BIOSTAR
DES BIOÉNERGIES POUR LES PME D'AFRIQUE DE L'OUEST

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Characterisation of West-African agricultural waste as feedstock for biochar production in a circular economy context

Dupont, C., Sharma, N., Bedzo, O., Ndyaye L., Himbane, PB., Radbeau, B., Nganwani, M., Yao, B., Campargue, M., Commandre, JM.

IHE Delft

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This project has recieved funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101000762

Biochar value chain from “dry” biomass

Dry resource

Grinding

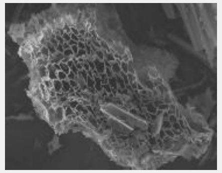
- 300-700 ° C
- Heating rate: 1-10 ° $C.min^{-1}$
- Absence of O_2
- Atmospheric pressure

Pyrolysis

Volatile matter
- Gas (CO, CO_2, CH_4…)
- Condensates (water, tars)

Biochar

- ✓ *Carbon-rich*
- ✓ *Porous*

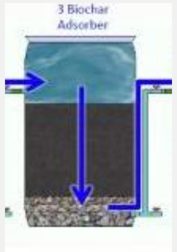


Biochar upgrading

Fuel

Soil improving material

Water/gas filtration



Anaerobic digestion

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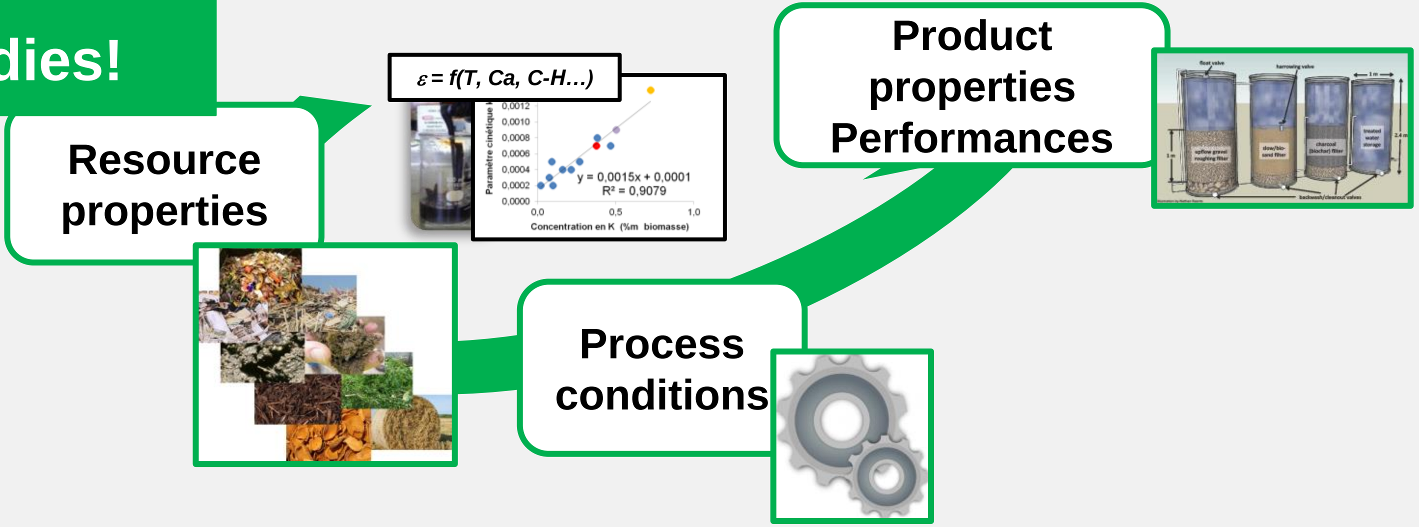
Technical challenges towards biochar value chain implementation

- Design **efficient & robust & cheap** technologies
- Recover **byproducts**

- **Understand the link resource/process/product**

Lack of systematic studies!



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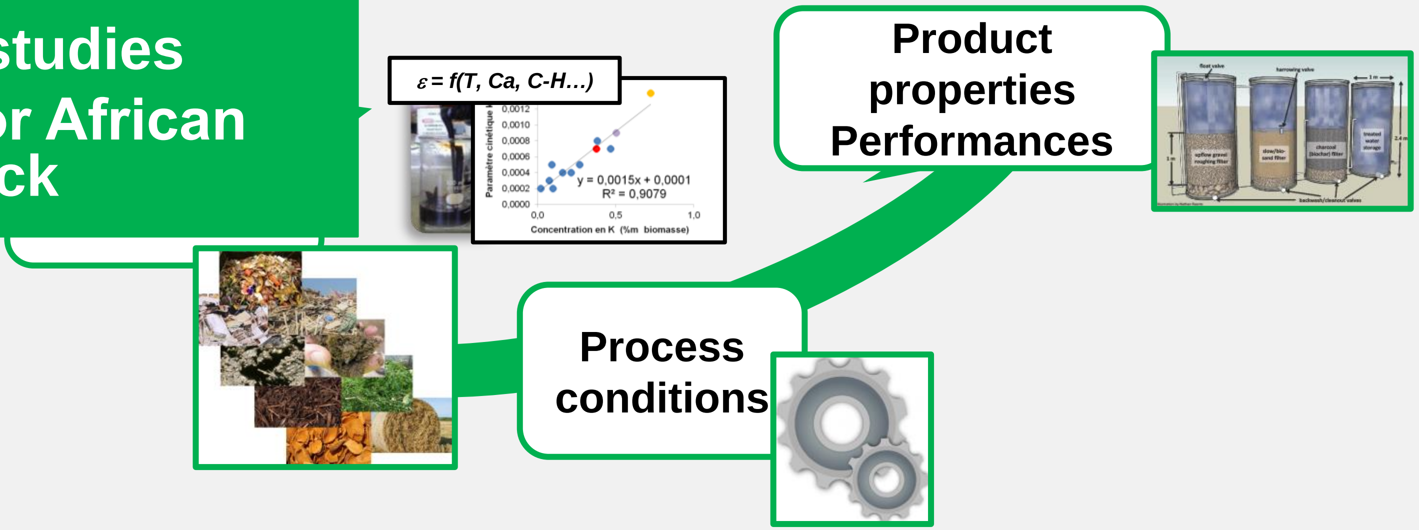
Technical challenges towards biochar value chain implementation

- Design **efficient & robust & cheap** technologies

- Recover **byproducts**

- **Understand the link resource/process/product**

Lack of systematic studies …especially for African feedstock



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Objectives of the study

Provide an extensive physico-chemical characterization of lignocellulosic biomass with high potential in Western Africa as feedstock for biochar production

- Sample selection and collection
- Sample physicochemical characterization
- Assessment of biomass suitability with biochar production

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Methodology

- 28 samples selected based on a database of potential availability of biomass in:
  - Senegal (UASZ)
  - Côte d’Ivoire (INP-HB)
  - Ghana (Savanet)

Includes samples of the same biomass from different countries/collection points

- Collection of samples

- Characterization according to EU standards on solid biofuels (CELIGNIS laboratory) → more than 20 physico-chemical properties/sample

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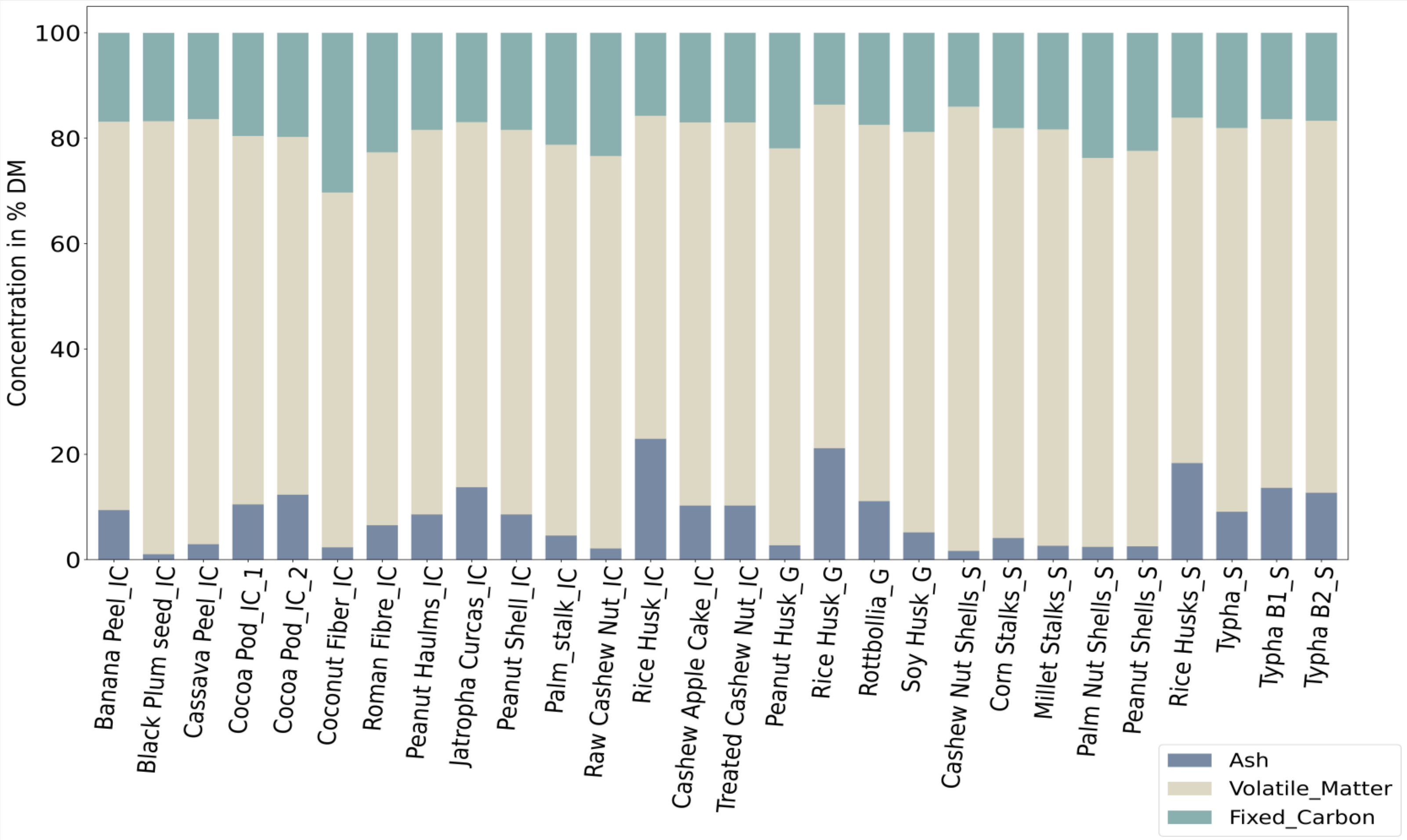
Proximate analysis



SD < 1 %DM

- Trends as expected for lignocellulosic biomass
- Ash content from 1 to more than 20%DM (rice husk)
- Slight differences due to country origin/collection point
- Feedstock with the highest fixed carbon, the most suited: coconut fiber, palm nut shells, peanut shells

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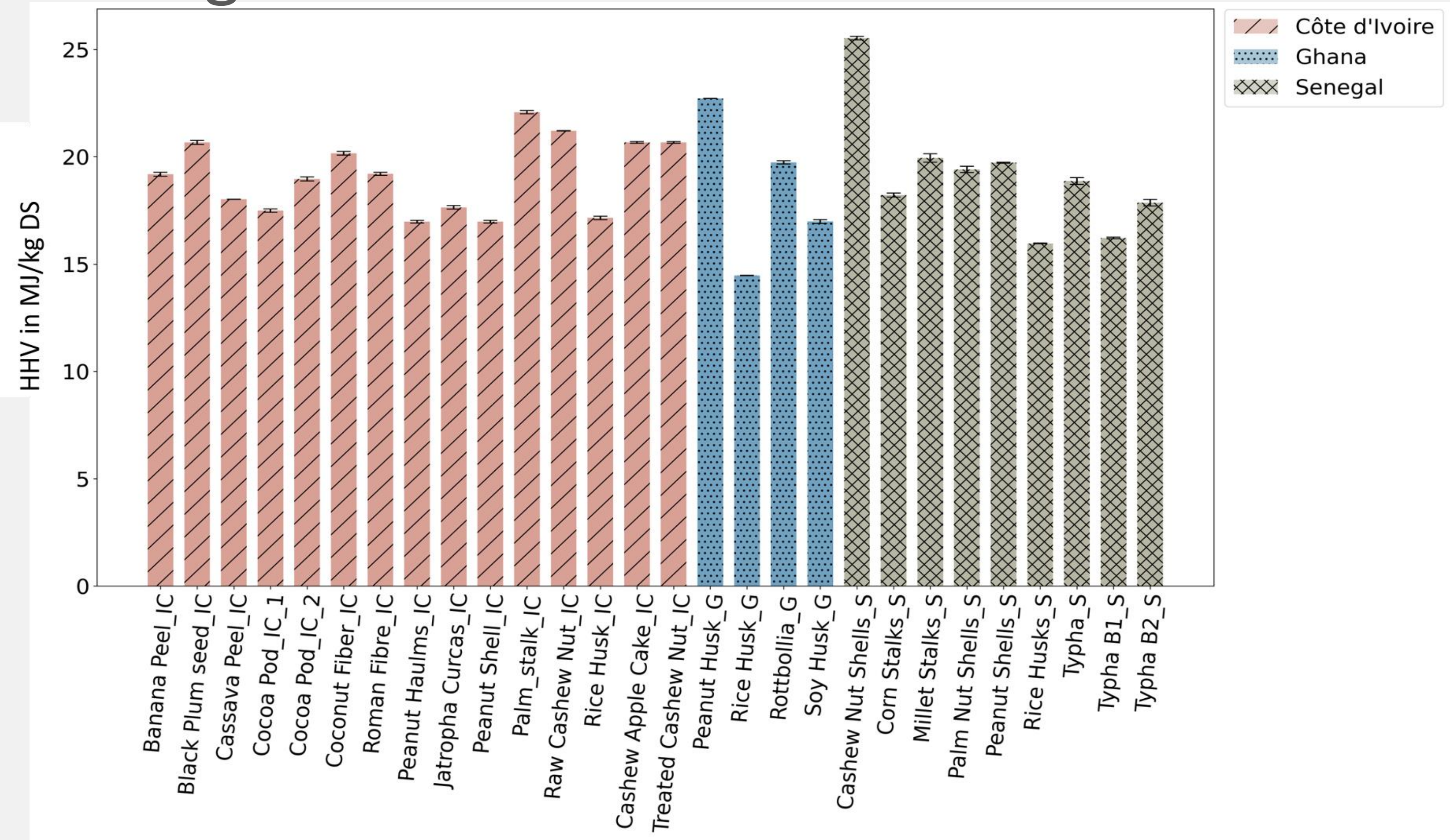
Higher Heating Value



- Expected range for lignocellulosic biomass: 15-25 MJ/kg DS
- Differences due to ash content (rice husk) and extractive content (cashew nut shell)
- Slight differences due to country origin/collection point
- If used as solid fuel (directly), most suited biomass: black plum seed, palm stalk, peanut husk

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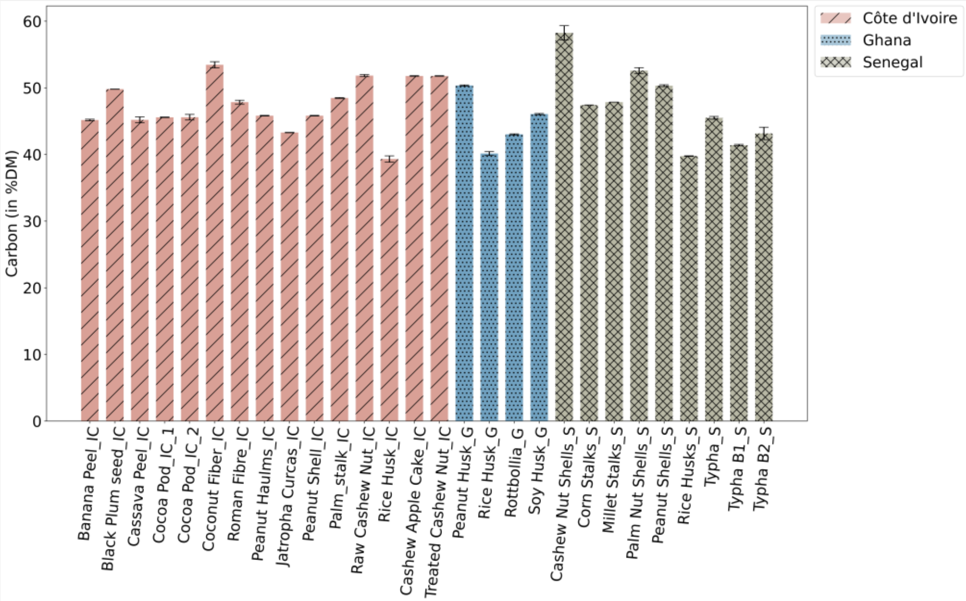
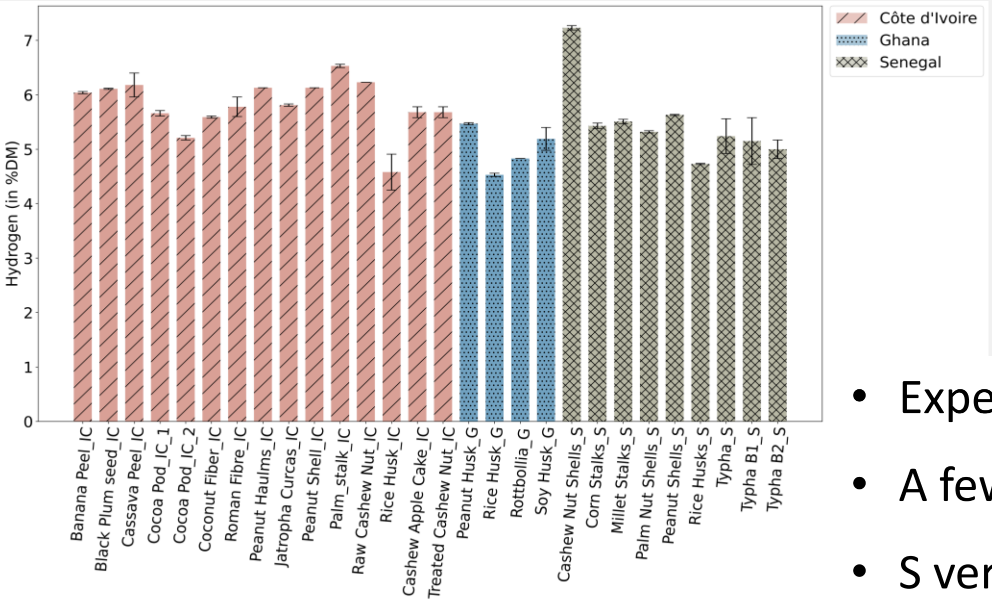
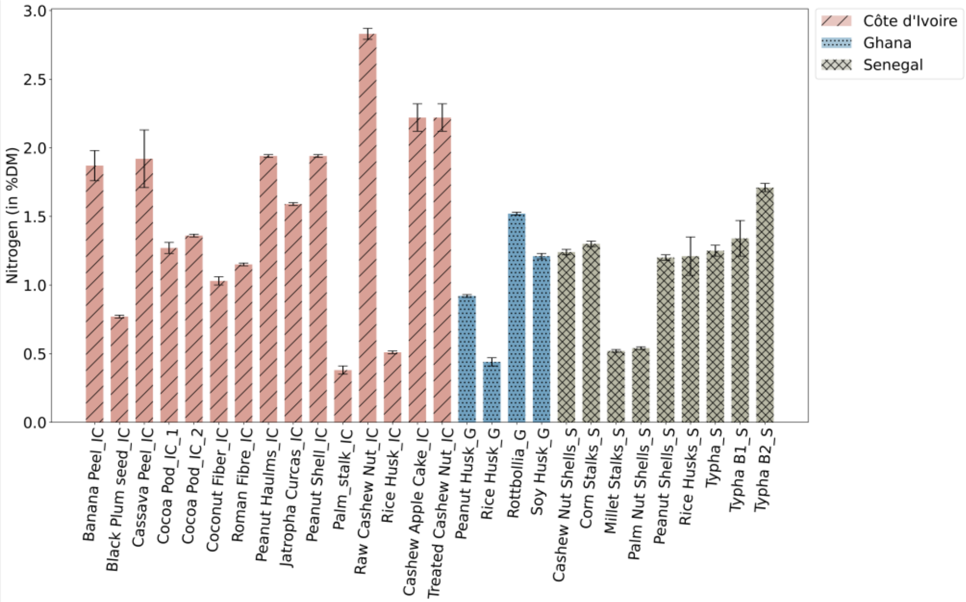
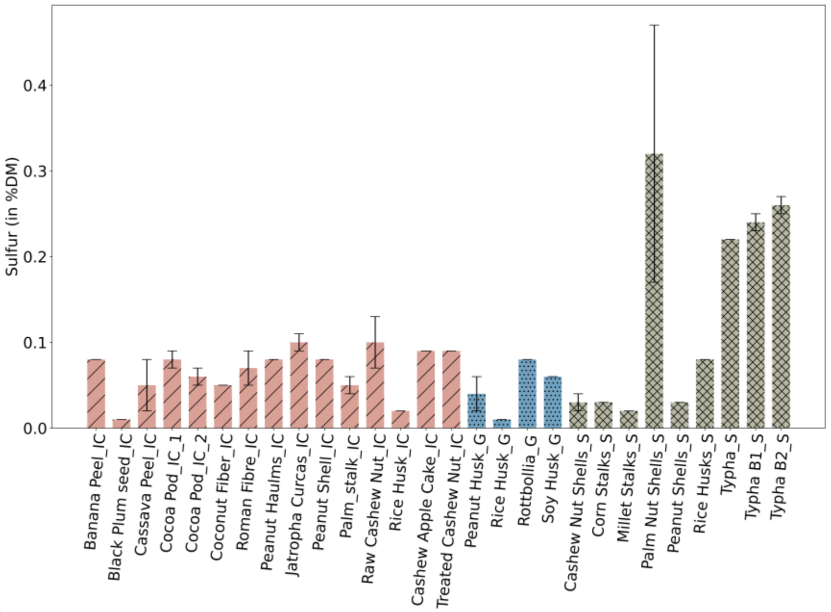
Elemental composition CHNS









- Expected ranges
- A few outliers regarding N
- S very low
- No differences due to country origin/collection point
- Impact of high N when biochar used as soil amendment

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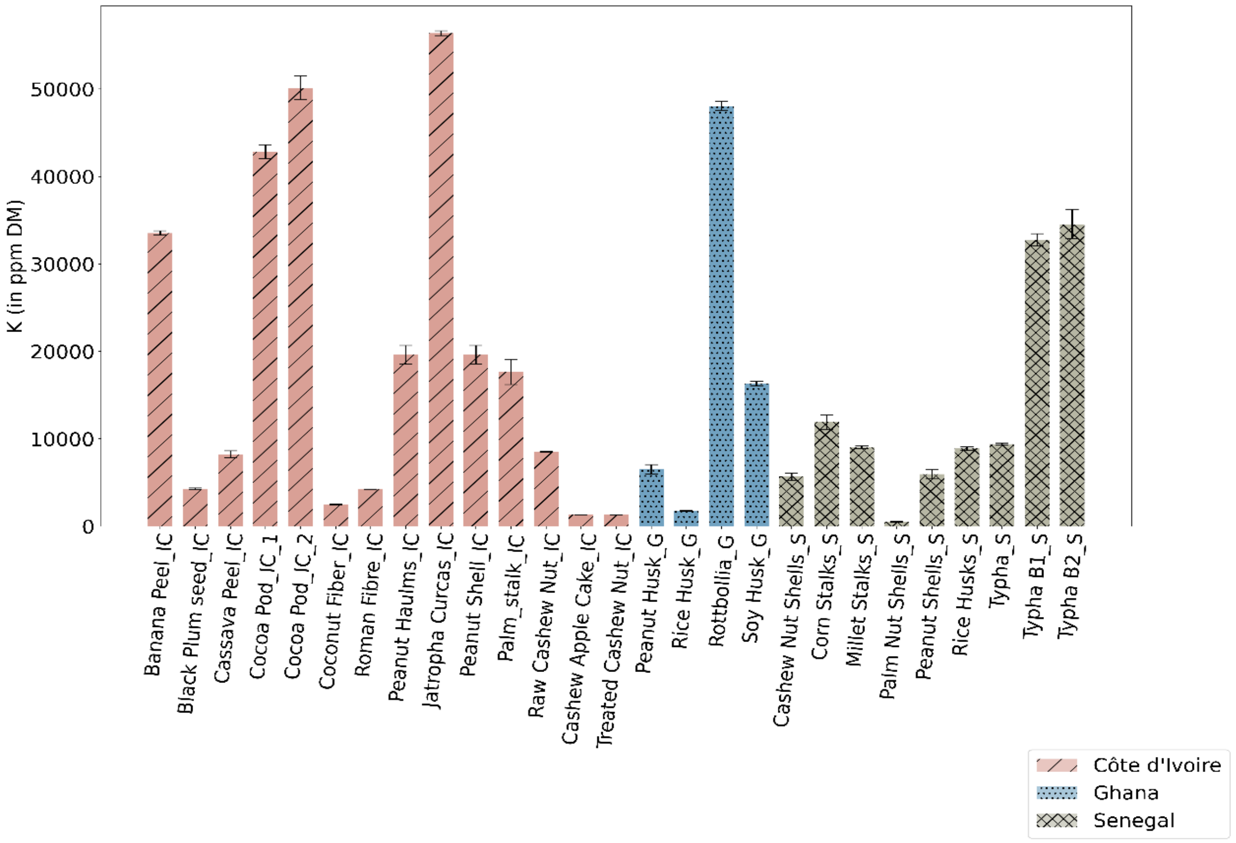
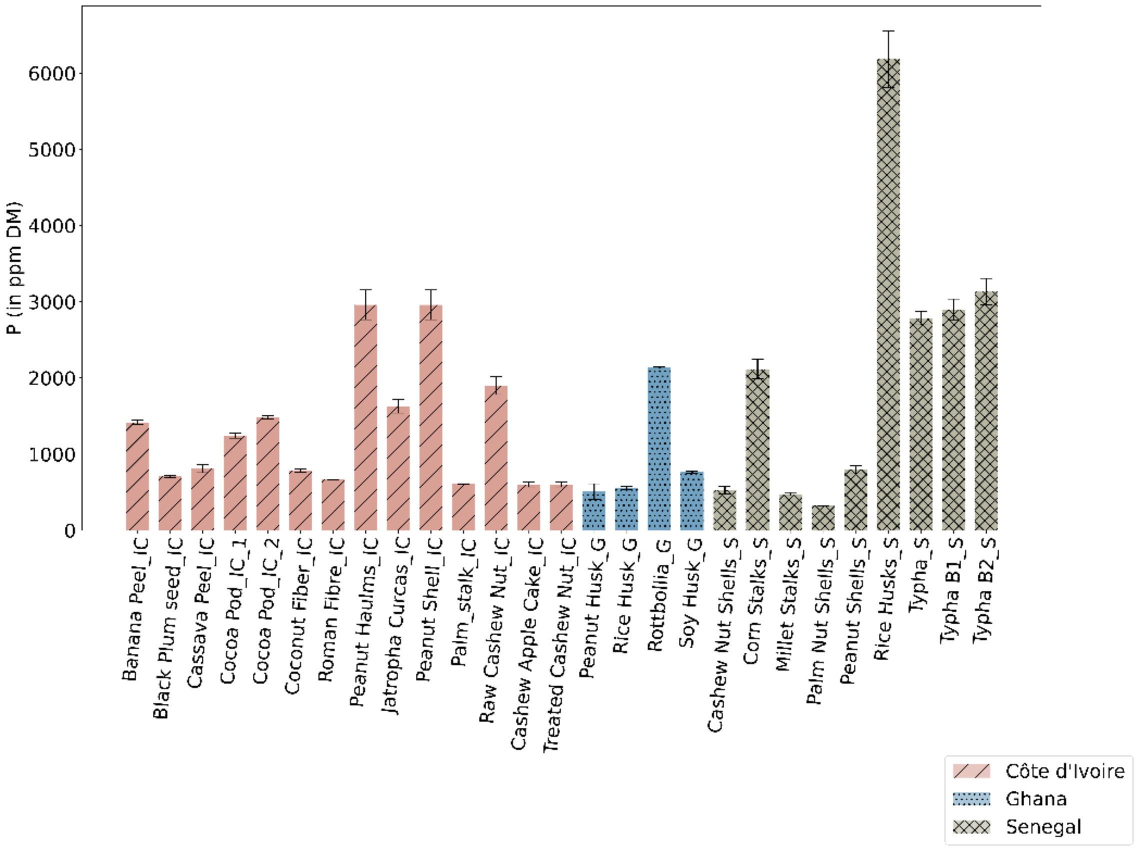
K and P concentrations





- Expected range for lignocellulosic biomass
- Large variations due to biomass type and origin (rice husk)
- Important to consider for use of biochar as soil amendment

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Cl concentration

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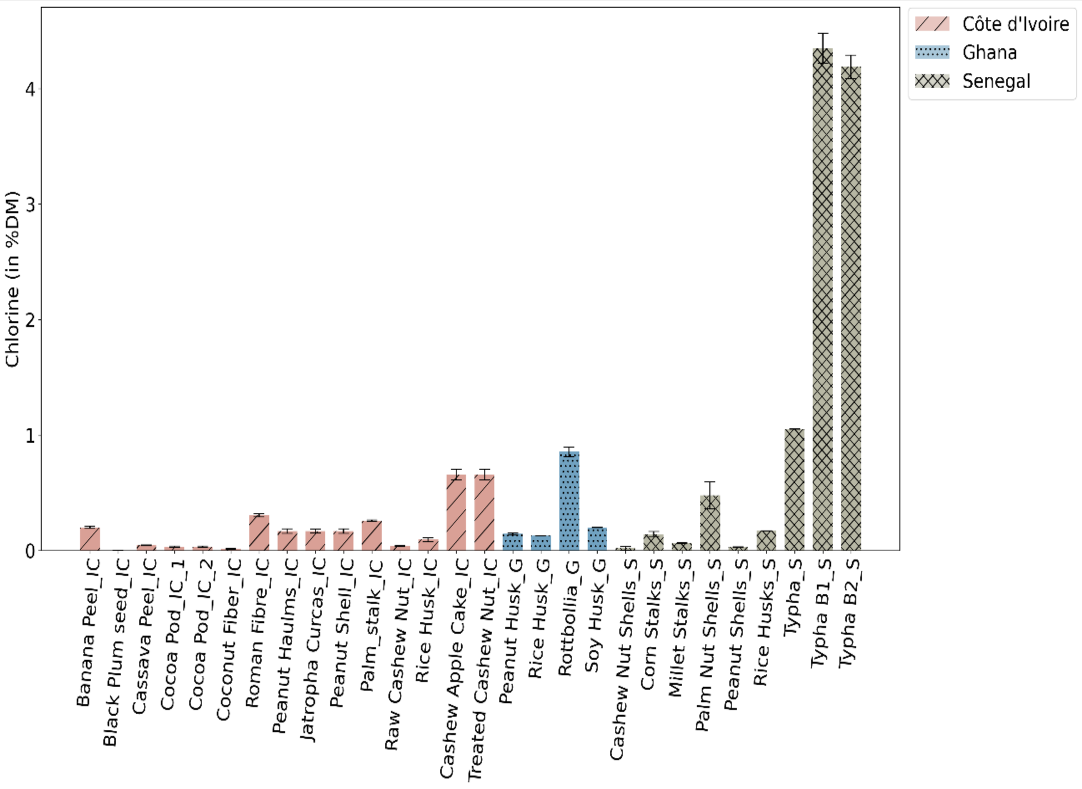

- Expected range for most biomass <1%DM
- Much higher amounts in typha (wetlands) with differences due to collection point
- If used as solid fuel, typha can be problematic

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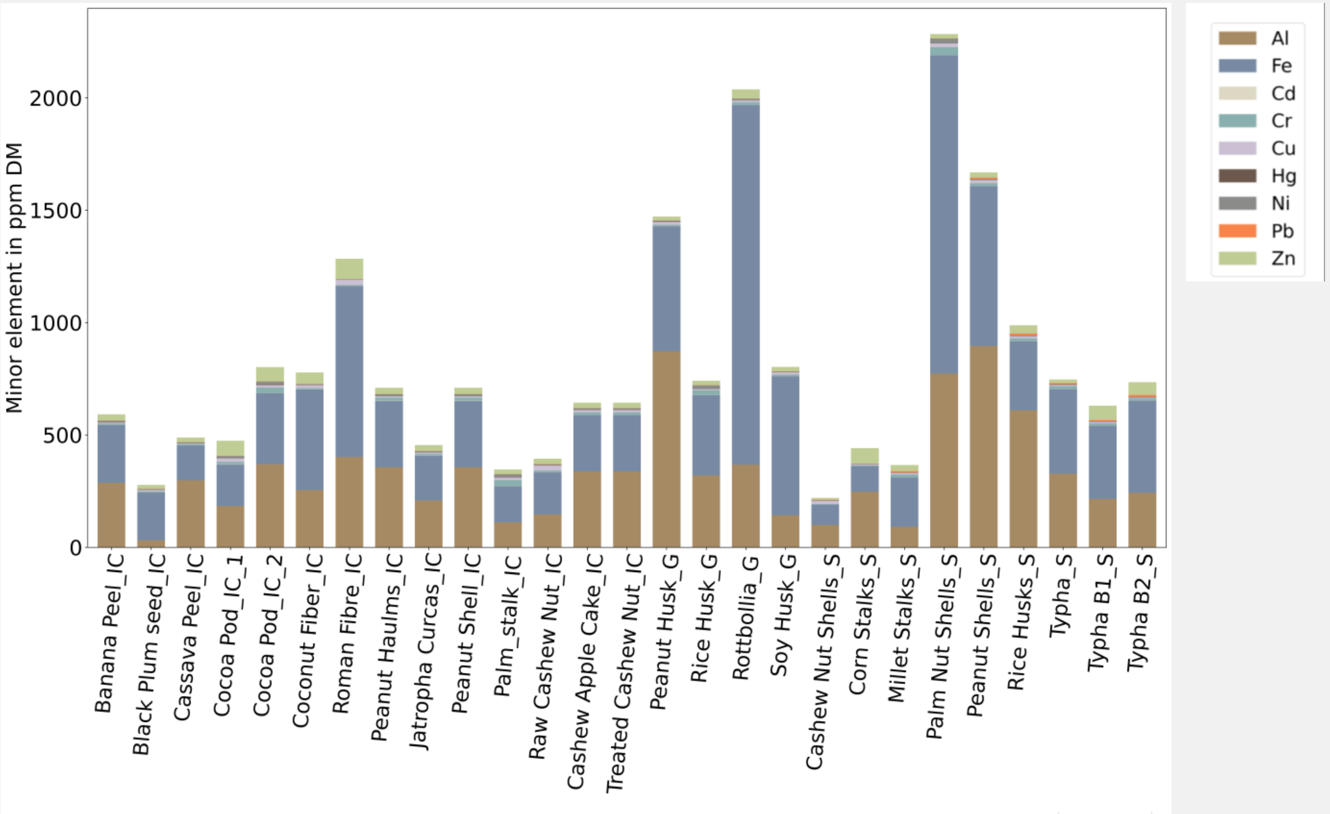
Minor element concentration



- Generally relatively low <1000 ppmDM, with mostly Fe and Al
- Some outliers: romana fibre, peanut husk, rottbollia, palm nut shells, peanut shells
- Presence of harmful elements as traces
- Slight differences due to country origin/collection point
- Outliers should be avoided especially as solid fuel or soil amendment

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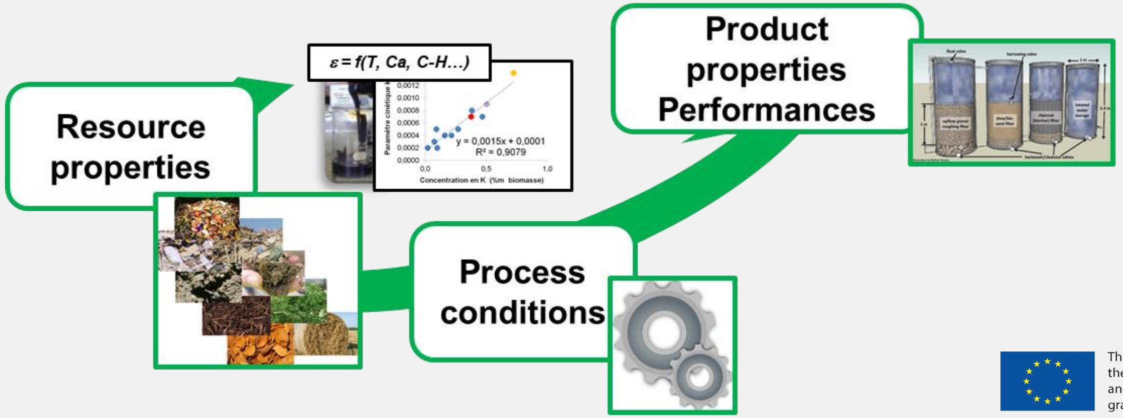
Conclusions and next steps

- **Open database** of Western-Africa biomass physicochemical characteristics →will be made available to the community at the end of the project

- Most biomass samples can be used as feedstock for biochar production
- Significant influence of the country of origin/collection point on inorganic elements

- Processing of the samples

  to confirm suitability with process



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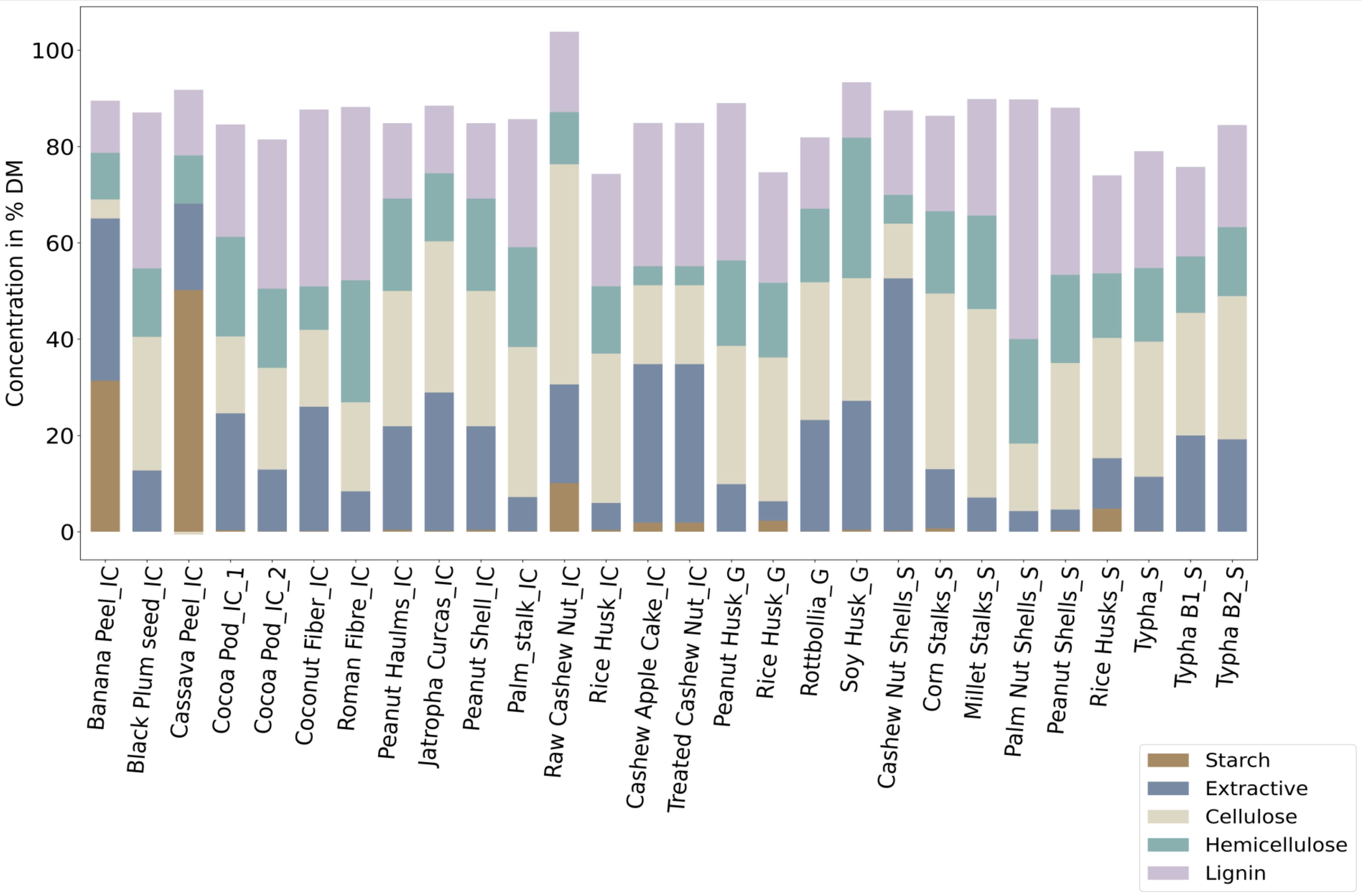

Figure 2 Macromolecular composition in biomass in %DM with SD < 1%

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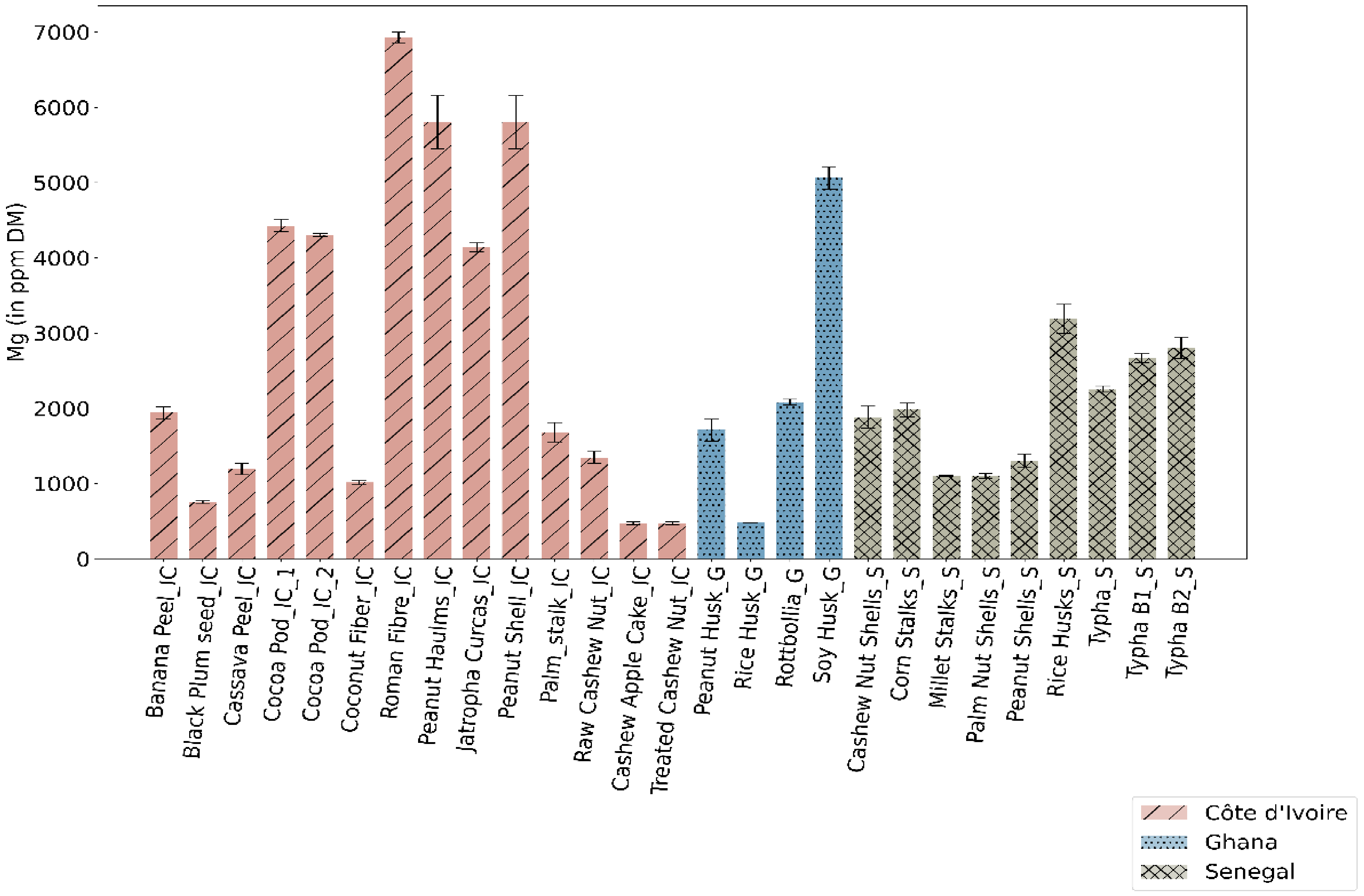

Figure 8 Mg concentration in biomass sample in ppm DM

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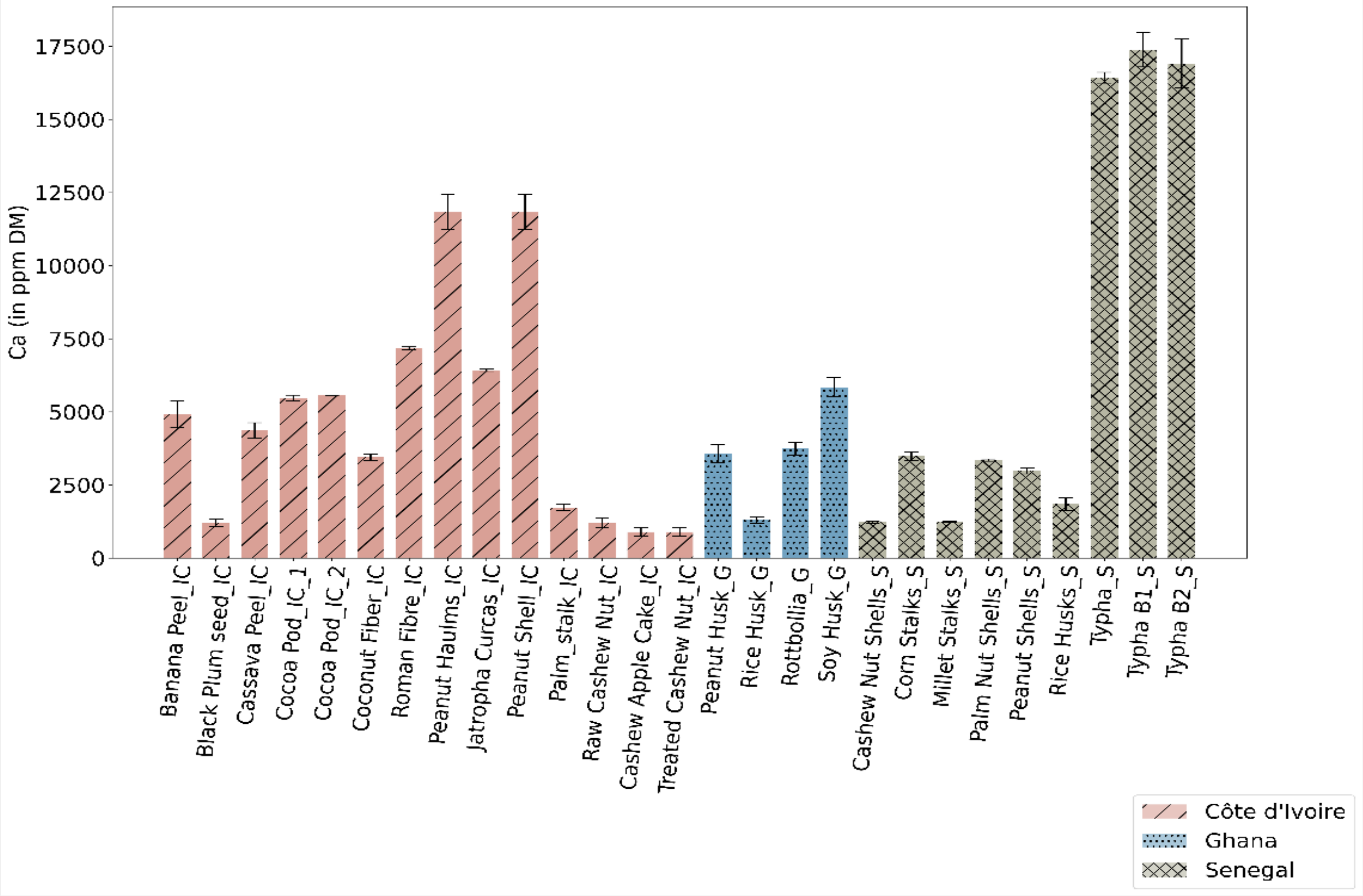
Ca concentration



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