Does the Growth of Urban Settlements Follow a Certain Pattern? – Answers Given by Long-term Monitoring of European City Regions

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1 INTRODUCTION

The land use and its structure are basis indicators for the socio-economic and ecological capacity of cities (Arlt et al., 2001). Yet, the growth of settlement and traffic areas is alarmingly high, not only in Germany but also in other Western industrial countries (Federal Environmental Agency, German Environmental Index DUX, 2003). Since in particular the multi-temporal recording is very time-consuming, there are only a few national and international GIS data bases available which allow quantitative, comparative investigations of the land use development. Within the research project "Long-term surveys of land use changes and their environmental effects on soil and landscape structure", which was started at the IOER in 2001, urban and rural regions have been investigated over long-term periods. As an example for this purpose the land use data of the EU project MOLAND (Monitoring Land Use/Cover Dynamics, EEA 2002), recorded at four time slots during the past 50 years, for the cities of Bilbao, Bratislava, Copenhagen, Dresden, Lyon, Munich, Oporto and Palermo were chosen for decided GIS analyses in order to answer questions on the sustainability of the urban development. Furthermore, the provision of the cities with recreational areas including their reachability as well as the degrees of soil sealing and urbanisation were calculated. For the city of Dresden the investigation was expanded to a period of 200 years (eight time slots), and sophisticated analyses in connection with the population trend, the traffic route development and the consumption of valuable land for agriculture were accomplished.

2 DEVELOPMENT OF LAND USE

The development of the land use according to the main classes of the eight European study cities revealed some commonness (Fig. 5). The areas of urban fabric as well as areas used for industry, commerce and traffic saw a steady increase on the expenses of agriculturally used land, forests and semi-natural areas within the past 50 years. Admittedly, a decelerated development of this process was visible within the last survey period starting from the middle of the 80s. The development of land use – distinguished by core and surrounding area – also revealed that the growth of settlements took place mainly in the surrounding zones although there were still potentials – albeit to a different extent – for a densification in the core zones of the cities (Fig. 6).

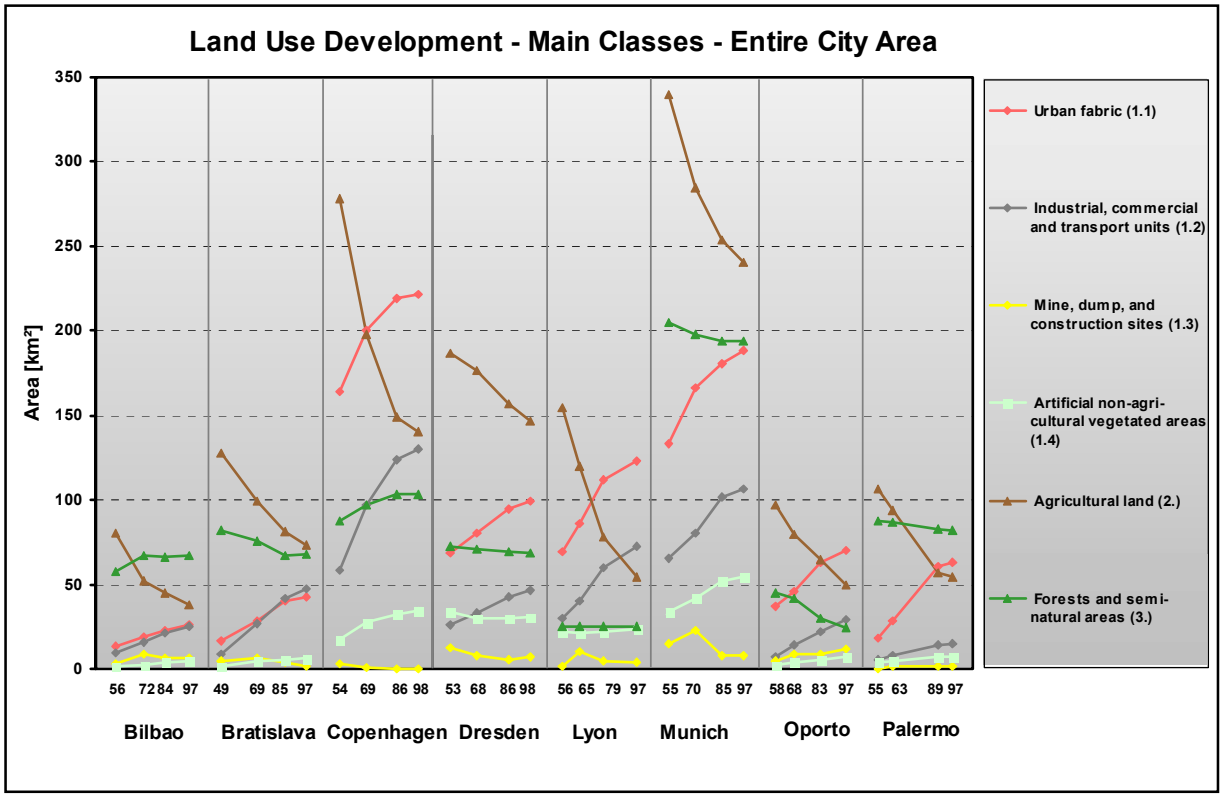


Fig. 5: Comparative presentation of the development of land use according to main classes for the entire city area.

The degrees of soil sealing for the core, surrounding and entire city area were calculated by assignment of a specific average degree of soil sealing for each land use type (Fig. 6).

The degree of urbanisation is defined by the ratio of the settlement area to the total area. It was calculated separately for the core, surrounding, and extended surrounding area as well as the entire city zone and entire study area of Dresden (Fig. 7). Most remarkable is the almost linear increase of the degree of urbanisation in all analysis periods since nearly 200 years, despite the completely

different societal and economic conditions during that time. Only the period of promoterism between 1880 and 1900 ("Gründerzeit") saw an even bigger rise of the degree of urbanisation caused by a strong population growth and a powerful economic development.

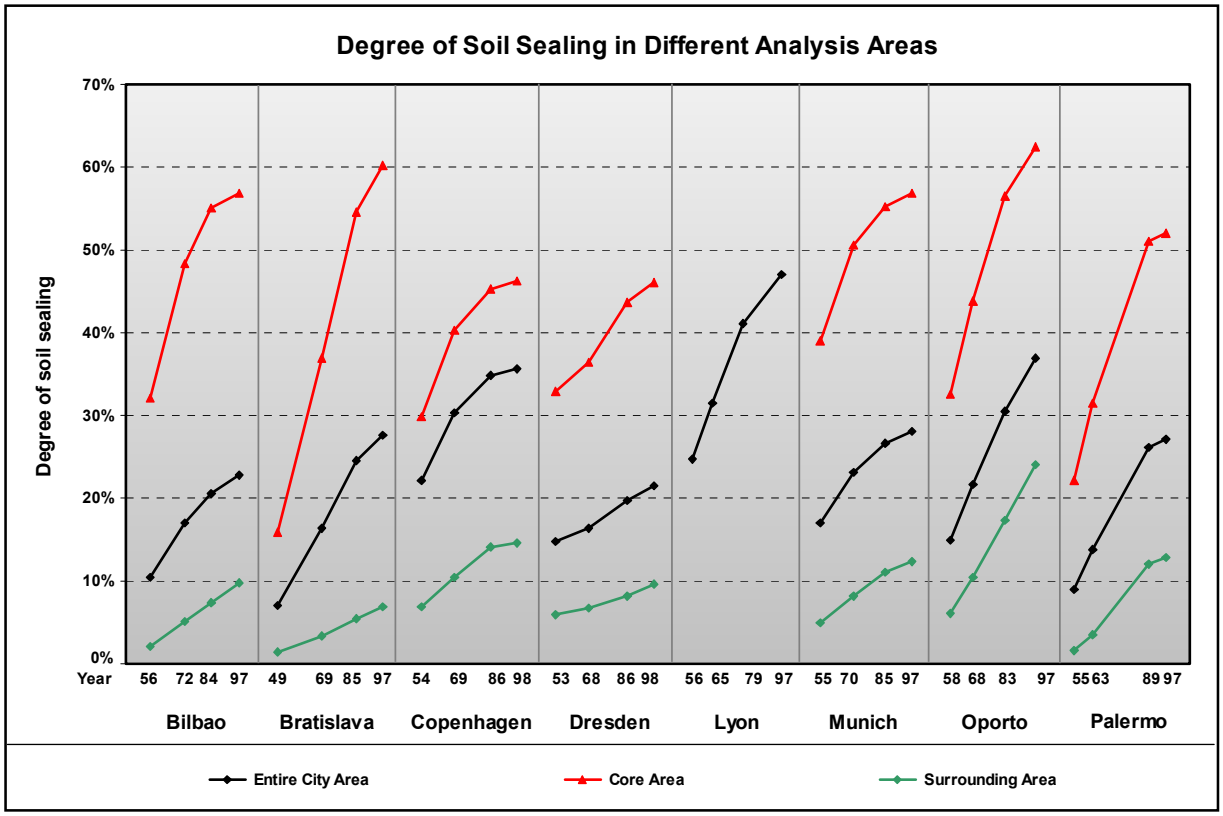


Fig. 6: Comparative presentation of the development of the degree of soil sealing for core, surrounding and entire city area.[1]

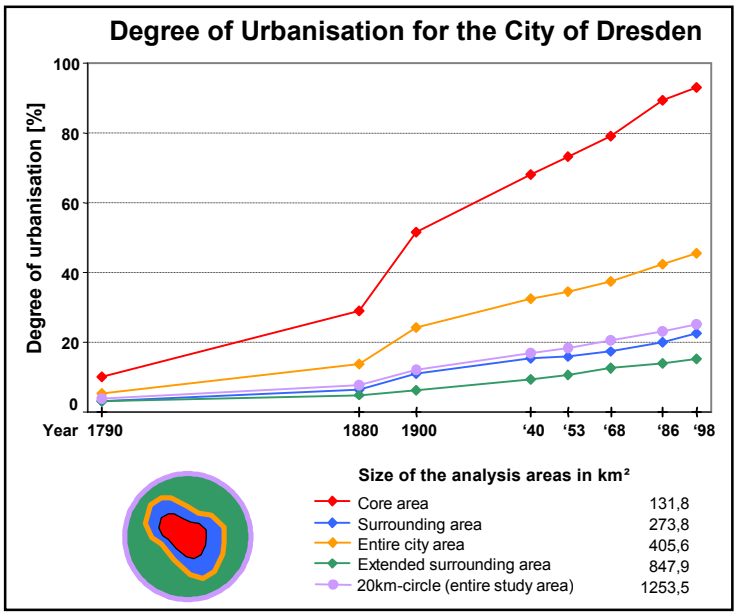


Fig. 7: Development of the degree of urbanisation of the city of Dresden for different extents of the analysis area.

3 ASSESSMENT OF NEW SETTLEMENT AREAS

In order to achieve a sustainable city development preferably short distances of the new settlement areas to the settlement core (e.g. traffic-reducing effects) and their strong integration into the existing settlements (minimizing development costs, etc.) should be aspired. For that purpose every new settlement area was evaluated according to its location in relation to the settlement core and its degree of integration into the existing settlements. For the classification according to the location three classes were created: 1st inner

[1] Since for the city of Lyon no core demarcation line had been delivered investigations could be carried out solely for the entire city area.

development (I), if the new settlement area was situated within the respective old settlement core, 2nd fringe development (F), if the settlement growth took place between the old and the new settlement core within two time slots, and 3rd outer development (O), if the new settlement area was situated outside of the new settlement core (Neumann, 2002). By means of a GIS-supported analysis of all new settlement areas for all study periods and subsequent cumulation the periods of development can be assessed regarding their sustainability (Fig. 8). It appeared that the last period (1986-98) was characterised by high settlement processes in the outer region (Type O), which did not characterise a sustainable development.

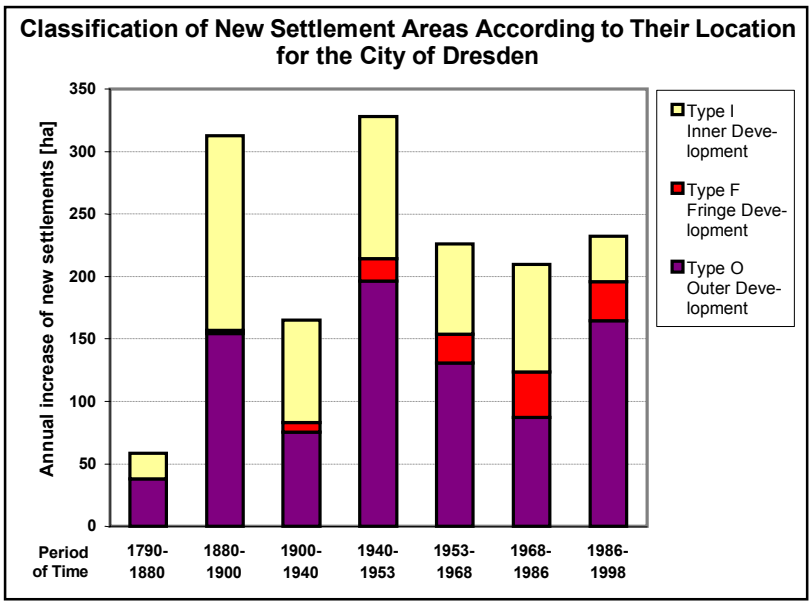


Fig. 8: Statistics of new settlement areas differentiated by their location for the city of Dresden.

The degree of integration of new settlement areas into the existing settlements can be assessed by the ratio (I) of the length of the shared borderline of the new artificial area with the existing settlement area and the perimeter of the new artificial area itself (Winkler, 2001). Thus, four classes of the new settlements were created according to the way of their integration into the existing settlements (Fig. 9): totally (I>2/3), well (1/3<I≤2/3), less (0<I≤1/3) or not integrated (I=0).

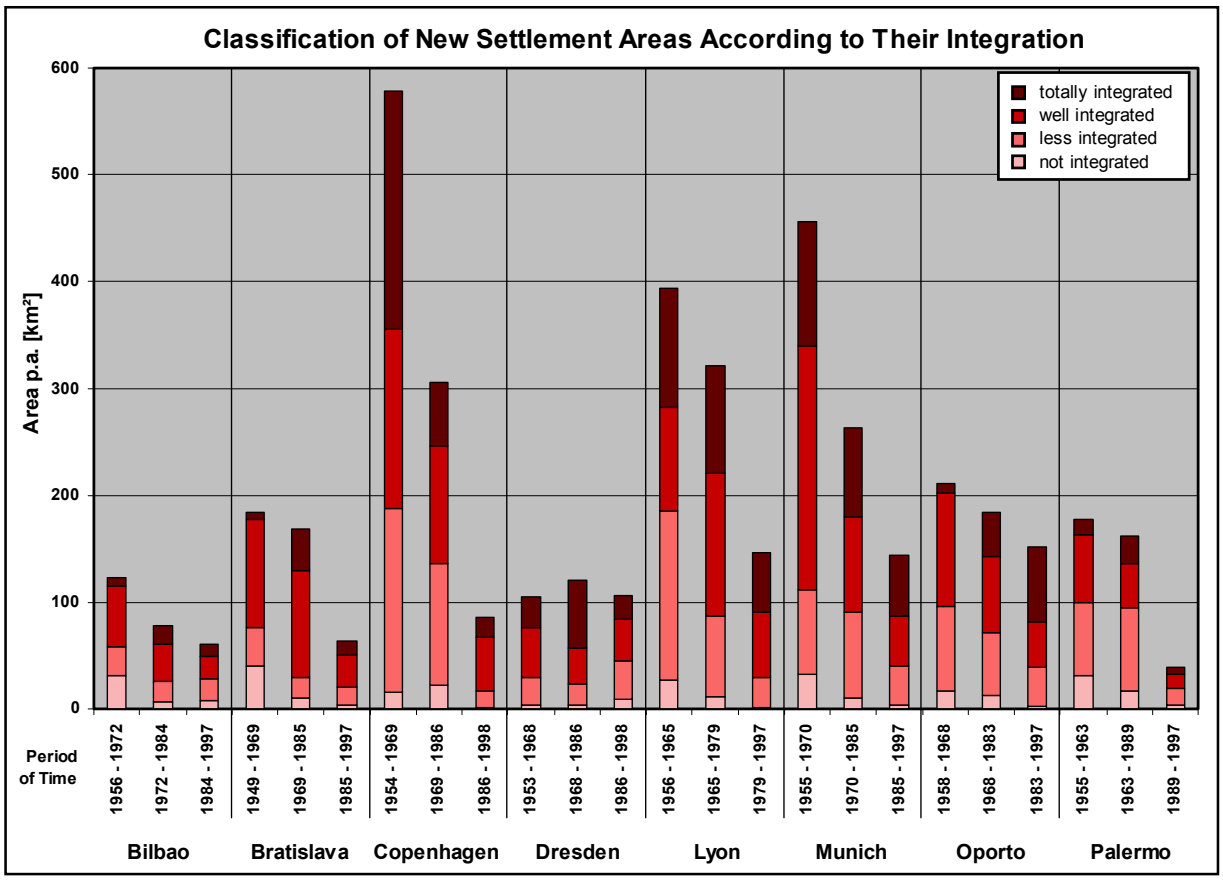


Fig. 9: Statistics of new settlement areas by their degree of integration into the existing settlement area – comparative overview.

4 PROVISION OF RECREATIONAL AREAS

Furthermore, the provision of public recreational areas within the eight study cities, including their reachability for the urban population, was investigated (Meinel/Winkler, 2003). The analyses yielded that there was not only a drastic decrease of the amount of recreational areas in all study areas (Fig. 10) but also a worse reachability became visible particularly in the core zones of the cities (Fig. 11). The research was based on the calculation criteria of the "European Common Indicators" (Technical Report - European Common Indicators, 2000) which refers to the share of residential areas being situated within a buffer zone of 300 m around public recreational areas (mainly parks and forests, to a lower degree agriculturally used areas).

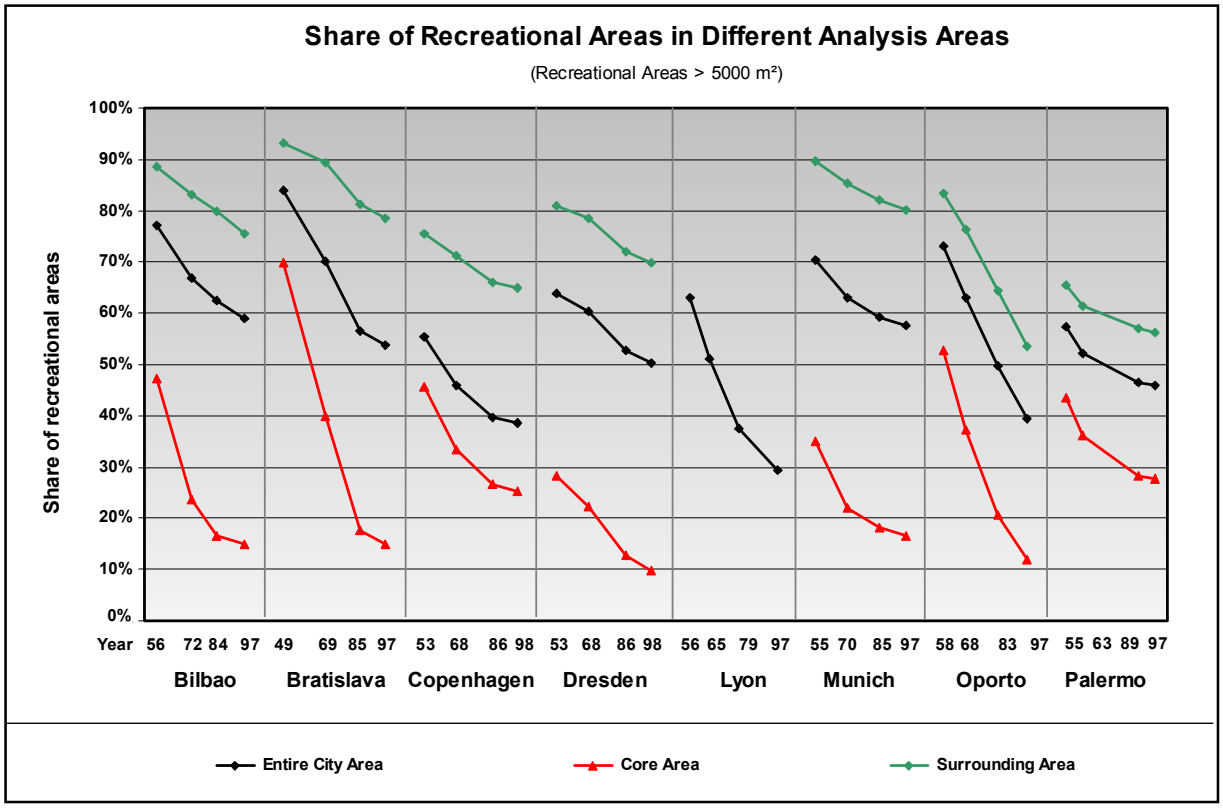


Fig. 10: Share of recreational areas in different analysis areas.

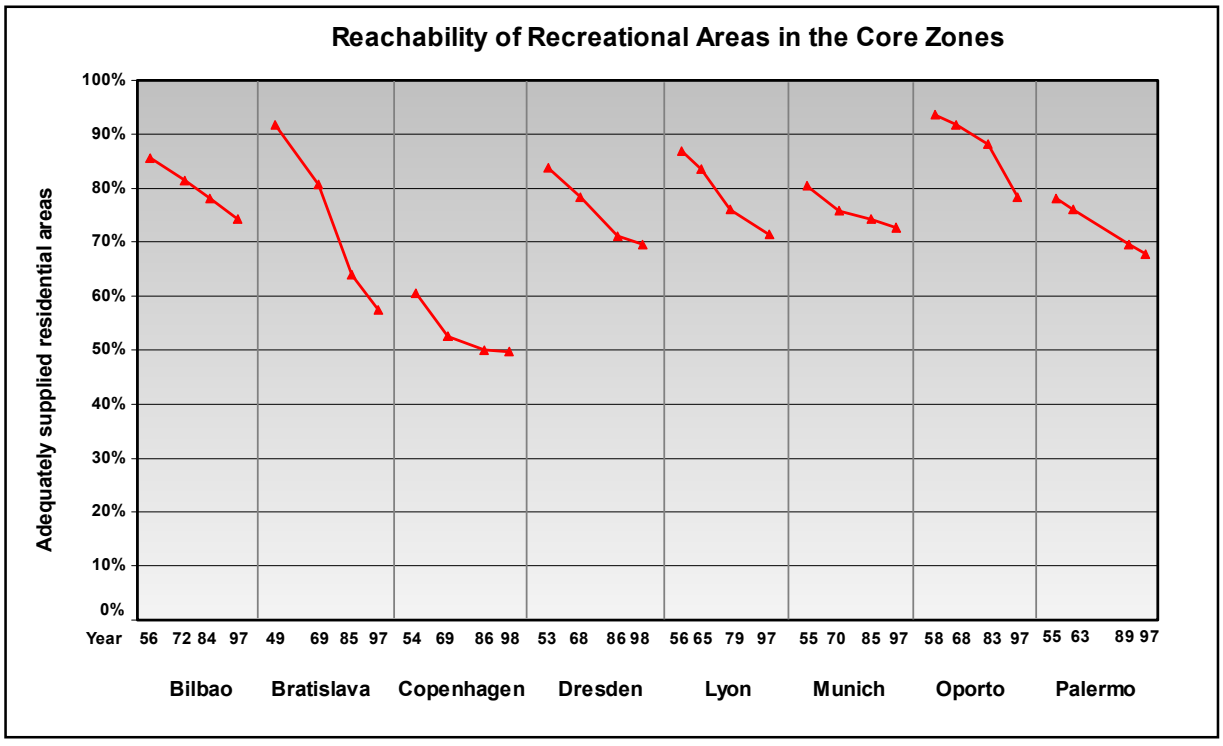


Fig. 11: Reachability of recreational areas accessible to the public and free of charge in the core zones.

5 LIVING DENSITY AND POPULATION FIGURES

The increase of settlement areas is determined by population growth, increasing demands for living space (size of flats and urban open space) as well as an expansion of industrial and commercial areas. In order to differentiate between these driving forces the population figure was put into ratio with the residential area (Fig. 12). The figure shows that the highest living density (27,000 inhabitants/sqkm) was reached in 1900. Until 1998 this figure dropped down by around 75 % to 7,000 inhabitants/sqkm due to a decreased building density in the residential areas (also caused by the massive destructions in World War II) as well as increased demands for living space and urban open space (Meinel/Neumann, 2003). As an additional reason the incorporation of suburban communities with a lower population density compared to their settlement density can be stated.

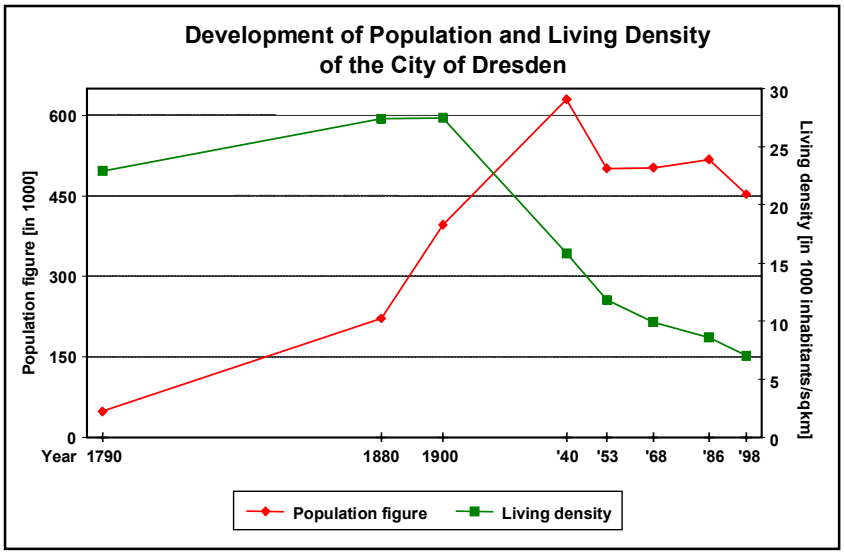
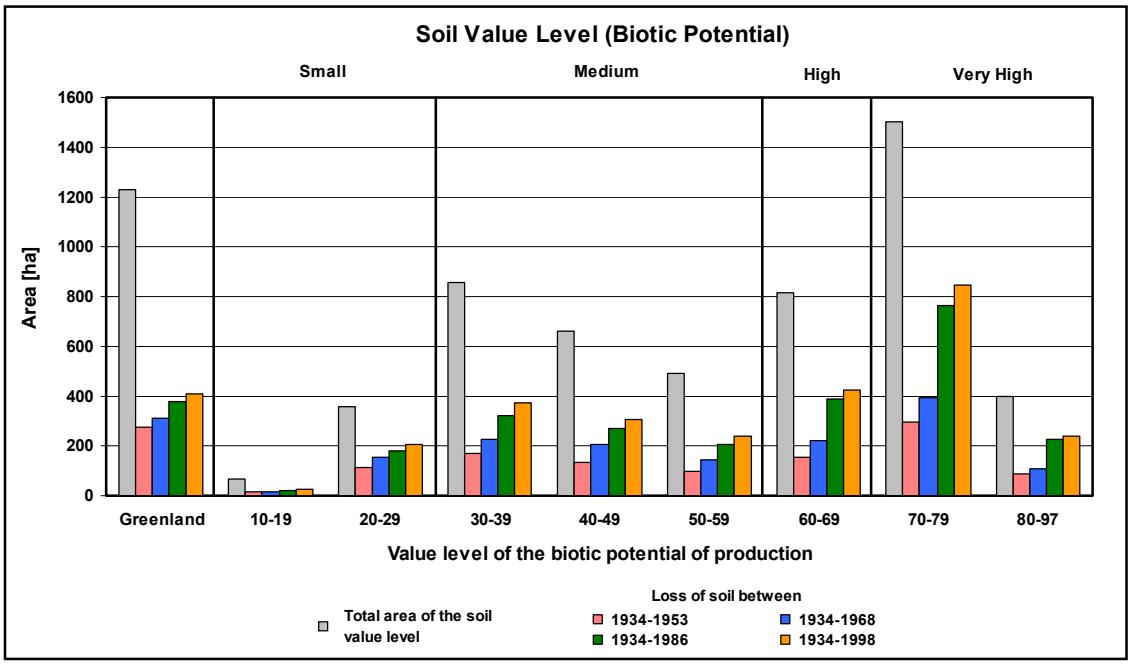


Fig. 12: Development of the population figures and the living density in the past 200 years for the city of Dresden.

6 CONSUMPTION OF FRUITFUL SOIL

Many cities have been grown along rivers and therefore in most of the cases on very fertile floodplain soil. Due to suburbanisation processes very fruitful arable land has been used for settlement activities and got sealed until today. In doing so it lost its capability for agricultural usage in a mostly irreversible way. By processing of the data of the "Reichsbodenschätzung"[2] and subsequent intersecting with the land use data bases of the city of Dresden the consumption of soil differentiated by their biotic potential of production could be calculated (Fig. 13). It was revealed that the land had been used for settlement activities without considering its quality. At no point of time fruitful soil has been conserved.



2 The soil assessment was started in the German Reich in 1934 and finished in the German Democratic Republic in 1955 (data taken from the "Environmental Atlas Dresden").

Fig. 13: Loss of soil caused by building and sealing, differentiated by their biotic potential of production for the city of Dresden.

7 PRESENTATION OF THE STUDY RESULTS

The continued consumption of land and the therewith related problems are still insufficiently reflected in the society. Easy-to-understand dynamic and interactive presentations of the creepingly ongoing land use development could improve the perception of the problem. Therefore different methodological module and results of the studies of the research project "Long-term surveys of land use changes and their environmental effects on soil and landscape structure" have been prepared for the Internet (www.ioer.de/Langzeitmonitoring). The start up web page can be seen in Fig. 14.

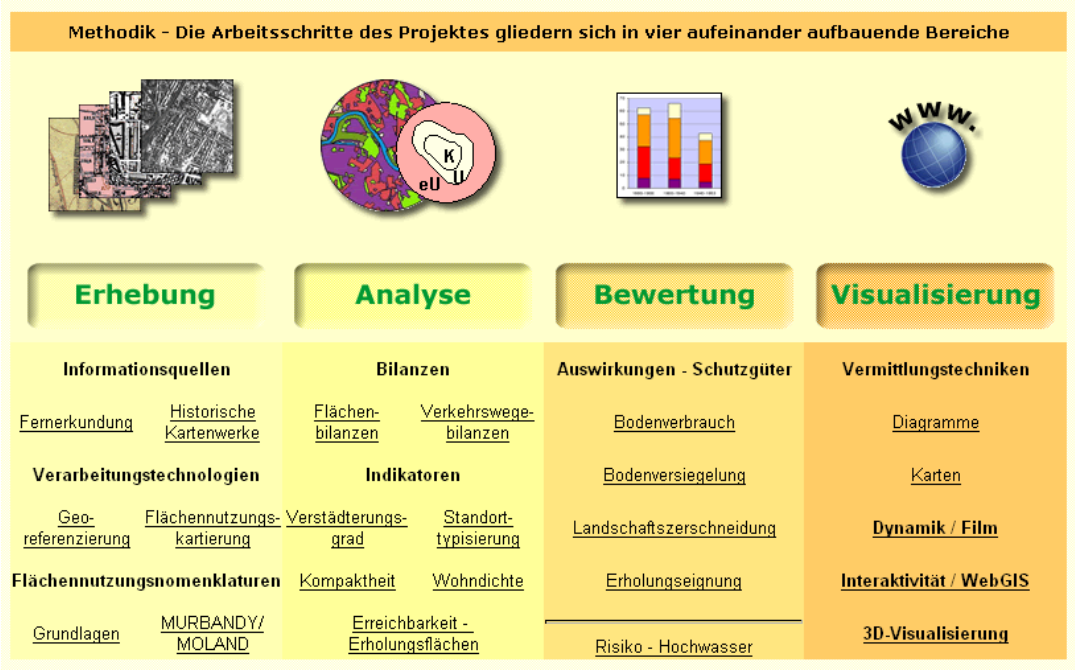


Fig. 14: Start up web page of the research project „Long-term surveys of land use changes" (www.ioer.de/Langzeitmonitoring).

With the aid of the Macromedia Flash the development of the core settlement area of Dresden – among several other applications – was displayed using a morphing algorithm of the eight different time slots Fig. 15, (Seckel, 2003). Furthermore, the land use data bases as well as the historic maps were made accessible in an interactive presentation in the Internet on the basis of ArcIMS including the options "Select Layers", "Zoom", "Roaming" and "Queries" (http://map.ioer.de/website/FNDD/viewer.htm).

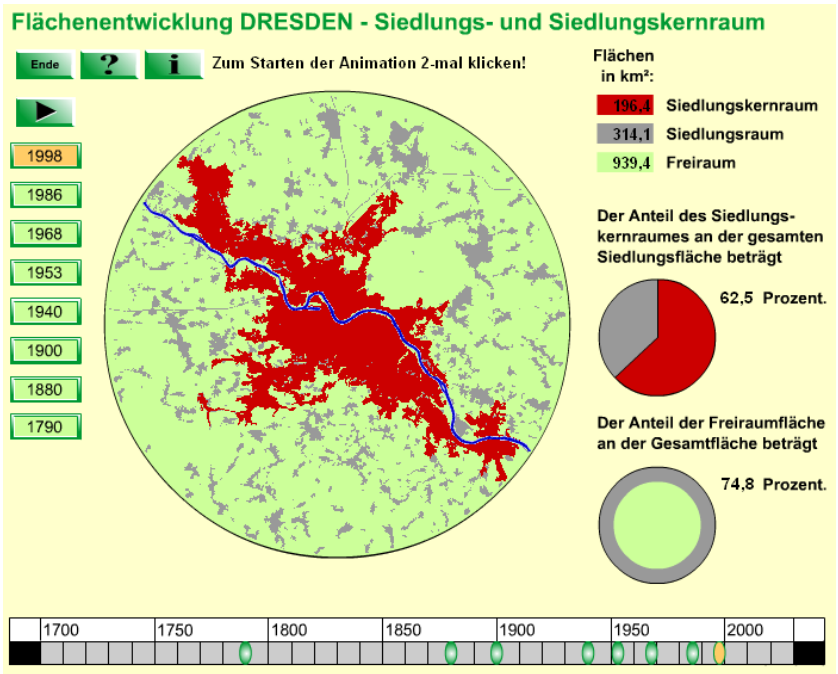


Fig. 15: Dynamic presentation of the settlement development of Dresden on the Internet using Macromedia Flash.

8 BACK TO THE INITIAL QUESTION

When looking at the results of the researches one may come to the conclusion that the growth of urban settlement areas seems to follow a certain pattern. Widely uncoupled from the societal conditions including the economic and demographic development the urban settlement area has increased (Fig. 7). For that many reasons can be identified. In Germany, for instance, the settlement growth has been determined by domestic constructions by almost the half of the building activity since 1993 (Federal Statistical Office, 2003). The subsidisation for the erection of single-family houses provided by the state[3], the strong lobby of the building industry (including building and loan associations) and the wish of large parts of the population to live in the green caused this settlement growth which could be decelerated only by the economic stagnation in Germany since 2001. On the other hand there are a growing number of unused areas in the form of derelict land (increase 12.7 % from 1993 until 2001) due to shrinking processes (e.g. surplus of flats). In Germany there are more than 128,000 ha of derelict land which were formerly used for industry, commerce, military, and traffic (BBR 2003). A sustainable development can only be achieved by a consequent usage of these derelict lands by revitalisation or recycling. Thus, the manifold obstacles of the revitalisation of these areas (e.g. unsettled ownership structures, land contamination, endeavours of speculation of the owners) must be reduced (Tomerius/Preuß, 2001). This long-term learning and working process requires an open-minded discussion among the groups and persons involved (e.g. municipalities, owners, possible users, planning offices, and residents). Tackling that challenge is not only a German but a European-wide issue.

ACKNOWLEDGEMENTS

The workings of the presented paper were based on data of the project MURBANDY (N°. 17430-2000-12 S0SC ISP DE). We would like to thank Mr. Carlo Lavalle (JRC, Institute for Environment and Sustainability) and his team for their kind support of the works, and the appropriation of the data bases. Furthermore, we would also like to thank Ms. Kathleen Neumann and Ms. Anja Seckel as well as Mr. Jörg Hennersdorf for their fruitful contributions to this paper. The project was partially financed by the Deutsche Forschungsgemeinschaft DFG (Me 1592/1-2).

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3 In 2002 the Federal Government of Germany spent 9.5 billion € (Federal Office of Finances of Germany, 1999-2002) on the so-called "Eigenheimzulage". The "Eigenheimzulage" is a special tax relief for families investing in housing property for their own usage. It is mostly granted for erecting single family homes at the urban fringe.

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