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SPATIAL AND TEMPORAL DYNAMICS PROJECTION OF INDUSTRIAL LANDSCAPE IN THE ENVIRONMENTAL STATE. CASE STUDY: 3RD DISTRICT OF BUCHAREST

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Abstract. After the fall of the communist regimes in 1989, East and Central Europe cities went through a period of economic and political transition, reflected in the urban landscape through destructuring, abandonment or conversion of the industrial units into large commercial, residential, services or mixed-used developments. In Bucharest, as a consequence of the state-sustained and designed industrialization process from 1945-1989 and the changes recorded after 1989, the urban landscape shows an accelerated, functional and aesthetic dynamics with implications for the environment. The study assesses the industrial landscape evolution over time and space in 3rd District of Bucharest, considered a study case representative for the whole city, using available maps, historical materials, GIS and observation sheets and the changes occurred after 1989 in the urban environment due to the change and fragmentation of the industrial landscape. Significant trends in conversion or the patrimonialization of the industrial units were identified.
The research revealed that 3rd District, a heavily industrialized area before 1989, still has important remnant industrial traits and features with important consequences on the environment. 1989 brought significant changes in the organization, function and spatial distribution of the industrial areas, most of them today in relocation, deindustrialization and conversion stages. In these conditions, there is a manifest need to reshape the components of the urban space in order to reduce the effects of new threats to the inhabitans' quality of life and vital infrastructure within the city and its urban periphery.

Introduction

Before 1989, Bucharest was considered the largest and most complex industrial centre of Romania, gathering units with lower pollution potential, as the

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food industry, textile and so on, but as well units with higher pollution potential, such as those in energy production, chemical industries, metallurgy, construction, machinery and equipment manufacturing.

The industrialization phenomenon underwent differently in intensity and spatial expansion, depending largely on the political, historical and economic factors. Four major stages of development of the industrial landscape were identified (Mirea et al, 2012): *the paleo-industrial stage or stage craft and manufacturing production (until 1918), capitalist industrialization stage (1918-1944), socialist industrialization stage (1944-1989) and post-industrialization period or deindustrialization (after 1989).*

Bucharest industrialization began in the second half of the 19th century, by inserting industrial units into the urban tissue and urban landscape. There were small units, territorially dispersed and located mainly in the central area of the city, today's Old Town, and rarely in urban peripheries of that time. Among these units we can mention: Assan Mill (1853), Oppler Brewery (1854), Army arsenal (1863), Lemaître Factories (1864), Tonola M. Brick Factory (1869), Manufacture of State Tobacco (1872), Filaret Matches Factory (1879), Wolff Plants (1883), Stella Soap factory (1884), etc.

The industrialization process intensified between 1918 and 1945, when, considering the number of units, active population and labor force, Bucharest become a modern **industrial city**. By inserting pro-industrial policies during the socialist period, Bucharest strengthened its position as the largest and most complex industrial centre in Romania, with an industrial area of **2685.4 ha** (1989), covering **11.77%** of the total area of the city. If the first three stages are characterized by the establishment and development of industrial units, post-industrial period is characterized by the decline of activity, the destruction of the planned economy, the destructuration of industrial units and areas, massive jobs restructuring and loss of employment, industrial site abandonment, demolition or functional and aesthetic conversion of spaces.

After the industrial landscape became a *major economic and cultural presence in the urban landscape of Bucharest* (Chelcea, 2008), a visible change is remarked in the landscape since 1989 by creating *urban deserts* and conversion of industrial to other functions, required by the continuously changing city, to be competitive at European and global level (Mirea, 2012).

At the same time, extremely rapid changes occurring particularly after 2000, led and still lead to irreversible losses of industrial heritage. Examples of lost, damaged or abandoned industrial units with buildings of heritage value are the Belvedere Cigarette Factory, Ford Plant, Assan Mill, November 7 Fabrics Factory (former Dâmboviţa Fabrics), Silk Enterprise Select, Timpuri Noi Plants (former Lemaître) etc.

Originally, the term industrial landscape designated spaces where productive or extractive activities were being carried out, the approach being strictly functionalist (N. Iorga, 1927 V. Mihailescu 1935, Herbst 1971, C. Herbst et al., 1963, 1964, and so on). Awareness of the cultural value of this type of landscape, recognition of the multiple possibilities offered by industrial structures for conversion, urban regeneration through the rehabilitation and conversion of industrial buildings and success conversion projects such as the Venetian Arsenal, Venice - Italy, Fiat Lingotto, Torino - Italy etc. have led experts to adopt a new meaning to the industrial landscape concept in Romania (Pătroescu M., C. Smith, 1994 C. Smith, 1996, 1999, and colab.1998 Ianoş I., I. Iamandescu 2003, 2006 , 2008 L.Chelcea 2008 etc.), in European Union countries (M. Preite, 2002, 2005, 2008, 2011, G.F. Fontana, 2005, 2008 etc.) and worldwide (M. Palmer, P. Neaverson, 1998 R. Parker, 1998 A. Marc, 2005 Nae M., D. Turnock, 2011).

1. Methods

The landscape, defined as ***a part of the territory as perceived by humans and whose character is the result of the action and interaction of natural and/or human factors*** (European Landscape Convention, Florence, 2000) can be analyzed using historical maps - retrospective mapping method, in order to show the evolution and expansion of industrial landscape and its relationship with residential areas.

Retrospective mapping method involves using a large number of historical and cartographic materials from different periods of time, preferably at the same scale, which are analyzed, correlated, georeferenced and vectorized in order to extract, for our study area, the necessary information for spatio-temporal analysis of the industrialization phenomenon. With an undeniable utility in landscape analysis, the retrospective cartography method presents also drawbacks, such as maps with different geographical projections and systems of representation, generalizations, misinterpretation, etc.

To analyze the temporal and spatial evolution of the industrial landscape in the 3rd district of Bucharest 16 cartographic representations were used, considered to be representative for the study, namely: Borroczyn Plan – 1852, Map of Romania – 1864, Pappasoglu Plan - 1871-1975, Cerkez Plan - 1890 Plan Delattre – 1893, Bucharest City Plan – 1898, Plan of Bucharest - 1900, Bucharest City Plan – 1911, Plan of Bucharest - 1914, Bucharest City Plan – 1923, Plan of Bucharest – 1947, Cadastral Plans - from 1975 - 1990, topographic maps - 1977 - 1978, General Urbanisation Plan - 2001, Orthophotoplans – 2008, Plan of Bucharest - 2010.

Cartographic materials available for the period 1852-2010 were used together with historical materials (Giurescu, 2009 Potra, 1990, Iorga, 2008) and documents

related to environmental conditions (Iojă, 2008; ARPM Report Bucharest - 2004, 2005, 2006, 2007, 2008, 2009).

Observations obtained from charts, cartographic and historical sources were checked and collected into a complex database, involving eight items - location, industrial unit, description, identification data, historical data, industrial landscape description, its relationship with proximity residential areas and environmental conditions. 87 observation sheets were completed.

2. Study area

Located in the eastern part of Bucharest, with an area of **3.400 ha** and **397,882 inhabitants**, 3rd District holds **14%** of the total area of the municipality and represents the most densely inhabited district (20.46% from total numbers of inhabitants of Bucharest in 2008, DRSM Bucharest, 2009, 2010).

The analysis of historical maps showing the city layout of the 1842 – 2010 period, and historical data, reveals that 3rd district has been located within the south – eastern and eastern part of the Bucharest Historical Center, evolving and growing in surface, initially by incorporating slums and villages of the Colentina field, afterwards by incorporating industrial sites and socialist residential areas (Fig.1., Fig.2.).

An important stage in the district development was the socialist period, when through systematic planning policies, urbanization and industrialization process was accelerated (Fig. 2), increasing housing density. These actions have irreversible effects on the environment and geographical landscape. After a stage of accelerated growth of industrial and residential areas during the socialist era, the political, economic and social changes following 1989 caused the abandonment and partial conversion of industrial units (Fig. 3).

3. Results and discussion

In the original landscape of 3rd District, before industrialization, considering physiognomic and functional factors, three concentric, relative to the city center, areas could be distinguished, namely: the pericentral area, complex and heterogenous, followed by an inner peripheral district or *slum* (Majuru, 2003) characterized by a special housing, and an outer peripheral district, with vineyards, orchards and arable land (Fig.1).

The first production units in the area of the 3rd district were placed in the center, without imposing a specific landscape physiognomy. Since the second half of the 19th century, the first industrial production units established specific urban landscapes and dysfunctionalities in the state of environment at the limit between inner and outer peripheral areas (Fig. 1) (Factory of Bronze Articles T. Dumitru (1840), Lemaître Factories (1864) afterwards Timpuri Noi, etc.).

The industrial survey of 1901-1902 allowed us to achieve a precise image of paleo-industrial landscape of 3rd district. There are 32 units, placing the 3rd district in second place in terms of number of units, after the 1st district (47 industrial units).

In terms of spatial distribution of the industrial units in this period were individualized three areas, namely: the central area (delimitated by Victoria Avenue - I.C. Bratianu Blvd.) characterized particularly by manufactories which do not establish specific physiognomies; the area located on the 1900 city boundary, delimitated by I.C. Bratianu Blvd. – Mihai Bravu Blvd. characterized by units with considerable spatial footprint and a high pollution potential; and the area located in the suburban villages, subsequently integrated to the city (Dudeşti Village, nowadays neighborhood of the city) (Fig.2.).

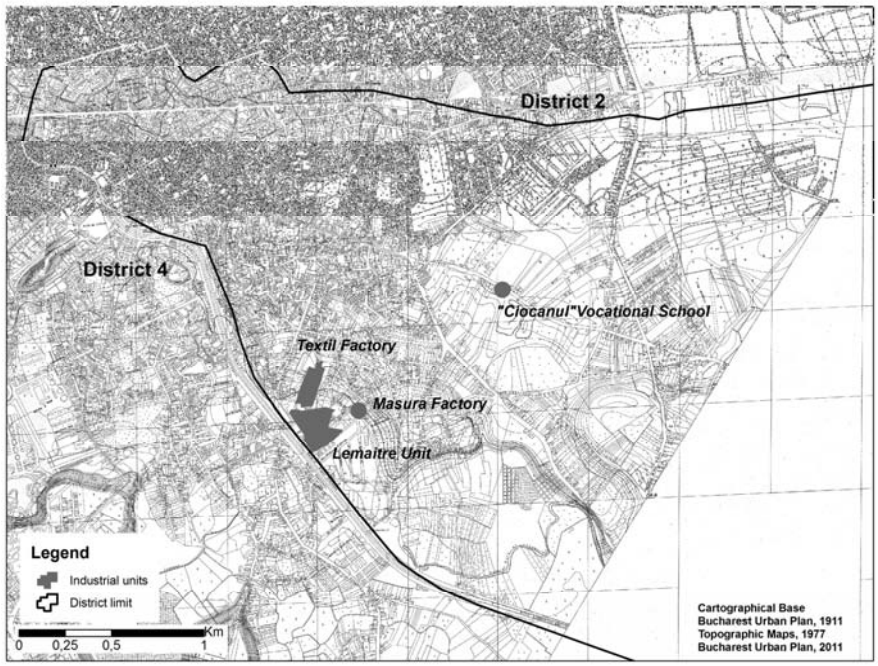

Fig.1. Industrial landscape units of 3rd district identified in 1911 (Source: Bucharest City Plan Bucureşti – 1911)

There are two polarizing areas – the center, with its mixed functions and possibilities for immediate distribution of products established many manufactories, and Dambovita River which gathered many intensive water consuming units (Fig.2).

Of the 32 industrial units listed in the Industrial Survey (1901 – 1902), only 3 units lasted up to the present– Lemaître Factories (afterwards Timpuri Noi, 1864), the Romanian Knitwear (later SC Crinul SA, 1896), National Bank Typography (1880). These are representative for the paleo-industrial landscape in the area of the 3rd district. Despite the technical and historical importance of these three industrial units, the first two were completely demolished in the period 2008-2011 and the National Bank Typography was relocated.

Industrial policies implemented after 1904 led to a continued development of industrial units and the establishment of the first industrial sites, founded by the entrepreneur Malaxa (Malaxa Factories, 1920).

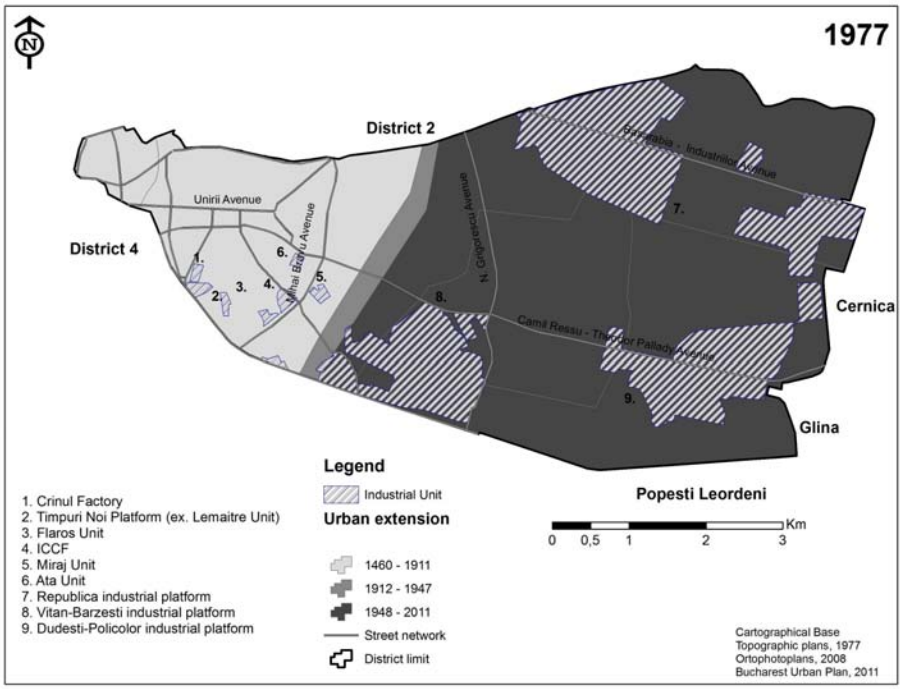

Fig.2. Spatial and temporal evolution of industrial landscape in the 3rd district

The maps analyzed allowed us to determine the area occupied by industrial unities as an indicator of the industrial landscape extension over time and environmental pressures. Industry occupied 10.1 ha (0.2% of the sector delimited according the Urban Master Plan, 2002) in 1923 (estimated based on Bucharest

City Map - 1923) and 12 years later reached 313.5 hectares (9.2% of the sector delimited according to Urban Master Plan 2002, estimated based on Bucharest Systematization Plan - 1935). Comparing the two values demonstrates the intensity of industrialization between 1923 - 1935, mainly due to the emergence and development of Malaxa Factories, a very large industrial area of metallurgy and iron works.

If until now the process of industrialization is not reflected in the residents' quality of life, from this moment, industry is developed in an integrated way, determining the building of canteens, hospitals, clinics, residential areas, etc. in the proximity of industrial units. The first unit who will be built according to this concept in the area of 3rd district is the Malaxa Factories, right form the design having its own residential areas, hospital, etc. in its proximity.

The socialist period led to an accelerated industrialization and urban expansion. The area occupied by industry in 1977 was **722.8 ha** (**21.2%** of the 3rd district, as delimitated by Decree 284/1979), with **409.3 ha** more than in 1935 (Fig. 2.). The existing industrial units suffered many transformations, such as nationalization, refurbishment, increase of the occupied area, upgraded production capability and capacity, a process carried out simultaneously with the establishment of new units and their concentration in industrial sites. Between 1947 and 1977 four industrial sites emerged within the area of 3rd district, including: industrial site Republica (252.8 ha), based on an industrial unit from the capitalist stage represented by Malaxa Plant (later Faur and Republica), Industriilor Site (85.9 ha), Industrial Site Dudesti-Policolor (313.5 ha) based on the paleo-industrial unit represented by Dudesti Mold Factory (1896) and Vitan-Barzesti Platform.

The industrialization process of the socialist period was marked by intensive and extensive construction of residential areas (Vitan Barzesti, Nicolae Grigorescu, Titan, Industriilor, older neighborhoods being profoundly altered - Vitan, Dudeşti, Dristor). Some of the new residential areas averaged 250,000 - 400,000 people and were destined to fulfill the housing needs necessary for the ever larger industrial sites. The location of residential areas was chosen mainly due to economic reasons, but locational conflicts resulted from residents' exposure to air pollutants (particulate matter, high content of metals - Pb, Zn, Al, Fe, etc., gases and vapors - SO_2, CO, CO_2, etc.), odors, noise, electromagnetic pollution, etc. Unavailability of data from this period makes impossible the quantification of industry impact on residential area from proximity.

Year 1989 marks the beginning of profound changes in the environment state and urban landscape. Before the political changes, industrial units occupied an area of **806.8 ha** (**23.7%** of the district as defined by the Urban Masterplan of Bucharest, 2002), placing the 3rd district on the first place in the Bucharest area in the terms of this indicator. After this year, there is a rapid decrease of the industrial areas, with a 347 ha loss.

The industrial landscape is now a landscape of transition, being affected by abandonment and demolition, functional and aesthetic conversion. The field observations led us to establish five classes for pointing out the industrial landscape transformation in the 3rd district and the impact on the environment (Fig. 3).

1. Abandoned or demolished units, true *wastelands*, occupying an area of **41.7 ha**, are representing **1.2%** of the district. In this situation are industrial units as – Timpuri Noi Factories (former Lemaître Factories), Crinul Unit, Sections of Flaros Unit (formerly Flamura Rosie), Masura Unit, Republica, ICSIM etc.

2. Industrial units established before 1989 that are still active and have not suffered a functional or aesthetic conversion. Occupying an area of **455.3 ha** (**13.3%** of the district), it demonstrate that the district maintained a strong industrial character.

3. Industrial units with a high physical footprint, established after 1989 with an occupied area of **4.5 ha** (**0.1%** of the district area) (Fig.3).

4. Units that suffered a functional and physiognomic conversion. Occupying an area of **45 ha** (**1.3%** of the district), this category includes units as: Ata Factory, 7 Noiembrie Factory – In City (industrial – residential conversion), Granitul – Cora Esplanada, Bricostore, Mobexpert (industrial – commercial conversion), etc.

5. Industrial units that suffered functional conversion as a result of renting by various manufacturers and retailers. This class occupies an area of **262.7 ha** (**7.7%** of the district) and is the most accessible for conversion, therefore the most common in our study area (Fig.3).

A comparative analysis of the five categories (Fig.3) shows that conversion of industrial units particularly targeted small areas (< 4 ha), located close to center. It can also be noted that the industrial – commercial conversion is the most common, because investors could recoup their investment faster and residents are open to this kind of investments in their neighborhood. Industrial-commercial/residential/services conversion is considered an alternative to polluting industrial units or abandoned industrial areas within the urban system, but brings a number of problems related to traffic, accessibility, parking, urban dysfunctionalities etc.

While in the process of deindustrialization many polluting units were closed, and it is estimated that overall pollution from industrial sources has diminished considerably, the multiplication of small and scattered pollution sources resulted from the disintegrated of industrial giants, along with pollution from old industrial sites, still causes discomfort among residents (Fig. 4). Also, the conversion of industrial units to commercial platforms/shopping centers leads to new environmental issues and new sources of pollution in the urban system. Traffic congestion, air pollutions by increased circulation, noise and vibration are among the most important.

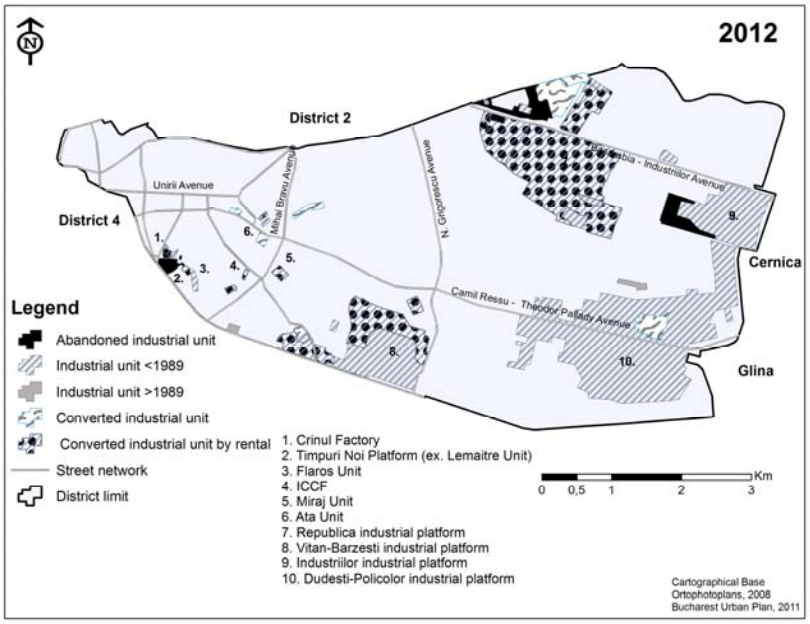

Fig.3. Industrial landscape – Landscape in transition in the area of 3rd district of Bucharest

Industrial sources of air pollution in the 3rd district: CET Sud (SO_2, NO_x, CO, CO_2, particulate matter, smoke, ash etc.), SC CHIMOPAR SA, SC POLICOLOR SA, SC Anticorosiv SA, Republica SA, SC FAUR SA, SC STIROM SA (Iojă, 2008). In order to track and analyze the pollution levels, the Regional Agency of Environmental Protection established in Titan area a monitoring station for industrial activities for CO, CO_2, SO_2, NO_2, PM_{10}, Pb, Cd, Hg, and CH4. There were exceeding of limit values for particulate matter PM_{10} (36 µg/mc is the VL and there were 48 cases of exceeding, ARPM Bucharest, 2010), in the case of other pollutants we noticed a downward trend. Although annual averages are declining due to the decline in the industrial activity and the implementation of Integrated Program Management for Air Quality, in 2010 the daily limit value was exceeded by more than 35 times (ARPM Bucharest, 2010). Of the industrial sources of water contamination in the area of 3rd district, we can mention CET Sud due to the used and discharged water with no filtering into the collector network.

Concerning the state of soils, in the area of 3rd district is estimated that 3.5 ha (0.10% of the district) are degraded soils, requiring, however, detailed research (ARPM Bucharest, 2004, 2008). Soils were heavily modified, first due to construction by stripping and foundation building operations. Degradation by

incorporation of toxic chemicals (heavy metals, sulphur compounds) from industrial activity or increased traffic added afterwards.

Soils charged with these pollutants damage the physical, chemical and biological elements, reducing the productive capacity of soils (Regional Agency of Environmental Protection, 2010).

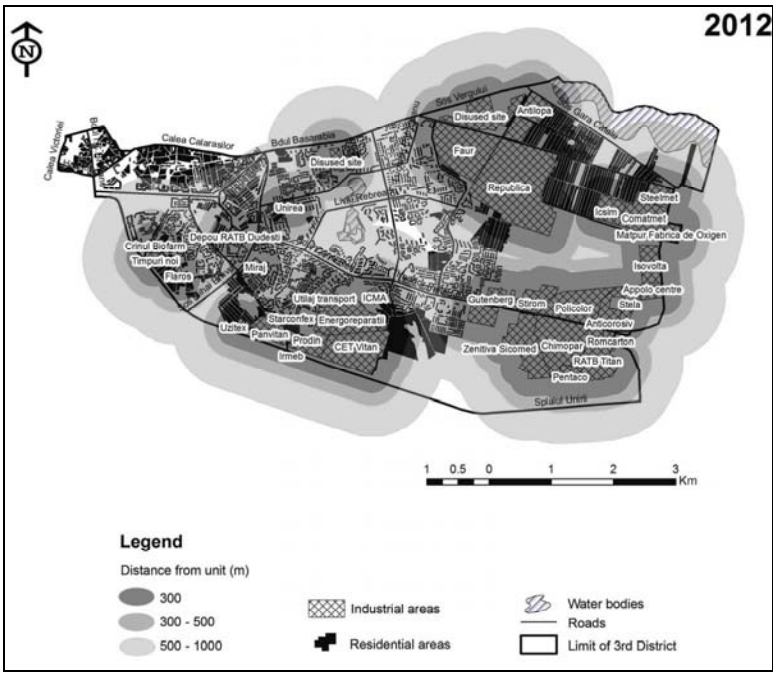

Fig. 4 The distance between residential areas and industrial units in the area of 3rd district of Bucharest

Republica SA, SC Antilopa SA, SC Timpuri Noi are among the most concerning through the amount and complexity of waste materials. These sites are designated for demolition, but site contamination is a problem that should be addressed. Inventory and mapping of contaminated soils of industrial units that have been demolished and underwent conversion should be a priority.

The industrial noise sources are represented by industrial sites – Republica, Industriilor, Vitan – Barzeşti and Dudesti – Policolor, with day and night impact on densely populated neighborhoods – Dristor, Titan, Nicolae Grigorescu etc.

Despite the deindustrialization process and conversion, the residents are still exposed to organic and anorganic particulate matter emissions, containing metals

(Pb, Zn, Al, Fe, Cu, Cr, Ni, Cd), gas and vapors (SO_2, NO_x, NH_3, HCl, CO, CO_2, H_2S), organic solvents, soot, residual pollution, electromagnetic and visual pollution. The destructuring, deindustrialization and conversion processes have led to a pollution decrease from industrial sources, but aparition of the new problems require sustainable solutions.

Conclusions

The 3rd district can be considered also nowadays the most industrialized district of Bucharest (13.5% of the district), concentrating many industrial units of chemical, metallurgical or machine building profile, still important sources of environment degradation.

The development of the industry was carried out in several steps, west-east axe, in conjunction with the urban sprawl at the expense of arable land, vineyards and orchards on of the urban periphery and rur-urban fringe.

The year 1989 brought major changes in the organization of the industrial units, projected today in the urban landscape through relocation, deindustrialization and conversion of industrial units. Although it is estimated that there is an overall improvement of environmental quality of the district with the closure of the large industrial pollutants, destructuration of industrial units led to an increase of diffuse pollution sources. Also, the conversion of industrial units in large shopping centers as Auchan, Cora etc., changed the typology of degradation sources on the environment.

Residential-Industrial relation, even in its destructured or converted form produce a large plethora of problems as: urban air pollution, diversification and amplification of noise, locational conflicts, unequal distribution of green areas, odor pollution, degradation of housing and internal habitat, low functionality of technical infrastructure, poor waste management, high percentage of paved/covered surfaces, traffic and housing insecurity, moral and visual pollution, electromagnetic pollution, urban heat island phenomenon, direct projected in the quality of internal and external habitat and sanogenesis status of residents from the proximity of industrial units etc.

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