

Chapter 10

Cluj Napoca - benefits and risks of urban development

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Introduction

Cities have always been engines of innovation (Glaeser, 2011), essentially ensuring the vitality of civilization (Nikoofam & Mobaraki, 2017) and it can be said that urban density provides a sure path to prosperity and better education (Glaeser, 2011). It is no wonder that the urban population is continuously growing and estimates predict that by 2050 two-thirds of the world's population will live in cities (Moslinger, 2023). Cities already contribute 70% of global greenhouse gas (GHG) emissions (Fausing, 2020). Economic growth, industry, municipal waste generation, urban sprawl, and transport are the main drivers of urban pollution and urban GHG production (Moslinger, 2023). Statistics and UNEP reports (2023) highlight that air pollution is both an environmental and a public health concern for the population, as it is closely linked to GHG emissions, and improving air quality would benefit not only the environment but also urban health and economic development (UNEP, 2023).

Urban population growth also leads to an increase in transport needs, both for people and goods. Unsustainable transport leads to increased urban congestion, and pollution, and not least negatively affects the quality of citizen's life (Galambos, 2024). On the other hand, Magazzino & Falcone (2022) highlight the existence of a bidirectional causality between economic growth and waste production, i.e. GHG. In this context, proper waste management, urban transport, and sustainable urban planning play a significant role in reducing urban air pollution and GHG emissions (Magazzino & Falcone 2022).

Cluj Napoca is one of the largest cities in Romania with a population of 308343 inhabitants in 2024, with a continuous upward trend since the early 2000s, due to its economic development, which is also growing (Maroși, 2019). In addition to the more than three hundred thousand inhabitants, about one hundred thousand other people work in the city, either commuters or students of the city's universities, who contribute not only to the amount of waste generated in the city but also to the GHG produced by urban transport.

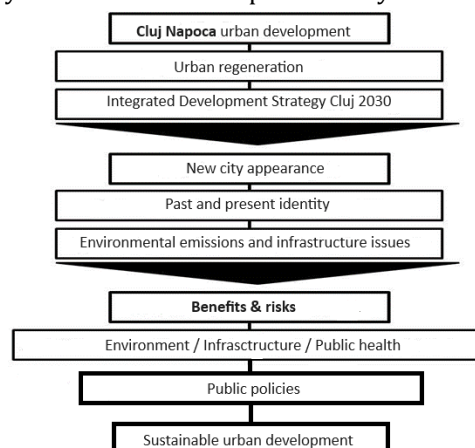


Fig.1. Structure of the Study.

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This chapter aims to evaluate the relationship between the main activities that influence the carbon footprint at the urban level, and the image of the urban landscape in newly developed areas, as a relationship that can enlighten aspects on how to improve the quality of life in the Cluj Napoca municipality, Romania (Fig. 1).

A sustainable urban development is helpful to reduce the carbon footprint of cities, greenhouse gas emissions, to improve the quality of the environment and the quality of life of the urban population.

In Cluj Napoca, as in many other cities of the world, industrial activities with their polluting potential no longer take place in the town, so the industry is no longer a source of pollution, and the city's carbon footprint often increases due to other factors. A substantial influence is, for example, the faulty waste management at the urban level. The increase in consumption and the increase of the built space, the land covering, and the transport are also largely responsible for the carbon footprint at the urban level. A special context for the analysis of these factors is provided by the recent urban developments in the form of urban sprawl - which rapidly change the hilly landscape of the town.

Urban Sustainability in Cluj-Napoca

Urban sustainability means opportunities and safety for people, affordable housing, sustainable economy and infrastructure, and the creation of green public spaces through inclusive urban management. Besides living conditions, the living environment and its quality are crucial for people's health. It includes green spaces, air quality, water and soil resources, and biodiversity (Molina-Gomez et.al., 2022). The sustainable city is more than a physical space arranged with infrastructure and facilities, it is a complex space that provides a set of opportunities and experiences to its inhabitants, an adequate cultural space, all of this ensuring the quality of life of its citizens, concomitantly preserving the natural space (Dias et.al., 2023).

Urbanization provides easier access to health services, easier access to resources and a better quality of life from a cultural, educational or financial perspective, while on the other hand it comes with risks related to pollution, land occupation, insufficient green spaces, climate changes (Tonne et.al., 2021). The objectives of urban sustainability aim at finding optimal solutions that realistically integrate the advantages and disadvantages of urbanization.

Cluj-Napoca is a growth pole city situated in the centre of the historical province of Transylvania, Romania. Its concentration of study and work opportunities (related to services) has made it an attractive city for young people and a dynamic playground for residential developments. Since 2009 the City of Cluj-Napoca has started working on urban regeneration projects and strategies, starting from the city centre. Over the years, most of the public spaces in the city centre and the areas right next to it have been improved and became models of good practice. The city is investing in creating a suitable context to unlock the productive potential of the urban environment: public safety, infrastructure and service reliability, economic and social systems, social innovation and digitisation are essential in building the community-society oriented system.

Cluj-Napoca has developed and assumed a development strategy for the 2014-2020 and is right now in the process of defining the new Integrated Development Strategy Cluj 2030. Both of these strategies include urban development which involves: recycling the urban territory to avoid greenfield developments that are uncorrelated with the city values, ensuring the development of the city as a compact and efficient living space and encouraging sustainable growth development as opposed to the urban sprawl. However, urban sprawl is a reality of the present situation of the municipality and, whether it is legally or illegally developed, it has transformed the city environment, from its centre to its periphery.

In order to evaluate these data, a geographical and administrative distinction must be made between different areas of the city (see figure 2).

This will be analysed taking into consideration the relationship between four factors: the situation of the traffic, of waste management, of residential buildings and of the landscape.

First, the historical centre (Old Town) corresponds to the area that has undergone major transformations in the recent years. Many areas have become pedestrian or shared space ones and the traffic has been concentrated to the larger streets or boulevards. The centre is well connected to the adjacent districts via public transportation while ecological means of circulation such as cycling or electric scooters are available and encouraged.

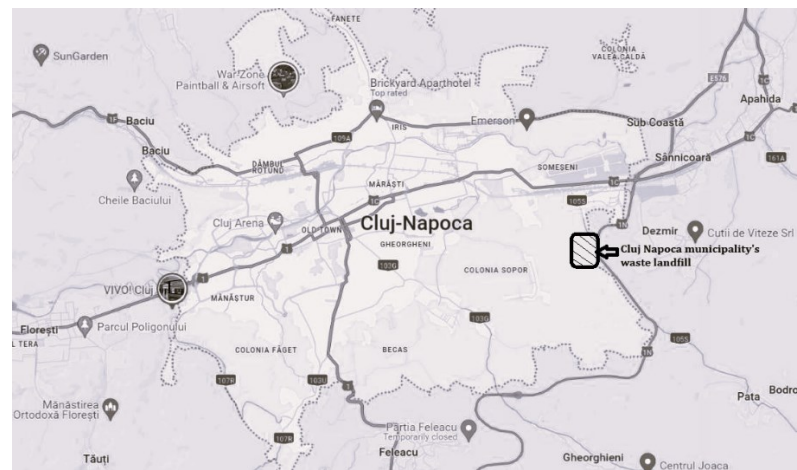


Figure 2. Map of Cluj Napoca and the location of the current municipal waste landfill

In the city centre, residential areas exist but they are mixed with public services, commerce, and retail buildings as well as educational and cultural institutions (fig. 3). This results into a rather scenographic environment where liveliness depends upon the hours of public activities.



Figure 3. Built-up area of the city centre

Secondly, the socialist neighborhoods (districts) have been the subject of refurbishment as well, especially along the reorganization of the traffic and around the theme of green spaces. The blue-green corridor created by the river Someș has been the occasion to intervene in several neighborhoods and to develop alternative means of transportation along its passage. Cycling routes have also been prioritized and the public transportation, consolidated. Recent design competitions in these neighbourhoods have targeted especially parks – which have been renovated or reinvented, according to contemporary visions. These neighbourhoods are mostly residential and dense since the socialist era but have been subject to new densifications where possible.

Thirdly, the neighbourhoods developed at the outskirts of the socialist town, after the 1990s are areas with an agrarian or rural background which also provided, traditionally, green reserves for the city (forests or pastures). After the 90s, they quickly became areas of residential developments with a rapid growth, often without proper masterplans or urbanistic visions (fig. 4). These developments have led to a profound transformation of the surrounding landscape of the city and have altered its traffic while also impacting and being impacted by the waste management system. The connections to the city from these areas exist in terms of public transportation, but they haven't replaced or eased the heavy traffic generated by these neighbourhoods throughout the town.



Figure 4. Build up area of urban sprawl

The three types of areas of the municipality of Cluj-Napoca can be further studied separately in terms of their urban landscape and its dependence upon residential development, transportation generated pollution and waste management. In order to establish the characteristics of this interdependence, a three-hold methodology is proposed below.

Material and Methods

In order to establish the interdependence between residential developments, waste management and pollution, generated by traffic, two directions of investigations are proposed.

The first one presupposes the collection of data on the status of building developments, especially with residential character, in each area described in the previous chapter. The urban regulations as well as the level of development of the infrastructure, facilities for building and quantity of projects are to be looked at.

A World Bank study (2021) on housing strategies in Cluj Napoca highlights that about 70% of the city's buildings were built before 2000 and that built-up areas are dominated by new and old multi-family housing (75%). The number of dwellings in Cluj Napoca increased by 12.39% between 2010-2018 and continues to grow, albeit at a lower rate, especially during the pandemic period (2020-2021). However, infrastructure is deficient, urban sprawl and fragmented urban development generate a poor quality of life in the new housing developed in the city, and overcrowding is an increasingly visible urban problem (World Bank, 2021).

The fragmented urban development and the increase in the number of dwellings and the areas serving them, including streets, alleys, etc., respectively the reduction of urban green spaces is exacerbating the urban heat island (UHI) phenomenon in the city, with human health implications (Dyer et.al., 2024). Thus, temperature differences between Cluj Napoca and neighbouring rural spaces are inevitable, which also affects the urban quality of life. The UHI phenomenon in Cluj Napoca was already highlighted in the studies conducted in 2018 and 2016 by Herbel et.al., and the increase in the number of dwellings and the reduction of green spaces with built-up areas in the urban area have accentuated the values already determined then. In the case of summer heat waves, the UHI effect is potentiated, and this is reflected on the city and its citizens both by reduced labor productivity (about 70%), so economic losses, and possible health problems that may occur in the population (Herbel et.al., 2018). From the studies done in Cluj Napoca on the effects of UHI it can be observed that the highest temperatures recorded in the city are on the east-west direction, passing through the city center. For the most part this includes the built-up area, but hot-spots have also been signalled in areas with soil without vegetation (generally agricultural soils with little vegetation) (Herbel et.al., 2018; Herbel et.al., 2016).

Collecting data on waste management and transportation from the available city statistics is another way of approaching these studied areas.

The management of municipal waste mainly through landfilling and the presence of the landfill in the eastern part of the city, and in its proximity, is a source of emissions that also contributes to the urban vulnerability.

On the other hand, transportation in the city, the almost continuous congestion throughout the day is also a reality, and it is generated by several factors, including the lack of an urban belt road to take some of the traffic. Other aspects concerning the causes of urban agglomeration and the pollution generated by transportation will be discussed in the following chapters.

These approaches are then to be combined and a conclusion for the type of urban landscape generated in each area is to be formulated (fig. 5).

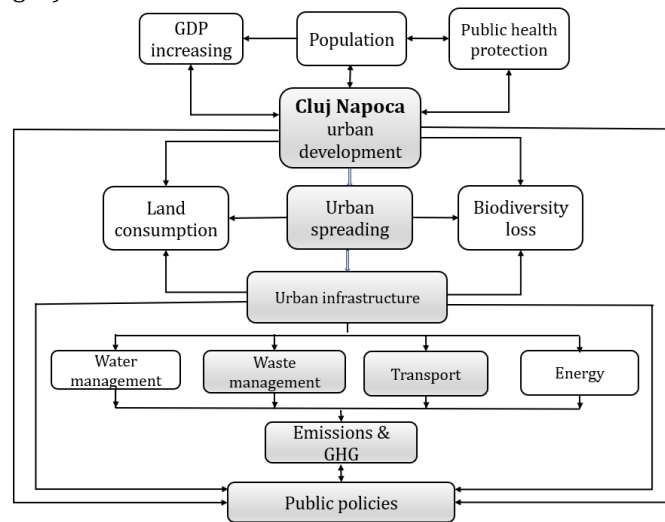


Figure 5. Connecting urban development, environment, and sustainable development in Cluj Napoca.

Urban development of Cluj Napoca implies urban sprawl, land consumption, and biodiversity loss, while increasing GDP and GHG emissions. To ensure sustainable urban development and protect public health, we need a durable and resilient infrastructure, with supportable maintenance costs both for the local budget and for the population or companies operating in the city.

The urban infrastructure to be developed consists mainly of waste and water management infrastructure, transport (roads), electricity supply, and energy reduction. For this study, we have chosen to investigate two of the most pressing problems of Cluj Napoca, waste management and transport in the city (see fig.5).

Gathering datasets – following the proposed methodology

Urban regulations

Corresponding to the three types of areas identified in the section about urban sustainability in Cluj Napoca, three types of urban regulations regarding urban policies can be identified.

In the city centre, which roughly corresponds to the limits of the 19th century (see fig. 6) walled town, the urban regulations and policies have focused on two important issues. First, they have prioritized pedestrian circulation meant to make the centre livelier and more people-friendly, which was also correlated to the functionality of the city centre – oriented towards public services, leisure, educational and cultural ones. Secondly, the urban regulations of the last 15 years [PUG Cluj-Napoca], have encouraged through their prescriptions a historic perspective towards the city, valuing its historic monuments but also its historic atmosphere. This last aspect has led to a lack of new projects, even though there are obvious underbuilt areas, as shown in the figures below.



Figure 6. One level buildings in the city centre, close to important historical areas – preserved for their decoration (drawings from personal archive, author Smaranda Todoran)

This under-use of the existing infrastructure in the city center goes together with the scarcity of residential areas and a scenographic environment that becomes devoid of inhabitants when tourists or town dwellers go back to their homes.

In the neighborhoods outside the city center, there has been an abundance of buildings with mainly residential character. These have generated a lot of traffic, sometimes on small roads, even though a pedestrian or velo infrastructure is available and could be used to go to schools or job places. These areas are searched especially by what can be called the digital nomads (McElroy, 2019) – people working in the IT industry, who dispose of a steady income and form a middle class that often displaces traditional populations, such as Roma, from the areas perimetral to the city center. These neighborhoods generate pollution also by means of the lack of proximity to schools or jobs. Urban regulations in these areas propose densification and collective housing – which replaces existing more precarious and less dense types of residential neighborhood, often to the extreme. Two examples shown in the photos below, the project close to Piata Abator (fig. 7 b) and the proposed one for Carbochim (fig.7 a), both on the banks of the Somes River, show the scale of the interventions in powerful contrast to the existing tissue – a sudden increase in density, without intermediate types of interventions.



Figure 7. Malls and dense residential projects close to the city centre and to the socialist neighbourhoods.

The areas developed after the fall of the communist regime suffer from the scarcity of clear urban regulations and have been the subject of many studies on urban sprawl, ad-hoc urbanism and vernacular architecture (Vincze, 2019; Racu, 2011; Petrovici, 2011). These areas have been developed largely based on an urban planning instrument at a zonal level according to vague prescriptions in the general urban plan. The infrastructure stays often behind the residential development and even though there are regulations which impose to the developers the building of roads and the prolongation of utilities, these are done in many steps, often creating repeated traffic problems. Even though areas like these are in a normal phase of development, where conditions in already developed areas cannot be expected, the lack of strategies in metropolitan areas or of larger urbanistic plans (only one has been proposed and approved since the nineties at whole city level) impact the landscape as well as the level of traffic and subsequent pollution.

Considering these three different situations, a further look at the situation of pollution and its relationship with urban regulations is further proposed.

Waste management

The role of waste management in sustainable urban development is critical. Improving waste management is essential for reducing the loss of resources, but also for reducing the emission of greenhouse gases (GHG) and last but not least for the protection of people's health (figure 8).

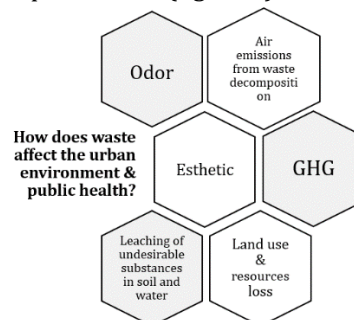


Figure 8. Waste in the urban environment

The quantities and diversity of waste in cities, respectively the problems related to their management are connected to the urbanization of the area, both due to demographic growth in more developed urban areas, such as Cluj-Napoca, and by increases in consumption correlated with the increase in its purchasing power. According to data published by the Cluj County Council the urban population of the county produces annually 615 kg waste/capita (or 1.68 kg/capita daily), much higher than the annual average for the country, even exceeding the European average. The average annual amount of waste produced in the Cluj County is, also above the country average. On the other hand, the urban areas produce about 86% of the waste produced in the county, compared to 14% of waste from rural areas. The degree of coverage with sanitation services at the county level was up to 90 %, according to the existing waste management plan, which places the county in the upper middle-income zone compared to the other areas of the world. In urban areas, the percentage of waste collection tends to be higher than in rural areas, as waste management is considered an urban service par excellence (Kaza, S. et al., 2018). Although the percentage of waste collection in Cluj Napoca city is significant, waste separation at source is not yet fully implemented. 75% of the city's population lives in multi-family dwellings, and there are 844 waste collection points for multi-family dwellings in Cluj Napoca. In the neighbourhoods with single-family houses, household waste is collected "door-to-door", according to a schedule agreed upon between the sanitation company and the municipality, every day another type of waste is picked up (e.g. paper, plastic and metal, glass, food waste).

On the other hand, new neighbourhoods with housing under construction generate both household waste and construction and demolition waste. According to a World Bank study (2021) conducted in Cluj Napoca city, about 30% of the city's housing is new, built in recent years and consists of either multi-family blocks flats or single-family houses. Due to incorrect collection, but also to lack of a reliable recycling infrastructure, most of the waste collected in Cluj Napoca ends up at the landfill in the proximity of the city. A significant part of the construction and demolition waste also ends up in the landfill, being used as intermediate layers to protect against unpleasant smells.

Green landfill sites appear to be cheap waste management solutions, but in the long term, they are not. A lot of resources are wasted by landfilling and this is not sustainable. Emissions from landfills are a major source of environmental pollution, and when hazardous waste resulting from households ends up in landfills, the environmental pollution becomes significant, with harmful effects on people's health. Among the sources of air pollution, emissions from landfills have a significant contribution. In the studied case, the waste landfill of the whole Cluj County is located inside the Cluj-Napoca municipality. Thus, waste management in the city becomes an important dimension in terms of its influence on the environmental quality and health of the population.

The decomposition of organic waste, which is largely made up of food waste that is not separately collected, results in methane (CH₄) emissions, and other gases such as CO₂, CO, H₂S, NO_x, etc. Methane, CH₄, is a gas with a much higher GHG production potential than carbon dioxide (CO₂). The leachate resulted from landfills, due to the moisture content of municipal solid waste (MSW) and the percolation of rainwater through the landfill. Leachate continuously results from the landfill during the entire lifecycle of the landfill, including after closure. From the Cluj Napoca landfill, approximately 40 m³/day of leachate is resulted, which is treated on-site. The sludge resulting from the leachate treatment ends up back in the landfill. Leachate contains a mixture of substances, some of them being hazardous substances: heavy metals, ammonia compounds, a wide range of organic substances, including polycyclic aromatic hydrocarbons and organophosphate flame retardants, emerging pollutants such as pharmaceuticals, plasticisers and per- and poly-fluoroalkyl substances (PFAS) (Tolaymat, T. et al, 2024; EEA, 2024; El-Saadony M.T. et al., 2023; Beldean-Galea et.al., 2020; Masoner, J.R., et al., 2014). These substances enter the environment pollute soil and groundwater, are persistent in the environment, and are harmful to human health.

Researchers warn that leachate can be generated from landfills many years after the landfill has been closed, which in the long term means that it should be collected and treated (Koda, E. et al., 2017; EWA, 2017). Total PFAS depends on the type of waste in the landfill and it can be found that mixing of hazardous and biodegradable waste increases the probability of leaching of PFAS. It was estimate that 84% of PFAS input is still present in the landfill, while annually, 11% is released via leachate and 5% via landfill gases (Tolaymat, T. et al, 2024).

The current Cluj Napoca landfill has a sealed base and leachate is collected and treated on-site in a modern treatment plant, but the old landfill of the city even though it has been closed, remains nearby and continues to pose environmental and human health risks. The landfill area of the city is considered to be a contaminated area, as proven by the studies carried out on the site, including the analysis performed by the Environmental Protection Agency. In this context, the availability of a good separate waste collection network and the recycling infrastructure is critical. For waste that can be reused, the second life is also a good solution. In this sense, there are recycling and waste recovery initiatives in the city of Cluj Napoca, some with the support of local authorities, and others with private support, also from NGOs or charitable associations. For example, the new return guarantee system for packaging, introduced and operational at the end of 2023, has encouraged the population to stop throwing away returnable packaging and to bring it to the collection points for recycling.

It is also important to highlight the initiative of certain "zero-waste" stores to offer products in bulk so customers can purchase them using their own reusable containers, so eliminating some of the packaging.

For the separate collection of electrical and electronic waste, there are sustained campaigns and there are many private companies involved in e-waste collection, so that nowadays mostly of them do not end up in landfills, with some exceptions. The exception is usually the batteries and light bulbs, which the population probably does not perceive as be harmful and whose collection is done sporadically in a few collection points that are insufficiently popularized or insufficiently visible to citizens (for example, these types of e-waste are collected in some supermarkets). That is probably why light bulbs and batteries often don't end up at collection points, but get mixed in with household waste.

For textile waste, there are some collection points run by charitable organisations where some of them are sold as second-hand and some of them is sent for recycling. The authorities are not yet committed to a separate collection.

Food waste, which probably accounts for a minimum of half of the city's municipal waste, mainly ends up in landfills, often mixed with other waste.

There are no designated locations for the collection and storage of household hazardous waste in the city. Household hazardous waste includes for examples, expired drugs, chemicals, oil, thinners, paint, cleaning product residue, glue, etc. This is one of the reasons why they often end up in the municipal waste landfill, contaminating other surrounding waste and generating dangerous leachate and hazardous emissions. Another reason is that people do not know they contain hazardous substances because of a lack of information and awareness.

Urban sprawl comes with an additional burden on both the waste generated and on its transport from the place of production to the landfill or a recycling infrastructure. Waste management plans at the county and city level are not focused on recycling, reuse and recovery. This can be improved by better-linked public policies at local and regional levels that better integrate urban development, environmental protection and population health (including additional charges for landfilling of waste).

Urban public policies that can be promoted for sustainable waste management in partnership between local authorities, population, collection companies, and recyclers: (i) encouraging voluntary participation of citizens in waste sorting operations, to reduce consumption and therefore the waste produced; (ii) actions to raise citizens' awareness on the importance of recycling and a visible and accessible fee system; (iii) stimulating trust and cooperation between residents and the municipality through reductions/increases in taxes for sustainable/unsustainable waste collection behaviour; (iv) "pay as you throw"; (v) additional taxation of unsorted waste; (vi) taxes for waste landfilling; (vii) ensuring adequate collection and recycling infrastructure at the urban level; (viii) research and development to ensure upstream interventions in eco-design to ensure good recyclability of products or second life for them and not easily become waste.

The cover of urban land with a waste landfill is a sustainability issue, and the landfill of the Cluj-Napoca city is categorized as a contaminated area, then the problem in this case is obvious. More involvement from all actors implicated in waste management, in order to improve it, and increase the percentage of recycled waste at urban level is imperiously necessary, all the more so, as the data at the city level in the last two years, shows that only about 10% of urban waste produced are recycled, a percentage far below the European average, although, as shown above, the amount of waste produced in Cluj Napoca is above the European average.

It is accepted that waste management infrastructure creates burdens on the local budget. So, it is important to recycle waste to balance the cost of waste management and the benefits gained from recycling. Thus, municipalities can benefit from revenues from the sale of recyclable materials, revenues from the production and sale of alternative fuels resulting from waste, government subsidies and grants, fines for non-compliance with waste management, etc. (Firillo & Merkaj, 2024). For sustainable and responsible waste management, both financially and environmentally in Cluj Napoca the municipality must maintain a good balance between costs and revenues from waste management in the city.

Urban transport

Air pollution is the biggest environmental threat to public health globally and is also linked to climate change and greenhouse gas emissions (UNEP, 2023). On a global scale transport is considered a major pollutant. In Cluj Napoca, transport is also a significant source of urban air pollution with fine particulate matter (PM), and other gases. The causes of urban pollution generated by transport in Cluj Napoca are multiple and among them we can mention (fig. 9):

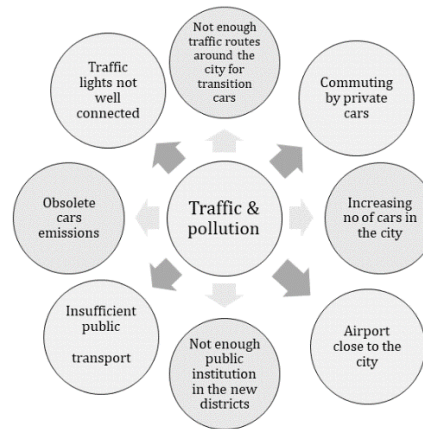


Figure 9. Main causes of transport pollution in Cluj Napoca

(i) the lack of a metropolitan belt that makes many cars in transit pass through the city instead of bypassing it; (ii) the largest increase in the number of cars per capita in the country in the last 20 years; (iii) the lack or insufficiency of public institutions (schools, kindergartens, hospitals, etc.) in the newly built neighbourhoods, which forces the inhabitants to use the car daily; (iv) the obsolete car fleet and too many cars still using fossil fuels, including diesel; (v) the under construction neighbourhoods in the city which increase the traffic of heavy trucks; (vi) the poor functioning of the intelligent traffic lights which could reduce the number of stops/starts, if they were better synchronized; (vii) suburban residents who commute daily into the city by personal car; (viii) insufficient routes of public transport and lack of links between some neighbourhoods; (ix) insufficient means of public transport in terms of frequency; (x) the depression relief and topography of the land in the city which predisposes to the accumulation of pollutants along the Somes river valley which crosses the city from west to east and which at the same time discourages cycling on the steep slopes in some areas; (xi) the airport in the vicinity of the city and the flight routes of some aircrafts crossing the city from east to west.

Transport pollutes the atmosphere with GHG as CO₂, CO, NO_x and SO₂, fine particulate matter (PM_{2.5} and PM₁₀), volatile organic compounds (VOC), different hydrocarbons and noise. Some of these pollutants are also risk factors for human health (Kijewska et al., 2016; Nieuwenhuijsen, 2016). In the database of the European Environment Agency, Cluj Napoca city appears periodically, in recent years, with exceedances of the maximum permissible air pollution values for different parameters, such as PM₁₀, SO_x, NO_x, benzene, Pb, Cd, As, and the identified sources of pollution are the urban traffic. Certainly, the topography of the terrain, namely the placement of the city in a rather narrow valley facilitates the accumulation and stagnation of pollutants in the inhabited area, and the daily traffic and congestion contribute to this, although the European pollution standards in this regard are also adopted in Romania.

Even the CO₂ emissions from cars in use have also decreased in Romania, as in Europe, although in Romania old cars and cars running on diesel still account for a significant proportion of the total number of cars in use. The number of cars purchased and registered in the country in 2022 has also increased compared to 2021.

Reducing transport emissions also depends on the number of electric cars in the area (Mandal & Bird, 2017). Of the total cars owned by the inhabitants of Cluj County in 2023, only 0.75% are electric cars. In these conditions, transport from the new housing districts to the city centre will be a generator of traffic congestion, pollutant gases and dust emissions into the atmosphere.

Reducing transport emissions can be achieved by changing urban development patterns such as land use, urban density and urban design, the existence of public transport and alternative transport facilities such as cycling or walking, the age of the car fleet and the use of private cars, or local policies to discourage the daily use of private cars in the city, etc. Local authorities are the ones who through public policies can reduce the effects of pollution from various sources on the population and the environment in cities (Moslinger et al., 2023).

As far as urban transport is concerned, there are several initiatives of local authorities in Cluj Napoca worth mentioning. For example, bike sharing provides free public bicycles to those who want to travel within the city during the warm season. Green Friday is another initiative that has become popular among citizens and consists of free transport on all means of public transport and throughout the whole city on every Fridays of each month. Before the pandemic period (2020-2021) there was also a car-sharing application in the city, and the cars used were generally hybrid cars. The app stopped working during the pandemic probably for health reasons. Although the activity was restarted in other cities, in Cluj Napoca it did not continue. After the year 2022, some taxi companies have acquired a fleet of mostly electric or hybrid cars for urban traffic in Cluj Napoca.

In Cluj Napoca run the most electric buses in the country, and the public transport fleet is renewed relatively often. The parking surcharge in the central area, which increases exponentially according to the number of hours parked, is also intended to discourage the use of cars in the city centre. Increasing the amount of pedestrian space

in the central area and narrowing the roadways should also be beneficial in reducing the number of cars in the city centre (Gehl, 2010).

Reducing the environmental impact of transport in cities can also be done through measures and policies that encourage environmentally friendly transport and discourage excessive use of private cars in cities. So, (i)access regulations in the central area, (ii)additional charges for transit through the city centre, (iii) some charges for old cars with high emissions, (iv)establishing low-emission zones, (v)buffer zones with vegetation and protective plant cover, (vi)encouraging walking and establishing more pedestrian zones in the city, (vii)encouraging cycling or using clean public transport, (viii)ensuring a sufficient number and a better frequency of clean public transport, (ix)implementing electric mobility solutions (electric cars, bicycles, electric scooters, etc.), (x)discouraging commuting by personal car through additional taxes, (xi)providing a transport belt for the city that allows cars in transit or trucks to bypass the city and choosing a route through an area that does not cause irreparable damage to biodiversity, are some of the measures that can be taken to reduce urban pollution from transport, ensure good urban mobility and decongest urban traffic. (xii) A better connecting the new neighbourhoods with public transport can also help reduce urban pollution.

Results and discussion

A sustainable city means a city whose citizens have a decent quality of life, and whose activities do not affect the environment in an undesirable way. For sustainable city development, coherent local and regional public policies can play a significant role, both in terms of urban development, new construction and aesthetic and functional aspects in the city, as well as in the area of waste management, resource protection, city traffic, all with the aim of improving the quality of life of the urban population and reducing impacts and risks on human health.

At the urban level, the three rather distinct areas studied in the article establish a possible relationship between urban policies and regulations, waste management, urban transportation and landscape pollution. While urban regulations are precise for the city centre and correspond to a privileged pedestrian oriented traffic, public transportation, and care for reducing waste landfills in favour of recycling, the lack of development in terms of residential buildings transforms this area into an isolated scenographic part of the city that lacks life outside the public or touristic hours.

In the areas close to or inside the socialist neighbourhoods, residential areas have been developed strongly, aiming at high-density areas. A special attention has been given to green spaces as well as to pedestrian ones, but not at an exhaustive scale. However, the transition from the centre density to the districts is not smooth in terms of landscape – and this results also from the regulations. The proximity to the center does not solve the traffic these new developments generate and which the infrastructure often does not support.

The areas outside the 1990 limits of the town are characterized by urban sprawl and precarious regulations which create problems at all levels discussed – in terms of waste management, urban transportation and urban landscape. Urban sprawl and very high prices of housing in the city (also noted in the World Bank report, 2021) have led many young families to move to adjacent areas, which has contributed to urban traffic congestion, as many commuters from the suburbs commute by private car to their jobs in Cluj. Also, in the new housing neighbourhoods, public institutions serving the population are insufficient or not yet in place. Thus, a significant percentage of children in those neighborhoods commute to kindergartens and schools in the city center with their parents. All this contributes to the increased traffic in the urban area, although school buses have started to appear, they have not yet managed to reduce the traffic in the school zones at the beginning and end of the school year.

On the other hand, the transformation of several spaces in the central area into pedestrian only areas and the developments around the rivers and canals in the city are a plus from an urban planning point of view, which the community has quickly adopted and which has led to an increase in social cohesion in those areas, which have become quite quickly meeting points for people in the city.

Increasing the density of trees in the central area in already pedestrian-only spaces, as well as at the edge of sidewalks to delimit the road space from the walking spaces, is increasingly requested by the city's population, and the advantage would be a certain reduction of temperatures in the central area, an improvement of air quality and a better water circulation in urban nature.

Increasing the amount of urban pedestrian space at the expense of space for cars, integrating urban nature into the built space and integrating the city's rivers and channels into urban nature, reducing traffic congestion and promoting alternative travel strategies, lead to an increase in urban resilience, a reduction in vulnerability to climate change and other possible hazards in the urban space.

Urban public policies of local governments have an important role to play, both in promoting efficient traffic strategies aimed at reducing urban congestion and adopting alternative, less polluting transportation styles. Public policies can also intervene in a more efficient waste management at the urban level, in the promotion of actions aimed at reducing consumption by the urban population, but also in the recycling and recovery of waste resources, in order to reduce the tendency to landfill waste, with all the resulting disadvantages for the environment and the health of the population. Continuing to manage municipal waste mainly through landfilling and a low recycling rate

are unsustainable actions with long-term effects that cannot be reduced without the involvement of the authorities, which must also be involved in providing adequate collection infrastructure for recycling.

Above all, public policies are those that regulate the use of urban space and help to develop urban development strategies that aim to improve the quality of life of the population, both through better use of public space, as well as through other actions that have as their effect sustainable urban development, reducing urban pollution and why not public participation in the development of urban space.

By optimizing the linkages between urban growth, urban infrastructure development, and improving people's quality of life, it can prevent or reduce the risks associated with urban development while preserving the benefits of urbanization.

Conclusion

The importance of urban regulations appears evident in the relationship between pollution, both environmental and visual. In the spirit of sustainability, a more attentive and holistic approach to the town could benefit all areas, re-using the historical tissue and being just as attentive to the natural environment. A possible beneficial shift in regulating building policies could be to approach zones of intersections between the limits of the specific areas of the town and adopt specific strategies for each situation.

Reducing the risks that come with urban development means not only a better quality of life for the urban population but also an increase in urban resilience, i.e. a reduction in the vulnerability of the city inhabitants to current environmental challenges. The relationship between different factors at the urban level, reflects the how each element regarding urban development affects the other and how problems that seem to have been 'fashionable' a few decades before - such as heritage - are influenced and determined by today's equally urgent matter of ecology. But the sustainable way to look at the two matters appears to be a holistic one, where all factors interact for a better quality of life.

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Conflict of Interests

The author declares no conflict of interest.

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