

# Regional Effects of Urban Planning – an Informal GIS Tool to Support Sustainable Strategic Planning

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## 1 ABSTRACT

Nowadays the demand for a more sustainable urban development rises. At the same time demographic, climatic and structural economic changes are new overall conditions that require new concepts in spatial planning. The article describes a new tool for Geographic Information Systems that supports strategic planning with objective values about the local, municipal and regional effects of planned urban development projects. The tool models different economic, ecological and social effects of residential areas and areas for industry, commerce and retail. For example costs for infrastructures, financial benefits, ecological, climatic and traffic effects as well as accessibility to important infrastructures are considered. For a new residential area in Germany the article presents the results of the modules “municipal revenues” and “land use change and ecological value” and reports on first reactions of partners working in planning practice.

## 2 INTRODUCTION

The European population and economic development cause land use change for new areas for housing, industry and commerce or retail. Although the population in Europe is growing in total, there is a coexistence of growth and shrinkage in several countries on all spatial levels. In shrinking areas the infrastructure costs per inhabitant rise and schools and other infrastructures are threatened to be closed. This enhances the competition for inhabitants and firms between regions and municipalities with the aim to maintain these infrastructures. In Germany the situation is intensified because the financial equipment of municipalities mainly depends on the amount of inhabitants and located firms. This system is an incentive for an extensive settlement development as a basis for new inhabitants and firms.

But at the same time, the demand for a sustainable development rises. Not only fiscal effects, but also ecological and social consequences of settlement development should be taken into consideration in planning and negotiation processes. The knowledge about fiscal, ecological and social effects is often very limited. This especially applies in an early stage of planning, when important decisions about the locations and main characteristics of the projects are made. As a consequence, discussions about new projects in spatial planning are often more dominated by general statements than by science-based analyses. Furthermore, spatial planning and decision-making processes are characterised by isolated considerations and fragmented responsibilities. Sustainable urban development needs tools, instruments and methods to consider effects of planned projects.

## 3 STATE OF THE ART – EXISTING TOOLS IN GERMANY

In the German discussion about the effects of new residential areas – especially for single family houses – the aspects of infrastructure costs and fiscal impacts are very important. Especially municipal revenues are an essential factor for the competition between municipalities for new inhabitants. But decision-making processes are often dominated by general statements: It is a common opinion that new residential areas will have positive fiscal effects for a municipality.

The fiscal impacts of urban sprawl is discussed since several years – especially in the USA, but also in Germany since the 1970s (Danielzyk et al. 2010). In the last few years a lot of tools have been developed in Germany with the aim of giving objective and science-based information about the costs and benefits of new residential areas (an overview gives Dittrich-Wesbuer/Osterhage 2010 or the website of “Allianz für die Fläche”<sup>1</sup>). In spite of their similar aims they are based on different concepts, referring to the technical realization, the level of details and the precision of results. The existing tools are web- or MS Excel-based or have been developed as independent software. Furthermore, municipalities can purchase reports for a cost-benefit-calculation. Further differences result from the technical realization and vice versa. Some tools focus on the calculation of costs for investment and maintenance as well as operating costs. Technical

<sup>1</sup> <http://www.allianz-fuer-die-flaeche.de/Kosten-Nutzen-Modelle-273.html>

infrastructures like streets or (waste) water infrastructures are considered in all mentioned tools. Some of them also include social infrastructures (for example kindergarten, schools), public transport and fiscal revenues. But the level of detail and the precision of results are connected to the expenditure to compile and enter the necessary data. Web-based tools can often be used to create results in a few minutes if all required information is available. They are more suitable to give an impression of general relationships and make decision-makers and spatial planners aware of the consequences of their decisions. More complex tools produce very detailed analyses that can be used in different stages of spatial planning or the political discussion. There are different tools that can be used in all imaginable spatial applications.

These new tools are already in use and support local spatial planning processes with objective and science-based information about costs and fiscal impacts resulting from new residential areas. The experience is that not all new residential areas have positive fiscal impacts for municipalities, even though general statements are not possible. Impacts depend on the individual local situation. Infrastructure costs decrease with an increasing density, but they also depend on the specific location. This has an influence on the effort of building additional and the utilization of existing technical and social infrastructure.

Against often expressed fears, these tools did not lead to dominating economic aspects in spatial planning. Instead infrastructure costs and fiscal impacts can be one aspect in the consideration of interests. Additionally, there is a rising awareness for the long-term follow up costs of infrastructures as an important aspect for sustainable settlement development.

But in addition to these tools, a more expansive view on impacts of urban development projects is necessary. This concerns different aspects: Sustainability requires the consideration of economic, ecological and social aspects. The tools are limited to housing areas, but settlement development also includes new areas for retail or industry and commerce. In addition to that, the impacts of analysed projects are mostly not restricted on single municipalities, but the projects can cause effects on the regional structure and the development of interdependent municipalities. There is a need for additional decision-support-systems (DSS), that expand the view by more information about the impacts of urban development projects in all dimensions of sustainability.

## **4 A NEW APPROACH: REGIO PROJEKT CHECK**

### **4.1 Overview**

Based on these experiences the project team – consisting of institutions that have developed some of the mentioned cost-calculators – has worked on a follow-on project called RegioProjektCheck. The new instrument expands the existing decision-support-systems in three different aspects. Firstly, it illustrates the effects for both the affected neighbouring municipalities and the region. Secondly, in addition to housing, models for companies and retail become involved. Thirdly, it models additional topics of impacts (Fig. 1).

Fiscal impacts remain an important topic. Production and follow-up costs for the public sector as well as changed municipal revenues resulting from taxes and other payments are modelled. The effects are replenished by a regional model for multiplier effects, containing effects on jobs or consumption. Besides the fiscal topics the tool also covers ecological and social effects to expand the existing instruments. The ecological topic contains models for soil sealing, landscape fragmentation, energy consumption and emissions. The social effects deal with accessibility of infrastructures and therefore give evidence for inhabitants with limited mobility (for example children, handicapped, persons without a car). Every effect is visualized in a different way because the effects might occur in monetary dimensions, points, distances, minutes or CO<sub>2</sub>-emissions.

Therefore the tool can be used in a wider context, for instance in strategic regional planning processes. Because of this complexity it aims at experts who interpret the results and use them to advise municipalities and regions concerning multidimensional effects of projects. These experts can be external personal working as consultants or internal employees working in the public administration of the affected region itself. Single values as well as joint evaluations are available depending on the topic of effects. The aim of the tool is to visualize effects of decisions and to objectify discussions by offering a joint basis for decisions. It has to be underlined that the new tool should not replace existing formal processes but expand and support them in an early consideration.

Technically it is realized via a set of toolboxes in a Geographic Information System (GIS). According to the local context and problems, the tool offers different toolboxes which can be used optionally in a modular system. The users are able to modify single parameters to test variations of projects and different basic conditions, so the regional discussion becomes enriched.

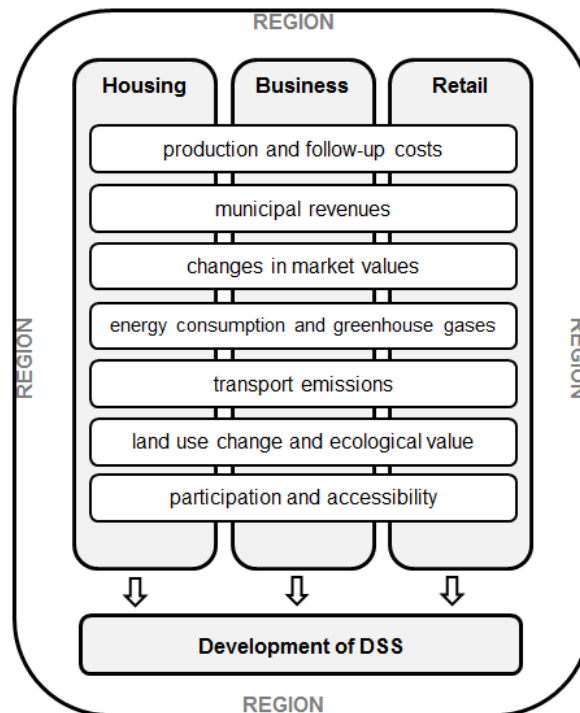


Fig. 1: Overview RegioProjektCheck

## 4.2 Test calculations

To illustrate possible results of the tool, we use it for the case study of a housing area and juxtapose the fiscal effects on the one hand with the effects on land use change and ecological value on the other hand. These topics of effects are very different with regard to their methodologies and evaluations. Our case study is a new housing area in the municipality of Kürten (19,500 inhabitants; district: Rheinisch-Bergischer Kreis) consisting of 70 single-family houses on 2.9 ha.

### 4.2.1 Municipal Revenues

The municipal revenues contain tax revenues and effects on the municipal revenue sharing system as direct effects. The regional value added, job effects and effects on regional consumer spending are modelled as indirect effects in an economic point of view (Kronenberg 2010). The model does not deal with the whole municipal budget but it visualizes the project-depending absolute change in revenues in order to simplify a comparison between projects and municipalities. While the direct effects are modelled for every affected municipality, the indirect effects are modelled for a wider region.

Fig. 2 shows that the municipality of Kürten gains additional yearly revenues concerning property tax, income tax and equalization payments but also has to pay additional county rates. The neighbouring municipality of Bergisch Gladbach loses income tax and equalization payments but has to pay less county rates. This effect is caused by the inhabitants moving from Bergisch Gladbach to Kürten. The new housing area also has effects on the district Rheinisch-Bergischer Kreis. It receives additional county rates caused by additional inhabitants in the district. These shifts in inhabitants are calculated in a complex population model which operates in the background and offers the project-related effects on migration in different municipalities.

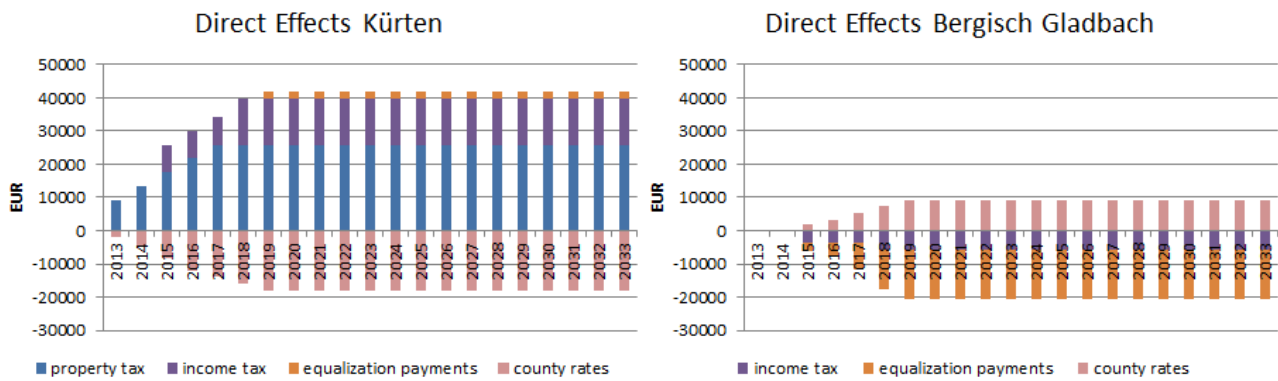


Fig. 2: direct effects on two neighbouring municipalities

In addition to these direct effects, the housing area evokes temporary indirect effects. The construction of the housing area stimulates additional demand in the construction industry. The regional value added amounts to yearly 1.1 million EUR, at maximum 5,300 EUR additional income tax and 29,000 EUR less social subsidies for the region during the construction phase. This brings along 6,000 EUR additional consumer spending in the region divided into different product groups.

An evaluation of the direct effects is possible, when we compare them with the production and follow-up costs. Our experiences show that the additional revenues can become considerably reduced, sometimes the yearly costs even exceed the yearly revenues. Both direct and indirect effects can be evaluated if they are compared to other similar projects on the regional level.

#### 4.2.2 Land use change and ecological value

The topic of land use change and ecological value models and evaluates the ecological effects resulting by the shift of the built environment. The effects of human use (energy consumption, greenhouse gases and transport emissions) are covered in other topics of effects. This topic falls into three parts: the effects on the project area, the effects on the regional area and a regional evaluation of the rarity of the ecological conditions as well as the quantity and quality of land use change.

Local effects on the project area itself are evaluated by the model of an ecological area performance (Arlt/Lehmann 2005). It evaluates the contribution of different types of land use referring to the maximum ecological potential, for example concerning percolation or thermal storing. Regional effects are at first evaluated by the model of undissected lowtraffic areas (UBA 2003: 283) which regards the dissection of the biotopes in a regional context. As a second step, it is examined if the location affects regional cold air flows. The regional evaluation of rarity compares the existence of nature reserves on the one hand as an indicator for regional rarity and evaluates on the other hand. In addition, the quality of land use change is evaluated by the location to existing settlements (demand for integrated locations) and the density, that is to say the efficiency of land use. More integrated projects minimize the requirement for additional infrastructures and have positive links to other ecological effects. Table 1 shows the results for the case study. The different effects are evaluated either in a scale (1 = very poor to 5 = very good) or via a qualitative description.

	Evaluation	Explanation
1. Local Effects	1	
2. Regional Effects		
Undissected Lowtraffic Areas	2	
Regional Cold Air Flow	No effects expected	
3. Regional evaluation		
Existence of nature reserves	!	Conservation area “Mittlere Suelz” Fertile soil to be protected
Integration	1	
Density	5	

Table 1: Evaluation of land use change and egological value

### 4.3 Evaluation of the results

The test calculations indicate the great variety of effects additional projects might have on the municipal and the regional level. Considering the municipal revenues we can say that the quantity of new inhabitants and their previous place of residence form very influential issues. These keyfactors mainly influence the revenues with regard to the income tax or the fiscal equalization system.

For land use change and ecological value the exact location and the former use of the area are more important. Soil sealing before and after realizing the project are crucial for the local level, the location in relation to biotopes and cold air flows might concern neighbouring municipalities and existing nature reserves might be affected. Considering the degree of integration and the density results are very different. While in the presented project the density is higher than the mean of the district, other results in this module are worse because of the chosen location.

Because of the variety it is not easy to summarize the results in terms of single values over all types of effects. The experiences with the partners working in planning practice have shown that this complex point of view is very helpful for the experts. But additionally, for political discussions an easier way of showing the results would be useful, for example as “traffic-light-systems”. But an automatically generated overall evaluation neither is possible nor makes it sense. A possible result for local effects might be that one municipality makes a profit regarding one topic while neighbouring municipalities lose compared to the status without the project. Concerning another topic the result might even switch into opposite. Furthermore, for the regional level results are of a different nature. On the one hand a region can be understood as a summation of single municipalities, on the other hand some joint effects cannot be located exactly within the region (like CO<sub>2</sub> emissions). In this case, the region as a whole is considered.

## 5 CONCLUSIONS

With an isolated way of looking at the situation the revenues of single municipalities increase with a higher immigration rate. New housing areas seem to be the solution for every municipality. But especially in times of demographic changes the amount of population is limited in a regional context. Additional revenues in one municipality cause less revenues in others. Because of strong interconnections concerning migration and commuting within regions as well as regional social and ecological effects of settlement development we need regional cooperation – and DSS with a spatially and thematically expanded point of view.

The models are predominantly developed and partly already programmed as GIS-toolboxes. First urban projects have been calculated, but further tests are necessary to verify the models. RegioProjektCheck illustrates the effects for different topics on different spatial levels. The consideration of the different effects should be integrated in planning and political processes. By using that kind of instrument, knowledge about the decisions’ consequences can be increased and cooperation concerning regional development can be encouraged. First experiences show great interest from different administrative institutions of spatial planning, that comprise municipalities, regions and a federal state. They all need a DSS with a spatially and thematically expanded view to push on sustainable urban settlement development.

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