SUSTAINABLE DEVELOPMENT GOAL



SUSTAINABLE CITIES AND COMMUNITIES

CONTRIBUTIONS OF EMBRAPA

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Technical Editors





Brazilian Agricultural Research Corporation Ministry of Agriculture, Livestock and Food Supply



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Chapter 2

Challenges for sustainable urbanization

André Rodrigo Farias Junia Rodrigues de Alencar Joanne Régis Costa Patricia da Costa

Introduction

The Sustainable Development Goal 11 (SDG 11) of the UN 2030 Agenda aims to make cities and human settlements inclusive, safe, resilient and sustainable. The *Third United Nations Conference on Housing and Sustainable Urban Development* (Nações Unidas, 2016) proposes a new agenda to guide "sustainable urbanization for the next 20 years." It is a big challenge, and partnerships between public and private sectors and civil society are crucial for effective progress towards sustainable urbanization.

When the city is observed from the perspective of a sustainability agenda, it becomes mandatory to consider the urban phenomenon not as a point on the map, but as a broader area that also includes the region over which it exerts its influence (IBGE, 2017).

Understanding urbanization not only as a particular and specific fact in societies but also as a phenomenon that relates to diverse social domains and geographic scales, allows in-depth analyses consistent with concrete reality. These analyses can support solid initiatives capable of producing the desired changes within the scope of SDG 11.

Within this context, behavioral changes and encouraging innovation in different areas (oriented to face challenges imposed by growing urbanization), are needed, among other changes.

Characteristics and trends in urbanization

According to Santos (1993), Brazilian urbanization can be seen as a process, as a form and as a content, that is, urbanization level, urban design, population's needs are to be analyzed in light of economic, political and socio-cultural sub-processes, technical achievements and territory uses in varied historical moments.

The history of cities, therefore, relates to the history of other relevant social events that directly influenced its emergence, its consolidation and its expansion. From this perspective, cities and societies are faces of the same coin, an inseparable set that is meaningless when viewed in isolation. There are no cities without social participation, just as there is no large gathering of people, housing, diverse services, jobs, cultural and political agitation without the required construction of buildings, streets, avenues and all other material characteristics that mark cities, especially in the present moment. For Rolnik (1997, p. 13, our translation),

The history of cities is marked by special or ordinary events that act on immense inertia of buildings and traditions. We can capture this movement in multiple ways: through social history, following the subjects that constitute it; through the intellectual history, capturing ideas and concepts that weave its culture through the history of its architecture and urbanism, building a map of its geography built by man.

In this sense, it can be stated that urbanization has always been strongly related to economy, from the time it was a commercial center between agricultural areas distant from each other and a place of agglomeration of traders from various regions, until today, when cities are the main locus of housing for the majority of the world population, besides being the priority area for the installation of industrial parks, administrative and financial departments of companies of varied branches of economic activity, research, education and knowledge institutions, headquarters of public administration institutions, among other diverse sectors.

Due to this characteristic of bringing together different activities and social groups in an enclosed space, cities have historically become centers of great sociocultural and political diversity, of coexistence and of conflict between different social agents. So, it can be said that cities themselves are shaped and molded by this whole social arrangement in the same way that the actual and concrete structuring of cities mold social actions. For Lefebvre (2001), the city is a work because it is a social construction as well as the site where society projects itself, given the inseparability between society and geographical space, which is the material basis of its existence.

From this perspective, the city can be described as form and content, for a form concretely represents the material production of objects performed at different historical moments, but it is also content because it is constructed and continuously transformed according to the dictates and the social complexity in

force. Therefore, analyzing the phenomenon of urbanization in the sense of making cities inclusive, safe, resilient and sustainable necessarily implies transformations of the social, political and cultural contexts in order to plan and promote initiatives that address directly these aspects. Furthermore, it is important to point out that such adjectives related to SDG 11 represent highly complex concepts, are open to numerous interpretations and involve a significant range of variables. Being aware of such complexity and endeavoring to seek precise definitions of their meanings is of paramount importance, especially in order to guide further research and establish guidelines for the development of initiatives aimed at meeting such assumptions.

The concept of inclusion, for example, is widely debated in different domains of society. This term can refer to unique proposals for organizing the educational system, in which the system itself is structured based on the diversity and needs of all students, regardless of subdivisions or subgroups of students (Mantoan, 2015), or to the urgent and necessary demands of people with disabilities, especially with regard to guaranteeing their rights and the exercise of their citizenship (Sassaki, 2003).

Despite several other examples of the use of the concept, what is relevant to point out is that dealing with inclusion, for obvious reasons, necessarily implies acknowledging the existence of exclusion and the fact that it is a social problem to be confronted. Searching the definition for the meaning of social exclusion, Sposati (1999) states that this concept relates directly to the concept of universal citizenship, and exclusion could be defined as the very negation of the latter. The author also makes an important distinction between poverty and social exclusion: while the former concerns the inability to acquire and retain property, the latter refers to a wide range of social situations in which material conditions only represent one of the variables. Social exclusion, from this point of view,

> [...] reaches cultural values, discrimination. This does not mean that the poor cannot be discriminated against because they are poor, but that exclusion includes even abandonment, loss of ties, and the denigration of social relations, which are not necessarily related to poverty. (Sposati, 1999, p. 4, our translation).

From this perspective, making inclusive spaces means understanding that part of society is permanently in a state of exclusion and that this phenomenon presents itself particularly in cities as these, by their own intrinsic characteristics, bring together an enhance this condition. In other words, educational, cultural, behavioral, financial exclusion, among many other possibilities, is given substance in the space of cities, which, in turn, reflect conflicts and social contradictions. It is precisely for these characteristics that the challenge of making cities inclusive involves transformations of various orders and in different social domains, in order to address all these issues based on the widest and most holistic perspectives possible.

It is important to emphasize that the sense of inclusion does not necessarily imply social and/or spatial homogenization, such as keeping all persons and spaces under a certain order imposed by someone or by some institution. Inclusion, from another point of view, is intended to offer equal conditions to all so that each individual is able to exercise their full citizenship, based on guaranteed rights and duties. In the cities, for example, inclusion may be expressed by the offer of equal and fully accessible conditions in terms of urban infrastructure, separated into its different kinds, such as urban mobility, basic sanitation conditions and electric power supply, leisure culture, education and health equipment. In these cases, it is a question of guaranteeing high quality material conditions for living in society.

This holistic conception of inclusive cities directly relates to the proposal of establishing safe cities, as posed by SDG 11, since inclusion and safety are mutually influenced. Inclusive cities tend to be safer cities in the same way that the latter tend to have lower levels of exclusion. The meaning of the noun safety (Segurança, 2018), which, according to Michaelis dictionary, represents a condition or state of what is free of damage or risk, when used to describe cities, may refer both to the possibilities of damage from natural disasters or phenomena caused by human action, or to the safety of individuals in city spaces with regard to social acts of violence of various motivations.

However, in both situations of unsafety, caused by either human action or natural processes, their respective solutions are extremely complex, involve many variables and social determinants and necessarily require a set of long-term systematic actions to produce representative and effective responses.

Based on these considerations, it is feasible to assume that permanently and integrally safe cities are related to utopian views. It is perfectly consistent, however, to accept that it is possible and, more than that, it is mandatory to make substantial progress in addressing issues of violence in cities and in proposing efficient natural phenomena risk management. In this way, their potentially negative impacts would be reduced to the smallest possible extent or they would be of short duration and intensity, so that the previous balance would be quickly restored, in accordance with the concept of resilience, the third specific target of SDG 11. This balance must be critically assessed, since not every balanced situation is desirable or does not require significant changes.

As for the concept of resilience, its origin is associated with the scientific fields of physics and engineering, but it has now been used in several academic areas. According to Barlach et al. (2008, p. 102, emphasis added by the author, our translation), "from Latin, the world *resilio* means to return to an earlier state, being used, in Engineering and Physics, to define the capacity of a physical body to return to its normal state [...]". When associated with environmental studies, resilience refers to the ability of a given space (in this case, cities) to overcome a given adversity and to restore its previous condition or to adapt positively to that change. In the case of natural phenomena such as earthquakes and extreme climatic events, resilience would be related to the way a particular space would absorb the negative impact of such an event and to how the return of the previous condition would be realized. With regard to the social domain, however, it is necessary to consider the significant complexity between different social groups and the contradictions and conflicts in using the concept in scientific approaches and in public policy design.

All of these concepts, i.e., inclusion, safety and resilience, must necessarily be included in a sustainable urbanization approach, as they directly influence whether or not this primary target is met. Sustainability, which was initially widely used in environmental research and analysis, has now been used in different approaches and complemented by several adjectives in several area of study, such as economic, business and urban sustainability, among others. In addition, the notion of sustainability has been strongly related to the concept of development as part of different sustainable development proposals that are currently being presented and discussed.

Considering the objectives of this publication and the various definitions of sustainability, it is important to restrict the analysis to what we consider to be the central point of discussion of this theme: being sustainable or practicing sustainability means providing the necessary material or immaterial conditions for maintaining and developing life in society in accordance with the demands of current and future generations. In this perspective, sustainable cities are not only those with ecologically appropriate procedures and methods, but they involve a series of actions and political positions that reach various domains, whether

related to natural or social processes. In this perspective, Boff (2012, p. 25, our translation) highlights:

The concept of sustainability cannot be reductionist and applied only to growth/development, as it is prevalent in our times. It must cover all territories of reality, ranging from people, taken individually, to communities, culture, politics, industry, cities and especially the Planet Earth with its ecosystems. Sustainability is a way of being and living that requires aligning human practices with the limited potential of each biome and the needs of present and future generations.

Addressing these issues, of course, is not an exclusive attribute of public management institutions, research and development initiatives or organized civil society, but it involves establishing a collective view on society around priority issues to be addressed. With regard to the activities of Embrapa, the search for viable research, development and innovation solutions for sustainable agriculture (Embrapa, 2015) directly and indirectly impacts the life of cities, but it is not able, per se, to transform them in full, according, for example, to specific SDG 11 goals. These are, in short, scientific and technological innovations engendered by numerous research and development initiatives that produce beneficial effects in several areas of knowledge and productive fields, but which must be accompanied by other political actions within a certain strategy so as to reach paradigmatic changes in urban spaces.

According to this approach, transforming cities must be based on a collective understanding, that is, it must never be restricted to individual initiatives of an institution or solely and exclusively related to the government, although it plays the main role in several areas in cities and is exclusively in charge of some services. In this context, Harvey (2018) points out that:

> The question of what kind of city we want cannot be divorced from [...] what kinds of social relations we seek, what relations to nature we cherish, what style of daily life we desire, what kinds of technologies we deem appropriate, what aesthetic values we hold. The right to the city is, therefore, far more than a right of individual access to the resources that the city embodies: it is a right to change ourselves by changing the city more after our heart's desire. It is, moreover, a collective rather than individual right since changing the city inevitably depends upon the exercise of a collective power over the processes of urbanization.

The collective understanding of urbanization is not restricted to social agents and institutions, but it is also closely related to the establishment of a territorial view of the process. This means that cities must be interpreted from a territorial perspective in which they are seen as one part in a whole that is always moving. In this context, it is important to recognize that analyzing a given city or the effectiveness of a public policy for cities will be necessarily influenced by other geographic and social domains, especially after globalization has emerged and been established.

Currently, cities not only relate to regions under their influence, but also establish multiple relations and diverse kinds of interactions with other cities, with other regions, with the country itself and foreign players and conditions, which is an unequivocal fact of the present historical moment. Not only are these relations diverse, but their pace is fast, leading to quick and often ephemeral large-scale changes.

All these variables, typical of the present moment, make the transformation of cities a great challenge for public/private planning and action and require reorganizing urban interpretation and instruments used for public policy design. On the one hand, there is a growing need to know the reality of each city based on collecting primary data on its spaces and society, seeking to build a broad picture of the current situation in these areas; it can all be performed by countless information technology and geotechnology advanced tools. On the other hand, a series of multidisciplinary and multi-institutional efforts are necessary to interpret this reality revealed by the data, producing information for public policy design, always considering that every policy for cities is social policy by definition, based on a given economic, political and cultural context and molded by other domains that, to a great extent, transcend the scope of the cities targeted by such policies.

For that matter, in what concerns the knowledge of Brazilian cities reality, the study *Caracterização e Tendências da Rede Urbana do Brasil (Characterization and Trends of Brazilian Urban Network)*, coordinated by the Institute for Applied Economic Research (Ipea), considered Brazilian urbanization as a synthesis of economic processes, and its territorial transformations mainly induced by economic, especially industrial and agricultural, activities (Desenvolvimento..., 2002).

Santos (1993, p. 27, our translation) considers that:

The term industrialization cannot be taken here in its strict sense, that is, as the creation of industrial activities in places, but in its broadest significance, as a complex social process, which includes both the formation of a national market with efforts to equip an integrated territory, and the expansion of consumption in various forms, which drives the life of relations (namely tertiarization) and causes the process of urbanization itself. This new economic basis surpasses the regional level, and extends throughout the nation; for that reason, an urbanization that is ever more involved and more present in the territory is due to sustained demographic growth of medium and larger cities, including, of course, state capitals.

According to UN's 2015 report on Millennium Development Goals (MDGs) (United Nations, 2015), since 1990, the proportion of the world's rural population without access to sanitation has declined by almost a guarter, and rates of open defecation in rural areas have declined from 38% to 25% by 2015. In the same year, one in three people (2.4 million) still used rustic sanitation facilities, including 946 million people still relying on open defecation. In 2015, it was estimated that over 880 million people lived in slum-like conditions. Contrary to this, only 18% of people living in urban areas lacked access to sanitation in the world. Between 2000 and 2014, more than 320 million people gained access to adequate water, sanitation and housing. The proportion of the urban population living in poor neighborhoods in developing regions decreased from 39% in 2000 to 30% in 2014. Although the target had been achieved, absolute numbers of urban residents living in slums continued to grow, partly because of the rapid pace of urbanization, population growth and the lack of land and housing policies. In 2015, it was estimated that more than 880 million urban residents lived in slums, compared to 792 million in 2000 and 689 million in 1990.

Sustainable cities and communities

The City Statute (Brasil, 2008), Law No. 10,257 of 2001, which regulates articles of the Federal Constitution that deal with Brazilian urban policy, is one of the greatest legal advances in terms of urban planning and management in Brazil. In section I, it presents, as one of the tools for urban territorial planning, the Master Plan; in legal terms, it is a tool for managing urban areas, although its range of action, in some municipalities, encompass urban and non-urban (rural) areas (Pereira, 2011). There are, however, countless weaknesses that make it difficult to implement a sustainability agenda for cities and human settlements on the planet and in Brazil. Issues are multifaceted and require multidimensional solutions.

Eliminating inequalities in access and service levels is therefore crucial to the UN's post-2015 development agenda. Perin (2004) states that reducing inequalities is a recurring theme and one of the major challenges of the 21st century, considering that less than 25% of the world's population consumes 80% of goods and 75% of energy produced on the planet, thus creating ghettos of individuals excluded from development.

In this sense, urban and rural planning and territorial management are necessary, based on permanent public policies that take into account all dimensions of sustainability and regional and local contexts. A commitment to territorial management and policies that guide urbanization by producing material and immaterial goods that reconcile economic growth with sustainable forms of appropriation and use of urban space are necessary, according to Vecchiatti (2004). In this way, it will be possible to promote quality of life and build sustainable cities and human settlements.

Internet of things and its implications for digital agriculture

Considering SDG 11 and the role of Embrapa in addressing challenges (mentioned in its guidelines and targets), it is worth noting some observations made in the World Bank's Development Report (Banco Mundial, 2016): although we are in the midst of the greatest information and communication revolution in the history of mankind, when more than 40% of the world's population has access to the internet, the poorest households are more likely to have access to mobile phones than to a toilet or clean water. Traditional development challenges persist and prevent the population to have a better quality of life.

To address these challenges, the UN Food and Agriculture Organization (FAO) recommends that all agricultural sectors be smart, and that agricultural work be equipped with innovative tools and techniques, particularly digital technologies, thus promoting increased production at a feasible and sustainable cost, within the context of digital agriculture (Minerva et al., 2015). Topics such as precision agriculture, automation and agricultural robotics, big data techniques and the Internet of Things (IoT) are part of this digital agriculture.

In the case of precision agriculture, some of its technologies are already being used, and an increasing participation in the management of production chains is expected, so as to improve yield per agricultural unit using the most continuously

sustainable and modern means to achieve the best in terms of quality, quantity and financial return. A range of technologies that includes services such as Global Positioning System (GPS), sensors and big data to optimize crop yields are also used. Instead of replacing the experience of farmers and their instincts, decision support systems based on information and communication technologies (ICT) with real-time input can also provide information on all aspects of agriculture at a previously impossible level of detail, thus allowing results with less loss and maximum efficiency.

With regard to IoT, this technological revolution that connects daily-used electronic devices to the internet has been considered as one of the foundations for the so-called fourth industrial revolution that will impact on agriculture 4.0. It will be increasingly connected and remote, allowing performance command and control, location of machines, equipment and sensors and real-time field data generation and analysis. All these concepts converge in the sense of having a digital agriculture or smart farming. Opportunities and challenges arise in all areas, from investment, development and use of IoT technologies in the field to training, regulation, standard setting and information security issues. As a disruptive and enabling technology capable of promoting knowledge-intensive agriculture, it aims to sustainably increase agricultural productivity, thus leading to cost reduction and improved field conditions (Minerva et al., 2015).

There has been such a considerable concern about this theme in Brazil that the Brazilian Development Bank (BNDES) has signed an agreement with the Ministry of Science, Technology, Innovations and Communications (MCTIC) to begin drafting a National Plan for IoT to leverage the development of new technology in Brazil. The first initiative of the partnership is a technical study carried out by a consortium formed by McKinsey, Centro de Pesquisa e Desenvolvimento em Telecomunicações (Center for Research and Development in Telecommunications) and Pereira Neto/Macedo law firm, with financial support from BNDES, to diagnose and propose public policies on the internet of things (Amorim; Capelas, 2016); this is an opportunity to leverage Brazilian agribusiness, one of the most interested sectors in using IoT, and to become a worldwide reference in developing solutions for this area, thus disseminating the Smart Rural concept.

In 2016, Embrapa Agricultural Informatics and the Intelligence and Macro-Strategy Division of Embrapa organized the panel named Internet of Things and Its Implications for Digital Agriculture in order to detect trends and signals for the ICT observatory in agriculture – linked to Sistema de Inteligência Estratégica da Embrapa (Agropensa) (Embrapa Strategic Intelligence System) – and support the formulation of new research, development and innovation strategies. Representatives from IBM Brasil, John Deere, Bayer CropScience,

Centro de Pesquisa e Desenvolvimento em Telecomunicações (CPqD) (Center for Research and Development in Telecommunications), Universidade Nova de Lisboa and the consulting firm McKinsey participated in the event.

IoT is considered a new 21st century computing paradigm, which will allow the physical world to be coupled with the information world and will provide an abundant services and applications, thus allowing physical users, machines, data and objects to interact with each other in autonomous and transparent way. To build up this reality, multidisciplinary research efforts are required, involving several areas of knowledge, such as: distributed systems, mobile systems, computer and sensor networks, software engineering, artificial intelligence, nanotechnology, as well as specific knowledge areas in agriculture. Technologies that will support IoT are: big data, high performance computing, cloud computing, radio frequency identification (RFID) and communication and positioning systems.

The panel discussed agriculture and potential areas for applying IoT, such as: precision agriculture, automation, logistics, herd management, and environmental and productivity monitoring. At the end of the panel, an initiative was announced, called SitloT, which makes an experimental area of Embrapa Environment available for partners to test their IoT technologies and innovations for agriculture, so as to develop integrated and interoperable solutions.

Brazilian agribusiness is one of the main sectors favorable to the use of IoT, due to its high degree of solidity (Roselino; Diegues, 2016). This is one of the central axes of economic development in Brazil, characterized by a profitable business structure, links with global production chains and high investment power. The historical presence of technology in solution development for agribusiness (often led by public institutions such as Embrapa and several other institutes) and the prominent position of Brazilian agribusiness worldwide lead to a high potential demand for digital solutions.

IoT involves the use of sensing technologies, analytical solutions for data analysis, telematics and geospatial positioning technologies, tools and softwares for making real-time decision systems, communication systems, traceability and food certification and logistics. Combining these technologies favors rational use of natural resources and inputs and reduced transport losses. IoT will help reduce rural exodus by incorporating a technological appeal and better working conditions, thus reducing physical labor. Digital agriculture will help the population (Figure 1) and public policies design, because the amount of data generated will be much larger and varied than that available today. With more information, public policies can certainly be designed taking regional differences into account, both in macro and micro regions.



Figure 1. <u>Hortaliças na Web</u> (Vegetables on the Web) is a web page developed by Embrapa Vegetables to encourage vegetable consumption and to promote a healthy diet for the whole family.

Agriculture, however, faces challenges such as limited arable land, global climate change, water scarcity, cost of available energy, and impact of urbanization on its workforce. Such challenges can be mitigated with the adoption of digital agriculture, as it favors reduced crop loss due to diseases and climatic events; builds up savings by applying pesticides and fertilizers only when necessary; optimizes water consumption; offers better working conditions, reducing physical labor and attracting younger generations; and allows precise scheduling of harvest (Enabling..., 2016). There are also post-harvest benefits, such as reduced transport and processing losses that occur on the way to the consumer.

Final considerations

In this chapter, characteristics and trends in urbanization, need for urban and rural planning and territorial management, and the role of Embrapa in terms of this SDG have been highlighted. The IoT was also approached by the panel of experts named Internet of Things and Its Implications for Digital Agriculture, organized by

Embrapa Agricultural Informatics and its Intelligence and Macro-Strategy Division of Embrapa.

The use of digital technologies in agriculture is expected to contribute to raising productivity rates, increasing input use efficiency, reducing labor costs, improving workers' quality of work and safety, and reducing environmental impacts. Digital agriculture will increasingly be related to the domains Embrapa aims to achieve: advancing agricultural sustainability, creating employment opportunities and reducing rural and urban poverty, supporting public policies design, keeping Embrapa at the knowledge frontier and strategically positioning Brazil in bioeconomy.

Although digital technologies are spreading rapidly across much of the world, there are still large digital dividends that must be taken into account by all those working to end poverty and promote shared prosperity. The biggest boom in information and communication technologies throughout history will not be truly revolutionary until its benefits reach all people around the world (Banco Mundial, 2016).

Given this context, implementing action strategies paves a broad and solid way so that Embrapa and its partners can promote development for all.

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