Biomass as Energy Source: Modelling with GIS

Sybille Brozio*, Daniela Müller*, Hans-Peter Piorr*, Susanne Fleischmann** & Frank Torkler*

University of Applied Sciences Eberswalde, * Faculty of Landscape Use and Nature Conservation; ** Centre for Transfer of Technology and Innovation; Friedrich-Ebert-Strasse 28, D-16225 Eberswalde, Germany

Summary

At the University of Applied Sciences Eberswalde calculation of agricultural biomass potentials as renewable energy source is worked out and visualized by GIS based on spatial data. Yield potentials under the restriction of site specific crop rotations are modelled and annual yields of biomass determined. The spatial distribution of bioenergy sources is the input parameter for strategies where and how biomass farming could be to placed.

Objective

Available knowledge about renewable energy is compiled at the University of Applied Sciences Eberswalde, including the instrument of Geographic Information Systems to specify site-specific potentials of agriculture and forestry. The aim is to visualize the annual harvestable biomass with high spatial exactness. The results will be used for discussions with farmers, companies and pilotical decision-makers for planning and advisory purposes. This abstract gives a first overview about concept, programming and first results.

Model development

The quantity of usefull bioenergy depends on site conditions, cultivation intensity and cultivation aims. The calculation of biomass is realized by combining algorithms in a model. At first - in Top-Down-Approach - yields of several crops are calculated on the scale of administration borders of communities.

Available geo data base in Germany (fig. 1) are:

- Administration borders of communities,
- Land use data: CORINE and ATKIS to calculate the area of every landuse system,
- Soil data: “Ackerzahlen”, yield index or yield messured data,
- Meteorological data: annual precipitation.

Therefore, information of potential yields, annual precipitation and area of landuse systems are available for every community.

Algorithms of potential yields are modelled based on the spatial data. Depending on climatic and soil conditions typical crop rotations are

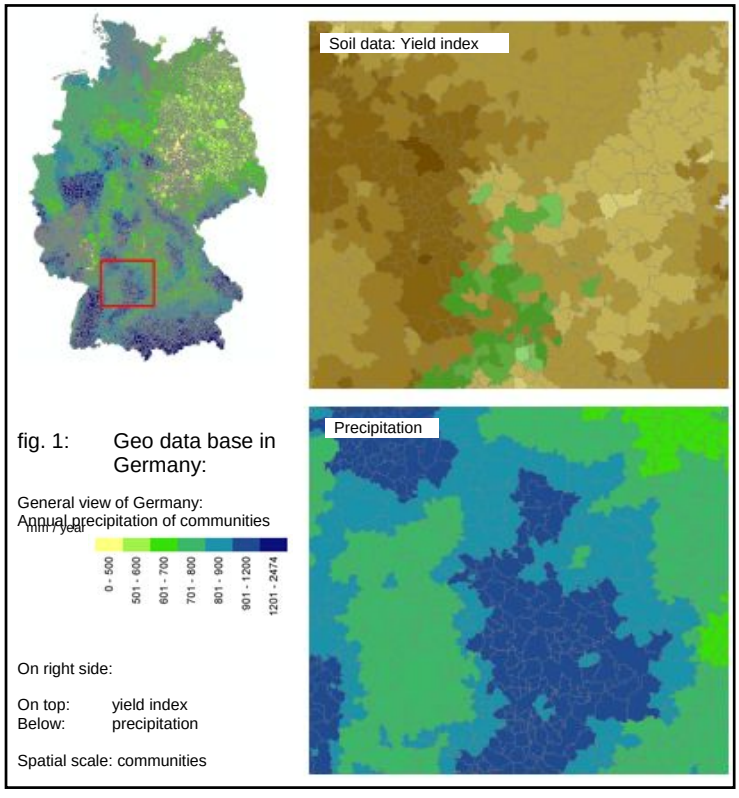

fig. 1: Geo data base in Germany:

defined. Within this rotation process the yield are calculated about yield responses (fig. 2). As well dry mass of straw and leaves from cereals, rape, maize and sugar beets is balanced. Crop rotation effects are integrated by factors considering impacts of previous crops (fig. 3).
Algorithms are combined and summarized in a data bank based model. Refering to spatial scale of communities the quantity of bioenergy and organic matter for production of humus is visualized.

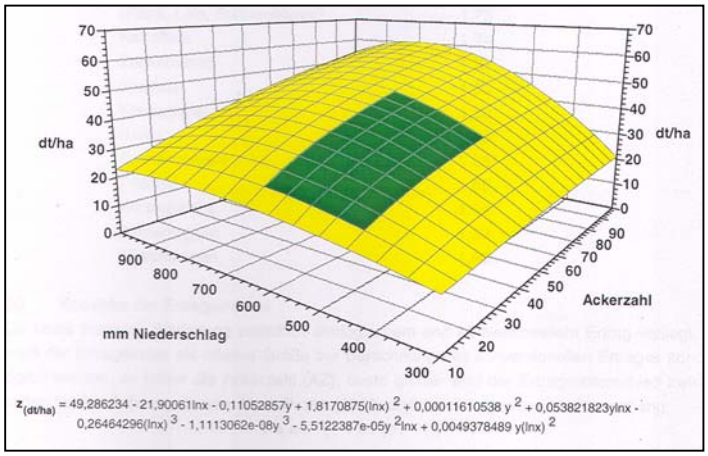

fig. 2: Grain yields of winter rye (dt/ha) in dependence on the yield index ("Ackerzahl") and annual precipitation ("mm Niederschlag").[1]

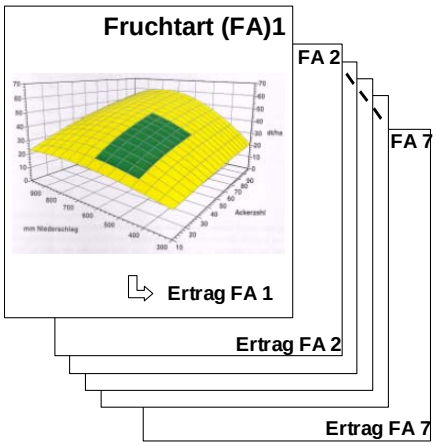

fig. 3: Schematic description of crop rotation algorithms ("Fruchtart" / "FA" = crop, "Ertrag" = yield).

Programming and first results

Spatial data are visualized in Geographic Information Systems (GIS). The algorithms are programmed in the system ESRI ARCGIS and the programming language Visual Basic.

The structure of the developing model is easy to understand and flexible. New knowledge or changes in yield responses and algorithms of crop rotations are easely possible to implant.

At present on the further development of the model and its application in diverse rural areas are worked out. First tests show site-specific differences in the production of bioenergy.

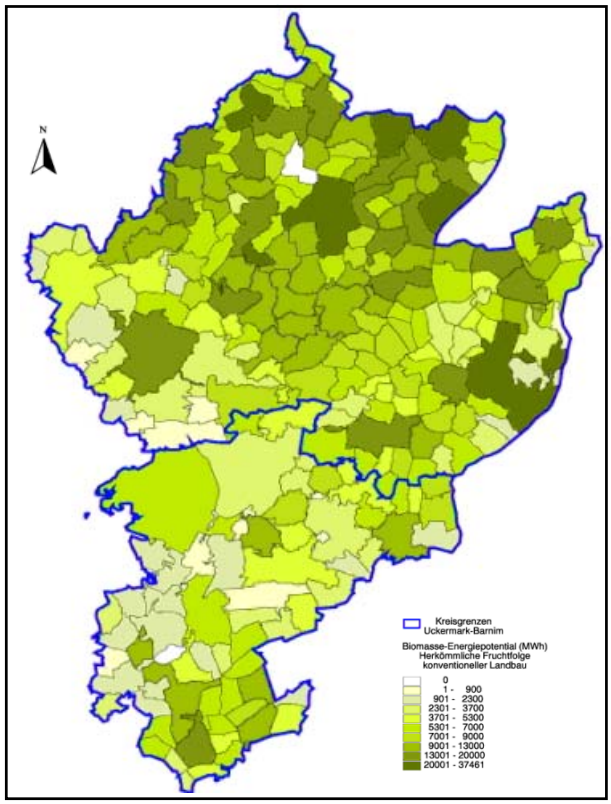

Abb. 4: Calculation of quantitative annual bioenergy in communities of east-German districts Barnim and Uckermark.[1]

Next steps

The visualization is the basis for discussions with farmers, administration and companies. In the next steps the yield model is adapted on other farming systems like organic farming or energy farming. Furthermore the approach is heading for application an different spatial scales reaching from field – farm- district to the national level. Next working steps include analysis of logistic and ecologic aspects.

[1] PIORR, SCHOLZEN (2002): IN: Regionalatlas Erneuerbar Energien, Hrsg.: Regionale Planungsgemeinschaft Uckermark – Barnim, Eberswalde.