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NACHHALTIGE ERNÄHRUNGSSYSTEME UND LANDNUTZUNGSWANDEL

Mit Beiträgen von

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THE SIGNIFICANCE OF STANDARDIZATION AND HARMONISATION OF IACS DATA FOR LAND USE ANDBIODIVERSITY ASSESSMENT IN GERMANY

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IACS, data management, Common Agricultural Policy, big data, land use

1 Introduction

The objectives of the Common Agricultural Policy (CAP) are to secure food supply, to enhance rural development and to conserve natural resources (European Parliament and the Council 2013a, 2013c, 2013b). In this framework farmers can apply for direct payment funding (first pillar) and participate in specific funding programmes for agro-environmental and climate measures (second pillar). EU Member States are obligated to administer and control these processes with the "Integrated Administration and Control System", better known as IACS (ger.: Integriertes Verwaltungs- und Kontrollsystem). In federal Germany each Bundesland (Bdl) is committed to collect the required information on funding, farming practices and land use (Deutscher Bundestag 2014).

IACS data has a wide range of advantages for comprehensive land use and biodiversity research. The data has a high geographical accuracy and representation, it provides annual georeferenced data since 2005. IACS data is providing insights into changes of agricultural landuse itself and land use intensity, and to which extent environmental measures and policy requirements are implemented by farmers across Germany. Each Bdl has the mandatory requirement to regularly update the data and do on-site validation, which reinforces quality control procedures to ensure a high data quality. In addition, using IACS data for research purposes is cost-effective, as it has already been collected and actively maintained by the respective Bdl, reducing the substantial expenses associated with independent data collection.

Currently, IACS data has been used in different research projects to evaluate measures and to portray the land use patterns on short-term sub-national scales (Reiter & Roggendorf 2007; Nitsch et al. 2012; Lakner et al. 2017; Röder et al. 2018; Röder et al. 2022). A holistic method, to unify and harmonize IACS data on a national scale has not yet been implemented due to a number of challenges and limitations. A methodological approach to overcome these limitations and create a harmonized national time series dataset has been proposed by the Thünen Institute.

2 Limitations, aim and approach

The federal structure of Germany results in specific state-based programmes for Second Pillar funding in addition to the national First Pillar funding which farmers in the respective Bdl can apply for. Furthermore, the regulating and administrative processes differ widely between the Bdl federal states (Röder et al. 2022). For researchers and other users this leads to the following limitations towards easy data usage:

1. Data protection: To obtain raw AICS data, a legal agreement for each research project and the respective Bdl needs to be signed in form of a Data Usage Agreement. Researchers

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interested in using the harmonized and processed data have to be informed and are obligated toagree to the legal regulations.

2. Data uniformity: Different Bdl have unique data processing workflows and historical changes in processing practices resulting in different data-types, -formats, structure, keys, encodings, etc.
3. Data volume: Next to a good IT infrastructure, high data security, back-up systems, large storage volume, skilled data scientists are required.

These challenges combined lead to a low reproducibility and comparability which interferes with good research practice and quick data analysis. To address such challenges and limitations, a team of experts in data wrangling and management with the know-how on data harmonisation and development has been assembled at the Thünen Institute for rural studies. The aim is to:

(1) develop an intuitive and flexible data management strategy and workflows,

(2) implement purposeful and sustaining coding standards,

(3) develop a state-of-the-art data accessibility concept.

Currently, when new datasets arrive, it is stored in secure servers and undergoes a thorough quality-check and pre-processing, which is tailored to the unique data attributes. The data is subsequently uploaded to a PostgreSQL-Database with a PostGIS extension. To ensure data privacy, any personal and sensitive information not needed for the research purpose is removed and only pseudonymized farm ids are present in the database. To enhance data apprehension, meta information such as table and column comments are added to the data. Data harmonization steps are then implemented to guarantee further compatibility between different data, e.g. harmonisation of the procedural codes, standardisation of the data formats, and building time series. The approach ensures data centralisation and enhances data accessibility, enabling advanced spatio-temporal research.

3 Preliminary results

The data harmonisation process has opened a platform for the development of a fundamental product that serves as a foundation for further advancements in the field.

A comprehensive set of seven data tables that contain harmonised and culminated data in a time series format has been developed. Currently, these tables consist of data from eight (8) federal states and cover the period from 2010 to 2018. Two of the tables contain spatial data on primary land use (e.g crops, vegetables, pasture), landscape elements (e.g hedges, tree rows) and environmental measures (e.g. wildflower strip, fallow land, legume). In addition, one (1) tablecontains livestock data and four (4) of the tables provide aggregated data on farm level on farming practices and facilities as well as livestock farming.

To further streamline the data, a point grid map of German, with a 10m by 10m resolution of more than 3.5 billion points covering Germany has been generated (Röder et al. 2023). The grid therefore provides a time series for the agricultural land use at each point. Its point grid layout allows the easy addition of other relevant geodata, such as DEM; soil, biosphere and environmental protection information, and can be queried for various research questions with reasonable performance.

4 Outlook

The ultimate objective is to enhance the existing data sets and to develop an updated time series database, starting from 2005 and continuing with annual updates in the future. Achieving this goal requires the implementation of more harmonization routines, as well as processingautomation to facilitate a faster workflow and expedite results.

IACS data is an invaluable source of information regarding land use and the application of agri-environmental measures. It offers insights into farming practices (on-site and nationwide) that are unmatched by any other dataset. Furthermore, the harmonized IACS data allows for monitoring of land use change, in relation to biodiversity conservation, climate change, soil and water quality. It is essential that this data source, despite the limitations associated with obtaining and processing it, be utilized for further research in all relevant fields.

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