
URBAN SPRAWL AND DEMOGRAPHIC DYNAMICS IN SUCEAVA METROPOLITAN AREA¹

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Abstract: *The quantification of the extension process of settlements boundaries is relatively new in the field of urban and territorial planning, taking scale once with the use of Geographic Informational System, in terms of remote sensing and photo interpretation of the satellite imagery from different periods of time. The contiguous build-up areas present high densities of population fact that is one of the premises of sustainable development. Using aerial and satellite imagery a highly-detailed map of the urban foot print of the studied area for the years 2004, 2010 and 2014 which showed that the last 10 years the settlements expanded with almost 15%, mostly around Suceava and fragmenting the landscape. The demographic data showed that the population has grown on average, but some of the administrative units have lost population, the city of Suceava suffering the biggest population drop. In Romania urban sprawl is a phenomenon that also occurs for medium sized cities and the challenges for them are bigger due to the incapacity of the planning documents.*

Keywords: *urban expansion, GIS, urban sprawl, Suceava metropolitan area.*

1. Introduction

At this moment, cities are the main places for growth, both economically and demographically and this growth has major spatial implications almost all the policies that govern a country, a region or a city has a territorial effect. This case study of Suceava Metropolitan Area show that incoherent spatial planning in the last two decades lead to major urban sprawling in an area considered one of the poorest in the

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EU, with considerable landscape changing and deficiencies in what concerns a good quality of life for the people who live in the sprawled areas. Using remote sensing methods and statistical data I will show that the city of Suceava suffered a demographical process of shrinking in the same time with a territorial expansion while the rural and urban settlements in its metropolitan area had shown a growth both in built-up area and in demographics.

It is considered that urban sprawl is a characteristic for big cities, this type of low density landscape surrounds all the major metropolitan areas (Gilli, 2009) and many of the largest cities in the world have to deal with the problems of what the sprawl implies because it is seen as a factor for un sustainability both ecological and economical for the nowadays cities (Goetz, 2013). Many of the West European cities have elaborated strategies and plans in order to stop this phenomenon because the build-up areas of the settlements have increased with 20% while the population has increased only with 6% in the last 20 years (EEA, 2006).

The terminology difference between urban sprawl and urban expansion is quite thin. A clear distinction was made by Jan K. Brueckner who said that the urban sprawl is the extreme version of urban expansion, it is the form where the city is increasing in dimension but the growth isn't produced by the growth of the number of inhabitants, while urban expansion is a normal process where "cities must grow spatially to accommodate an expanding population" (Brueckner, 2000).

In Romania, besides Bucharest with a population of 2.1 million people in 2014 according to the National Statistics Institute, other large size cities deal with this issue and while in North America and in Western Europe this is an issue from the mid-20th century, in Romania it is quite new and it's a characteristic for the post-communist Romanian cities (Grigorescu et al. a.2012, b.2012.).The factors that gave birth to this phenomenon were set in three periods of time: a) 1990-1992, when the law that regulated the settlements' systematization is abrogated and the previous state-owned properties return to their owners or to the inheritors; b) 1992-2000, when the construction activities were under an permissive law and people built along the main roads together with some enterprises and commercial activities who extended the built-up area of the cities; c) 2001- present. Starting 2001, all the administrative territorial units were obliged by law to make urban planning and land use plans, but under the pressure of a high demand for residential buildings and the lack of space inside the cities, the natural and agricultural landscape surrounding the cities was transformed into low-density housing often with poor road connectivity and poor utilities distribution (Suditu, 2009).

As the mentioned author said, in the last 10 years it was a high demand for dwellings, people wanted to live at the periphery because of the poor quality of the flats and the desire to escape from this type of collective housing that was considered a reminiscence of the communist regime and they had the financial possibility to do that, as most of the new buildings were financed by mortgages and loans. Another source of finance for the residential developments were the money sent by the Romanians who worked abroad, mostly in the EU countries and who contributed massively to this sector of the economy (Sandu, 2010).

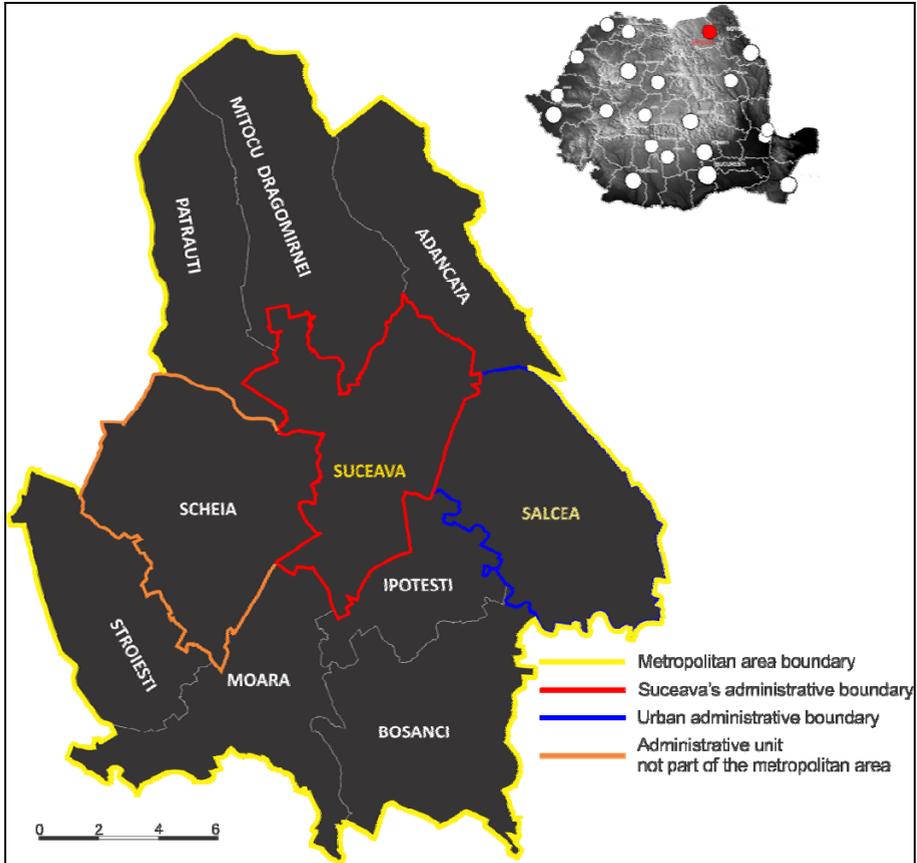
After the economic crisis hit Romania the number of residential developments has decreased, but the issue of urban sprawl was put on the public agenda in the Romanian Territorial Development Strategy, where in one of this document's reports it is shown that between 1993 and 2010 the cities built-up area has increased with 87% while the ratio of urban population has increased with only 0.8% (SDTR, IHS Romania, 2013). One of the objectives for territorial development that this document states is referring to assure a balance between the settlements' need for expansion and the sustainable use of the land resources but without a coherent vision for each city and its metropolitan area translated into their General Urban Plans (PUG), this objective will be hard to be attained.

The data revealed by this document and the research of other authors showed that urban sprawl is a phenomenon that is present in small and medium-size cities in Romania (Suditu et al. 2010) and Suceava and its metropolitan area is a revealing example as it will be shown in the next chapters. This paper is structured as follows: the data requirements and the methodology will be presented, the results of the applied methodology and discussions on the findings will come after and at the final some conclusions will be presented.

2. Materials and methods

This research has two major components: the urban foot-print component and the demographic component. The area of the study is the city of Suceava and its metropolitan area. In Romania only the 1st degree cities can form a metropolitan area according to the 351/2001 Law but other cities that are the seat of the county can form a voluntary based association with the urban and rural administrative units that surround them and this association can work as a metropolitan area.

In present the Suceava's Metropolitan Area Association is an assembly of two urban administrative units: Suceava and Salcea, and six rural administrative units: Adâncata, Bosanci, Ipotești, Mîțocu Dragomirnei, Moara, Pătrăuți and Stroești (fig.1). From this association the Șcheia administrative unit refused to take part despite the fact that is closely connected to Suceava and the built-up area of these two localities, in time, created a unitary urban footprint. Considering this fact the study area included this village, in order to create a better image for the studied processes, people and economies being slightly indifferent to the local political frictions. The city of Suceava has a population of 116,311 inhabitants in 2014, the entire metropolitan area a population of 174,580 which means that on a surface of 443.77 square kilometers the density is 393 inhabitants per square kilometer in 2012.

Figure 1. Study area: Suceava Metropolitan Area

There is a lot of literature that analyses the dynamics of the urban sprawl using remote sensing and GIS because temporal satellite imagery is a powerful resource in quantifying the land use changes around the globe. In order to make a recent and a detailed assessment of the built-up area in the studied zone I used high resolution aerial and satellite imagery from three different years: 2004, 2010, and 2014 (table 1).

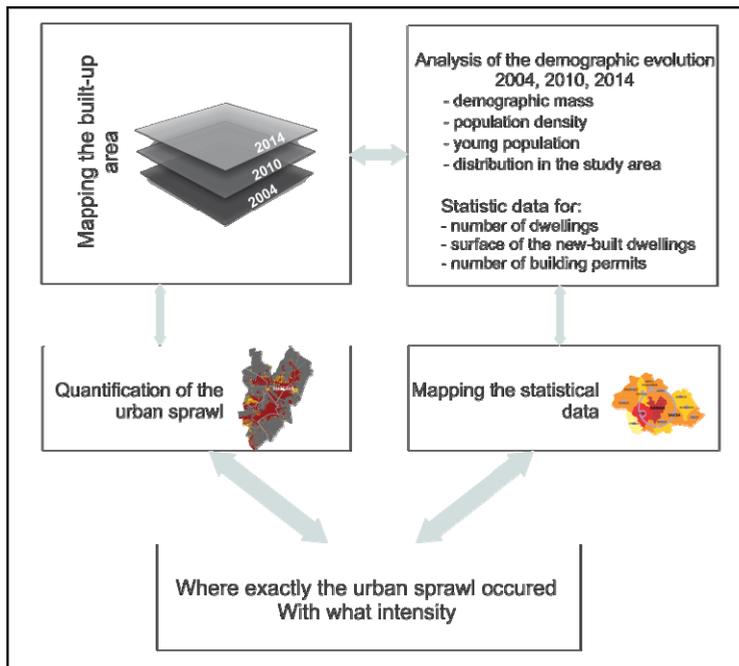
Table 1. Imagery sources and mode of mapping

Year	Source of the imagery	Software of digitization
2004	ANCPI (aerial imagery; 0.5 m/pixel)	Arc GIS 10.1
2010	Google Earth Pro (satellite imagery, 0.5m/pixel)	Google Earth Pro 7.1
2014	Google Earth Pro (satellite imagery, 0.5m/pixel)	Google Earth Pro 7.1

The mapping of the built-up area was made by manually digitizing the areas with clusters of buildings indifferent of their use. This method allowed me to make a highly detailed map for the studied years. The mapping had as a base unit the parcel and not the buildings. The GIS layer that contained the administrative boundaries were obtained also from ANCPPI (National Agency of Cadaster and Land Registration). Other authors used an automatically method to map the temporal situation of the built-up areas (Ramachandra, 2014, Siedentop & Fina, 2010) but the results' accuracy isn't the one needed for an assessment at this scale.

Statistical data was used to confirm the analysis based on the aerial and satellite imagery. These data-sets contains information regarding the number of dwellings built in the three years of study, the living area of the homes and the number of building permits emitted in 2004, 2010 and 2014 (fig.2).

Figure 2. Methodological scheme



The source of the above mentioned statistical data is the National Statistics Institute, from its TEMPO-Online (<http://statistici.insse.ro/shop/?page=info>) platform. The same data source was used to obtain data for the demographic component of this paper. All this data was compiled in a spatial database in a GIS environment and it was mapped using the Arc GIS software. The methodology applied was set to give an exact

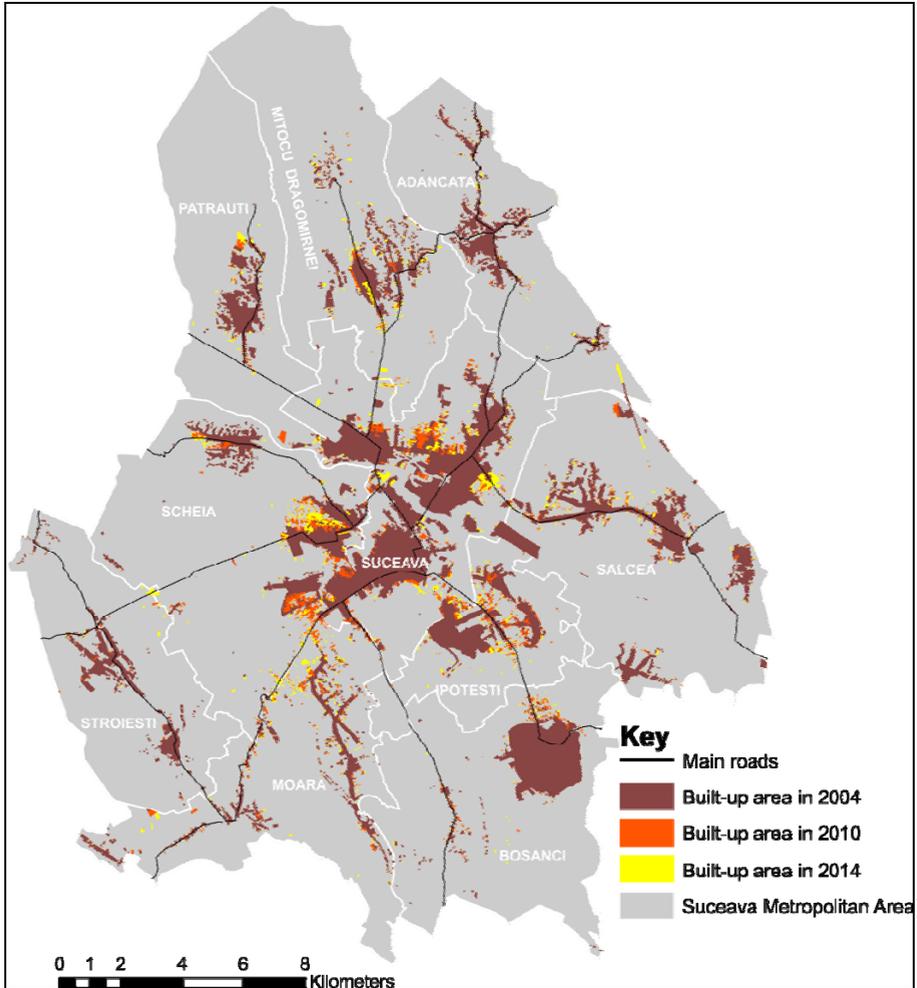
image of where are the areas where the sprawl occurred and the intensity of this phenomenon.

3. Results and Discussion

Urban sprawl. Based on the aerial and satellite imagery, mapping the urban footprint lead to a highly-detailed map of the built-up area for 2004, 2010 and 2014 (fig. 3). At the scale of the entire metropolitan area, the settlements' morphology is very fragmented, it was fragmented in the baseline year 2004, and the fragmentation continued at a high rate, the new-built areas being localized at the localities periphery. The expansion was intense at the periphery of Suceava city, especially in the northern part of its administrative boundary where many residential buildings were placed between 2004-2010 and also between 2010-2014. The functions of these buildings are mainly individual homes, retail and some with logistic activities. This area attracted many of the city's residents because it was an escape from the high-density blocks of flats, the traffic that became more and more intense, the need for more living space and this area was close to the city-center, had a good connectivity with it and has a good natural environment, being close to a forest. Other areas that faced a major expansion of the built-up area are located at the western part of Suceava but administratively belong to the Șcheia and Moara communes, therefore in rural areas. Here, the built-up areas of the villages are combined with the one of Suceava, forming a slightly heterogeneous but single urban foot-print. The un built spaces in 2010 were filled in four years by buildings, the majority of them weren't developed by real-estate developers but by individuals that bought a parcel of land and built a home on it without a zoning plan, often without a building permit, the construction law in Romania gives the possibility for an owner to obtain the permit in some conditions after he built the establishment.

The new-built areas are located mostly in the proximity of the main roads that in time are transformed in streets, as a consequence of the lack or poor quality of the existing streets, often unable to take the morning and evening traffic.

In ten years (from 2004 to 2014) the built-up area has expanded with an overall figure of 14.95% (table 2), gaining 8.93 square kilometers. The growth rates differ between the administrative units in the metropolitan area, the most intensive increment happened in Moara and Scheia, these two communes have now with more than a quarter more built-up surface than in 2004. The lowest growth rates have been registered in Bosanci and Stroiești communes, the distance between them and Suceava and the poor quality of infrastructure determined the people from the city to choose localities that were closer to the jobs and the services provided by the city.

Figure 3. *The built-up area in 2004, 2010 and 2014*

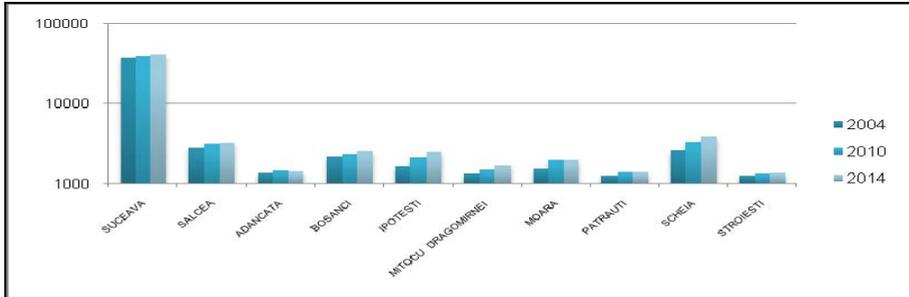
The temporal analysis of the two periods of time shows that in some communes was smaller in 2010-2014 than in 2004-2010, not surprising because this period of time is smaller than the previous one. What is surprising is that the later period is the one when the economic crisis hit Romania and the real-estate developments were one of the principal activities that were affected. Mitocu Dragomirnei, Adancata and Stroiesti had a bigger rate of territorial expansion in 2010-2014 than the previous interval, Moara and Scheia suffering a major drop between the two intervals.

Table 2. Urban expansion between 2004-2010 and 2010-2014 in Suceava Metropolitan Area

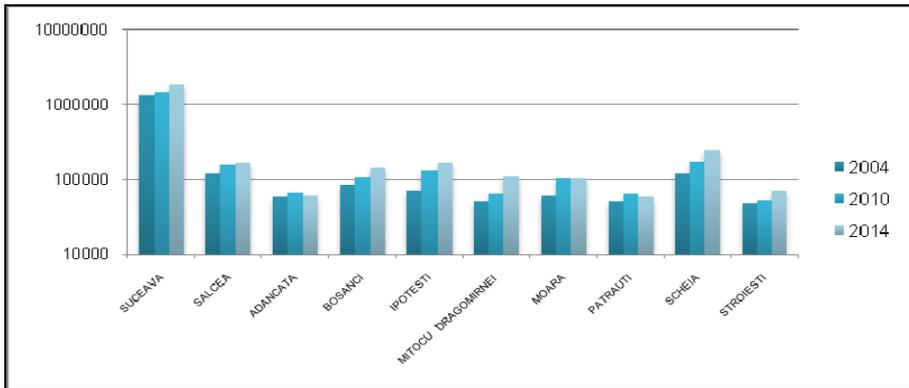
Territorial administrative unit	2004 (sq km)	2010 (sq km)	2014 (sq km)	Evolution 2004-2010 (%)	Evolution 2010-2014 (%)	Evolution 2004-2014 (%)
SUCEAVA	14.56	15.91	16.879	8.54	5.69	13.74
SALCEA	5.81	6.182	6.459	6.02	4.29	10.05
ADANCATA	3.039	3.124	3.279	2.72	4.73	7.32
BOSANCI	5.434	5.696	5.808	4.60	1.93	6.44
IPOTESTI	3.681	4.061	4.337	9.36	6.36	15.13
MITOCU DRAGOMIRNEI	3.059	3.376	3.834	9.39	11.95	20.21
MOARA	3.2	4.006	4.434	20.12	9.65	27.83
PATRAUTI	2.361	2.592	2.803	8.91	7.53	15.77
SCHEIA	5.816	7.291	7.881	20.23	7.49	26.20
STROIESTI	2.506	2.596	2.69	3.47	3.49	6.84
Total	49.466	54.843	58.404	9.34	6.31	14.95

The results of the photo interpretation of the aerial and satellite imagery are confirmed by the official records for the number of existing homes and the surface of the living surface (fig. 4 & 5). The number of homes has grown in most of the administrative units in Suceava's metropolitan area but the rate of the growth isn't as spectacular as the built-up area analysis showed. The reason for this is that in some of the communes and in Suceava and Salcea cities were built other types of non-residential constructions such as retail buildings, storehouses, industry, and infrastructure (the airport is a good example). By far, the most numerous residential spaces are located in Suceava but the city of Salcea and Scheia village are becoming satellite settlements, becoming the place where people live and not the place where they have economic activities. In Adancata and Patrauti the statistics show that the number of dwellings in 2014 is lower than 2010, which is a bit strange giving the fact that the sprawl has increased and it is not likely that some dwellings were demolished, at first site there may be a statistical error in data collection.

The total surface of the dwellings has increased significantly between 2004 and 2014, which means that besides the fact that more homes were built, the average area of the residential buildings has also increased, most of them being individual homes, often with more than one level.

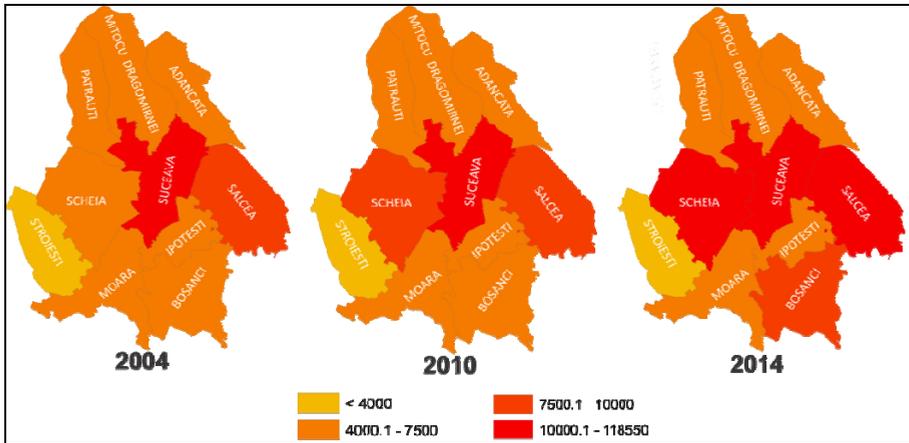
Figure 4. Number of existing dwellings in 2004, 2010 and 2014

Source: National Statistics Institute

Figure 5. Surface of the homes in 2004, 2010 and 2014 (square meters)

Source: National Statistics Institute

Demographic dynamic. The phenomenon of shrinking cities in Romania has occurred at a higher rate after the integration in the EU, when the external migration has increased significantly. In this period, the urban population was more attracted to the suburbs of the medium and large size cities in Romania, a consequence of the increasing incomes and that the residential spaces inside the urban area were not sufficient for the demand (Grigorescu et al. 2012(a), Sârbu, 2012). In an era of concentration and centrality the reasons for suburbanization and urban sprawl are numerous: the increased individual mobility that allowed people to travel from longer distances to their jobs that were located in town; the low land-prices that determined people to renounce to living in the city and move in places that they could afford; the low air-quality and other environmental-related causes determined young families to want to raise their children in non-polluted areas, etc. All these causes are part of one big important process: urban planning (Fernandez et al. 2012) which in the metropolitan area of Suceava has produced little effects.

Figure 6. The number of inhabitants in 2004, 2010 and 2014

Source: National Statistics Institute

In the post-communist period Suceava has suffered a quite drastic process of deindustrialization, this causing major social problems that determined people to migrate in west-European countries in search for jobs. The population loss was quite big between the last two national censuses (2002 and 2011), when according to the published results the city of Suceava had with 13,744 less inhabitants (-12.9%).

At the metropolitan level the population mass has increased between 2004 and 2014 mainly in the rural settlements and in the city of Salcea (fig. 6, tab.3). In this interval Salcea and Scheia have passed the threshold of 10.000 inhabitants, the new residents bringing a big contribution to the sprawl mapped at *figure 3*.

According to the data provided by the National Statistics Institute (tab.3), Suceava has only lost 1.89% of its population between 2004 and 2014 and the entire metropolitan area has gained with 14.39% more population. The biggest growth rates were registered in the villages that are very close to Suceava, Ipotesti and Scheia, practically, the people living in these villages are living in an urban area but administratively they belong to rural units. Besides Suceava, two other units recorded a decrease in population number, Adancata and Stroiesti that also had a very low increase in built-up area, so their attractiveness isn't very high. The city of Suceava experiences an accelerating population decrease, in the last four years it lost more inhabitants than in the previous 6 years and it is possible that the trend will continue, the rural settlements attracting more people.

Table 3. Number of inhabitants and dynamics 2004-2014

Territorial Administrative Unit	Suceava	Salcea	Adancata	Bosanci	Ipotesti	Mitocu Dragomirnei	Moara	Patrauti	Scheia	Stroiesti	Total
Population 2004	118550	9115	4433	7044	4997	4180	4446	4444	7413	3522	168144
Population 2010	118089	9861	4378	7371	5826	4638	4859	4879	8851	3406	172158
Population 2014	116311	10347	4363	7649	6732	4976	5277	5237	10313	3375	174580
Evolution 2004-2010 (%)	-0.39	7.57	-1.26	4.44	14.23	9.87	8.50	8.92	16.25	-3.41	6.47
Evolution 2010-2014 (%)	-1.53	4.70	-0.34	3.63	13.46	6.79	7.92	6.84	14.18	-0.92	5.47
Evolution 2004-2014 (%)	-1.89	13.52	-1.58	8.59	34.72	19.04	18.69	17.84	39.12	-4.17	+14.39

Source: National Statistics Institute

The rural areas in the Suceava metropolitan area are more attractive for the population who doesn't want to live in an apartment inside the city but that still want to have general access services in their reach. This kind of argument is very present for the people in the studied area because they constructed mainly in the areas located in the proximity of the city that also had good road connectivity, therefore the engine for the sprawl is a cultural one. The city's economy isn't nowadays between the most competitive in Romania, actually Suceava is located in one of the poorest regions in EU but it represents an island of welfare in the region so it attracts population from the rural areas in the county. Also, some of the economic activities are located in the outskirts of Suceava and in the near rural settlements so the employees that don't live in the city will be more tempted to buy or build a home near their workplace, in order to avoid the in-city traffic.

Giving the fact that in general the people that decide to move in the suburbs are economically active, relatively young families with their children, Suceava will suffer a more accentuated ageing of the population, the share of old people will increase causing putting the health system under pressure. The life in the new-sprawled areas isn't as good as the inhabitants expected. In most of the cases they don't have asphalted roads; their houses aren't connected to any centralized utilities such as water, sewage, gas; don't benefit from waste collection and the public transport is not in reach. The separate urban planning for all the localities that compose the metropolitan area of Suceava leads to this type of dysfunctions that alters the quality of life for the inhabitants. The changes for the landscape are considerable, the type of sprawl that occurred in Suceava in the studied years, have fragmented more the built-up areas,

creating low-density, discontinuous urban foot-prints, changing the land use form agricultural to rural or partial urban. The natural environment in the metropolitan area is quite fragmented and this can be an opportunity to stop the territorial expansion of the localities and guide them to a more thoroughly urban planning that will create a better environment for inhabitants and contribute to a better quality of life.

4. Conclusions

Suceava and its metropolitan area has encountered in the last 10 years with major transformations in what concerns the way of living, the landscape and the mobility of its inhabitants, these transformations happening with a different rate for a medium-sized city like Suceava. The engine for the urban and demographic dynamics are various, the changes in the Romanians' culture and incomes combined with an ambiguous and un-coherent planning policies have provoked some irreversible transformations, that will need time and investments to correct.

The used methodology for assessing the dynamic of the urban sprawl and the demographic one has shown that for most of the territorial administrative units the urban expansion was a consequence of a demographic growth, but the sprawl's rate of growth was bigger than the demographic one. Between 2004-2014, the metropolitan area of Suceava increased its urban foot print with 14.95% and its population grew with 14.39%. Only the city of Suceava has experienced an inverse process: while the built-up area was expanding, the population decreased and the trend is continuing in this direction. The GIS based methodology for measuring the dynamic of the urban sprawl can be a useful tool for planners that will provide a clear image of the land use changes (Aguilera et al. 2011, Jinki & Ellis, 2009). For a more comprehensive image of the causes and more important, the consequences of the urban sprawl in Suceava, further sociological research must be made in order to determine what type of population choose to move in the city's suburbs and how their life changed since they live there.

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