Renewable energy resource as an indicator of the change in rural areas

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Abstract

The rural countryside performs a variety of ecosystem and living space functions. At the same time it undergoes a high anthropogenic impact pressure. Today a considerable increase in the cultivation of biomass as a renewable energy resource can be observed. It is inspired by national and European strategies for climate protection and securing energy supply. With the currently noticeable increase in the area under cultivation, amongst others on marginal lands and set-asides, an increase in the intensity of land use is associated. Often this is assessed as a positive impulse for the rural areas. Nevertheless, this change and intensification of rural land use due to bioenergy production will have strong impacts on the human and natural environment. Besides pressures exerted on ecosystem functions, goods and services, effects on the social and economic lifeworld must be expected. Moreover, other European and national regulations and frameworks aiming at environment/nature conservation on the one hand, and rural development on the other hand may even be foiled.

Against this background, the change rural regions are currently undergoing is critically analysed and activities for a sustainable socio-ecological land use and development of rural areas, under special consideration of the cultivation of renewable energy products (biomass), are identified. Taking into account synergy and feedback effects between social and natural environment, a draft for a sustainability analysis of case study regions that can be applied to other regions shall be presented and measures towards securing sustainability are deducted. The research is conducted as an interdisciplinary socio-ecological research project by natural and social scientists.

Keywords: rural development, landscape change, renewable energy, socio-ecological research

1. Introduction - (Why) do we have a "Biomass-Boom"?

Renewable energy resources give new incentives to rural areas (EU2007.de). At present we are facing a biomass and bioenergy boom as energy becomes more and more a precious commodity. Biomass is seen as a grand and important challenge for the development of rural areas. The 2007 EU energy strategy calls for renewable energies to increase up to 20% until 2020 (KOM 2007). Both, the EU and the German government (Bundesregierung 2007), have been emphasising the increasing cultivation of biomass products and the increasing use of bioenergy as fuel and in the electricity and heat sectors in their energy strategies. Renewable energy resources in Germany are mainly produced from rapeseeds, grains of maize and culm shaped biomass (cereal crops and grasses), besides usable biogenic waste.

Between 2005 and 2006 the area under cultivation of renewable energy crops has increased twenty fold (IE 2007). Thereby an augmentation of the intensity of land use and the expansion into marginal lands can be noticed. The pressure on formerly extensively used or not cultivated areas increases, and marginal, extensive farm lands and set-asides gain in importance. As more and more renewable energy resources are consumed by the power generation, these marginal areas are needed to produce the target amount of biomass. This change in the use of rural areas will increase in the future.

Besides pressures exerted on ecosystem functions, goods and services, effects on the social and economic lifeworld must be expected. Aspects of regional, social and ecological challenges and therefore aspects of sustainability are debated insufficiently at the moment.

In this paper we will focus on biomass as renewable energy resource in Europe, especially in Germany and their impact on the change of rural areas as well as renewable energy resources being an indicator of the change of rural areas.

2. Analysis of the change of rural regions

2.1. The rural areas – Social, ecological and economical functions, goods and services

Rural areas are subject to diverse functional and structural changes in many parts of Europe: changes in agricultural structures, demographical change, decentralisation and regionalisation, high dynamics in economies, new types of land use conflicts and security of open spaces, nature and resource protection and

cultural landscape preservation (Grabski-Kieron 2004). Nowadays, the rural countryside is no longer a monofunctional agricultural space, but is multifunctional – both in perception, use and demands from society and in the underlying nature of environment and ecosystems. The multifunctionality combines aspects as food production with rural landscapes, conservation of cultural landscapes, new market activities, commodities and non-commodities, public and private activities, quality management, food security, creation of new jobs, animal welfare, soil and groundwater conservation, biodiversity, habitat connectivity, new rural lifestyles, traditions, rural tourism, natural catastrophes protection, health aspects and others (e.g. Huylenbroeck/Durand 2003; Knickel 2004: 16; Sprenger 2005). It carries out ecosystem and living space functions while facing a very high pressure of human use.

Agricultural land use also takes responsibility for a wide set of environmental and ecological problems such as soil erosion, pollution of surface and ground waters or loss of biodiversity, far too often disregarding sustainability standards. The landscape in Western and Central Europe has been strongly shaped by more than 2000 years of intensive use. Only in very few spaces like in Bialowiezka, Poland, untouched nature can be found. The ecological functions, the ecosystem equilibrium and the status of environmental compartments (e.g. as soil, water, biosphere) of these post-natural cultural landscapes have been constrained and affected by diverse human impacts, among others through agriculture, forestry, settlements, transport and tourism. This anthropogenic shaping and use of the countryside has, however, created new forms of countryside and (cultural) landscapes, worthy to protection. Or, as Lütz & Bastian (2002) put it, "the cultivated landscape is a nature conservation resource of great value", which performs important ecosystem functions at a new 'equilibrium'.

Currently, formerly marginal, extensive farm lands and set-asides gain in importance for the intensive agricultural use. An increase in the intensity of land use can be noticed. This intensification has manifold impacts on the human and natural environment, rising the pressures exerted on the landscape and thus on the ecosystem functions, goods and services: More area under cultivation and intensification of cultivation will bring about negative impacts on soil and water resources, reduce biodiversity and influence climate regulation and disturbance prevention, and as such impair the regulation functions and the habitat functions of the cultural landscape (cp. de Groot et al.2002 for definition of ecosystem functions, goods and services).

With this, but not only through the medium of land-use induced impacts, also socio-cultural and economic values and functions may be affected. But here the strong negative notes of the above listed impacts are more diverse, also bringing about positive changes to the social and economic lifeworld by giving positive impulse for the rural areas in terms of rural development.

The added value of agriculture can nowadays not only be found as economic and social added values of the cash crops, but also as ecological added value. Ecological systems produce goods and services that contribute to human welfare directly and indirectly, offering benefits to human society. A valuation of these goods and services, also in economic terms, has been discussed widely (Costanza et al. 1998; De Groot et al. 2002). So in fact, goods and services provided by agricultural landscapes range from natural regulation functions (e.g. climate protection, maintenance of healthy soils and water) which are difficult to measure in direct economic market terms, to much clearer and more easily measurable socio-economic functions (e.g. production of food, feed, fibre and raw materials, recreation and tourism).

2.2. The renewable biomass energy resources: demand of space

The expansion of the biomass cultivation to produce energy will be increasing in the future as the European Union more and more supports and promotes the use of renewable energies. The principal underlying EU policies are: Directive on Electricity Production from Renewable Energy Sources (2001/77/EC); Directive on the Promotion of the Use of Biofuels or other Renewable Fuels for Transport (2003/30/EC); Directive on Restructuring the Community Framework for the Taxation of Energy Products and Electricity (2003/96/EC); Directive on Establishing a Scheme for Greenhouse Gas Emission Allowance Trading within the Community and amending Council Directive 96/61/EC (2003/87/EC) and the Biomass Action Plan of the European Union (EC 2005). "In terms of future trends in the utilisation of renewables in Europe, consideration will have to be given both to the power sector – focussed on up to now – and to transportation, heating and energy efficiency steps if the target of raising the share 12% of total energy consumption by 2010 is to be met." (Scholwin 2007: 4)

The main actual and future potential of space can be found in the re-use of set-asides and the increasing usage of marginal lands (Junk 2007, Institut für Energetik und Umwelt 2007). It is often stated that areas where food production has decreased in recent years due to EU wide overproduction may now be used for cultivation of energy crops or crops for bioenergy use. This would imply that the former predicted extensification of agricultural land use in Europe is currently turning into an intensification.

In Germany, 6.6 % of the primary energy consumption in 2007 originated from renewable energy resources, having more than doubled in only 5 years (AG Energiebilanzen 2007a, 2007b). The amount of renewable energy is supplied to 67.9% by biomass, 16.0% by wind, 13.0% by water, 1.0% geothermal energy, 0.6% by photovoltaics and 1.8% solar thermal energy (BMU 2007, AG Energiebilanzen 2007b). The biomass production and the strategies that are pursued are very complex and vary very much from country to country. But also within a country like Germany there are heterogeneous developments in terms of renewable energy allocation. As a federal republic, each single federal state can embark on an own strategy under the federal law. The following maps show the diversity of the relevance of biomass for the total energy consumption in each German state. Statistics listing the federal states separately are currently available only up to the year 2004 (Länderarbeitskreis Energiebilanzen 2007a, 2007b).

During the last years, a gradual increase in renewable energies produced and consumed can be observed in the German Länder, supported by EU-level and national regulations supporting the feed-in of renewable energy into the power supply system (Renewable Energy Act / Erneuerbare Energien Gesetz – EEG, 2000), stipulating a minimum admixture of biofuels (Biofuel Quotas Act / Biokraftstoffquotengesetz, 2006) or guaranteeing direct payments when growing energy crops since the 2003 CAP reform (Council Regulation (EC) No 1782/2003 of 29 September 2003 / Energiepflanzenprämie). Between 2000 and 2004, the share of renewable energy resources in the primary energy consumption has more than doubled in the northern and eastern German countries (cp. Figure 1).

Figure 1: Share of renewable energy resources in primary energy consumption (%) in the German federal states

Figure 2: Share of biomass energy in primary energy consumption (%) in the German federal states

For Schleswig-Holstein and Mecklenburg-Western Pomerania, much of this increase has to be attributed to an increase in wind power generation (Länderarbeitskreis Energiebilanzen 2007). In the Free State of Thuringia (9.4 % of 10,9 % of total share of renewables) and Brandenburg (4,1 % of 6,2 % total share of renewables), though, a significant increase in the share of biomass in the primary energy consumption has occurred between 2000 and 2004 (cp. Figure 1 and Figure 2).

In Germany, approximately 1,771,000 hectares were under cultivation of energy plants in 2007 against 1,295,000 ha in 2006, which amounts to an increase of 36 % in one year and to more than 10 % of the total agricultural area in Germany (FNR 2007, BMELV 2007). In 2007, 63 % of the total energy plant area was cultivated with rape (for biodiesel), 22.5 % with plants like corn to be used for biogas, and 14 % with sugar and starch plants for bioethanol production. In 2006, 350,942 ha (27 %) of the energy crops were grown on set-aside areas, with rapeseeds making up 49 % and corn (29 %) (UFOP 2006: 9). Yet, another 248,958 ha cultivated with energy crops for German consumers had been contracted with other foreign countries of Europe in 2006 (mainly France and Great Britian), three times the area of what had been produced abroad in 2005 (UFOP 2006: 9; all figures only refer to areas receiving direct payments for energy crop cultivation and set-aside, cp. IE 2007: 85 f.).

In Niedersachsen (Lower Saxony), 157,973 hectares are under cultivation of renewable energy resources in 2006, which makes up 8.5 % of the arable land. One third of this area has been former set-aside area which is now reused for the cultivation of this new non-agricultural, energetic resource production. In 2006 the main energetic crops that were cultivated were maize for silage, rapeseeds, energy crops and starch plants (Niedersachsen Netzwerk Nachwachsende Rohstoffe 2007, Niedersächisisches Landesamt für Statistik 2007).

Set-aside, introduced as a supply management instrument when grain production in the European Community exceeded market outlets. The amount of set-aside areas under cultivation of renewable energy resources shows the importance and the impact that these new forms of non-agricultural, on-farm diversification measures have for rural areas. There are concerns that ecological benefits of set-aside for protecting biodiversity, diversifying landscape structures and recovering to intensively used soils could be lost due to the cultivation of energy crops and the increase in re-use of set-asides for thisNow, a special regulation of the European Union for the year 2008 which suspends compulsory set-asides for the year 2008(Council Regulation (EC) No 1107/2007 of 26 September 2007, derogating from Regulation (EC) No 1782/2003). About 1,000,000 hectares ware set-asides in Germany in 2007, from which about 400,000 ha are under cultivation of renewable energy resources and another 200,000 ha are presumed to be reused for production of food and fodder (Deutscher Bauernverband 2007).

An increase in cultivation of energy crops also leads to competition with land used for domestic food and feed production and organic farming, as well with land designated for nature conservation, soil conservation or flood protection (cp.). Soil / space is a finite resource, it is simply not expandable – not in Germany, not in the European Union and not worldwide.

2.3. Effects the functions of rural areas

To examine the effects of the biomass production (boom) on the functions of rural areas considering sustainability, the aspects 'social', 'economic' and 'environmental' are centred as it is common basis since the Rio Summit in 1992 and the World Summit on Sustainable Development 2002 in Johannesburg.

Social and economic implications of biomass production on rural sustainability can be:

- Disposition and needs of farmers;
- Disposition and needs of electric supply companies/ consumer;
- Organisation of the participating actors/ lobbies/ conflicts;
- New forms of social and economic networks in rural areas;
- Mechanisation/ rationalisation/ intensification of cultivation methods;
- Structural change in rural areas and in agriculture;
- Diversification of household incomes in rural areas;
- Land use conflicts with non-energetic agricultural products, between non-agricultural land use and between renewable resources;
- Change of the scenery (e .g. cultural landscape aspects, recreation function);
- Planning control (national spatial/ regional planning, local land use planning and landscaping, nature conservation);
- Innovative potential (technologies, services, organisational forms, partly development of new elites);
- Opposing environmental political discourses (nature conservation versus renewable energy production).

Environmental aspects of the biomass production can be described as follows:

- potential climate change mitigation effect
- effects on ecological functions (e.g. soil and water quantity and quality; gas and climate regulation, nutrient regulation, pollution control, pollination, trophic-dynamic relations, biodiversity, habitat functions for wild plants and animals), resulting in conflicts with environmental tiers and nature conservation goals; and impacts on landscape functions (landscape aesthetics, scenery, recreation, tourism)
- effects on ecological impact/ feedback mechanisms (e.g. climate change – land use type / intensity – land use potentials – energetic biomass use – CO2 balance – climate), resulting in impacts on the production function and natural biomass potential (e.g. quality and quantity of the food, feed, fibre, fuel and energy production; supply of clean water and healthy soils)

3. Measures and activities towards rural sustainability

Analysing the impact of biomass production on the rural areas especially in Germany, but also in other countries, measures and activities towards rural sustainability must be focused. In this chapter the identification of activities for sustainable socio-ecological land use and development of rural areas in consideration of the cultivation of renewable energy products (biomass) will be presented.

The increase of biomass production is often constituted to be of several advantages. It shall have positive impacts on resource policies, environment, labour market and economy as well as on agricultural and structural policies (Breuer/Delzeit/Becker 2008: 60).

In order to asses the impact of the described increase in biomass production on rural areas and develop effective measures towards rural sustainability, European and national / federal policies and programmes have to be analysed in this context, too. Each of them are designed to support and promote EU policy, yet having diverse effects on the development of rural countrysides: Regulations such as the Renewable Energy Act in Germany, the Biomass Action Plan will further push the cultivation of biomass for energy; market developments, otherwise, will also guide farmers in their decision what to grow on their land – energy crops, or food/feed crops. EU-level agricultural policies and programmes aiming at the development of rural areas (e. g. EAFRD) may support each, depending on local and regional activities, e.g. through regional LEADER projects. Regulations aiming at nature conservation and environmental protection (among others: Natura 2000 network and European Biodiversity strategy, European soil strategy, Water Framework Directive, Flood Directive) may be affected, too – adversively, or even be foiled. Environmental effects can be diverse – positive and negative. Which predominate, and how far other environmental goals and standards are affected, will strongly depend on the intensity of land use, e. g. on soil cultivation, application of fertilizers

and pesticides, types of crops grown, breeds, the geo-ecological disposition of the farmland towards soil erosion or nitrate leaching, the overall structure of the landscape in terms of biodiversity.

Besides conservation aspects, the main focus in this context should lie on the socio-economic frameworks, the effects and interdependencies. Also important are the natural conditions as biological basis of the biomass production and ecological effects. Therefore, the question arises which potentials can be actually provided by the rural area between the conflicting priorities of social, ecology, economy . How must this potential be dealt with in the future taking sustainability aspects into account? What is the impact of the land use systems on the ecosystem(s) and their functions? (How) does the production of biomass and bioenergy have to be managed and regulated in the future, not to avoid other development and environment targets? How can these targets be achieved? Which synergisms can be used therefore?

The SRU lists in its latest report several studies that have analysed the biomass potential under different aspects, based on assumptions made on agriculture and forestry (production increases), on the development and demand for food supply (degree of selfsufficiency) and on nature conservation requirements (cp. SRU 2007: 28). But the SRU also warns that some do not "conform entirely to existing legal provisions, especially with regard to nature conservation…", "with the result that these scenarios overestimate the potential and cannot therefore be regarded as an upper limit as things stand at present" (SRU 2007: 29). The pressures exerted on nature and environment following the increasing in demand for agriculturally produced bioenergy, i.e. following increasing crop yields or a geographical expansion of land use and a shift in land use on formerly extensively farmed land, "justifies the need standards, farming practices and framework management" according to the SRU (2007: 60 ff).

Further issues to be addressed when developing a sustainable bioenergy implementation scheme are:

- Which cultivation methods, regulation strategies and supporting policies and schemes make sense taking socio-economic aspects and natural conditions into account, following actual and future technical development and standards?
- Can an implementation operate properly, and how? What can be socio-economic and ecologically reasonable and practicable, considering aspects of sustainability?

Taking all these different aspects into consideration, the following recommended actions can be derived:

- A balanced structural policy for the rural areas (e.g. agricultural social structure, limits of bearing strength, guidance of agricultural subventions, added value and regional marketing, safeguarding / creating jobs; energy independence);
- Sustainable and climate/ environment conservative energy policies, especially with a view on production and use of renewable energy resources/ biomass;
- Promotion of the reuse of set-asides to minimise land use conflicts, however, considering cultural landscape conservation measurements for a sustainable development;
- Promotion of the building of networks in rural areas of different potential conflict partners to find new ways of common land use;
- Implementing new innovative technologies.

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