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Local Food Systems: Making Visible the Invisible Through Urban Agroecology

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The world is going through the second wave of urbanization. Although cities still occupy a relatively small area, they are the main consumers of natural resources, energy and water. And in general, they depend for their food, on resources from outside. The economic and bioecological crisis such as the economic one, the social one, pandemics, war or clime change, have faced cities with unexpected problems but also with new perspectives. Likewise, the advance of industrial agriculture nearby urban areas generates other types of impacts. The intensive use of agrochemicals and synthetic fertilizers, especially in developing countries but also in developed countries, impacts the socio-environmental health of urbanites. Making visible the invisible and the immeasurable—through tools such as ecological economics–puts under a comprehensive umbrella, a set of ecological, social and economic aspects that urban societies had not perceived until now such as greening of cities, the recovery of ecosystem services and restoration of "brown lands" or the relevance of food self-sufficiency production. Urban agroecology plays a significant role to reach these ones and begins to be a real possibility to build local food systems and new ways of consumption and networks. This is a particular contribution in times of crises.

Keywords: urban agroecology, environmental services, environmental invisibles, ecological economics, food crisis, productive green shields, food self production

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INTRODUCTION

The climate, economic, environmental, pandemic, war or political crises almost always shows one of its first tragic faces in the lack of access to food, a strong dependence on those who provide it and a boundless increase in food prices. A crisis just benefits a part of the food chain but could harm many inhabitants of towns and cities.

Several economic crises in Latin America have showed that it was possible to feed the most vulnerable part of the population under the premise of self-production food systems. From this perspective we discuss here the viability of urban agroecology and the "discovery" of the value of various environmental intangibles, essential for life itself. This proposal contributes to new perspectives in the adjustments of cities going through different crises. This is also a contribution to urban development through the promotion of green infrastructure both within and outside urban areas. Likewise, industrial agriculture sees its impacts on cities reduced by erecting productive green shields—under agroecological premises that do not allow synthetic agrochemicals and fertilizers—on its limits that set a barrier to pesticides, act to regulate impacts and promote new local production and consumption systems.

Economic crisis, particularly in a context of inflation, tends to worsen market food access for the most vulnerable sectors of the population by exacerbating two main factors: the price of food and the income level. As Altieri and Nicholls (2018) mentioned *"urban agriculture, has been critical during times of crisis. During World War II, United States households produced enough to meet 40% of the nation's fresh vegetable demand during the "victory garden movement"*. In Sarajevo, Bosnia and Herzegovina, 2 years after the blockade began in 1992, self-reliance in urban food production was estimated to have grown from 10% to over 40% for vegetables and small livestock (Brown and Jameton, 2000). In Cuba, urban and peri-urban agriculture produce about 50% of the fresh food of the island covering about 56,000 ha (Funes and Vázquez, 2016; Altieri and Nicholls, 2018). In Dakar (Senegal), 3,000 family have vegetable farms (14,000 jobs) of which 1,250 are fully commercial (9,000 jobs) (Mbaye and Moustier, 2000). Big cities such as Shanghai (China) has 2.7 million farmers, representing 31.8% of all workers, contributes to 2% of the city's GDP through urban agriculture (Yi-Zhang and Zhangen, 2000). In Dar es Salaam (Tanzania) 15–20% of all families in two city areas have a home garden. Urban agriculture forms at least 60% of the informal sector and is second largest source of urban employment (20%) in 1997 (Sawio, 1998). The Gaza Strip is a small stretch of land where urban gardening phenomenon is to support productive activities that can make essential contributions to dignity, resilience and improve food security status (Khalil, 2018). In Brazil, The Carioca Urban Agriculture Network (REDE CAU) calls attention to the number of women involved in the program activities (De Oliveira Batitucci et al., 2021; FAO, 2021). In Ecuador, during the COVID19 crisis peasants supplied cities like Guayaquil through agricultural brigades like those of FECAOL (Peasant National Movement of Ecuador) and gave food and medicinal herbs to urbanites (El Telégrafo, 2020).

Urban agriculture (Stone, 2016) is a complex system encompassing a spectrum of interests, from a traditional core of activities associated with the production, processing, marketing, distribution, and consumption, to a multiplicity of other benefits and services that are less widely acknowledged and documented (Zidak and Bedenik, 2019). But urban agriculture in several times can use chemical or synthetic fertilizers.

A new way to assess services and benefits of agrifood system is rising in the world (TEEB, 2018). Ecological Economics contributes to a holistic view of the socioeconomic system, of the immeasurable and of the footprints, rucksacks and urban metabolism that our society carries (Wackernagel and Rees, 1996; Giampietro et al., 2014; Kowalski and Haberl, 2015; Martinez Alier and Muradian, 2015; Galli et al., 2016; Banerjee et al., 2021). The application of systems thinking to understanding and managing the complexity of the global food system is an important step in achieving this transformation (UNEP IRP, 2013; TEEB, 2018). Taking in consideration the Four Capitals (TEEB, 2018) opens opportunities to recognize the values of natural, human and social capital that the current economic system has not been taking in consideration. By making the invisibles, visible, society will be better positioned to take into account the impacts of activities that have previously been ignored. And this is relevant when we incorporate an agroecological perspective to the analysis.

URBAN AGROECOLOGY

Agroecology (Altieri, 1995; Altieri et al., 2015) is a discipline that proposes a holistic management in the food system and the utilization of natural pesticides and fertilizers. Agroecology has its premises, methodologies and objectives (FAO, 2018) that show it as a science, a practice and a movement (Wezel et al., 2015). In the case of cities, this is relevant for a high quality production with less pesticides of both the agroecosystem (rururban areas) and the neo-ecosystems (urban areas). Agroecology and of course, urban agroecology, takes advantage of the biological management of pests and plant diseases, local manure and natural resources and its main focus is the production of quality food at fair prices or for self-consume. It integrates with the social economics and builds social capital through new production, consumption and exchange networks. Urban agroecology is a scaling up of urban agriculture by focusing comprehensively on the sustainability (environmental, social and economic) of urban systems.

Today, 20% of the global food supply (Altieri and Nicholls, 2018) relies on urban agriculture: social-ecological systems shaped by both human and non-human interactions (Egerer and Cohen, 2021). Agroecological systems are not intensive in the use of capital, labor, or chemical inputs, but rather they improve the efficiency of biological processes such as photosynthesis, nitrogen fixation, solubilization of soil phosphorus, and the enhancement of biological activity above and below ground (Altieri and Nicholls, 2017). The "inputs" of the system are the natural processes themselves; this is why agroecology is referred to as an "agriculture of processes" (Gliessman, 1998). Within the city it allows to recover the urban green, regulate the consumption of water, land and energy (IRP, 2018) and, analyzed in an integral way, it uses each of these resources more efficiently (IRP, 2022). Likewise, local food systems, which base their forms of production on agroecological premises, have proven to be better in solving the partial lack of food under crises situations (climatic, ecological, economic, political, humanitarian or war) and support local jobs and new networks in the local food systems.

PRODUCTIVE GREEN SHIELDS AND PERIURBAN AGROECOLOGY

Environmental and social impacts of industrial agriculture—contamination with agrochemicals, eutrophication of rivers and streams, intensive use of energy, effects on human, animal and plant health—especially in the surroundings of towns and cities, can be reduced by promoting an agroecological transformation in the periurban areas of towns and intermediate cities.

Implementation of agroecological practices in the interfaces, resolves the growing socio-environmental conflict between producers, consumers and policy makers. Particularly this is a relevant problem in developing countries where environmental

rules are generally weaker. Agroecological Green Shields (AGSs) (EVAs *in Spanish*) (Pengue and Rodriguez, 2018) represent an opportunity to transform peri-urban areas—generally degraded, polluted or more uncontrolled—into a viable productive environment that resolves the conflicts stated and contributes to a new look at the urban planning of intermediate cities and towns.

On the other hand, agroecological practices (Wezel et al., 2020) allow the recovery or restauration of ecosystem services and degraded sites. The regulation of the local climate, the improvement in the use of water, the cycling of nutrients, the better use of waste, the use of local resources begin to be valued.

INVISIBLE VALUES OF URBAN GREEN PRODUCTION

Cities account for 80% of global GDP and will host 75% of the world's population by 2050 (WEF, 2022). Green infrastructure of cities can provide us with new services. These environmental services have been invisible during decades but relevant for a sustainable way of life in urban areas. This invisible services of urban agroecological systems include several aspects for each of the Four Capital Values of TEEB:

(a) *Social Capital* such as positive interrelationships between producers, processors and consumers, and a shared construction of knowledge among them, community development, stronger community ties and a feeling of positive dependency, more and better quality jobs generated locally, the availability of a diversity of locally grown food and less dependence on external inputs, "re-valuation and recognition" of the role diverse stakeholders have played and continue to play toward the common goal of achieving sustainability [e.g., "Prohuerta system" (see below)],

(b) *Produced capital* such as economic spill over at the community and possibly regional level, strengthening of the social and solidarity economy, monetary savings at municipal levels, increased home and land values, stronger relationships and social economy in different nets for diverse products, freshly produced _food in local markets, savings in energy as biomass is converted into biogas or natural fertilizers when producing compost,

(c) *Natural capital* such as lower negative impacts on health and the environment, crop diversification in time and space, enrichment of soils quality, promotion of pollinators and beneficial insects, water conservation, enhanced soil biological activity and improved chemical and physical properties, enrichment of landscape ecology and diversity, generation of safe places for different species, reduction of blight, habitat restoration, increased landscape quality,

(d) *Human capital* such as environmental education, education to food self production, cross-generational and cultural integration, identity preservation among the local communities, strengthening of local community networks, interactions among young and old generations, general wellbeing in terms of mental health and physical activity, recovery the dignity of several social actors, particularly those who have lost their jobs or are finding a way for a better quality of life.

Urban agroecology contributes in cities for a restauration of ecosystem services. Ecosystem services, which are essential for life on the planet (Pascual et al., 2017; IPBES, 2019), are equally strongly undervalued but are beginning to be recognized by society in one way or another, when their value is contrasted against their absence in urban areas.

However, there are some tensions over the different ways to promote food production systems. Some authors are oriented toward the promotion of decoupling in the use of resources, sustainable intensification or ecological intensification (Tittonell, 2014; Mockshell and Villarino, 2019; Cassman and Grassini, 2020) and a monetary recognition of values. While others focus on the importance of agroecology in its role promoted by social movements that have food sovereignty as a core issue and access not only to food but to land, water and genetic resources (Pretty et al., 2011; Altieri et al., 2015).

FOOD SELF-PRODUCTION SYSTEMS

Several cases begin to show interesting strategies. In Argentina, Food Self-production Program—based exclusively on the premises of agroecology—has facilitated the production of food to an average of 3,000,000 people, especially in situations of socioeconomic crisis. ProHuerta supports 500,000 urban gardens, 7,000 school gardens and 4,000 community gardens. The program incorporates over 3,600 villages, as well as larger cities like Rosario, Mar del Plata and Buenos Aires. Over 80,000 metric tons of food is produced by 4,000 ha of orchards nationwide (UNEP IRP, 2013).

The "ProHuerta system" is easy to implement, if public policies work. It responds to an organization process that can quickly reach the entire territory of a country. And it makes the investment of economic resources to achieve self-production very efficient. It consists mainly of a plan that integrates *field technicians* and *promoters* with the *orchard farmers*.

The promoters train urban gardeners in the preparation of the land for food, and the construction of tools for small scale farming. Food produced in home gardens and orchards is typically consumed by the farmers' families, and community gardens serve those who do not have outdoor space at home. Home gardens of around 100 m^2 are suitable for feeding families, but schools require around 200 m^2 and community gardens are closer to 1,000 m^2 in size. The average annual production of a family garden is over 200 kg of fresh vegetables, which can feed a family of five. Some gardens are also able to supply eggs and meat from chickens and rabbits.

A survey by the National Council for Food Security (CNSA) in Haiti, where Prohuerta Program has also been implemented, stated that "93 percent of the families involved improved their food situation. There are 21,000 orchards with 1,500 promoters that benefit more than 140 thousand family orchards. In Haiti, the benefit/cost ratio of the agroecological garden project was four-to-one: for each dollar invested, four were obtained in vegetables produce under the self-production system" (INTA Prohuerta, 2014; Díaz, 2015).

Other experiences in urban farming that involves agroecology or at least some practices related to it are being developed in Africa, where women participation is a key point. Several medium and big cities in Africa present an average of 35% urban farming as a proportion of the urban population (Prain et al., 2010) each one with theirs peculiarities, styles and goals. Two-thirds are led by women. Forty million Africans depend exclusively on growing food in cities.

In addition to the production of food based on agroecology, several invisibles are beginning to be registered, whose value is immeasurable: Urban farmers emphasize that they have recovered the dignity of being self-sufficient with their own resources and making themselves visible to a society that did not consider them. Social capital increases trust, reciprocity and mutual obligations, and creates norms that guide behaviors (Pretty, 2020). Other relevant value is directly related with immediate access to food and guarantee food security and food sovereignty, something particularly important in situations of economic, social or more recently COVID-19 crises (Gemmill-Herren, 2020).

In developed countries balcony farming, rooftop gardens, rooftop greenhouses, indoor farms, balcony farming, aquaponics (Proksch et al., 2019), hydroponics and other building-related forms (defined as "*ZFarming*") are rising. After an analysis of 96 documents published in accessible international resources, it was found that ZFarming has multiple functions and produces a range of non-food and non-market goods that may have positive impacts on the urban setting (Specht et al., 2013). In population dense cities like Cairo, Dhaka, Singapore or Tokyo, rooftop gardening or vertical farming is gaining in popularity. In other cities like Quito or São Paulo, vacant lots are made available to those who are interested in vegetable farming (FAO and CIRAD, 2021).

DISCUSSION

The economic, ecological or climate crises generate vulnerability in the access to food of the urban population. Supply chains of raw materials and staple foods are affected in these processes. The last example has been shown to us by COVID-19, since restrictions of different types and the increase in food prices acted as another barrier to food access.

Health professionals increasingly recognize the value of farm- and garden-scale urban agriculture for nutritional health, personal wellness, urban greening (IPCC, 2022; IRP, 2022), and an engaged and active citizenry. Furthermore, approximately every $1 invested in a community garden plot yields $ 6 worth of vegetables (Doron, 2005). However, when economic conditions improve, many urban gardens can be abandoned. This is not the case in crises, where they can quickly become the mainstay of families.

Periurban agroecology and local food markets (Hinrichs, 2000) can be seen in both environmental and socioeconomic respects. With local trade (Pimbert, 2015), the local economy may expand, contributing to food security, human health, reduction in carbon emissions, and local employment. But in addition, in many social systems, the barter economy, in times of crisis, especially promotes a system of exchange of goods and services, without the participation of money.

There is a substantial recovery of environmental services. But the most relevant aspect and for which COVID-19 has left us a lesson is linked to the availability of food *in situ*. Recurring crises of different kinds, must prepare the cities, to achieve at least, significant fraction of its food supply with fresh food through agroecological gardens.

Agroecological practices seem to be well-adapted to different social, economic and ecological environments (Altieri and Nicholls, 2017). They are less intensive in physical and financial capital, and integrates better into the social and cultural capital of rural territories and local resources (knowledge, natural resources, etc.), without leading to technological dependencies (Côte et al., 2019). In cities, the organization of urban land for agroecological production is essential. Policy decisions for the promotion and agroecological use of productive space is unidirectional. As well as economic instruments, such as tax deferrals, subsidies or soft loans to promote local production on private land. Most of the threats to the realization of urban agriculture were related to regulation and governance and to land tenure and use (Castellarini, 2022).

Urban and periurban agroecology has several beneficial aspects: physical, ecological, economic, material, emotional, social, mental, educational, establishing the reconnection with nature and widening the awareness of sustainability in cities.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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