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Top-down and Europe-wide versus bottom-up and intra-regional identification of key issues for sustainability impact assessment

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article info abstract

Keywords:
Bioenergy Cluster analysis
European Policy LAU Land use National Scale NUTS
Regional perspective Scale transition Sensitive regions
Stakeholder involvement
Sustainability impact assessment tools aim at optimising the development of policy measures. Here, we present an approach to designing policies for multifunctional land use with application to Europe and its regions. After the 35 environmental, social and economic impact issues of the European Impact Assessment Guidelines were reviewed on the basis of spatiotemporal indicators at both the top-down Europe-wide and bottom-up intra-regional resolution level, cluster analysis identified classes with specific sustainability characteristics and thus regions most likely facing similar sustainability problems. Sensitive region types such as post-industrial zones, mountains, coasts and islands were analysed separately. The results of the cluster analysis were tested against evidence-based information such as UNEP priorities and regional stakeholder evidence. Stakeholder evidence was specifically explored for the land use policy 'bioenergy promotion' in Lusatia, Germany. We concluded that these top-down and bottom-up spatiotemporal data classifications with cluster analysis represent useful ex-ante impact assessment tools and need to be supplemented by participatory assessments. This procedure with top-down and bottom-up data analysis, and also participatory evidence, provide a valuable three-step sustainability impact assessment approach in policy making.

1. Introduction

Key sustainability problems need to be identified and then managed on the appropriate scale. It can be debated whether policies should address top-down, here European, priorities or those at the local community level, in order to balance Europewide as well as national and regional needs. In countries with a strong government, the role of government is clearly more significant in providing guidance, restricting actions through policies, and facilitating changes. Under such conditions, the government can be seen as a driving factor in taking the lead and giving priority to particular policies and strategies. On the other hand, regional stakeholders and non-governmental organisations, which play a minor role under a strong government, can promote bottom-up innovation and thus push forward critical policy issues.

The national governments and international community clearly has a role in guiding policies and shaping discourses, but the details need to be developed at a higher resolution level to allow policy makers flexibility and to ensure that regional and local needs are being addressed in both mitigation and adaptation policies (Tompkins and Amundsen, 2008). The regional and local focus is also essential to get voters' confidence in future policies. Thus, case studies are relevant

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for testing the top-down findings of sustainability impact assessment.

Key European policies refer to land use for food, energy and natural resources safety (e.g., bioenergy and biodiversity) and also employment opportunities (Commission of the European Communities, 2009a). The impact of any policy may play out according to the region-specific environmental, social and economic character particularly in regions with sensitive or susceptible sustainability issues. Accordingly, the Commission of the European Communities released the impact assessment

Table 1 Environmental (ENV), social (SOC) and economic (ECON) issues according to the European Impact Assessment Guidelines and indicators and variables from top-down and bottom-up approaches.

Impact issue	Indicator, variable
ENV01. Air quality	SO_2, NO_X, O_3, CH_4, CO, Pm10
ENV02. Water quality and resources	Nitrates, pesticides, heavy metals, critical loads, water replenishment
ENV03. Soil quality or resources	Contaminants, carbon stock and content
ENV04. The climate	Atmospheric concentration of the greenhouse gases CO_2, CH_4, N_2O and O_3
ENV05. Renewable or non-renewable resources	Energy use in flats and buildings per fuel type
ENV06. Biodiversity, flora, fauna and landscapes	Species of the red list of threatened animals
ENV07. Land use	Land use change, arable, grassland, forest, nature reserve
ENV08. Waste production and recycling	Industrial, municipal, hazardous and radioactive waste production and recycling
ENV09. The likelihood or scale of environmental risks	Soil erosion
ENV10. Mobility (transport modes) and the use of energy	
ENV11. The environmental consequences of firms' activities	
ENV12. Animal and plant health, food and feed safety	
ENV13. Other environmental issues	Livestock density index
SOC01. Employment and labour markets	Unemployment rate, employment rate in total, by gender, by sector, by age, by qualification
SOC02. Standards and rights related to job quality	
SOC03. Social inclusion and protection of particular groups	Employment rate of women
SOC04. Equality of treatment and opportunities, non-discrimination	
SOC05. Private and family life, personal data	Educational level of pupils and of population
SOC06. Governance, participation, good administration, access to justice, media and ethics	Eligible voters and number of votes
SOC07. Public health and safety	
SOC08. Crime terrorism and security	
SOC09. Access to and effects on social protection, health and educational systems	
SOC10. Other social issues	Population structure by age and gender, elderly people, fertility rate
ECON01. Competitiveness, trade and investment flows	
ECON02. Competition in the internal market	
ECON03. Operating costs and conduct of business	Taxes
ECON04. Administrative costs on businesses	
ECON05. Property rights	
ECON06. Innovation and research	Gender, educational level
ECON07. Consumers and households	Household number and size
ECON08. Specific regions or sectors	Number of tourist overnight stays
ECON09. Third countries and international relations	
ECON10. Public authorities	Municipality debts, investments, incomes and expenditures
ECON11. The macroeconomic environment	Road and rail density
ECON12. Other economic issues	

guidelines in 2005 (Commission of the European Communities, 2005) for thoroughly addressing the three pillars of sustainable development, namely environmental, social and economic issues. These guidelines distinguished 35 sustainability issues with 12 environmental, 9 social and 11 economic issues and, if required, one extra issue for each of the three pillars (Table 1). Thus, the broad spectrum includes normative and strategic issues (Kidd and Fischer, 2007; Munda, 2006).

The combination of data analysis and stakeholder knowledge to balance the three pillars of sustainability is needed for impact assessment of policy options, including the definition of targets and limiting values for each of the issues and the respective indicators, e.g., atmospheric concentration of the greenhouse gases, the employment rate or income Helming et al., 2007. However, attaining this balance is difficult and adequate methodologies are still poorly developed. Due to the increasing relevance of sustainability impact assessment, the guidelines have recently been updated (Commission of the European Communities, 2009b).

The objective of this paper is to bring together the topdown, here Europe-wide, and the bottom-up, here local, data-

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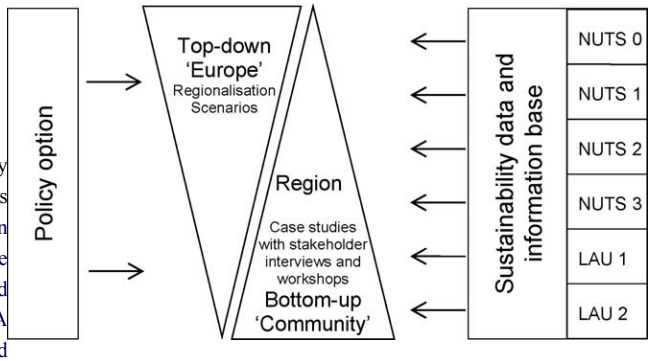

Fig. 1 – Bottom-up versus top-down approach for the data and stakeholder driven policy implementation. Abbreviations: Nomenclature of Territorial Units for Statistics (NUTS). National level 0 to highest resolution 3. Local administrative unit (LAU) with low resolution 1 and high resolution 2.

driven methodology referring to policy impact assessment guidelines (Commission of the European Communities, 2005) and also to include regional evidence-based and stakeholders' knowledge (Fig. 1). A bioenergy policy case study is presented here, which was examined for the post-industrial region of Lusatia, Germany, which has a large energy competence and is particularly sensitivity to top-down policies.

2. Materials and methods

2.1. Administrative units for impact assessment

The operational basis for the administration in the EU is the Nomenclature of Territorial Units for Statistics (NUTS) and the local administrative unit (LAU) regions (European Union, 2003). While NUTS is a geocode standard for referencing the administrative divisions of countries for statistical purposes, LAU is the administrative division of European countries, ranked below a province, region, or state. The NUTS level was created by the European Office for Statistics ('eurostat') as a single hierarchical classification of spatial units used for statistical production across the European Union. However, it is important to recognise that the NUTS divisions do not completely correspond with administrative divisions and the executive power within the country.

At the top of the hierarchy are the individual member states of the EU, with NUTS level 0, and below that are NUTS levels 1–3 and then LAU levels 1 and 2 (Fig. 1). Note that LAUs were introduced in July 2003, replacing former NUTS levels 4 and 5. Not all countries describe their locally governed areas this way but it can be descriptively applied in all EU countries to refer to counties and municipalities.

2.2. Protocols for top-down and bottom-up data analysis

A Europe-wide top-down overview was compiled for all countries in the EU-27 (Renetzeder et al., 2008) and for 4 sensitive region types (i) post-industrial regions, (ii) mountains, (iii) coasts and (iv) islands, applying the following 10step protocol: (1) geographical identification of Europe's potentially sensitive post-industrial zones, mountains, coasts and islands at the NUTS levels 2 and 3, (2) the literature review to identify sustainability issues and data sources, (3) assessment of the necessity of collecting complementary data, (4) data collection on key issues in sensitive areas, based on the sustainability impact issues identified by the European Impact Assessment Guidelines, (5) consultation with relevant stakeholders with regard to their view on sustainability issues in sensitive regions throughout Europe, which is particularly relevant for sensitive region types that are underrepresented at the NUTS levels 2 and 3 (e.g., islands), (6) simple web-based questionnaire to collect qualitative and (semi)quantitative data on key sustainability issues, (7) statistical analysis and clustering of sensitive regions based on available indicators to identify classes of post-industrial zones, mountains, coasts and islands with similar environmental, social and economic characteristics, (8) generation and interpretation of maps with key issues of sensitive regions; here the most sensitive regions were delineated, (9) drafting of sub-survey reports, and compilation into a final report, and (10) integrated and comparative analysis of key sustainability issues across sensitive-area types and against a 'regular' standard, e.g., European average (Dilly et al., 2008).

The bottom-up intra-regional resolution level procedure was essentially done with the same protocol. Here, thesensitive area case study is of Lusatia in eastern Germany, with five NUTS level 3 cells referring to 127 LAU level 2 cells and spatial and temporal data derived from regional administrations and stakeholders Rogass et al., 2007. About 60 indicators were analysed. This case study was selected since the region faces a large number of sustainability problems. Lusatia represents both a post-industrial and modern industrial region for power generation, relies on agricultural, forest and biodiversity issues and suffers from demographic change and migration. The economic structures show little involvement of small and medium sized enterprises(INKAR, 2005). Large industrialisation by opencast lignite mining activities has occurred since the early 1970s. There have also been drastic land use changes and new land use types such as bioenergy production, tourism, biodiversity conservation, agroforestry and viticulture, and tourism activities have been stimulated since German reunification in 1989. Population density has changed by more than a factor of two over the last four decades in the regional capital Cottbus. A low employment rate and a high average population age were characteristic of Cottbus and the region as a whole.

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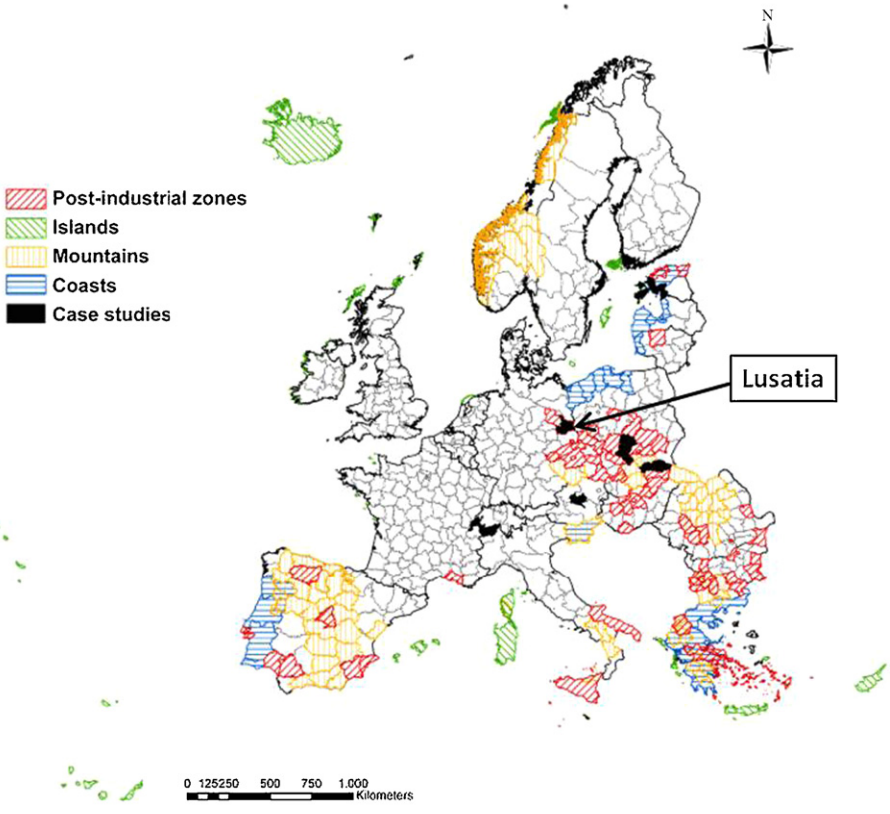
Fig. 2 – Pan-European overview for the sensitive region types: (i) post-industrial zone, (ii) mountains, (iii) coasts and (iv) islands; 7 case studies including Lusatia are shown in which bottom-up analyses were done.



The bottom-up approach was applied similarly to six other sensitive area case studies for bioenergy and biodiversity policies which are not presented here (Fig. 2).

It is important to note that the LAU level 1 is not consistently available across Europe. Thus, the common ground for bottom-up institutional classification was the LAU level 2. In accordance with the top-down procedure, the classification was also done with cluster analysis and the number of clusters was aggregated to three classes within a case study (Stuczynski et al., 2009).

2.3. Participatory approach

Evidence-based assessment and stakeholder-inclusive impact assessment was also carried out in the sensitive area case study Lusatia in Eastern Germany for the policy case 'promotion of bioenergy'. The sustainability impact assessment was done for five NUTS level 3 and for the three levels of promotion of bioenergy: (i) no promotion, (ii) business as usual and (iii) the threefold enhanced promotion, and for four policy measures. The policy measures were related to the Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport, the Directive 2004/8/EC on the promotion of cogeneration (Renewable Energy Incentive Program for Residential and Small Business Customers), the Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market, and the Council Regulation (EC) No. 1782/2003, article 9 and Commission Regulation (EC) No. 1973/2004 in the framework of the Common Agricultural Policy for the cultivation of energy crops on acreage not set-aside. Details were given in Dilly et al. (2007).

Stakeholders encompassed the following groups: (1) individuals like land owners, (2) community-based groups,

(3) local governance structures such as administration, police and the judicial system, (4) agencies with legal jurisdiction over the relevant natural resources, e.g., a state park agency with or without local offices, (5) local governmental services, e.g., education, health, forestry and agriculture extension, (6) relevant non-governmental organizations, e.g., dedicated to environment or development at local, national and international level, (7) political party structures at various levels, (8) businesses and commercial enterprises from local cooperatives to international corporations, (9) universities and research organizations, (10) government authorities at district and regional level, and (11) staff and consultants of relevant projects and programmes. Note that categories such as gender, age, disability and ethnicity may cut across these groups, or may be represented as sub-groups, e.g., a local NGO that supports an ethnic minority group in their struggles for access to land.

For the work here, 22 stakeholders across the mentioned groups were included in two-phase interviews and 6 participated in the workshop. Phase 1 interviewees were recruited from Brandenburg state ministries and other administrative organisations dealing with bioenergy issues. They were expected to provide information on bioenergy policy objectives and long-term implementation plans at national and

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regional levels. Phase 2 stakeholders represented different sectors involved in bioenergy production in Lusatia. Based on the experiences in phase 1 and phase 2 and on recommendations made by some interviewees, the participants for the workshop were selected. The group consisted of government officials responsible for regional development strategy and environmental protection, farm advisory and extension specialists and representatives of NGOs involved in promoting and developing bioenergy production. The group was selected to provide a broad view on drivers, benefits and conflicts resulting from different scenarios of increasing biomass production for energy. Furthermore, participants were selected to cover sectors and interactions related to the socio-economic and environmental aspects of bioenergy production such as agriculture, forestry, industry/energy, research, NGOs, farms, consultants and administration. The participatory approach was guided by Morris et al. (2008).

3. Results and discussion

3.1. Top-down view

The European Union consists of 27 member states and encompasses a broad spatiotemporal pattern of environmental, social and economic issues in one federal system. The topdown view looked at the national NUTS level 0 to the NUTS levels 2 and 3 (European Union, 2003) which encompassed 97 NUTS level 1 cells, 271 NUTS level 2 cells and 1303 NUTS level 3 cells. Eurostat calls NUTS level 2 cells 'Basic Regions', and thus describes these 271 entities as the appropriate level for analysing regional–national problems. The NUTS level 2 is the level at which both national and regional policies are generally implemented (Eurostat, 1998). In contrast, the LAU level 2 represents the most finely resolved administrative level for policy activities-too finely resolved to be considered from the European policy perspective during sustainability impact assessment.

The classification of the entire EU-27 at NUTS level 2 was found to be suitable for a top-down perspective in data-driven sustainability impact assessment for environmental, social and economic effects of multifunctional land use in European regions. Using cluster analysis of the freely accessible data on environmental, social and economic issues derived from the EU-27 member states (Commission of the European Communities, 2005). Renetzeder et al. (2008) separated 27 regions with similar characteristics. The Joint Research Centre in Ispra, Italy, and the European Environmental Agencies in Copenhagen, Denmark, aggregated the environmental, social and economic information which can be arranged according to the European Impact Assessment Issues (Table 1). Criteria and indicators from such sources were used for assessing sustainable land use by Hecht et al. (2009).

Cluster analysis was applied by Renetzeder et al. (2008) to separate 27 EU 'regular' cluster regions with highest endogenous similarity using a sequential approach of the primary, environmental landscape structures (Naveh, 2007) and secondary, socio-economic landscape structures. Cluster analysis is an exploratory data analysis tool which aims at sorting objects and variables at a defined spatial scale into groups in a way that the degree of connection between objects is maximal if they belong to the same group and minimal otherwise. This statistical procedure can be applied to various spatial levels, including the molecular level (Powell et al., 2004). This tool can be used to discover structures in spatial units without providing an explanation and interpretation of why they exist. Such an approach helps to conceptualize Europe as a geographical construct (Murphy, 2008) but this top-down view needs to be tested in sensitive regions and sensitive area case studies.

Sensitive region types, here defined as post-industrial regions, mountains, coasts and islands, delineated approximately 30% of Europe and showed different indicator values than those of Renetzeder et al. (2008). The differences are revealed in employment structure, population growth, gross domestic product and agricultural indices (Fig. 2). The indicators were selected carefully based on the impact assessment guidelines (Table 1) and with reference to administrative units. The compiled sub-overviews referred to the NUTS level 2 administrative units and considered additional expert knowledge, e.g., the United Nations Environment Programme has developed tools that were already implemented for proper policy measures (UNEP, 2006).

The cluster analysis separated classes of sensitive regions by their key issues and thus supported the European Commission departments' intension to mobilise and to exploit the most appropriate expertise, particularly for sensitive regions, with a view to establishing a sound knowledge base for better policies. The second objective is to uphold the Commission's determination that the process of collecting and using expert advice should be credible (Commission of the European Communities, 2002b).

In addition, evidence-based expert knowledge was also considered for the identification of priority areas of European sensitive regions for the following reasons. The delineation of post-industrial zones or brownfields has just started at the NUTS levels 2 to 3 (Stuczynski et al., 2009). For mountains, relevant work on sustainability problems has already been done in earlier projects (Nordregio, 2004). Furthermore, coasts represent critical transitional locations under scenarios of climate change with rising global temperature and increasing sea level (Brouwer and Ek van, 2004). Finally, island-relevant NUTS cells required expert knowledge since islands are not well represented at NUTS levels 2 to 3.

Overall, such top-down classification approaches for both regular and sensitive regions at the NUTS levels 2 and 3 are typically normative and strategic but consistent data is limited. The top-down perspective includes modelling and aggregation/disaggregation procedures that are limited in reflecting natural conditions. This view may lack credibility (Munda, 2006; Tangian, 2007) and thus should be extended to include bottom-up approaches.

3.2. Bottom-up key sustainability issues and indicator analysis

The bottom-up approach starts from the LAU level 2 resolution and is typically overseen by the NUTS level 2 state authorities who are in charge of the regional management of environmental, social and economic resources for sustainable

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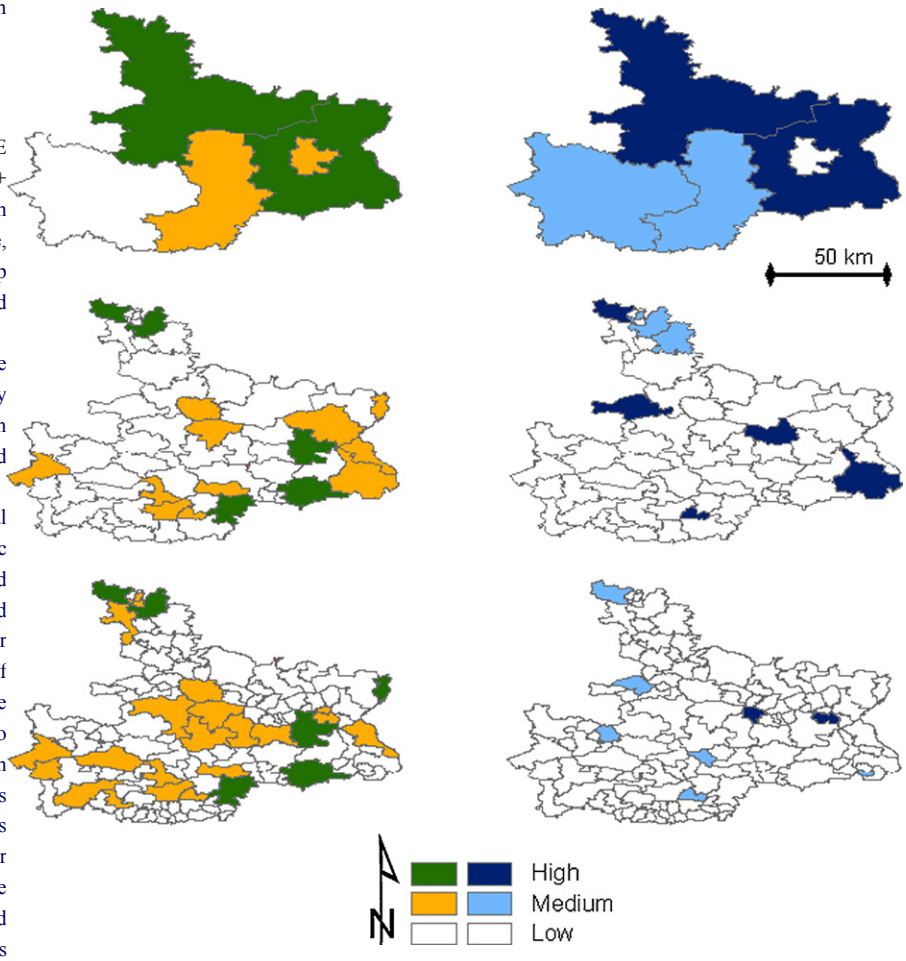
Fig. 3 – Sustainability grades/classes (left: at 1990 and 1992; right: changes from 1990 to 2004) at NUTS level 3 (top), LAU levels 1 (middle) and 2 (bottom) in Lusatia, Germany.



development, e.g., EFRE and LEADER+ programmes (European Parliament, 2007). Here, the bottom-up perspective is aggregated to the NUTS level 3.

The analysis of the sensitive area case study for Lusatia in eastern Germany tackled community-level environmental, social and economic characteristics and identified hot spots and thus priority regions for the careful application of policy measures from the NUTS level 3 down to the LAU level 2 with 127 LAU level 2 units and about 60 indicators (Table 1) by the cluster analysis. The three structural classes and their temporal changes separated 'low', 'medium' and 'high' sustainability values and with 'low', 'medium' and 'high' temporal changes between 1990 and 2004. This three-level ranking scheme was also applied by Reidsma and Ewert (2008) for the estimation of the vulnerability of food production to climate change. Here, key indicators covered the environmental, social and economic issues and were related to agricultural area, elderly population, inhabitant density, public and residential land use, business taxes and real taxes. The results should be checked separately at the NUTS level 3, LAU level 1 and LAU level 2. Fig. 3 shows that the northern regions close to Berlin can be classified as more sustainable at the NUTS level 3. In contrast, the western part of Lusatia, where agriculture is a more prevalent land use, seems less sustainable. However, the LAU levels 1 and 2 views showed that many cells across the whole region were classified in the low sustainability class and, furthermore, counties and communities differed within NUTS level 3 cells. Over time, the assessment has showed little changes in Lusatia between 1990 and 2004.

The bottom-up view is essential when trying to identify sustainability problems intra-regionally and to demonstrate the impact of policy measures under average conditions and under more extreme but realistic conditions. The clear advantage in considering case studies is that they allow policy makers to examine a wide range of real-world situations within policy will need to operate. Sensitive area case studies should be carefully explored in the new EU member states. The development and flow of expert knowledge between old and new EU member countries provides information on the response to policy measures ex-post and ex-ante.

We found here that the perception of intra-regional disparities in the EU is possible (European Parliament, 2007). In that respect, the collection of data and information at local LAU levels 1 and 2 would considerably improve the understanding of spatial disparities and key sustainability problems across the EU. The regional divisions in terms of NUTS levels

currently used for regional policy are generally too large for many subjects related to territorial cohesion (Veld, 2007) and thus act as an inadequate basis for grounding efficient public intervention (European Parliament, 2007). There is a need to integrate different policy arenas when policy programs are developed for issues such as energy efficiency, food and water supply and climate change. There are signs that this integration is starting to occur (Vine, 2008).

3.3. Stakeholder views

For the policy case 'bioenergy promotion' in Lusatia, semistructured interviews in two phases with up to nine questions gave an overview on the (i) perception of regional, national and EU bioenergy policies and (ii) the likely differences in outcomes for the three levels of bioenergy promotion. Such methodology was also proposed by Varvasovszky and Brugha (2000) in policy and planning.

The 22 interviews were followed by a workshop with 6 stakeholders, for the detailed interactive exploration of issues. They each provided indicator scores which were used to rank the issues. Acceptable minimum values for each of the issue's indicators were negotiated (Dilly et al., 2007). The importance of the nine key impact issues (or land use good and services or land use functions, see Costanza et al., 1997 and Pe´rez-Soba et al., 2008) representing key negotiated topics drawn from the 35 sustainability impact issues of the Commission of the European Communities (2005) were investigated in the course of the workshop and were ranked in importance as follows (most important first): Provision of work SOC1, Water supply and replenishment rate ENV3, Provision of soil resources ENV1, Land-based production ECON 2, Health and recreation SOC2, Support and provision of habitat ENV2, Infrastructure and mobility ECON3, Residential and non land-based industries and services ECON1, and Cultural landscape SOC3 (Fig. 4). During the workshop, the stakeholders showed that environmental issues (ENV) were generally ranked higher than social issues (SOC) and economic issues (ECON). An exception to this was that provision of work was ranked most highly. It was estimated to be favoured by high promotion of bioenergy.

No promotion of bioenergy and a threefold increase in promotion of bioenergy were expected to induce both positive and negative impacts in comparison to business as usual policies (Fig. 4). Furthermore, there were substantial differences between the experts in their opinions about no promotion and a threefold increase in promotion of bioenergy. Such differences may be regarded by policy makers as problems when considering the adoption of either of these policy alternatives. Differences in opinion were particularly high for the high promotion option (not shown). These differences would be particularly relevant to discussion of policy for landscapes where agricultural land use predominates (Dilly et al., 2007).

The interviews and the workshop with regional stakeholders helped to test the output of data analysis and regional scenarios (Giljuma et al., 2008) and represent standards for consultation of interested parties (Commission of the European Communities, 2002a). ''EU institutions are perhaps best seen as one of the governance context within which local and regional actors must negotiate'' (Johnson, 2008). Stakeholder work will support the perception of regional problems by identifying their targets and limit values (Lambregts et al., 2008). The stakeholder work should aggregate the perceptions at the NUTS levels 2 and 3 and also evaluate the top-down against bottom-up perspectives.

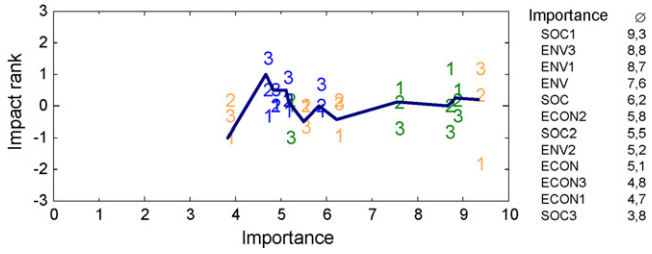


Fig. 4 – Assessment of the effects of no promotion (1), current promotion (2) and increased promotion (3) of bioenergy on environmental, social and economic characteristics in Lusatia by 6 stakeholders; the solid lines display the minimum values. Abbreviations: Provision of work: SOC1; health and recreation: SOC2; cultural landscape: SOC3; provision of soil resources: ENV1; support and provision of habitat: ENV2; water supply and replenishment rate: ENV3; residential and non land-based industries and services: ECON1; land-based production: ECON 2; and infrastructure and mobility: ECON3.

4. Conclusions

The top-down and bottom-up data-driven identification of key issues, as well as the participatory process, represent a threestep approach for sustainability impact assessment. The link between top-down and bottom-up environmental, social and economic indicators ensured that policy making considers the resources and sustainability characteristics of each region. The participation of stakeholders included regional expert knowledge. Such an approach combined pan-European perspectives with regional end-actor views. Stakeholder interviews and workshops helped to assess the impact of policy options and to favour success of acts, directives and regulations. Overall, the link between top-down and bottomup NUTS and LAU level application strikes a good balance between the expectations of interested parties and the need for a framework that, under the existing circumstances, is realistic and feasible in administrative terms (Commission of the European Communities, 2002b). This approach supports the European Commission's openness in seeking and acting on expert advice of an appropriately high quality and ensuring that its methods for collecting and using expert advice are effective and proportionate (Commission of the European Communities, 2002b).

The preference for top-down versus bottom-up approaches depends in part on whether normative, strategic policy perspective or the regional stakeholder perspective is considered more important. Traditional methods tend to adopt a more normative top-down approach while modern

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approaches rely more on consulting regional teams and European Parliament, 2007. Regional Disparities and Cohesion:
stakeholder perceptions and needs (Wale et al., 2009). Regional resources can be used most effectively by regional stakeholder inclusion aggregating the views at the NUTS levels 2 to 3. In the case study reported here, stakeholders clearly identified the importance of environmental issues when promoting bioenergy production.

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