

Sustainability related data acquisition for indicator analyses in Lusatia

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Kurzfassung

Das integrierte EU-Projekt SENSOR "Sustainability Impact Assessment: Tools (SIAT) for Environmental, Social and Economic Effects of Multifunctional Land Use in European Regions" verfolgt das Ziel, politischen Entscheidungsträgern der Europäischen Kommission Instrumente zur nachhaltigen Entwicklung in die Hand zu geben, die eine ex ante Abschätzung der ökonomischen, sozialen und ökologischen Folgen politischen Handelns ermöglichen und damit zu einer nachhaltigen Entwicklung der EU beitragen. Die dabei entwickelten Werkzeuge berücksichtigen ökonomische, soziale und ökologische Indikatoren mit sowohl regionaler als auch nationaler Auflösung. Politische Szenarien werden europaweit Modell gestützt entwickelt und durch Fallstudien (Sensitive Area Case Studies – SACS) validiert. Die Lausitz mit einer Größe von mehr als 7200 km² ist als eine von insgesamt 7 Modellregionen ausgewählt worden und repräsentiert hierbei eine typische post-industrielle Region. Die Datenakquise in dieser Fallstudie führte zur Identifikation von mehr als 60 Variablen, die sich an den Richtlinien "Impact Assessment Guidelines" (COM, 2005) der Europäischen Kommission orientieren. Die Variablen, die gleichzeitig die Sensitivität der Region Lausitz repräsentieren sollen, sind geographisch verknüpft mit 5 NUTS3, 57 NUTS4 und 127 NUTS5-Zellen (Nomenclature of Territorial Units for Statistics – NUTS, EU, 2003). Diese Zellen repräsentieren einen Großteil von Süd-Brandenburg, integrieren die Ergebnisse vorhergehender, statistischer Arbeiten und dienen Analysen räumlicher Unterschiede und Gemeinsamkeiten sowie der Beurteilung politischen Szenarien.

Abstract

The Integrated EU Project SENSOR "Sustainability Impact Assessment: Tools (SIAT) for Environmental, Social and Economic Effects of Multifunctional Land Use in European Regions" aims at providing the European Commission with tools that enable a political decision making oriented at the principles of a sustainable development. These tools include economic, social and environmental indicators covering regional to national resolutions. Policy cases will be explored all over Europe and validated in sensitive areas (Sensitive Area Case Studies – SACS). Lusatia was selected as one of the SACS comprising 7200 km² and representing a typical post-industrial zone. The data gathered for SACS led to the identification of a large number of variables being congruent with those provided by the European Impact As-

essment Guidelines (COM, 2005). The variables related to the sensitivity of the Case Study Lusatia have been geographically referenced and referred to so called NUTS categories (Nomenclature of Territorial Units for Statistics – NUTS, EU, 2003) representing different levels of resolution of information being available at the institutional level. These NUTS cells covering a major part of "Süd-Brandenburg" provided a sound data basis to classify and to integrate all relevant information to enable both an evaluation of regional distinctions and a validation of policy cases.

Key words:

Lusatia – sustainability – socio-economic and ecological issues – stakeholder, data analysis

Introduction

The EU 6th framework programme project SENSOR aims at predicting the consequences of a EU policy driven land use changes with regard to economic, social and environmental issues at regional levels. This approach was based on top-down modelling approach of various scenarios using low resolution of information commonly available and applied at the European level. Subsequently, the validation of respective outcomes will be evaluated in sensitive areas such as Lusatia representing a bottom-up approach based on a significantly higher spatial and temporal resolution of data and information.

The BTUC as module leader for sensitive area issues is in charge of gathering and validating economic, social and environmental data related to sustainability issues in Sensitive Areas (SA) and Sensitive Area Case Studies (SACS), which form a major prerequisite for a priori analyses in the SA and SACS and, particularly, for the testing of the predictions. Thus, one of the main objectives of this approach is an improved understanding of interrelationships between drivers, pressures, states, impacts and responses in European sensitive regions related to the EU DPSIR framework (EEA, 2007), which is supposed to allow an ex ante assessment of impacts being entailed with political measures taken at the EU level (DILLY et al., 2007). In this context Lusatia was selected as one out of seven Sensitive Areas to test and to validate this approach. The total set-up of Sensitive Areas comprises two post-industrial regions (Lusatia and Silesia), one coastal zone (Western Estonia with the island Osilia), one island (Malta) and three mountainous regions (Valais, High Tatras and Eisenwurzen) (Fig. 1).

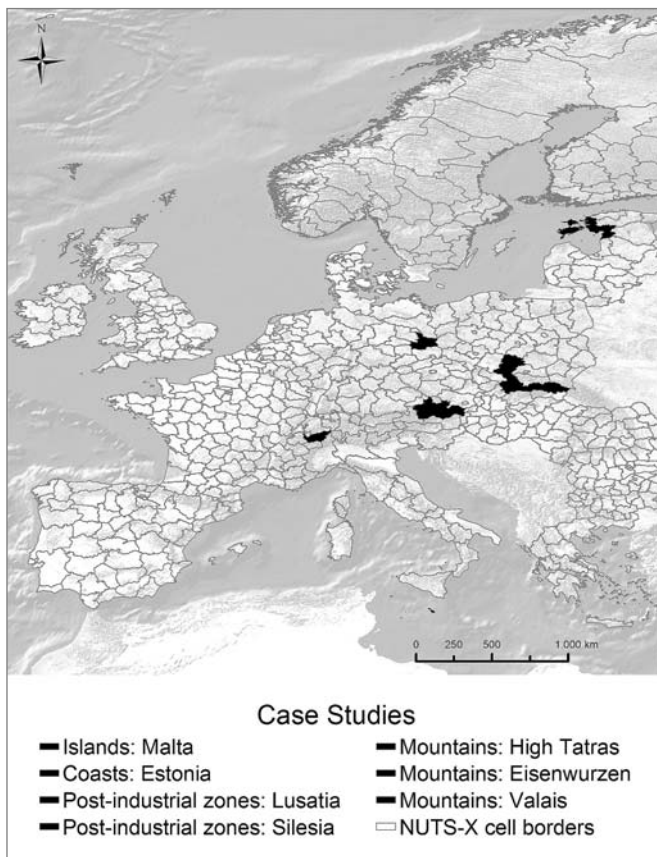


Figure 1:
Location of Sensitive Area Case Studies

Table 1:
The three pillars of the Impact Assessment Guidelines

Number	Economic pillar	Social pillar	Environmental pillar
1	Competitiveness, trade and investment flows	Employment and labour markets	Air quality
2	Competition in the internal market	Standards and rights related to job quality	Water quality and resources
3	Operating costs and conduct of business	Social inclusion and protection of particular groups	Soil quality or resources
4	Administrative costs on businesses	Equality of treatment and opportunities, non-discrimination	The Climate
5	Property rights	Private and family life, personal data	Renewable or non-renewable resources
6	Innovation and research	Governance, participation, good administration, access to justice, media and ethics	Biodiversity, flora, fauna and landscapes
7	Consumers and households	Public health and safety	Land use
8	Specific regions or sectors	Crime terrorism and Security	Waste production/generation/recycling
9	Third countries and international relations	Other social issues	The likelihood or scale of environmental risks
10	Public authorities		Mobility (transport modes) and the use of energy
11	The macroeconomic environment		The environmental consequences of firms' activities
12	Other economic issues		Animal and plant health, food and feed safety
13			Other environmental issues

With regard to the European NUTS classification system (Nomenclature of Territorial Units for Statistics – NUTS, EU, 2003), which refers to institutional units ranging from the NUTS0 level, i.e. countries, down to the LAU2 or NUTS5 level, i.e. rural municipalities, the planning region (“Raumordnungsregion”) Lusatia consists of 5 NUTS3 (districts), 57 NUTS4 (departments) and 127 NUTS5 cells. These NUTS cells integrate 410 communities. The districts, which are enclosed, named DE422 “Dahme-Spreewald”, DE424 “Cottbus”, DE425 “Elbe-Elster”, DE427 “Oberspreewald-Lausitz” and DE429 “Spree-Neiße”. In comparison, the State of Brandenburg (NUTS1) contains in total 18 districts, of which 9 refer to the NUTS2 cell “Süd-Brandenburg”.

Methods

a) Data acquisition

In 2005 the European Commission released the Impact Assessment Guidelines (COM, 2005) which refer to the 3 pillars of sustainability, the economic, the social and the environmental one. These pillars enclose about 30 sustainability issues which implicitly call for a broad and sound data and knowledge base (Tab. 1).

In a first step the spatial, temporal and thematic data frame was defined by using expert-knowledge of partners involved in the project.

In the next step all regions were delineated by NUTS cells, which represent different institutional resolutions from a country down to a municipality (Nomenclature of Territorial Units for Statistics – NUTS, EU, 2003) depending on the level of aggregation. This approach was essen-

tial to enable the comparability with NUTS related data as being provided by EUROSTAT (Statistical Office of the European Communities) for same areas.

Taking into account the fragmentation and the inhomogeneity of statistical data before the German Reunification and the overlapping observation periods applied by SENSOR partners, an annual interval from 1990 to 2005 was chosen as a priori timeframe. Maintaining those preconditions potential data holders and groups of interests were identified with the help of local experts and with the help of internet exploration.

Besides the collection of thematic data geo-referenced vector maps were obtained from national administrative bodies such as the Brandenburg Agency for Infrastructure and Regional Planning (MIR). This national agency was also the main supplier of highly resolved and continuously regionalised economic and social data sets.

The second supplier of economic and social data was the Federal Agency for Civil Engineering and Regional Planning (BBR) giving access to the database front-end – INKAR2005 (Indicators, Maps and Charts of spatial development across Germany and Europe) which is based on different sources for integrating regional and national issues. Ecological data have been obtained from the Brandenburg National Environment Agency (LUA) and from the Brandenburg National Agency for Mining, Geology and Raw Materials (LBGR).

b) Data conversion

In order to achieve a high level of geographic compatibility and comparability, each data set was transformed into a standardised structure using specific ID's. By integrating the German variations of the indication and dotting of coordinates the same geodetic system had to be used, i.e. the realisation of the European Terrestrial Reference Frame 1989 (ETRF89) called European Terrestrial Reference System 1989 (ETRS89).

To avoid intra-module GIS-related problems the same GIS-utilities (ESRI ArcGIS) and also the similar data types and structures were used by module partners in Malta, Switzerland, Poland, Slovakia, Austria, Estonia and Germany. Several common data formats such as "mdb", "dbf" or "xls" did not cope with the requirements which exist for mapping procedures as the maximum amount of records is often limited except for the new Microsoft Office 2007. Hence, an ASCII-format was used to be completely platform-independent.

Available data sets were crosschecked for overlaps, inconsistencies and regional status (2004 in Lusatia). This was done to avoid a mismatch of GIS-based allocations of thematic and geographic data. Subsequently, data sets were harmonised and transformed into an intermediate table structure.

Although a collection of ready-to-use indicators would facilitate the data processing and modelling work, all submitted indicators were separated into variables to avoid misinterpretation of similar indicators from different sources. This approach also supported a distinction between common and specific variables.

c) Pre-processing

The collection, validation, transformation and harmonisation of submitted data were essential steps for further processing of data. With regard to the main responsibility of BTUC of being in charge to submit detailed, ready-to-use data of sensitive regions it is crucial to pre-process data sets in order to increase their level of precision. Potential approaches to gain a higher precision could be:

- reduction of seasonal impacts with regard to a potential comparison of data
- padding of gaps to enhance interpretability
- removal of abundances to highlight regional distinctions expressed by the variables

For a better consideration of regional impacts it is important to harmonise scales and time periods. So, it seems to be necessary to define data-driven time-barycentres by using e. g. different unsupervised classification methods like minimum-distance, maximum likelihood together with cumulative relative frequency calculation.

By defining time-dependent thresholds several data can be recognised as case-sensitive with regard to their level of temporal fragmentation, which can be coevally used to select more reliable data. A possible approach could be the exclusion of time series in cases where the temporal fragmentation is higher than the upper quartile of a temporal fragmentation of the subject related group the variable belongs to. For instance if the time series "number of women" in the group "demography" in the pillar "social" would contain more than 50% data gaps as compared to the mean of all other indicators in the group "demography" it was excluded from the data set. From this weakness it was concluded to group coherent time series thematically in future. This would also increase the interpretability of further analyses, and e. g. clustering.

The gaps in the remaining data could be filled by applying simple polynomial, exponential or spline approximation. Regardless of which method will be applied, the approximating function must be in line with the prevailing real processes such as demographical development.

For removing redundancies in the data set, a shift-invariant correlation analysis was carried out. A possible approach is to use thresholds based on partial correlation analyses.

Results and discussion

For Lusatia about 60 variables could be identified at the NUTS3, LAU1 and LAU2 level (Tab. 2) which referred to the European Impact Assessment Guidelines and which could be used for a detailed analysis of economic, social and environmental indicators reaching a much higher level of detail and resolution usually required for political decision making at the EU level. Respective variables were based on about 145.000 data records which had to be transformed and harmonised for further analysis.

Table 2:*Excerpt of sustainability related variables of Lusatia*

Variable	Data Supplier	Short description	Related IAG issue
eeps	BBR	Employment – Employees primary sector in persons	Soc 11
dw	BBR	Demography – number of women in persons	Soc 4
bhs	MIR	Building – housing stock in flats	Soc 5
ti	MIR	Taxes – income in E/region	Eco 3
ons	BBR	Tourism – overnight stays in stays	Eco 8
aql	LUA	Air quality – Air leadfall in $\mu\text{g}/\text{m}^2 \cdot \text{d}$	Env 1
infil	BTUC	Climate – Infiltration rate soil	Env 4
airp	DWD	Climate – Air pressure in hpa	Env 4
luwa	BBR	Land use – area lentic and running waters in ha	Env 7
tc	MIR	Traffic – number of cars in cars	Env 10

¹ contain Number and Pillar given in Table 1

The data set comprised 5 NUTS3, 57 LAU1 and 127 LAU2 regions and reflected regional, sustainability related issues (Fig. 2). Data suppliers were identified as both stakeholders and stakeholder-independent real data suppliers.

One of the most important and time consuming work items was the transformation into a common data type and language. Several gaps and errors have been identified and eliminated. Most inconsistencies of the Lusatian data set occurred by different rounding methods of federal and national institutions, by measurements versus computation, by different spatial and temporal scales, by changes in the regional and institutional status of observed regions or by simple mistakes inside the agencies based on a difficult and permanently changing staff.

A crucial problem for collecting sound data refers to split responsibilities with regard to economic, social and environmental data at the federal and the geo-referencing of spatial data at the state level. Hence, federal data generally lack from a precise geographic reference. Thus, national agencies frequently maintain informal maps to avoid such inconsistencies in their own data set. It was, therefore, a major challenge within the frame of this project to harmonise geographic units and available data. Thus, a geometric stability of the NUTS cells for Case Study areas is regularly the case at the institutional level, and, likewise each variation of landscape, estate etc. within the observed time-frame has to be aggregated.

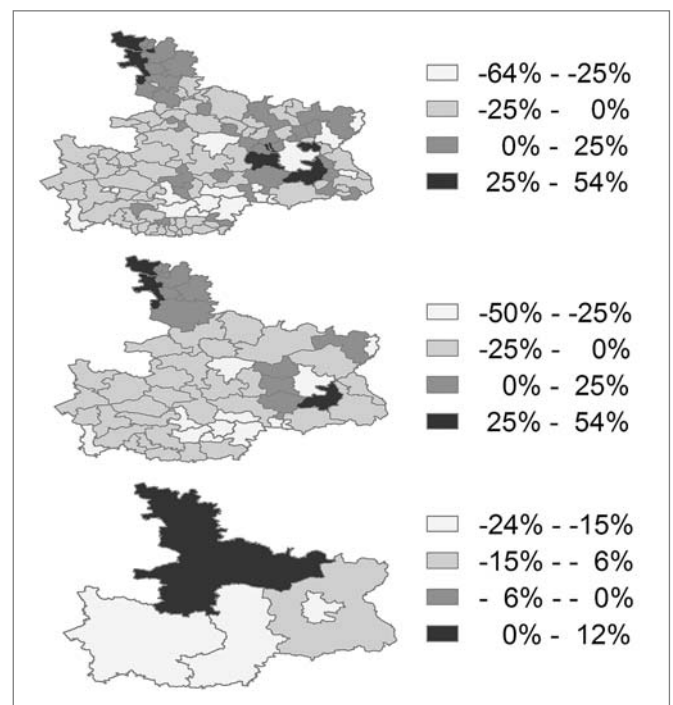


Figure 2: Population development in Lusatia from 1990 to 2004 at LAU2 (top), LAU1 (middle) and NUTS3 representing the IAG-issue “social other”

This geographic problem concerning potential gaps or overlaps between the polygons is unfortunately reinforced by the occurrence of additional NUTS-code-related mismatches. For years NUTS3 and LAUx cells of the State of Brandenburg have not been actualized by EUROSTAT (Statistical Office of the European Communities) who is in charge of transcribing European codes into regional codes. This partly applies also for Lusatia, since 1000 km² of open cast mining area and subsequent reclamation have not yet been considered in an adequate way. To overcome the problem of missing codes, we applied the EUROSTAT procedure of an alphanumerical counting and coding where the last 3 digits of LAU2 codes will be erased and missing values will be enumerated.

Conclusions

For the German context the applied data mining strategy enables an acquisition and pre-conditioning of economic, social and environmental data. Federal data are often costly and may contain inconsistencies as data are mostly generated or transformed from external data sources. Under the given circumstances it appears to be indispensable to include local authorities when gathering qualitative and highly-resolved data instead of contacting federal agencies. For a valuable database and meta-information following issues may be important:

- Integration of SACS tables into one geodatabase
- Structuring of the tables with regard to information type (geometric types, meta-information (origin, units, owner etc.), statistics (weights, correlation coefficients etc.))
- Implementation of artificial id's with regard to the instability of institutional borders
- Use of WGS84 as geodetic reference system instead of ETRS89 with regard to country-dependent "ETRS-problems" (amount of digits, timeliness of projection files)
- Implementation of auxiliary attributes for reflecting specific regional problems, cross-boundary effects and anthropogenic or natural origin

Integrated analytical approaches and relevant thresholds derived from both an expert-based and a scenario-based assessment in SACS should be applied in order to assure the comparability and compatibility of data and information. This will also form a prerequisite for identifying differences or similarities based on thematical clustering approaches. The present findings clearly reflect the importance of highly resolved spatial and temporal data at regional levels in order to verify the sparsely resolved data of EUROSTAT commonly forming the basis for policy measures in European regions.

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