

Pennisetum	Fertilization degree	Biomass crops expenses	Harvast + sherdded cost	Sherdded Penisetum (kg/m2)	Sun drying (kg/m2)					Biomass crops Landed cost without laboratory moisture (Euro/Gj)		
	Kg/ha	Euro/m2	Euro/m2	Plot A	Plot B	Plot A	Plot B	% moisture	Plot A	Plot B	AVG
F0	0	0,085	0,046	7,45	8,05	3,85	4,52	46,09%	2,33	1,99	2,39
				7,15	7,75	3,64	3,45	52,29%	2,47	2,61	
				8,05	8,12	4,01	3,34	54,53%	2,24	2,69	
F1	90	0,11	0,052	8,05	8,05	4,34	4,54	44,84%	2,56	2,45	2,55
				8,25	8,73	4,59	4,76	44,92%	2,42	2,34	
				8,11	8,14	4,01	4,02	50,58%	2,77	2,77	
F2	120	0,12	0,054	8,45	8,65	4,65	4,56	46,13%	2,39	2,44	2,40
				7,95	7,95	4,95	4,79	38,74%	2,25	2,32	
				8,35	8,19	4,85	4,65	42,57%	2,46	2,57	
F3	200	0,14	0,067	9,45	8,05	3,95	4,06	53,88%	3,02	2,94	2,92
				8,15	8,75	4,92	5,01	41,19%	2,43	2,38	
				8,65	8,25	4,45	4,03	49,85%	3,19	3,52	
Penisetum + Cassava	0	0,092	0,041	4,36	4,05	2,01	2,04	51,76%	4,54	4,47	4,48
				3,15	3,75	2,1	1,90	41,33%	4,35	4,80	
				4,05	4,15	2,05	2,15	48,79%	4,45	4,24	

• OPERATION ANALYSES

The consequence of coprocessing in overpower consumption can be expressed as 0,21euro/Gj



CONCLUSION

As populations increase in TOGO, so having scarcity of the food, energy and so does the need for more cement and concrete for housing and the infrastructure of development. The properly managed use of alternative fuels in cement kilns can help home done energy while contributing to the sustainable development of our country.
The mix crops of energy end food are the suitable project that can deal with technical, and social- environmental aspect.
The start-up used of Pennisetum as alternative fuel, it was necessary for us to eliminate its negatives and bottlenecks related to their co-processing this help us to minimize negative impact on clinker quality and kiln performance.

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PhDC: Essossinam BEGUEDOU
essossinam.beguedou85@gmail.com
Essossinam.Beguedou@hcafrica.com