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Land Use, Mobility and Environment

This Special Issue of TeMA - Journal of Land Use, Mobility and Environment, collects twenty-seven contributes of international researchers and technicians in form of scenarios, insights, reasoning and research on the relations between the City and the impacts of Covid-19 pandemic, questioning about the development of a new vision and a general rethinking of the structure and urban organization.

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Special Issue

Covid -19 vs City -20

scenarios, insights, reasoning and research

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Special Issue

COVID-19 vs CITY-20
SCENARIOS, INSIGHTS, REASONING AND RESEARCH

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Given the short time to produce the volume, the Editorial Board of TeMA Journal carried out the scientific quality audit of the contributions published in this Special Issue.

The cover image is a photo collage of some cities during the Covid-19 pandemic quarantine (March 2020)

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Contenets

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About the Sustainability of Urban Settlements.

A first reflection on the correlation between the spread of Covid-19 and the regional average population density in Italy

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Abstract

Urbanization is an onerous human activity: it affects municipal budget and foremost it costs the environment. Nevertheless, an ever-growing number of people (more than 75% of the European population) is living in cities and towns, so that identifying sustainable urban development solutions is a dramatically urgent need. Already in the 70s, some researches proposed parameters to evaluate urbanization costs in Italy, but they mainly focused on the economic and financial sustainability of real estate development. The land value capturing approaches proved to be inadequate when municipal budgets are facing growing social unbalances and critical environmental threats. The question being not just "where the money for urban infrastructures could come from", but also "what could be a more sustainable development model". In any case, now we are forced to rethink the whole organization of our urban life to defend ourselves from largely unknown threats, pandemics, Covid-19 being probably one among others that we could face in the near future. It is not yet clear if a link exists between the spread of the virus, the health consequences and the environmental conditions, but what probably will need to be assessed is the effect of population density on the spread of contamination. Even the traditional provision of services and public spaces will need to be defined again in order to protect and serve urban population. New evidences will force planners to redefine their thoughts and schemes

Keywords

Sustainability; Urban development; Pandemic.

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1. Introduction

Urban growth, both spontaneous and apparently unplanned and uncontrolled, is a significant and growing issue in Europe and all over the world (Brueckner, 2000; Batty et al., 2003; Bourne, 2005; Tira & Badiani, 2009; Christiansen & Loftsgarden, 2011). Development patterns always have several social and economic causes. From the perspective of land economics, high land prices in the core of the city force developers to seek lower prices in the more peripheral areas, as the price of agricultural land is universally much lower than the price of land zoned for housing or the development of services. From a social point of view, the lack of public funding and the new needs of urban population rise the pressure of new developments on greenfield.
From a physical point of view, the environmental concerns, the need for energy saving and for natural risk protection are some of the drivers for new constructions. Anyway, now we are forced to rethink the whole organization of our urban life to defend ourselves from largely unknown threats, pandemics, Covid-19 being probably one among others that we could face in the near future. The worldwide context in which we observe the spread of the virus has completely changed since the last pandemics. An estimated 500 million people from the South Seas to the North Pole fell victim to Spanish Flu (1918-1920): one-fifth of those died. At the time (see Fig.1), the world population accounted something less than 2 billion people, so more than 25% of the world's population was hit by the pandemic. In 1957-1958 the Asian flu pandemic, with its roots in China, claimed more than 1 million lives (being 2.5 billion the world population). AIDS became a global pandemic in the 1980s and it continues as an epidemic in certain parts of the world. AIDS has claimed an estimated 35 million lives since it was first identified. At 13th June 2020, 7,274 thousands cases of Covid-19 pandemic were recorded all over the world, and more than 413 thousands deaths. The world population is now 7.7 billion (2019), and it is expected to reach 11 billion by the fall of the Century. "The urban population of the world has grown rapidly from 751 million in 1950 to 4.2 billion in 2018. Asia, despite its relatively lower level of urbanisation, is home to 54% of the world's urban population, followed by Europe and Africa with 13% each" (UN, 2019). In the same period, "the rural population of the world has grown slowly and is expected to reach its peak in a few years. The global rural population is now close to 3.4 billion and is expected to rise slightly and then decline to 3.1 billion by 2050. Africa and Asia are home to nearly 90% of the world's rural population in 2018. India has the largest rural population (893 million), followed by China (578 million)" (UN, 2019). At what cost did all this happen and under which conditions it can be sustained in the future projections? What will be the consequences of present and future pandemics on this increasingly concentrated urban population?

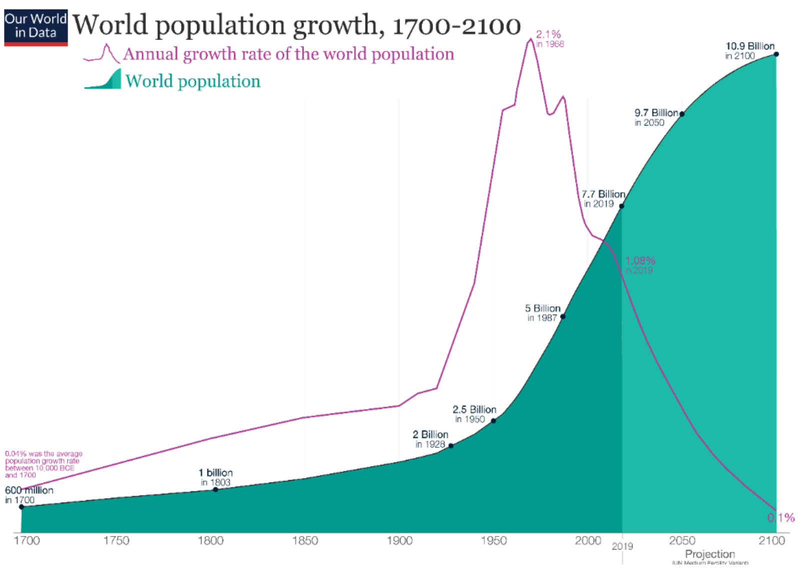

Fig.1 World population growth, 1700-2100 (Source: Our world in data, based on UN, 2019)

2. World's population growth

Two are the main factors at a macro-scale: world population is growing, and namely urban population is rapidly on the rise. "The world's population continues to increase: it is projected to grow from 7.7 billion in 2019 to 8.5 billion in 2030 (10% increase), and further to 9.7 billion in 2050 (26%) and to 10.9 billion in 2100" (See Fig.1; UN, 2019).

However, growth rates vary greatly across regions. "Nine countries will make up more than half the projected population growth between now and 2050. The largest increases in population between 2019 and 2050 will take place in: India, Nigeria, Pakistan, the Democratic Republic of the Congo, Ethiopia, the United Republic of Tanzania, Indonesia, Egypt and the United States of America" (UN, 2019).

The world's population is not just increasing but also growing older, "with persons over age 65 being the fastest-growing age group. By 2050, one in six people in the world will be over age 65 (16%), up from one in 11 in 2019 (9%). By 2050, one in four persons living in Europe and Northern America could be aged 65 or over. In 2018, for the first time in history, persons aged 65 or above outnumbered children under five years of age. The number of persons aged 80 years or over is projected to triple, from 143 million in 2019 to 426 million in 2050" (UN, 2019).

Falling proportions of working-age people are putting pressure on social protection systems and consequently on the provision of urban social services. Combining that evidence with the reduction in population size of a growing number of countries, the economic sustainability of urban public services is at stake: the fewer working people will have to support the services for the most, thus being obliged to work longer.

Whilst the world's population is growing, people living in cities and towns are rapidly increasing: "today, 55% of the world's population lives in urban areas, a proportion that is expected to increase to 68% by 2050. Projections show that urbanization, the gradual shift in residence of the human population from rural to urban areas, combined with the overall growth could add another 2.5 billion people to urban areas by 2050, with close to 90% of this increase taking place in Asia and Africa, according to a new United Nations data set" (UN, 2019).

The 2018 Revision of World Urbanization Prospects produced by the Population Division of the UN Department of Economic and Social Affairs (UN DESA) notes that future increases in the size of the world's urban population are expected to be highly concentrated in just a few countries.

3. How matter size and density of urban settlements

We know relatively well the economic and environmental effects of this tremendous change at a macro level. Even if urban areas cover the 1% of the global ice-free land surface (IPCC, 2019), they are responsible for the 60 to 80% of energetic consumption, the 75% of CO_2 emissions, large part of landscape degradation and rare events. Urban areas heavily affect the environment and human health. "Urbanisation can enhance warming in cities and their surroundings (heat island effect), and it can also intensify extreme rainfall events over the cities" (IPCC, 2019).

Nevertheless, at a micro scale, "urban areas, urban expansion and other urban processes and their relation to land-related processes are extensive, dynamic and complex" (IPCC, 2019).

The demographic dimension of urban settlement is one of the elements to explain that complexity. We are highly impressed by the huge extensive megacities: "Tokyo is the world's largest city with an agglomeration of 37 million inhabitants, followed by New Delhi with 29 million, Shanghai with 26 million, and Mexico City and São Paulo, each with around 22 million inhabitants. Today, Cairo, Mumbai, Beijing and Dhaka all have close to 20 million inhabitants" (UN, 2019). Nevertheless, urban dynamics are all but linear. "By 2020, Tokyo's population is projected to begin to decline, while Delhi is projected to continue growing and to become the most populous city in the world around 2028" (UN, 2019). Moreover, the relation between demographic dimension and other economic and social parameters is manifold and even if "by 2030, the world is projected to have 43 megacities with more than 10 million inhabitants, some of the fastest-growing urban agglomerations are cities with fewer than 1 million inhabitants, many of them located in Asia and Africa" (UN, 2019).

The percentage of people living in medium sized towns is bigger: "close to half of the world's urban dwellers reside in settlements with fewer than 500,000 inhabitants" (UN, 2019) and in Europe a large portion of urban dwellers live in small and very small settlements. That is particularly true for Italy, where around 88% of urban population (shown in Fig.2), that is the 62% of the total, live in cities and towns with fewer than 500,000 inhabitants, as shown in Fig.3. Moreover, some 70% of the urban settlements account less than 5,000 inhabitants in Italy.

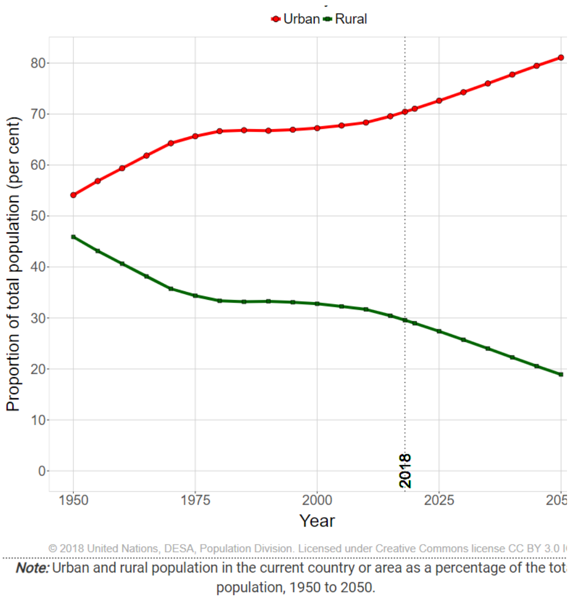

Fig.2 Percentage of urban population in urban and rural areas in Italy (Source: UN, 2019)

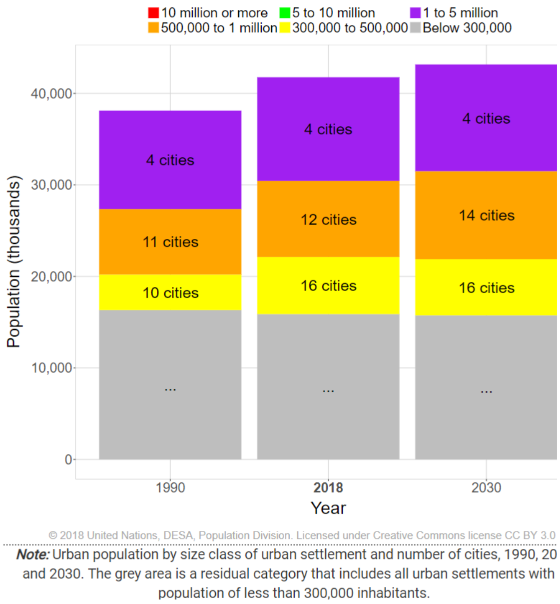

Fig.3 Urban population by size class of urban settlement in Italy (Source: UN, 2019)

Those phenomena that cost the earth are not confined to megacities. Probably, the easiest example is that of public transport. It is widely recognized that an efficient and vast network can significantly reduce private motorized mobility. At the same time, no public transport facility can be implemented under a threshold of minimum population: the costs would be unsustainable. Similarly, waste collection can result in a much more efficient system in low-density settlement, as the space for landfills (when other solutions for disposal are not implemented) is hard to find in large and dense urban areas.

When looking at pandemic, as shown in the paper, even local concentration of population and activities can spread contamination at an unsustainable level. That is the case of small villages in the Provinces of Brescia and Bergamo during the hardest phase of Covid-19 diffusion.

At the same time, according to the last report on Land consumption in Italy (ISPRA, 2018), the greatest contribute to greenfield transformation took place in the minor communities (71% of new land consumption between 2016 and 2017 regards those municipalities with less than 20,000 inhabitants). Population density on urbanised areas is roughly diminishing with town dimension, at such extent that it can halve in small communities, when compared to bigger cities. A recent research has shown how urban density has diminished to one third in almost 60 years in a low-density urban district in Lombardy, made of small and very small communes (Mazzata & Tira, 2008). The debate around pros and cons of a compact city, even concerning sustainability is long lasting and the results controversial. From one side, "there is a remarkable consensus among international institutions as well as local and national governments to implement large and compact cities as a way of reducing the ecological impact of urban settlements, and hence of contributing to the achievement of sustainable development" (Gaigné et al., 2011). On the other side, density has always been and still continues to be a tricky matter (see among others Burton et al., 2003). At the time of the first industrial revolution, it was a dramatic negative characteristic of cities and towns. Pandemic dramatically brings us back in time: even the most efficient urban settlements can suffer from the spread of un-known virus, quickly transmitted by an increasingly complex and inter-related urban environment. One Century ago, the Garden city movement and then the rational urban planning with the definition of urban standards aimed at loosing the overcrowding, cause of innumerous negative impacts. That could have been a bright way to address the problem and it is still considered as a possible solution (Hardy, 2008). Nevertheless, when the disruptive private car ownership exploded, the new mobility freedom paved the way to the urban sprawl. The compact city shows its ecological impact, due to the growing energy demand especially for buildings and the great dependence on a large (and so often distant) rural area. It can maximise the scale economies for many public facilities, like transport systems, but we observed an high vulnerability to pandemic. The low-density scheme pays the cost of extending lifelines and road network to an unwise dimension and paves the way to an irrational use of motorized private cars. At the same time, it is a most suitable scheme to energy self-sufficiency and easier for arranging social distances, as during the pandemic. Understanding the key trends in urbanization likely to unfold over the coming years is crucial to the implementation of the 2030 Agenda for Sustainable Development, namely by defining sustainable urbanization approaches. In an unexpected way, that analysis is now crucial to prepare health care systems to face future challenging crisis as the one the world is still suffering for.

4. The Covid-19 pandemic

The coronavirus Covid-19 pandemic is the defining global health crisis of our time and the greatest challenge we have faced since World War II. Since its emergence in Asia late last year (2019), the virus has spread to every continent except Antarctica. Countries have raced to slow the spread of the virus by testing and treating patients, carrying out contact tracing, limiting travel, quarantining citizens, and cancelling large gatherings such as sporting events, concerts, and schools. The pandemic is moving like a wave, one that may yet crash on those least able to cope. Covid-19 is much more than a health crisis.

By stressing every one of the countries it touches, it has the potential to create devastating social, economic and political crises that will leave deep scars. Every day, people are losing jobs and income, with no way of knowing when normality will return. Small island nations, heavily dependent on tourism, have empty hotels and deserted beaches. The International Labour Organization estimates that 195 million jobs could be lost (UNDP, 2020).

That is a brief, but dramatic description made by International Institutions of the Covid-19 pandemic. More than 413,000 deaths have been registered so far (WHO, 13th June 2020), but the pandemic is not yet finished and many Countries are still facing growing challenges. From an ethical point of view, we cannot accept hundreds of thousands deaths. From the economic perspective, job losses and financial crisis result in further deaths and suffering. Therefore, we are forced to rethink the whole organization of our (urban) life, to defend ourselves from largely unknown threats, as probably the last will be one among others in the near future. If the variation by age groups is quite clear (in Fig.4, we can observe the average distribution in Italy), the evidence about the geographical spread of the virus is still very poor and so it is the (possible) correlation with urban environments.

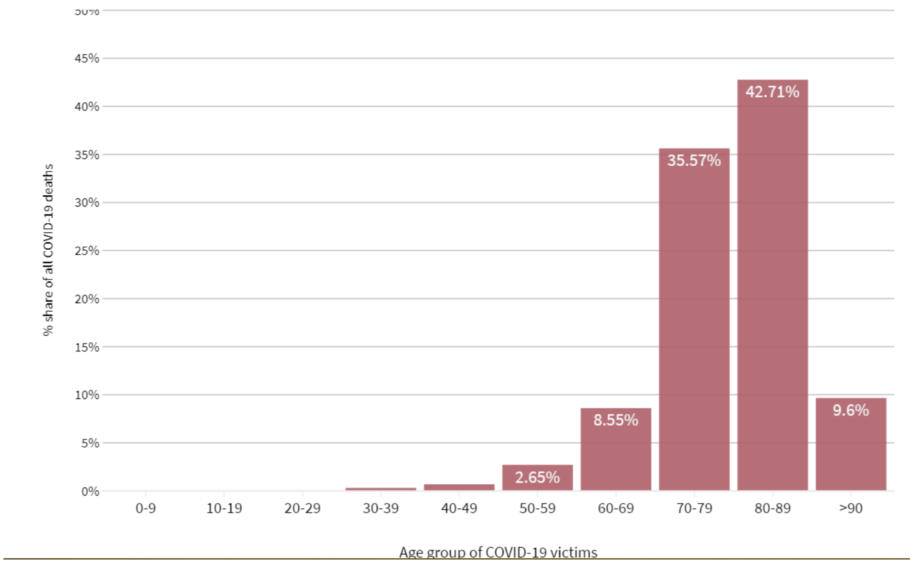

Fig.4 Covid-19 deaths by age groups (Source: https://www.euronews.com/2020/06/10/covid-19-coronavirus-breakdown-of-deaths-and-infections-worldwide, 2020). Study based on 1,625 deaths

5. The effect of average population density on the spread of the virus

What probably will have to be assessed in depth is the effect of population density on the spread of contamination. The figures describing the rapid and massive wave of infections recorded in Region Lombardy are in some way related to the high density of population and economic activities (as shown by an Italian study of some experts, coordinated by G Senna, from the Italian Society of Allergology, Asthma and Clinical Immunology-SIAAIC; paper under embargo). Data show that the infection rate is significantly different. At the basis of discrepancies there is probably a different density of population: where many people live nearby, the virus can circulate much more and the infections grow. In Tab.1 we may observe the distribution of positive cases, the deaths, the average population and their ratios.

We know that both positive cases and deaths are approximated figures. The positive cases depend on the number of coronavirus swabs, while the deaths may not be diagnosed as covid-deaths, due to other diseases or fragilities. Several documents state that the number of positive cases could be much higher, as well as the death toll. Anyway, we will elaborate official available data at 13th June 2020.

The goal is to assess the correlation between the positive cases and the average population density at different scales. If we look at the regional average figures, an explanation to the rapid spread of the virus can be given for Lombardy (see Tab.1), but we do not find any clear correlation between the average population density and the rate of positive cases per inhabitant in other Regions, even in the North of Italy.

For example, it is hard to explain the very high rate of positive cases in Aosta Valley and Trentino/South Tyrol, when looking at the sparse density.

On the other side, Veneto and Liguria show a similar regional average population density, but a quite different rate of positive cases. If we observe figure 5, we may find a partial correlation in Central Italy, where Tuscany, Abruzzo, Umbria and Molise show a similar proportion between population density and positive cases.

Similarly, Veneto and Friuli V.G. follow the same pattern and comparable ratio between positive cases/population versus the regional average population density.

Anyway, we restricted the observation to the North of Italy, assuming that the comparison with the central and southern Regions is not sound, as the pandemic has been confined by the restrictive measures approved by the Government from 8th March 2020 on.

Italian Regions	Population [a]	Regional average population density [b]	Positive cases [c]	Positive case density [c/a] *1,000	Deaths [d]	Deaths / positive cases [d/c]*100
Aosta Valley	125,666	39	1,191	9.5	144	12.1
Lombardy	10,060,574	422	91,414	9.1	16,428	18.0
Piedmont	4,356,406	172	31,029	7.1	4,006	12.9
Trentino S.T	1,072,276	79	7,056	6.6	755	10.7
Liguria	1,550,640	286	9,875	6.4	1,518	15.4
Emilia-R.	4,459,477	199	28,056	6.3	4,199	15.0
Marche	1,525,271	162	6,754	4.4	993	14.7
Veneto	4,905,854	267	19,212	3.9	1,977	10.3
Tuscany	3,729,641	162	10,172	2.7	1,082	10.6
Friuli V.G.	1,215,220	153	3,296	2.7	343	10.4
Abruzzo	1,311,580	121	3,275	2.5	454	13.9
Umbria	882,015	104	1,436	1.6	76	5.3
Molise	305,617	69	439	1.4	23	5.2
Lazio	5,879,082	341	7,941	1.4	806	10.1
Apulia	4,029,053	206	4,515	1.1	532	11.8
Sardinia	1,639,591	68	1,363	0.8	132	9.7
Campania	5,801,692	424	4,608	0.8	430	9.3
Basilicata	562,869	56	401	0.7	27	6.7
Sicily	4,999,891	194	3,456	0.7	279	8.1
Calabria	1,947,131	128	1,162	0.6	97	8.3

Tab.1 Distribution of Covid-19 positive cases and deaths versus population density of Regions at June 13th 2020 (Source: official database Civil Protection Service)

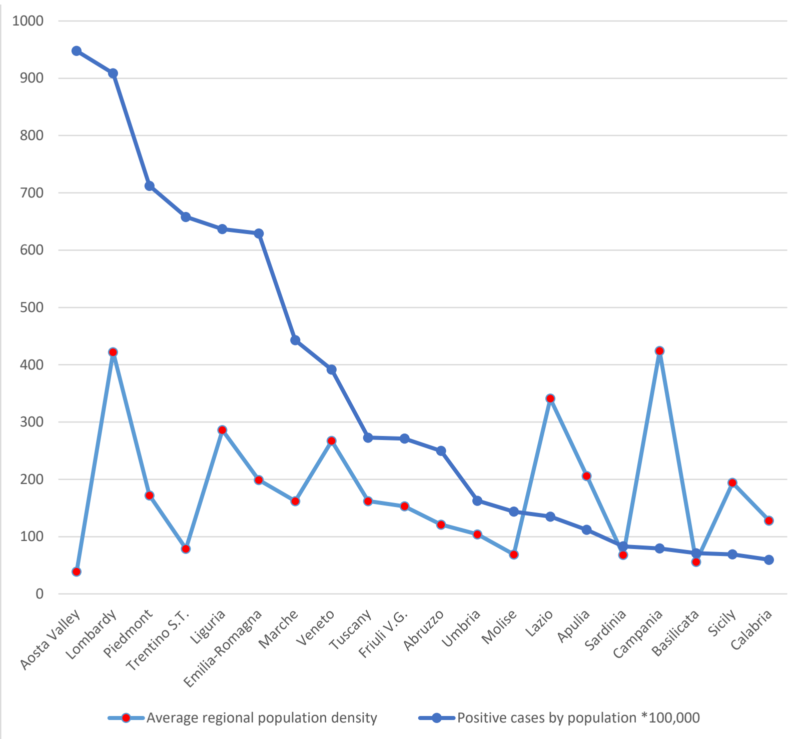

Fig.5 Distribution of Covid-19 positive cases by population (* 100,000) versus regional average population density at June 13th 2020 (Source: official database Civil Protection Service and ISTAT)

Even in that case, the observation must be brought to a more detailed scale, considering a more accurate definition of urban density. The average population density is strongly influenced by the distribution of the population in the diverse geographical regions: mountain, hills and plane and determined by the type of settlement. Therefore, the average figures do not explain the real distribution of population in the urbanised areas.

The ratio of positive cases has then been recalculated when considering (see Tab.2):

- the average population density, weighted by the degree of urbanisation, summing only the population living in intermediate density area (towns and suburbs/small urban area), and densely populated area (cities/large urban area);
- the average population density, weighted by three clusters of demographic size: municipalities with less than 5,000, from 5,001 to 250,000 and over 250,001 inhabitants.

The Degree of urbanisation (DEGURBA) is a classification that indicates the character of an area. Based on the share of local population living in urban clusters and in urban centres, it classifies local administrative units level 2 (LAU2) into three types of area: thinly populated area (rural area); intermediate density area (towns and suburbs/small urban area), and densely populated area (cities/large urban area).

The classification of local administrative units (LAU2) in the mentioned areas uses as a criterion the geographical contiguity in combination with the share of local population living in the different type of clusters. In a first step, the typology of clusters starts by classifing grid cells of 1 sq. km to one of the three following clusters, according to their population size and density:

- high-density cluster/urban centre: contiguous grid cells of 1 sq. km with a density of at least 1,500 inhabitants per sq. km and a minimum population of 50,000;
- urban cluster: cluster of contiguous grid cells of 1 sq. km with a density of at least 300 inhabitants per sq. km and a minimum population of 5,000;
- rural grid cell: grid cell outside high-density clusters and urban clusters.

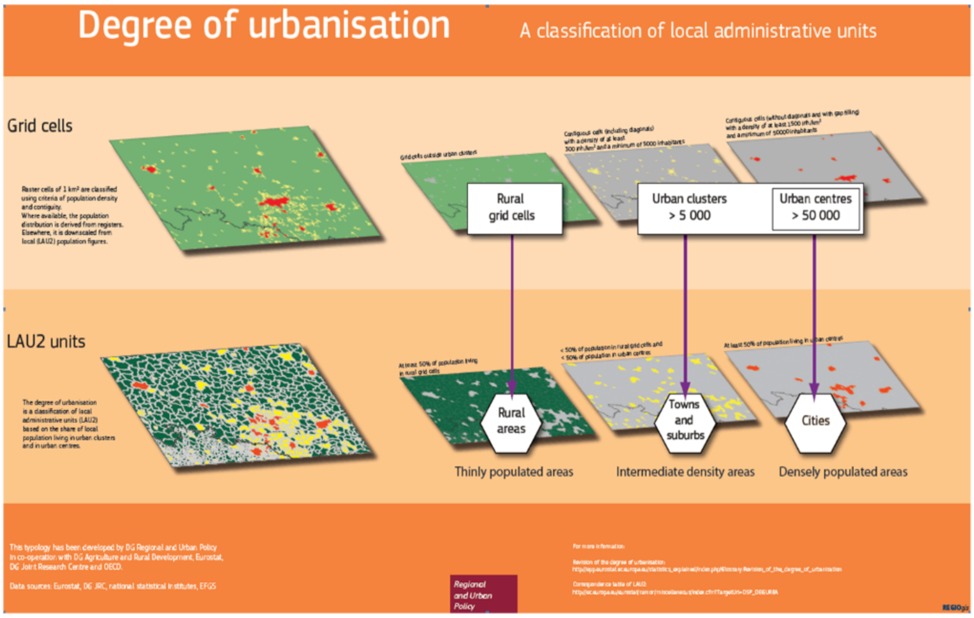

Fig.6 Degree of urbanisation – Grid cells and LAU2 units (Source: EUROSTAT, 2011)

In a second step, local administrative units (LAU2) are then classified to one of three type of areas:

- *densely populated area*: at least 50 % lives in high-density clusters; in addition, each high-density cluster should have at least 75 % of its population in densely-populated LAU2s; this also ensures that all high-density clusters are represented by at least one densely-populated LAU2, even when this cluster represents less than 50 % of the population of that LAU2;

- *intermediate density area*: less than 50 % of the population lives in rural grid cells and less than 50 % live in high-density clusters;
- *thinly populated area*: more than 50 % of the population lives in rural grid cells.

To classify municipalities, the previously identified areas are intersected with municipal borders and the percentage of population of the municipality that falls into each typology of area is calculated.

Using ISTAT (2015) database, we weighted the average density of population living in intermediate density and densely populated municipalities by the corresponding percentage of inhabitants, so obtaining the results of column [b] in Tab.2.

On the other side, if we weight the population density by the amount of people living in the three classes of municipalities (<5,000, from 5,001 to 250,000 and over 250,000 inh.), we obtain the results of column [c] in Tab.2.

Northern Italian Regions	**Population density [a]**	**Weighted (1) pop. density [b]**	**Weighted (2) pop. density [c]**	**Positive case density [from Tab.1]**
Aosta Valley	39	336	462	9,5
Lombardy	422	1313	1517	9,1
Piedmont	172	1195	1630	7,1
Trentino S.T	79	614	137	6,6
Liguria	286	1302	1207	6,4
Emilia-R.	199	525	465	6,3
Veneto	267	551	374	3,9
Friuli V.G.	153	976	317	2,7

Tab.2 Distribution of Covid-19 positive cases and deaths versus population density and degree of urbanisation (data 2014) of Northern Regions at June 13th 2020 (Source: official database Civil Protection Service and ISTAT)

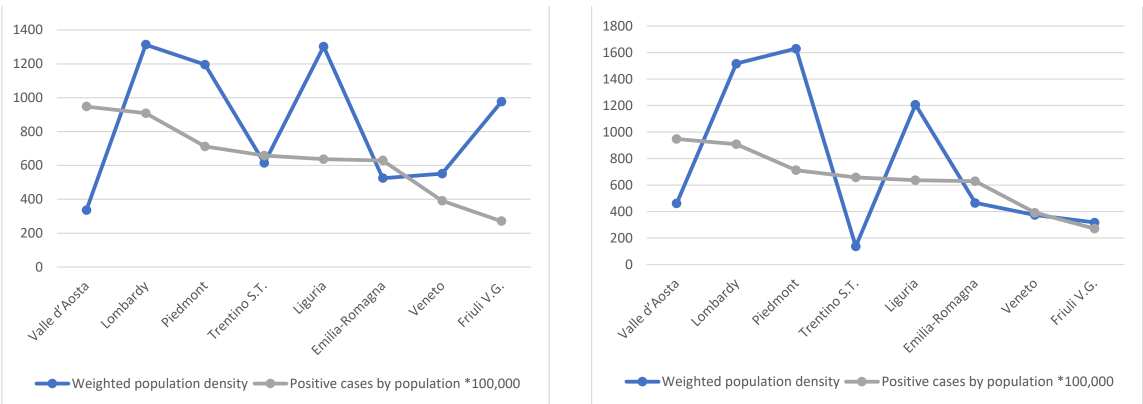

Fig.7 Distribution of Covid-19 positive cases by population (* 100,000) versus weighted regional population density at June 13th 2020 in Northern Italian Regions: 7(a) for the weighted 1 solution; 7(b) for the weighted 2 solution (Source: official database Civil Protection Service and ISTAT)

Through that simple refinement of calculation, we can explain better the high number of positive cases in Lombardy, Piedmont and Liguria. We may also observe that the difference between the average density and the two weighted population densities as calculated and shown in Tab.2 is smallest in Veneto. In other words, the weighted densities (that we postulate are closer to the real distribution of population in the urbanised areas) seem to explain relatively better the distribution of positive cases in Northern Italian Regions.

6. Conclusive remarks

The results are a first attempt to assess the spread of the virus at regional scale in Italy. As stated at the beginning, data approximation has to be considered, as depending very much on the accuracy of medical files and the number and frequency of health surveys. The dynamics of contamination are also obscure to a large extent, so that the spread in central and southern Italy have been much slower and so much smaller are the figures for those Regions. In the northern Regions, namely in Lombardy and Piedmont, we may observe a higher proportionality between the density of positive cases and the population density when a more accurate measure of population density is used. Similarly, that may be observed for Emilia-Romagna, Veneto and Friuli V.G. when the density is weighted by the municipal classes of population.

We may also observe that the difference between the average density and the two weighted population densities as calculated and shown in Tab.2 is smallest in Veneto. That Region is known for having faced the starting of pandemic and then for a better performance in fighting against the spread of the virus. The results here presented partially explain the difference from all other northern Regions (with the exception of Friuli V.G.) also by the smaller urban density.

Therefore, the observation must be brought to a more detailed scale, at the level of single provinces and towns, and even at the scale of single urban quarter, by using local density data.

A new challenge arises for urban density and new needs for public spaces and services.

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