Expanding cities, shrinking cities, sustainable cities: challenges, opportunities and examples

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Abstract: Over the last decades, experts have been studying with growing concern statistics and demographic trends that show in many cities the urban population appears to be climbing up to astonishing numbers all over the world. Mega-Cities like Tokyo, Mexico City and Seoul are developing and nobody appears to be able to control their growth, nor to handle their impact on basic resources like water and land. The housing demand of an aging society further stimulates excessive urban sprawl. On the other hand, according to recent studies many cities expose a tendency of shrinking, from California to Japan, from Finland to the Cape of Good Hope. Shrinking cities are reported from all over the world and again it appears difficult to deal with this recent phenomenon and its impacts on our society. In times of global markets and local bottlenecks, cities change constantly and rapidly, much faster than they used to do even in the boom-days of industrialisation. Changing cities have a strong impact on both, economy and ecology. The metamorphosis of urban spaces usually degrades the environment and exhausts the resources. However, changing cities also offer chances, not only to architects and investors but also to new forms of land and resource management. In this paper the issue of growing cities and shrinking cities will be discussed. Special attention will be given to the geotechnical challenges of contracting cities. Examples from regions characterized by post-industrialization and post-socialism are presented and strategies to stimulate a sustainable urban renaissance that respects geo-resources and the environment will be introduced and illustrated with examples.

Résumé: Durant les dernières décades, les experts ont étudié soucieusement des statistiques et des développements démographiques: La population urbaine semble d'accroître de manière étonnante par tout dans le monde. Mégapoles comme Tokyo, Mexico et Séoul s'étendrent et personne n'est près de contrôler ni leur croissance, ni leur impact sur nos ressources comme l'eau ou le sol. Le besoin en habitation d'une société en train de vieillir suscite des expansions urbaines excessives. Par contre, les études récentes indiquent que certaines villes ont la tendance de se rétrécir, de Californie jusqu'au Japon, de Finlande jusqu'au Cap de Bonne-Espérance. Villes contractantes sont constatées par tout et encore, il semble d'être difficile de traiter ce phénomène récent et ses impacts sur notre société. En temps de mondialisation, les villes changes continuellement et rapidement, beaucoup plus que dans le temps d'industrialisation. Les villes en plaines mutations ont des conséquences importantes pour l'économie et l'écologie. En général, la métamorphose urbaine nuire l'environnement et épuise les ressources. Néanmoins, villes qui change offrent des chances, pour les architectes et les investisseurs aussi bien que pour les formes nouvelles de management de terrain. Dans ce rapport, les problèmes de villes grandissants et contractants sont discutés. L'attention est appelée sur les défis géotechniques des villes en train de se contracter. Des exemples provenant des régions typiques pour la post-industrialisation et le post-socialisme sont présentés et illustrés et des stratégies afin d'encourager qu'une renaissance urbaine durable soit introduite qui respect l'environnement avec ses ressources limitées.

Keywords: Remediation, contaminated land, land use, urban geosciences, geoenvironmental engineering, geographic information systems

INTRODUCTION

The cities of the world are all unique. Everybody will perceive Paris in a different way than Berlin, and Nairobi certainly differs much from Rio de Janeiro. Still there are parallels, as Hall & Pfeiffer (2000) point out in their World Report for the Urban Future 21 Conference recently held in Bonn, Germany. They distinguish three types of cities:

- Cities characterised by spontaneous, excessive growth. Examples are many cities in Africa south of the Sahara, in India, in the Middle East and in the poorer regions of Latin America. These cities grow rapidly due to an in-migration from rural areas and high birth rates. The economic potential, however, is inhibited by miss-management and alleged corruption, which prompts the development of large unofficial settlements and impacts on both, economy and ecology.
- Cities with a dynamic growth pattern. Examples are cities of middle-income countries in Eastern Africa, Latin America, the Caribics and the Near- and Middle East. The population does not grow as dramatically as in the cities of the first category, which eases the ecologic pressure and leaves space for economic potential.
- The mature cities of Northern America, Europe, Asia and Australia. These cities suffer from an increasingly aging population, a trend that is globally observed but that principally inflicts upon the economies of mature cities. Nevertheless, many of these cities are comparatively wealthy and still have the capacity to renovate their infrastructure and to mitigate the adverse effects of maturation.

It will be these three types of cities that are going to dominate life in the twenty-first century. They will change economic growth patterns and will impose on our environment. They may degenerate into sterile megalopolitan corridors (Hall 1999) or improve to lively and wealthy urban spaces in line with the ideas of a sustainable urban renaissance.

EXPANDING CITIES

Urbanisation is defined as an increase in urban population faster than the increase in total population. The 21st century will be dominated by urbanisation. It will be kept on the move by expanding cities. According to demographic trends urban population will double from 2000 to 2025 to some 5 billion. In 2025, two thirds of the world's population, i.e. 5 billion people, will be living in cities. It is estimated that in 2015 there will be about 360 cities of more than 1 million, some 150 of which will be in Asia. 27 mega-cities of more than 10 million inhabitants will have been established, of which 18 will be located in Asia (Hall & Pfeiffer 2000).

While the city council of New Delhi has struggled to control the expansion of the city in an organised way and has used satellite photos to observe its growth, the urban planers of the industrialised nations follow a policy of suburbanisation that threatens the remnants of nature left around the old metropolitan areas. While new streets are constructed and new supply lines are laid to satisfy the demands of the "grease belts" of the cities of the industrialised world, half of the space consumed by the expansion of the poor cities in low-income countries will be occupied by informal settlements.

And yet another, even more disturbing trend has been observed: the average of our society is aging. Not only in the industrialized nations but also in countries in transition and low-income countries. By 2030, about 16% of the world's population will be older than 60 years. In North America, one out of four will be older than 60, while in Europe almost every third person will have exceeded that age. This trend can also be observed in Asia und Latin America, where by 2030 almost every fifth person will be older than 60, while in Africa this level is estimated to be reached by 2050 (Höhn 1996). There are many reasons for this development including improving health standards and care options for senior citizens.

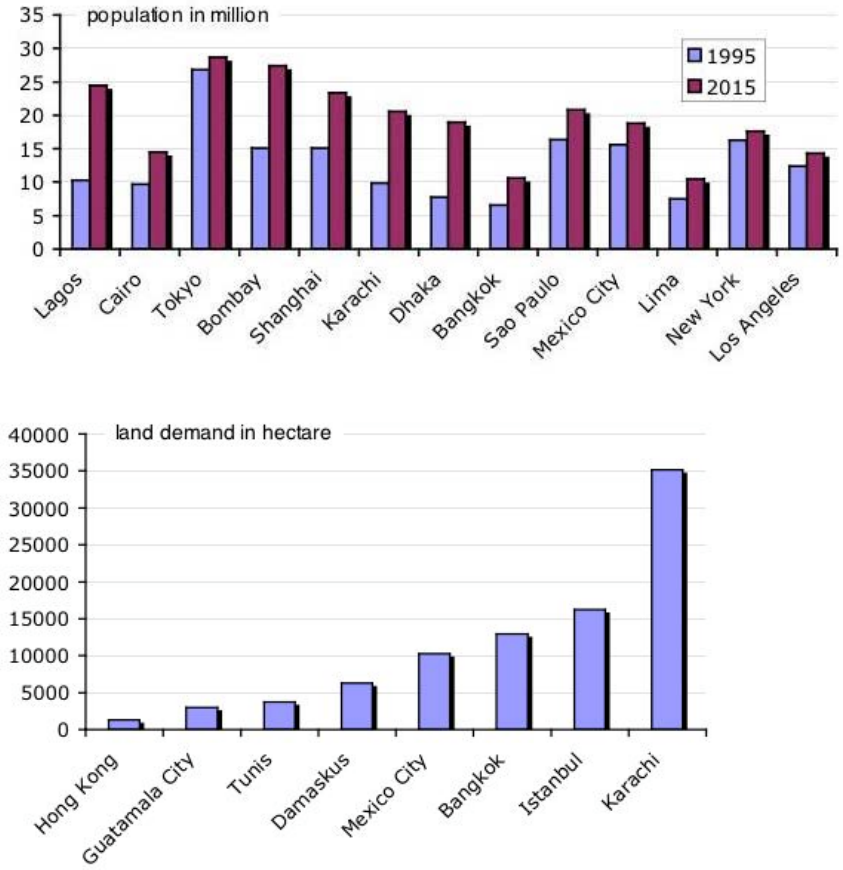

Figure 1. The population of some megacities and infrastructure demand 1990-2015 (data after United Nations Statistics 1995)

Another trend that is directly coupled with this development is a growing demand of housing space. Older people tend to stay in their dwellings they have occupied in their previous family phase (Schubert 1999). Furthermore, children tend to leave their parents home earlier to study, to work and to live individually in their own apartment. Young families tend to have fewer children. Consequently, the number of household members per household

decreases while the number of households keeps increasing. This holds especially for urban households, thus accelerating the land demand of our cities. To this can be added an increasing demand of appropriate infrastructure to cope with the changes in the demographic pattern.

All these trends and tendencies result in an increasing demand of urban land all over the world. Already in 1995 the United Nations stated that by 2015 Mexico City will need another 10000 ha, Bangkok will need 13000 ha, Karachi some 35000 ha (United Nations 1995). This trend was confirmed during the 2nd UN Conference of Human Settlement in Istanbul in 1996 (Habitat II) and was again at the top of the agenda at the World Urban Forum 2004 in Barcelona.

SHRINKING CITIES

In 2002 the project "Shrinking Cities" was launched, an international research initiative aiming at analysing the phenomenon of declining population numbers observed in many cities all over the world (www.shrinkingcities.com). The project is financed by the Federal Cultural Foundation of Germany and is carried out in close cooperation with the Leipzig Gallery of Contemporary Art, the Bauhaus Dessau Foundation and the magazine *achplus*. Four interdisciplinary teams are at the moment analysing the urban regions of Detroit (USA), Manchester and Liverpool (UK), Ivanova (Russia) and Halle/Leipzig (Germany). But these are only four examples of the large number of cities that are shrinking worldwide. Figure 2 indicates, that we are looking at a new development of global dimension.

The initiative "Shrinking Cities" intends to demonstrate that in many cases the mechanisms that cause a city to extend are outscored by reverse trends of contraction. The reasons for city shrinking are numerous. The initiative has already pinpointed deindustrialisation and post-socialism but many more factors appear to stimulate city shrinking

For instance, it has been observed that the fertility rate has been dropping significantly, a phenomenon which is again linked to urbanisation and which has been confirmed in both high-income countries and low-income countries. The global mean fertility rate has been dropping from 5.4 in 1970 to 2.9 in 2000. In order to stabilize the population of a country against war, famine, epidemic and disaster a birth rate of some 2.1 children is needed.

Although this trend appears healthy from the perspective of halting overpopulation, the number of people, although declining, still appears alarming. Bearing in mind the limited resources, socio-environmental crises may emerge, which could soon degenerate towards political conflicts and consequently lead to regional catastrophes, with all their consequences including war and refugee streams, which again change demographics and degrade land (Genske & Hess-Lüttich 2000).

Figure 2. The location of shrinking cities (from www.shrinkingcities.com)

CHANGING CITIES – SUSTAINABLE CITIES

Whatever the trend, whether cities are expanding or shrinking, the faces of our cities will change in this century. They will change in a dynamic way. And they will impact on both the local economy and the surrounding environment, if measures are not taken to mitigate the impacts.

Changes always bear opportunities. In the case of transforming cities, these opportunities are directly related to the notion of sustainable development. The Habitat conferences, international research and development projects, framework programs of the European Community focusing on the cities of tomorrow; all these initiatives underline that there are chances to achieve this transition without impacting on the resources of future generations while mitigating socio-economic conflicts.

What are the basic needs of a city? Land ready to develop, an intact environment to supply clean water and fresh air, and resources and energy to keep the urban infrastructure running. Every sound city will be in need of these three components and will need them constantly and in sufficient amounts.

But where is the land that can still be developed, given that the surrounding spaces should be preserved to halt the pressure on biodiversity and the emission of greenhouse gases and to allow for a recharge of the still intact aquifers? How can resources and energy be generated and utilised in cities that are in transformation?

In the mature and aging city the types of land to redevelop are the derelict sites of former industrial activity. The centre of Pittsburgh, for instance, where the Allegheny River and Monongahela River join to form the triangle that used to be an immense freight terminal from where coal and by-products were shipped all over the United States. The London Docklands, for instance, from where goods were sent to all parts of the world until the economy changed, and where now a city quarter provides housing and office space. The German Ruhr District, for instance, where decommissioned industrial complexes serve as theatre for the renaissance of a region devastated by deep coal mining, where the International Building Exhibition IBA Emscherpark has set standards for a sustainable urban re-vitalisation.

In poor cities, on the other hand, the sites of city renaissance are the unplanned and slum areas. The slums of Dharavi, for example, where a diverse ethnic community provides cheap work for the megacity of Bombay. The homelands of the Cape Flats referred to as "the dumping ground of apartheid" by Grill (2004), right next to the Airport Highway N2. The Casbah of Algiers, for example, where now a revamped small museum of local art acts as nucleus for the urgently needed revitalisation work.

It is estimated that the urban redevelopment potential in industrialized as well as low-income countries amounts to 25-40% (Schubert 1999). The sites of former industry and the sites of informal settlement are predestined to become the nuclei of a sustainable city revival.

The challenges that planners are facing in low-income countries are many and merit special consideration. In this paper, the focus is on how high-income countries deal with the phenomenon of city metamorphosis. Two examples will be presented: The renaissance of a city centre in the Ruhr District, a region with a high population density and well developed infrastructure and an example of a shrinking region from Eastern Germany.

CASE FILE 1: THE RUHR DISTRICT (WEST GERMANY)

The cities of the German Ruhr-District are examples par excellence of Halls' third category: mature cities with an aging society. Since the coal and steel crisis of the 1970's, the economy of this region has deteriorated despite the fact that the Ruhr-District was once the economic powerhouse of Germany. Many coalmines went out of business, many steel mills closed down. Together with them, many secondary businesses that used to supply the primary industries died as well. In the 1980's, the unemployment rate increased sharply all over the Ruhr District, in some cities well exceeding 20%. Large areas became industrial wasteland, in many parts highly contaminated and unfit for reuse. A region of 20 times 80 kilometres with a population of about 5 million fell into lethargy.

In 1989, the *Internationale Bauaustellung IBA Emscherpark*, an international building exhibition, was launched to re-vitalise the region and to bring back economic power. The approach differed fundamentally from the US-Superfund Legislation with its two types of actions (SUPERFUND 1999):

- Short-term removals where action may be taken to address releases or threatening releases requiring prompt response.
- Long-term remedial response action that permanently and significantly reduce the dangers associated with the releases or threats of releases of hazardous substances that are serious, but not immediately life threatening. These actions can be conducted only at sites listed on the National Priorities List (NPL) of the United States Environmental Protection Agency.

According to Williams (1995), however, the National Priorities List in practice has had the effect "of causing the site, plus much of the adjacent area, to be abandoned for any use, and severely depressed property values."

In order to avoid these negative side effects while re-vitalising degraded urban terrain the European Commission has chosen a different approach. Funds such as the European Fund for Regional Development EFRE or the KONVER-Fund for derelict military bases have been introduced to stimulate remediation activities on a local scale. As mentioned before, changing markets have forced key industries out of business all over Europe. The decline of European coal and steel industry has produced vast areas of industrial wasteland and has caused alarming unemployment figures. European funding schemes consequently have been used as a means to both recycle urban wasteland and reduce unemployment rates while protecting virgin land and stimulating innovative, clean industries. The funding scheme is structured in a way that the responsibilities are shared with the remediation partners involved, i.e. the local community, the investors, and the public. Since only part of the remediation costs are subsidised by the European Union, the creation of a variety of management models is stimulated, of which public-private partnership (PPP) has proven to be a successful model in Europe. In fact, PPP has become an indispensable financing and management tool in modern land recycling. In the context of the International Building Exhibition (IBA) European subsidies were successfully employed to stimulate PPP and to transform a degraded industrial belt into a productive and ecological compatible region (Genske 2003).

Practically, this means that the European strategy has stimulated an auto-empowerment of the ones concerned: the municipalities struggling to attract investors, the investors searching for cheap development sites, the ecologist fighting for a preservation of the nature left around the cities, the environmentalists trying to introduce new, clean technologies of resource utilisation and the unemployed searching job opportunities.

An example of the European approach to mitigate the problems of Halls' third category of cities, the mature, aging city, is the re-vitalisation of the industrial site of Mont Cenis (Genske 2003). Mont-Cenis was originally a coalmine that was established in 1871 in the vicinity of Herne in the German Ruhr District. In 1893, the coal washing building

was installed. Twelve years later the first coking facility was constructed. The mine prospered and became one of the biggest in the Ruhr District with 1750 company owned housing units for its miners. For many generations coal was extracted from longwall workings and refined on-site. In 1969, the 1300 meter deep shaft of Mont-Cenis was the deepest of the region. The mine, which had a record production of one million tonnes of coal in 1975, closed down just 3 years later due to the European coal and steel crisis.

The 26-hectare terrain became abandoned: an urban wasteland with all its negative attributes such as soil contamination, acid mine drainage, subsidence, and massive underground structures, obstructing any reuse of the site. In 1990, more than 120 years after the mine was founded, Mont-Cenis became one of the largest projects of the ambitious program of the Land North Rhine-Westphalia to remediate derelict industrial wasteland and to establish on the very same land new companies and enterprises, an important and urgent program since the unemployment rate in the Ruhr District exceeded 15 percent at that time. Because of the innovative character of the project Mont-Cenis became part of the IBA Emscherpark, which started in 1989 and ended in 1999. The project also participated in the EXPO 2000. Aspects of this project have been presented at the Biennial of Architecture in Venice and the World Climate Summit in Kyoto in 1997.

In 1991, an international architectural competition on the re-utilisation of the site was organised by the IBA Emscherpark and the Land North Rhine-Westphalia NRW. The aims of the project were (EMC 1998):

- The construction of an academy for the Minister of the Interior of NRW.
- Public service buildings for the town of Herne including a multi-purpose meeting hall, civic administration buildings and a library.
- Additional shops and services for the existing shopping centre.
- 250 housing units.
- A recreation park.

With this it was intended to upgrade the depressed image of a city quarter characterised by both a high unemployment rate and a contaminated environment. It was planned to achieve all this with a strategy that was in line with the ideas of sustainable development.

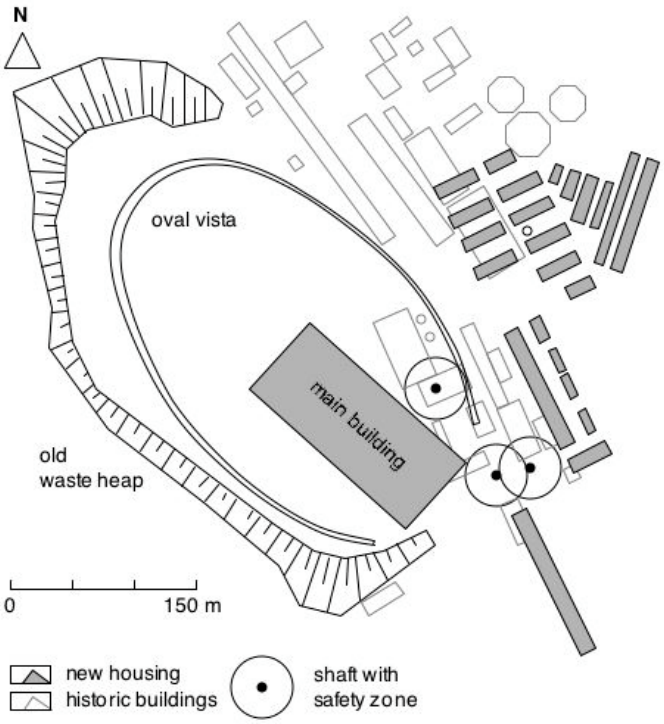

Figure 3. Map of Mont Cenis (simplified)

In 1991, the architects Jourda & Perraudin based in Paris, won the competition by proposing a tent-like structure made of glass and timber that would house the academy and many other facilities. The utilisation of wood was proposed because of their resource efficiency, an aspect treated in more detail in the report for the Club of Rome of 1995 (Weizäcker *et al*. 1997). Only wood from the forests close to the construction site was used in order to reduce transport cost. In a research project supported by the European Union, Jourda & Perraudin Architects proved (together with their partners HHS Planer + Architekten, Kassel, Ove Arup & Partners, London, and MTI France) that the tent structure creates a microclimate, which permits drastically reducing energy costs. The concrete buildings inside the structure balance the temperature differences that occur between day and night. 23 percent of energy for air

conditioning and heating is saved, resulting in a net reduction of 18 percent of CO_2-emissions. The microclimate created in the building reduces the energy consumption per square meter to 32 kWh per year.

To cover the structure, a roof-integrated solar power plant was installed, the largest of the world. Some 10,000 square meters of solar cells produce 1 Megawatt per year, more than twice the energy needed to operate the centre. A special battery facility was constructed to cover periods of peak consumption.

Besides the active and passive utilisation of solar energy, mine gas escaping from neighbouring shafts is utilised. In the Ruhr District every year 120 million cubic meters of methane are emitted from decommissioned coalmines. This amount of mine gas is equivalent to some 100,000 tonnes of fuel oil. The general practice is to burn the gas without utilising it, resulting in an emission of about 8 million tons of CO_2. For the first time in the Ruhr District mine gas of an abandoned mine is being exploited to produce energy for local consumption. It is expected that Mont-Cenis emits some 1 million cubic meters of mine gas, containing 60 percent of methane every year. The mine gas is converted into 2 million kWh of electrical energy and 3 million kWh of heat provided to adjacent buildings. With that, 12,000 tonnes of CO_2-emission will be saved every year, a small but necessary contribution to fight the greenhouse effect. The emission of mine gas is not constant and fluctuates with atmospheric pressure. Therefore, a supplementary natural gas power plant of 1800 kWh plus a hot water storage tank was constructed to secure a constant energy and heat supply. To buffer peak consumption, the installation is furthermore connected with the municipal energy system. This connection may also be used to discharge surplus energy produced with mine gas.

Rainwater from the roofs of all buildings is collected and stored in ponds and cisterns. The stored water is utilised in the academy building for cleaning the solar panels, flushing the toilets, and watering the gardens inside and outside the building. Ponds provide a natural buffer function and secure a constant supply of water. The living quarters in the south east of the oval vista are also equipped with rainwater storage facilities. Excess water is only infiltrated into the ground at places where the contamination of the soil is low enough so that the aquifer will not further be polluted.

In the northern part of the project area the soil is contaminated. An excavation of contaminated soil was not accepted since this would provoke the risk of an uncontrollable release of contaminants, an expensive off-site treatment procedure, and storage of non degradable wastes in landfills, which again would occupy space and thus contribute to land consumption. The alternative chosen was lining the contaminated sectors with membranes or clay liners on top of which herb gardens were established. With this sealing measure any further leaching of shallow pollutants into the ground water will be avoided. Above the liner, a gravel and sand filter is installed to collect the precipitation.

Figure 4. Mont Cenis: Glass façade with solar roof and shaft cap.

The overall investment for this project was in the order of 110 million Euro. The costs are shared between the Land North Rhine-Westphalia, local investors and the European Community. This mixed financing plan is characteristic for all rehabilitation projects subsidised by the European Community, calling for the active participation of community and private investors. Hence, it is a typical example for public-private partnership.

The role of the geoscientist in this context is to provide communities and local initiatives with information to optimise their individual planning. This includes aspects like: To what extent is the site degraded with regard to ground disturbances and ground contamination? Which zones are too contaminated or too disturbed to redevelop? How can basic resources like water be used wisely? How can contaminated soil be treated? Where can it be disposed of if needed? Which local sources of energy can be utilised? Are there options of renewable energy sources (sun, wind, waste)?

CASE FILE 2: THE BUNDESLAND THURINGIA (EAST GERMANY)

Situated geographically in the centre of Germany, Thuringia belongs, with its 16172 square kilometres, to the smaller ones of the new states that joined the Republic after the reunification in 1989. It is characterized by medium to small size cities and rural spaces with a low economic profile.

Since the wall opened, Thuringia has lost about 330,000 people from its population until 2004, that is, about 12.2 percent. This is due to the migration of people in search of work mainly to the former West Germany. In addition, the birth rate has been declining while the average age has been increasing continuously. According to the latest prognoses, another 217,000 people will leave the Bundesland within the next 15 years, that is, another 8.1 percent of the total population. From 1989 to 2020, within 30 years, Thuringia may lose about 20% of its population. Up to 2050 it will have lost 35 percent. These figures define the State of Thuringia as a region that is definitely shrinking.

Despite this development, the built-up land has increased in Thuringia from 1993 to 2001 by 11.2%. This equals a daily land consumption of 4.9 hectares (TMLNU/TSL 2005) and with that exceeds about five times the national target fixed by the German government (Bundesregierung 2004). On the other hand, the amount of land lying derelict has been increasing as well. It is estimated that Thuringia has about 12,000 hectares of derelict sites (Juckenack & Wittemann 2006), and every day this number increases. In fact, all types of derelict sites are represented including:

- Industrial wasteland, that is, land formerly used by industries that have left or are out of business. In the new *Länder* the reasons for the sharp increase of industrial wasteland are directly associated with the German reunification. On one hand, companies run by the former socialist regime proved to not work cost-effectively. On the other hand, many companies have been bought by West German investors to be later forced out of production in order to stabilize the job market in the former West Germany. In addition, the time of introducing a new product until an even newer product replaces the old one has decreased, and with that the cycle of utilisation of industrial land.
- Derelict mining sites are frequent in Thuringia, since the region is rich of all sorts of mineral resources including salt and uranium. Vast areas have been devastated by open-pit mining and underground mining. The former owners were the Government of the German Democratic Republic and the Russian Confederation. Since the GDR doesn't exist anymore and Russia has left, the responsibility for the former mines was taken over by the German Government, which rapidly closed down most of the sites due to their low productivity. Today, large heaps of waste rock dominates certain regions that also suffer from considerable subsidence and severe contamination.
- The investigation of former military bases revealed that many of them are heavily degraded. Although some of the former barracks are adjacent to cities their reutilisation potential is limited since a closer investigation including a risk analysis and the necessary clean-up work would just be too expensive.
- Due to the reduction in population, real estate has become obsolete in many areas. High rising concrete panelled buildings are abandoned especially in the suburbs. In some cities, entire city quarters are demolished to stabilise the real estate market and to cut back on supply costs for apartment buildings that are only occupied by a few people.
- After the German reunification, a large number of railroad and freight stations fell derelict and many railroad tracks became obsolete. This type of wasteland poses a particular problem because of its elongated shape. Railroad tracks, being a sort of "linear wasteland", have virtually no market value.
- ″Investment wasteland″ is a special category typical for the new German states. After the reunification, the German Government encouraged cities and communities to provide ready-to-build development sites to potential investors. Within a short period of time, the amount of sites offered greatly exceeded the demand. Nevertheless, the communities try to keep these sites on the market, thus investing in maintenance work without knowing whether this will ever pay back. In fact, many smaller communities have indebted themselves and finally had to give up the terrain that now falls derelict.

These are the most typical groups of derelict sites encountered in Thuringia. Their re-vitalisation would call for investments that are simply not available. The strategy to cope with derelict sites in the shrinking regions of Eastern Germany consequently differs much from the re-development approach as chosen, for instance, in the case of Mont Cenis. Although the re-development potential for derelict land in Eastern Germany is estimated by the German Federal Office of Building and Redevelopment (BBR) to be in the order of 70 percent (Dosch 2003), it has to be stated that for at least half of these sites there will be no re-development options in the near future (Juckenack 2005). With this in mind, the strategy of re-greening gains ground.

A good example is the systematic re-greening of the pioneer barracks in Raila, Thuringia.. In 1981, it was promoted to the "Central Pioneer Resort Hermann Matern" and included several concrete panelled multi-floor buildings, a gymnasium, fabrication halls, 67 bungalows and an assembling ground.

Figure 5. Derelict sites typical for Thuringia: abandoned Lauchhammer plant, dismantled concrete panelled apartment blocks, derelict ready-for-use site (photos: Ariane Ruff).

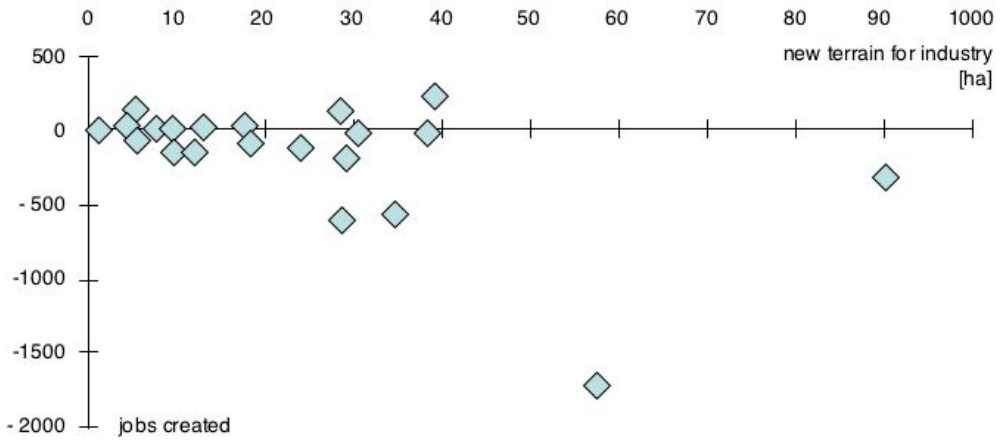

Figure 6. Although large areas have been prepared for investors in Northern Thuringia, the effect on the job market is negligible, perhaps even negative (after TLUG 2004).

Figure 7. The Raila Barracks before re-greening (DEGES).

After the reunification, the 16-ha site was not used anymore and was abandoned. It was sold to a private investor but his plans to re-vitalise the terrain failed. The buildings began to dilapidate but the owner allegedly refused to carry out any restoration or demolition work for fear what he may find in the ground. Although the community encouraged him to re-green the terrain he declined. By then, the neighbouring City of Saalburg became interested in the site. Since the construction of the new Autobahn A9 was ongoing, sites were searched to compensate for the destruction of natural land due to the highway project. According to German law, development projects on natural land shall be compensated by re-naturalizing degraded land (BNatSchG). Since the city council was in favour of the new Autobahn, it contacted the planning office (DEGES), offering them the derelict pioneer barracks. The DEGES accepted and the re-greening of the site began. The campaign involved three basic steps:

- In the first step, the buildings were dismantled to ground level. Foundations plates were broken and perforated to re-establish infiltration.
- Thereafter, the site was modelled with earth to harmonise it with the surrounding natural land.
- In the third step, the land was re-greened. In some parts meadows were seeded, in others trees typical for the region were planted.

The financial means necessary to re-green the terrain were in the order of 1.3 million Euro including 0.8 million Euros for the clearance work.

The demolition of obsolete built-up terrain for the sake of re-greening appears an attractive alternative in urban environments as well. In Halle (Saxony-Anhalt), the city quarter of Silberhöhe, mainly concrete panelled multi-floor apartment blocks, has been dismantled to stabilise the real estate marked. New green spaces are established in cities that formerly were densely populated. However, when green spaces grow too large, they may impose on the urban coherence and may create distances too large to be cost-effectively served.

The role of the geoscientist in the context of sustainable land management in shrinking regions aims at finding potential low-budget options of rehabilitation. This includes aspects such as: Where are derelict sites located, how larges are they and to what extend are they degraded (disturbance of the ground, contamination)? Which strategies of re-utilisation are feasible with regard to the fact that the region is shrinking and how can this re-utilisation potential be exploited? In the case of re-greening are earthmoving works necessary to re-model the site to natural appearance? Are there underground obstacles to be removed? Are there stability problems like underground cavities and steep slopes? How can the functions of the soil be restored?

In shrinking regions, the geoscientist is concerned with exploiting spatial data and judging feasibilities, having in mind the restricted budgets for possible redevelopment projects. A major part of this work deals with identifying areas of possible re-greening rather that contributing actively in development work with regard to detailed site investigation and cleaning-up procedures. In this respect, a geoscientist has to cooperate closely with specialists in forestry, agriculture and ecology as well as experts dealing with the potential of plants for energy production.

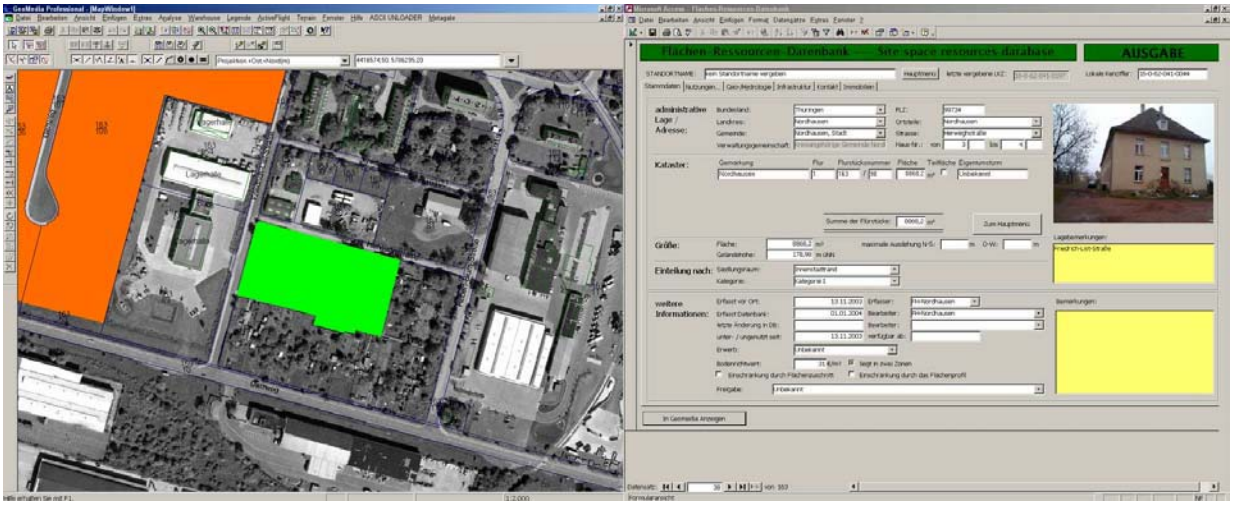

Figure 8. ResDbase® with derelict terrain and analysing tools (Ruff, Stuth, Bierig 2006).

In order to enhance the strategy of re-utilizing land in shrinking regions a GIS-supported tool has been developed. With ResDbase® a database has been established that integrates heterogeneous site information and spatial data of different formats. The database covers all types of derelict sites, visualises them and analyses possible options of redevelopment including re-greening. A difficult step in this strategy is to harmonize all the information that come in different digital formats and in some cases in analogous form as hard copies of maps. The set-up and application of this tool is presented in Ruff, Stuth and Bierig (2006).

CONCLUSION

One of the major challenges of the 21st century will be the transformation of urban and rural environments. On one hand, many of the cities today are characterised by spontaneous, excessive growth and cities exposing a dynamic growth pattern will expand to megacities. One the other hand, many mature cities of Northern America, Europe, Asia and Australia will loose a good part of their population and will start shrinking. In Europe, certain metropolitan regions will be promoted by EU-development funds whereas smaller cities and less populated regions will lose even more of their population. This development is accompanied by profound changes in the demographic pattern and will impact on our society.

The transformation process that we are facing needs to be carried out in line with Agenda 21 and the notion of a sustainable development. In this process the role of the geoscientist is to zone and analyse the terrains to be re-vitalised with regard to risks and opportunities. In expanding urban environments he is charged with developing land that has been used already. He is faced with heterogenous ground conditions that have been manipulated by man and that bear many dangers like hidden foundations, cavities and contamination hot spots. In a shrinking urban environment he is charged with an inventory of derelict terrain and the analysis of possible low-cost options of re-utilisation. In many cases the re-greening option will be the only feasible one.

New fields of activity unfold for the geoscientist with the focus shifting from the exploitation of greenfields to the rehabilitation and reutilisation of already exhausted land.

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