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Mapping and predicting the bio-feedstock availability for material transition as well as the impact on GHG emission mitigation

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To which design flagship did you submit your proposal?

A: Design Flagship Methodological Innovation

What are you exploring? With what objective?

In order to produce materials from biomass sources to facilitate bioeconomy transition. It is important to understand the biomass availability in the future. This study aims to use historical data to develop a predictive model to project the future biobased-feedstock availability from the major selected crops. Moreover, based on the projected biomass availabilities, the potentially mitigated GHG emission due to the transition will be also estimated.
The insights derived from this research will help the policy makers (such as the Common Agricultural Policy, the Sustainable Development Goals and the Paris Climate Agreement) to evaluate the potential of using biobased feedstock to replace the traditional fossil feedstock and to make policy concerning materials transition. It is also relevant when investment and intervention strategies needed to be made by the governments and organizations such as CGIAR, IFAD, etc.

Why is this interesting scientifically?

This research concentrates on the quantification and forecast of biomass availability. More specifically, from the available datasets, we derive current and future biomass availability by means of Machine Learning (ML) techniques. Due to the relatively small sample size, we will use the traditional type of ML models (e.g., random forest regression, support vector regression) instead of the deep learning models (e.g., long short-term memory, CNN) due to their well-known data-hungry nature. Moreover, we will compare the performance of our approach with the results of alternative time-series models (e.g., VectorAutoRegressive (VAR) models), which are commonly used for forecasting in the econometric and biometric domains. To the best of our knowledge, there are no studies that investigate and compare the two types of models with respect to future biomass availability. All in all, this research aims to fill the existing knowledge gap in the stream of literature concerning current and future quantification of biomass availability.

How is this relevant to the materials transition?

To facilitate the materials transition (i.e., replacing the fossil-based materials by the biobased materials), forecasting the availability of the biomasses especially from the major sources (crops) are essential. This research focuses on the “supply-side” of the story by developing a decision support tool for the decision makers to make better decisions concerning the material transitions.
This project is just the first step of our research line. In the next steps, we will address the “demand-end” issue and finally calculating the balancing points between demand and supply and producing the optimal transition pathways.

What are the key activities or steps?

- Connect different data sources to create the dataset. Calculate the current availability of the biomass. Consider existing models/data sources, such as output of MAGNET, land use projection by FAO.
- Develop the machine learning model to predict the availability of the biomass feedstock in the future.
- Develop a time-series model to predict biomass availability using the same dataset as a benchmark.
- Compare the results from two types of models, including the well-defined criteria
- A workshop to elicit expert-options to calibrate the model results with different scenarios (e.g., max, average, min).
- Calculate the mitigated GHG emissions due to the transitions.
- Develop the prototype of the dashboard to visualize the results.

What are key deliverables?

- Overview of data sources and harmonised dataset
- A predictive model to be potentially developed into a DSS tool
- A draft manuscript to be submitted to a scientific journal
- Wireframe dashboard as a prototype to visualise results

On what issues would you like to get input from others?

What are your general predications about the material transitions in terms of:

- Direction of the transition
- Speed of the transition
- Replacement rate of the fossil-based materials
- Impacts on sustainability
- Impact on global economy

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