BIORESOURCE INFORMATION TOOL (BRIT) - AN OPEN SOURCE TOOL FOR METHODICAL GIS-BASED BIORESOURCE INVENTORIES

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1. Keywords

Waste streams, feedstock availability, waste characterisation, geographic information system (GIS)

2. Highlights

- Open source tool for GIS-based bioresource inventories
- Case studies on urban bioresource generation and collection
- Modeling the seasonal variation of quantity and composition of residues

3. Purpose

It is a proclaimed goal of the German national bioeconomy strategy to open up, extend or replace traditional value chains in order to implement the guiding principles of cascade and cycle use to transform value chains into novel value networks. At the same time, part of the strategy is to integrate society and intensify national and international cooperation. [BMBF & BMEL 2020] One of the challenges to achieve this in a sustainable way is the rethinking of the utilisation of biogenic residues. Bringezu et al. [2020] project that converting biomass to material products will gain importance relative to established energetic use in the future and that the interplay between digitalisation, flexibilisation and process integration will play a major part in doing so efficiently. While at lab scale more and more processes for converting residues to material products become available, a major hurdle for the implementation of such technology is the complexity of the urban residue streams. There is a large variety of biogenic residues not only in type but also in composition as well as spatial and temporal availability. For a feasible utilisation it is necessary to look for synergies between processes or residue streams when processed together. However, in order to apply established methods for decision-making, such as material flow analysis, life cycle assessment or process modelling, the level of detail for available data in the local context is often insufficient. The BioResource Information Tool (BRIT) was developed to provide a consistent methodology for bioresource inventories through all layers of detail from georeferenced datasets and maps to chemical composition of specific waste streams. This allows stakeholders to make use of the existing database of inventories or methodically conduct their own case studies and produce compatible input data for further analysis with specialised tools.

4. Materials and methods

Based on previous GIS-based case studies for urban bioresources as e.g. documented in [Adwiraah 2015] and other case studies conducted in the projects KREIS, BERBION, DECISIVE and FLEXIBI, a generalised automatable workflow for GIS-based bioresource inventories was abstracted and implemented in Python in conjunction PostgreSQL and its spatial extension PostGIS. Two generalised models for point sources and area sources respectively were implemented and extended with time steps to account for the seasonal variation of residue quantity. As an example for a point source model, a case study for roadside tree pruning material in Hamburg, utilising the roadside tree cadastre was created. For the case that more complex models which rely on a specific set of parameters are

required, the possibility to extend the existing model library was maintained. As an example of such a model, a case study about generation of agricultural residues from growing cucumbers in greenhouses in Loire-Atlantique, France was included, which takes parameters specific to greenhouse type and growth cycles. Further, a layered material model compatible with the concept of material flow analysis as described by Brunner & Rechberger [2016] was implemented and extended with the same time step model as the GIS-based inventories to account for seasonal variation of the composition of the residues. The web framework Django was used to create a user-friendly browser-based user interface and allow the tool to be run as a web application. Material characterisation and inventory results are visualized in the interface but are also converted in machine readable form (json) so that it can be downloaded and imported into other applications.

5. Results and discussion

The first version of BRIT has proven that a consistent, yet flexible implementation of a GIS-based bioresource inventory is possible using purely open source software. First case studies have been implemented during the FLEXIBI project and there is follow up use in research in the SOILCOM project and for teaching bioresource management at TUHH. A public instance with the main public database is hosted and maintained by the Bioresource Management Group (BIEM) of the Institute of Wastewater Management and Water protection at Hamburg University of Technology. Users can choose to use the public web app or to host their own instance. While there already exists a variety of specialized modelling tools as well as geodatasets and material databases, the purpose of BRIT is not to replace any of these but it is a novel approach to integrate and facilitate the process of gathering adequate information for new paths of residue utilisation.

6. Conclusions and perspectives

BRIT is a piece of infrastructure for methodical information gathering and sharing in the domain of bioresource management in order to support stakeholders to understand the residue streams in their region and find new ways of utilisation. The development of the core tool was the first step. Its modular nature and the fact that it is open source allows to extend functionality over time. Its value for the stakeholders will rise with increased usage, as the database grows and more models are implemented. In current development the focus lies on including more data from previous and current case studies into the database as well as integrating interfaces for other tools.

The first version of BRIT was developed in the FLEXIBI project and has received funding from the German Ministry of Education and Research (BMBF).
The further development and implementation of new case studies is done in the scope of the ERA-NET project SOILCOM.

7. References

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