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Tropical agro-wastes for environmentally friendly non-load bearing bio-composites and comparative analysis with wood panels

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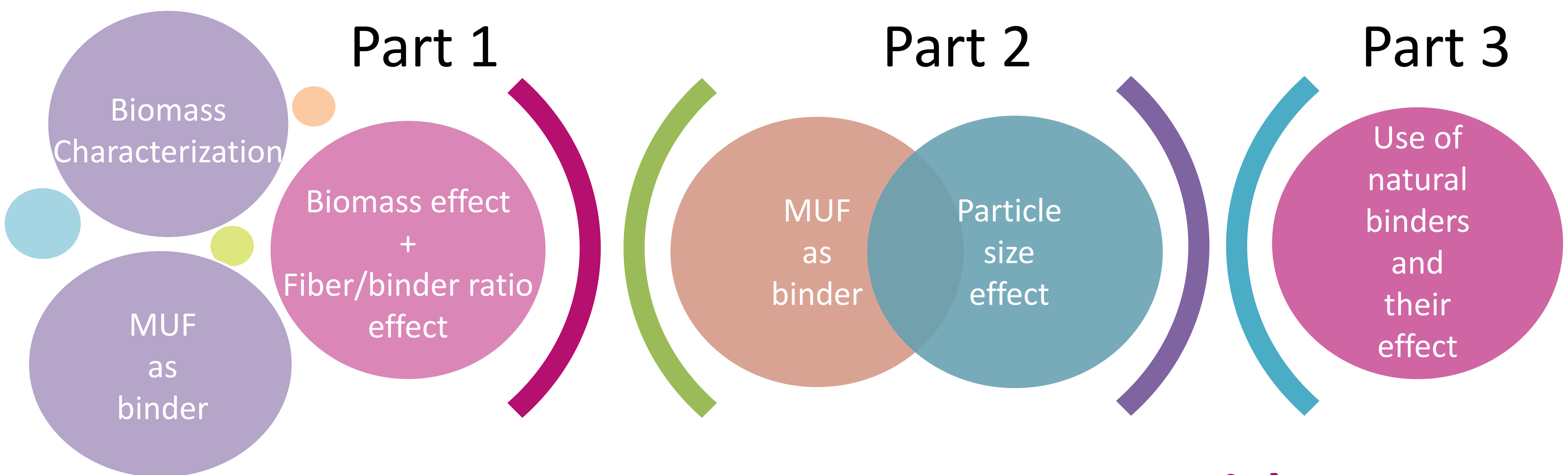
Context

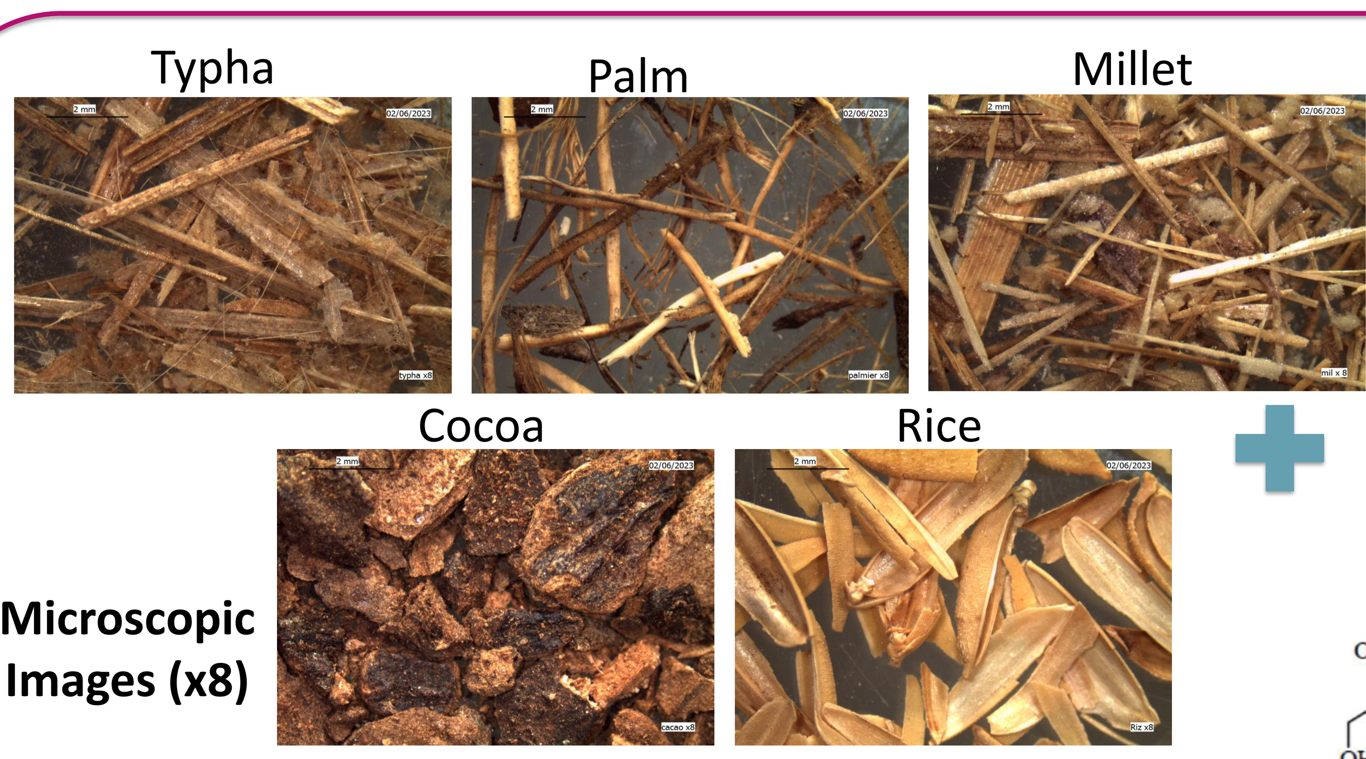
- Cote d'Ivoire is the first cocoa bean producer in the world with 2.200.000 thousand tons which is equivalent to 50.25 billion pod husks.
- Incorporating agricultural waste into biocomposite production is advantageous, as these waste materials lack nutritional value and are often abandoned in plantation areas **[1]**, posing disease risks **[2]**.
- Within the BIO4AFRICA project, five types of agricultural waste: cocoa pods, millet stalks, oil palm empty fruit bunches, rice husks and typha, are mixed with a binder to create medium-density fiberboards for non-load-bearing applications.

Main objectives



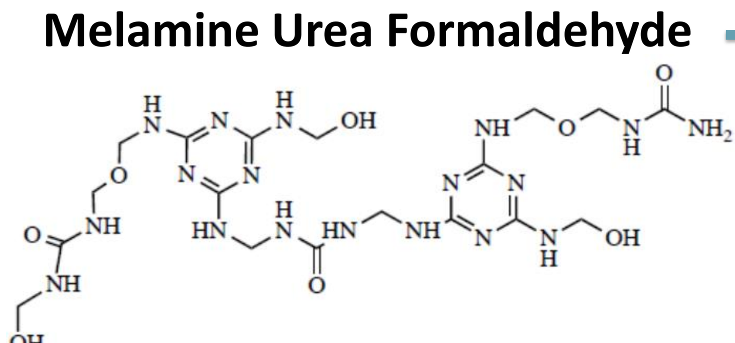
- Panels produced will be compared with wood particle boards
- Characterization tests will be conducted on both biocomposites produced and control wood particle boards

Materials



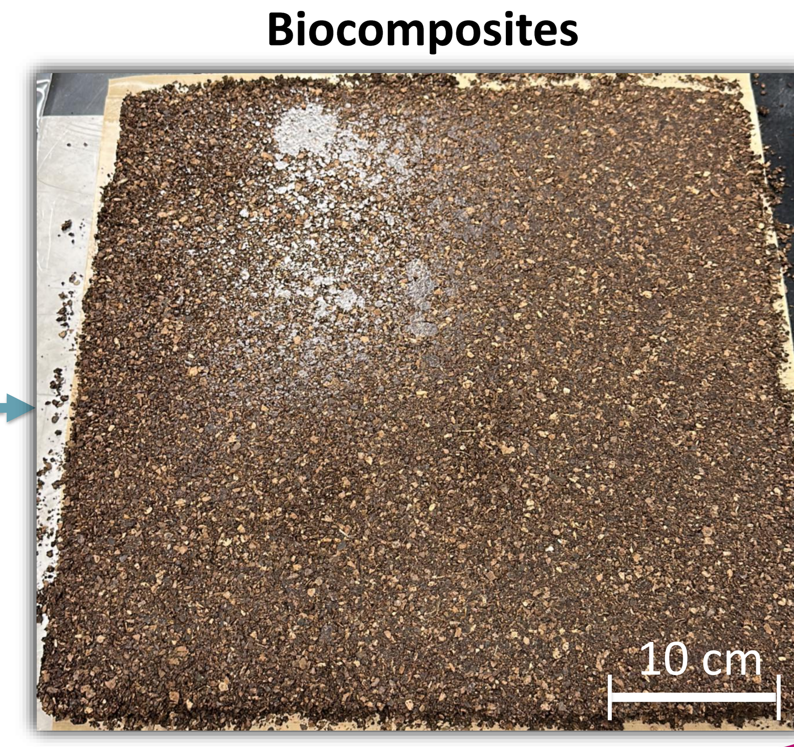
Microscopic Images (x8)

Melamine Urea Formaldehyde

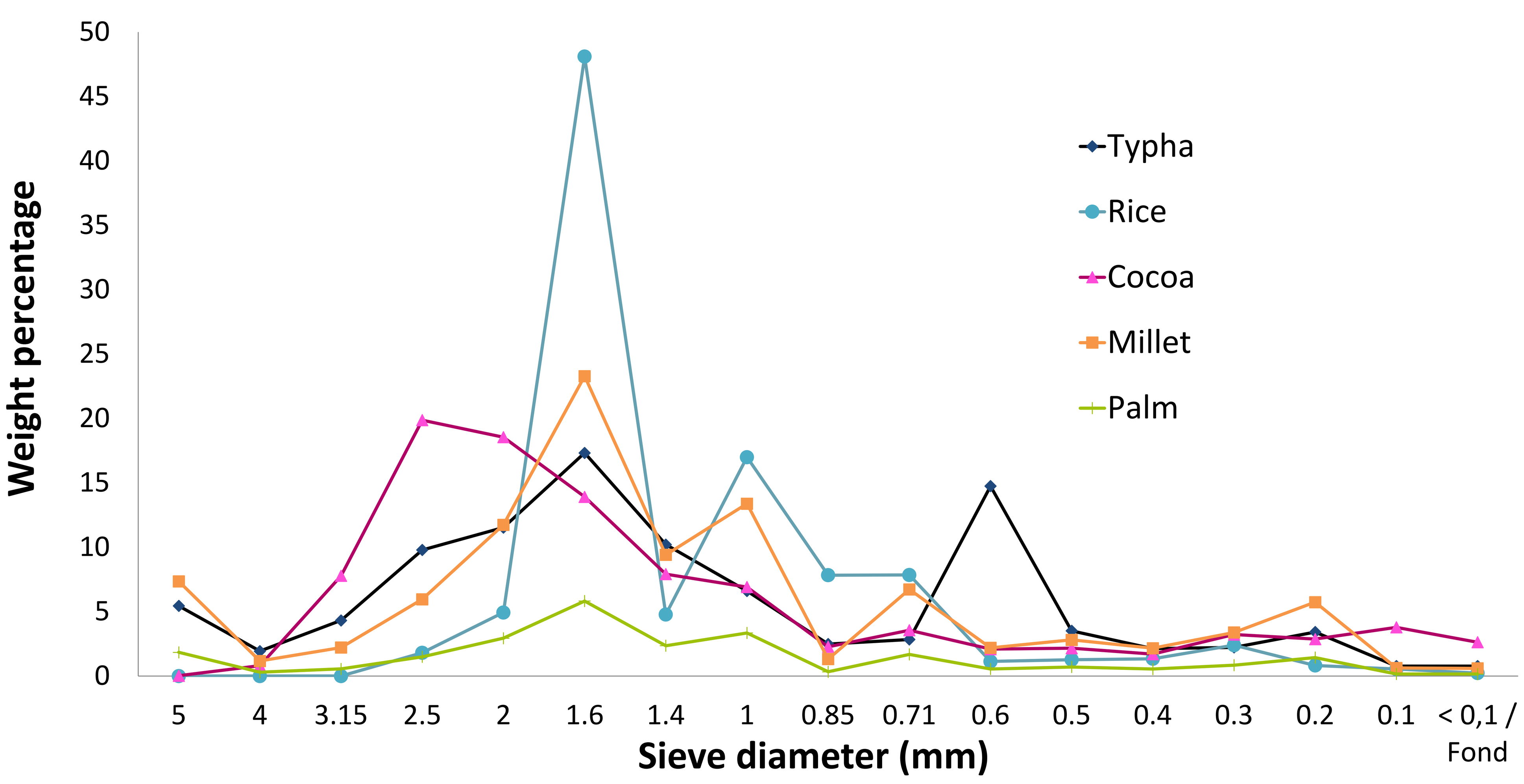


Thermopress

Biocomposites



First results on biomass characterization



Biomass particle size distribution

Biomass	Apparent density (kg/m³)	Real density (kg/m³)	Humidity (%)	Main Constituent loss (%) TGA	Degradation temperature (°C)
Cocoa	484.7	298.4	5.5 ± 0.1	52 ± 2	317 ± 3
Millet	93.6	123.0	5.9 ± 0.1	59 ± 2	317 ± 4
Palm	157.1	127.3	4.8 ± 0.1	64 ± 1	318 ± 5
Rice	150.7	148.3	4.9 ± 0	58 ± 2	348 ± 2
Typha	65.9	132.6	4.3 ± 0.1	62 ± 3	333 ± 4

Main properties of the different biomass

Conclusions

- Cocoa particle distribution is centered around 2.5 mm → related to highest lignin content.
- Rice is the most thermal stable → related to highest silica content.
- Different fibers/binder ratios were carried out to produce biocomposites materials.
- Obtained biocomposites present a resilience value around 1.5 ± 0.3 whatever the fibers/binder ratio and a significant water absorption which is less pronounced for the 60/40 biocomposite.

Perspectives

- The next step is finalizing the protocol to fabricate and characterize the biocomposite materials.
- The particle size will be studied and will have a significant effect on the material properties.
- Natural binders will be incorporated to substitute MUF and to produce a fully biobased biocomposite.

References

[1] Abdul, H. P. S., *et al.*, Oil Palm Biomass Fibres and Recent Advancement in Oil Palm Biomass Fibres Based Hybrid Biocomposites. Composites and Their Applications, 2014.

[2] Veloso, M. C. R., & *et al.*, Sustainable valorization of recycled low-density polyethylene and cocoa biomass for composite production. Environmental Science and Pollution Research, 2021

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