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Agro-ecological urban agriculture and food resilience: The Case of Quito, Ecuador

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The rural and urban divide, promoted by capitalism first and global neoliberalism later, has characterized the countryside as synonymous with “backwardness” and established the city as a model for “progress.” In recent years, promoting agriculture in cities seemed counterintuitive. Nevertheless, during the last decades, agricultural practices in the urban realm have been encouraged, and with great effort, by a group of cities worldwide. Quito is one of them. The Participatory Urban Agriculture Project (AGRUPAR) has promoted and supported urban agriculture in Quito for almost 20 years. However, aware that the food situation of its population requires stronger efforts, the city has decided to go beyond urban agricultural production. Led by AGRUPAR, and together with other municipal actors, such as the Metropolitan Directorate of Resilience, and the Secretariat of Productive Development, the Municipality of the Metropolitan District of Quito (MDMQ) is implementing public food policies that have outlined, as one of their central objectives, the need to strengthen the city’s food security and food resilience. This text presents a brief history of urban agriculture in Quito and reviews some of the achievements of AGRUPAR. Based on this experience, the authors hypothesize that cities that have gone from promoting urban orchards to establishing urban agricultural programs are in a better position to implement food policies as a contribution to resilience and sustainable urban development. This article displays the importance of clearly understanding the food value chain and the set of strategic dimensions that currently shape the agri-food system. The aim is to better connect the production, processing and transformation, distribution, sale and storage, commercialization, consumption, and post-consumption with the right to food, the right to the city, and a healthy environment to achieve food security. Although the results achieved thus far are valuable, if the benefits of urban agriculture are to contribute to improving Quito’s food security and resilience, additional progress is necessary. Therefore, it is imperative that a proposal be presented which includes urban agriculture as part of a city-scale urban policy.

KEYWORDS

urban farming, climate change adaptation, food policy, food resilience, agroecology

Agriculture and the city

Throughout history, cities have emerged thanks to increased food supply and availability due, among other things, to the introduction of irrigation, increased production, trade, and commerce (Soja, 2001). For Lefebvre (1978) and Maisels (1993) the origin of the city has to do with the agricultural revolution that results in the formation of the first agricultural villages. Along the way, the vision of nature changes from being a wild space from which we must protect ourselves to a basket of resources that we can use to our advantage (Gudynas, 2011; Harvey, 2018). For Mougeot (1999) and Da Silva (2006), urban agriculture is a process as old as cities themselves, and the perceived separation between agri-food production and cities is a recent invention in urban history, where “the Food stopped being a human right to become a business” (Duch, 2011).

For quiteños (inhabitants of Quito) agriculture is not a new practice. The Quitu-Cara culture, one of the first occupants in the territory, created important food infrastructures such as agricultural terraces on the slopes of mountains and ridge systems on the dried-up beds of the lagoons. These infrastructures provided local food supply, which later helped raise intensification of production, to allow for sustenance of the population growth over time. With the arrival of the Incas, criteria for maximizing soil use and sophisticated hydraulic systems were incorporated. This permitted the inhabitants to take advantage of the land considered unsuitable for agricultural production, and helped them to overcome the complications presented by adverse weather. As a result, tools, fertilization processes, soil conservation, and optimization of water use were innovated, while simultaneously managing to domesticate a wide variety of species in diverse climatic conditions and ecological floors. Incan practices included a sowing calendar, public infrastructure (under today’s idea of public e.g., streets, parks, water utilities), and a research methodology to improve food production. These practices allowed locals to connect with the higher world. It is estimated that they cultivated and domesticated about seventy plant species.

Ancestral knowledge and alternative technologies are still present when working the “chacra” (small orchards) and applied to the small, cultivated fields managed under the Andean worldview. These are still considered important agroecological bases. Andean production techniques have proven their worth in both technical and scientific support, and in their constant contributions over time. However, with the Spanish colonization this all changed. New crops such as fruit trees, vegetables, cereals, and farm animals were introduced, surpluses were privatized, and the massification of other forms of production replaced traditional forms. People “forgot” tradition. These changes strongly impacted agricultural production systems and, consequently, the population’s capacity to access food. Although food security with sovereignty of the entire colonial population was not always achieved, the engravings showing

how agriculture was part of the walled cities guarantee to food, are well-known.

Centuries later, agricultural production left the cities and remained in the countryside eliminating the urban use of land for agriculture. Capitalism first and global neoliberalism later, assimilated the rural to “backwardness” and the urban to “progress.” With the Green Revolution, agricultural food production became the heritage of large agricultural companies with global practices based on monocultures and the use of chemical synthetic fertilizers. As a result, family agriculture was relegated from public policies (Holt-Gimenez et al., 2006; Altieri and Toledo, 2011), thus misleading the collective memory and original meaning of the people, its culture, and its environment (Maela, 2011). This adverse environment caused urban agriculture to be left out of agricultural public policies and urban development plans, and in turn, develop into an alternative that is practiced in low-income sectors and in the peripherals of the city.

Over time, urban agriculture has developed in Quito, based on the combination of traditional and ancestral practices inherited from the pre-Columbian era (mainly potatoes, corn, broad beans, zambo, pumpkins, beans) with the implementation of microtechnologies typical of urban production (Long, 1996). However, urban agriculture was not able to escape the influence of the Green Revolution (especially the suburban and rural neighborhoods) that triggered the indiscriminate use of agrochemicals, the loss of biodiversity, the irrational use of global common goods (soil, water, air), in addition to breaking with the ties and logic of community work and with the sense of belonging and connection to the land (Santandreu and Rea, 2018). The notion that water, soil, and air, are now referred to as “resources” instead of the idea of being “global common goods” exemplifies this moment in the history of modern agriculture.

Although activities related to agriculture and food production have been carried out since ancient times in Quito, the process of conceptualizing urban agriculture and healthy eating as part of public policy is recent. Furthermore, urban and peri-urban agriculture is seen as an alternative to the loss of productive areas due the accelerated urban growth propelled by the real estate market.

AGRUPAR, a participatory urban agriculture project

Despite finding multiple approaches and definitions, in this article, urban agriculture is defined as a renewed way of understanding the relationships between the countryside and the city, as well as those established by people with each other, and the correlation between nature and the city. Seeing as urban agriculture is not synonymous to rural agriculture on a smaller scale, it is necessary to analyze some of its characteristics in further detail. It should be kept in mind that although

implementing urban orchards is necessary, it is not a sufficient condition to further urban agriculture as a policy for food and urban resilience.

A variety of activities need to be developed for urban and periurban agriculture to exist. These activities include: (i) the production and/or transformation of fresh produce and/or livestock into products based on agroecological principles, (ii) the promotion of short supply chains to improve food access in the “last mile” and to reduce the environmental burden of transport and storage, (iii) the stimulation of self-consumption and/or market exchange (barter or commercialization) based on social economic principles, (iv) the promotion of healthy foods and avoid offering ultra-processed foods, and (v) the sustainable management of residues that minimizes food loss and waste and favors circular economies, (vi) knowledge exchange as a two-way communication process where urban farmers receive training but also provide feedback to improve and scale better practices

Through the use of appropriate technologies and participatory processes, urban agriculture allows for a sustainable (re) emergence of global common and local goods that take into account local knowledge and culture. Such an approach enables social creativity and fosters the reconnection between people and nature. As a result, a forgotten philosophy of life is recovered (Santandreu and Rea, 2016; Rodríguez, 2018). This concept recognizes a cross-sectoral, transdisciplinary, and multi-stakeholder approach that considers the systemic complexity and multi-dimensionality of urban agriculture. Such approach allows for this activity to become permanent in cities and re-establishes urban agriculture as one of the cornerstones of health and food resilience.

In 2000, with the support of the Urban Management Program for Latin America and the Caribbean (PGU-ALC), the Municipality of the Metropolitan District of Quito (MDMQ) began to implement urban orchards in the northern, central, and southern parts of the city. Soon after, in 2002, The Participatory Urban Agriculture Project (AGRUPAR) was created to address urban and peri-urban production of agricultural products in the Metropolitan District of Quito. Since 2016, with the support of different organizations such as The RUF Foundation and RIKOLTO, and with the leadership of the Secretariat of Productive Development, to which the Metropolitan Directorate of Resilience was later added, the MDMQ began promoting a public agri-food policy that had urban agriculture as one of its pillars.

AGRUPAR connects the food value chain with a set of strategic dimensions of the agri-food system Rodríguez and Proaño (2016). It promotes the social and solidarity economy that seeks to guarantee food security and sovereignty by incentivizing and enabling the practice especially by the most needed, supports responsible consumption focused on promoting healthy food environments, and seeks to manage losses and waste by exploring the notion of a circular economy. AGRUPAR's approach local agro-ecological food production

with the human right to food; the city with a healthy environment; and the governance of the agri-food system to make better decisions to strengthen the city's food resilience (Carasso and Carasso, 2019).

From the beginning, AGRUPAR has transcended the urban border. According to the last census carried on by AGRUPAR in 2020, the project accounted for about 60 hectares of production distributed in spaces of up to 7,500 square meters, throughout its territory. This bridges the divide between sustainable production and healthy consumption, reaffirming a new way of understanding the urban-rural link. The project is estimated to have an annual output of more than 1,200 tons of healthy food. Around 53% of production is destined for self-consumption and 47% is commercialized through different channels.

This practice not only improves access to safe food, but it also promotes healthier family economies by decreasing food spending, increasing income, and becoming a means for living in low-income sectors. It provides an average income of \$175 per month, per urban orchard (can belong to a family, an individual, or to the community). The implementation of urban orchards has implied a modification in the family and collective space, symbolically and in practice. This has transformed the dynamics of food environments.

Since 2000, five municipal administrations with different political perspectives and priorities have passed, but AGRUPAR has maintained its core values and principles. Furthermore, over the years, AGRUPAR has strengthened its relations with various Ecuadorian actors (different levels of government, civil society, the private sector, academia and with citizens) and has deployed international alliances with diverse cooperation agencies, researchers, and other governments, that have allowed access to resources and new ways of addressing problems.

The Programme has also contributed to strengthening social relations between producers and consumers, as well as the inclusion of small farmers and vulnerable groups in Quito's food system in Quito Chiara Tornaghi (2018). It has created subsystems for vegetables, fruits, and medicinal plant production. The programme also provides seedlings, seeds, organic inputs (e.g., fertilizers and mulch) and bio inputs (e.g., organic pesticides), complementing the urban farm with the technical raising of minor species, beekeeping and artisanal food processing for value addition. Innovations have also been made to improve productive tools and infrastructure such as micro greenhouses and drip irrigation systems. Furthermore, AGRUPAR has supported the production of certain types of seeds to create a seedbank, however, seed production is limited to the varieties that are supported by the climatic floor, hence making AGRUPAR dependent at a certain extent of imported seeds.

For example, the design of rainwater harvesting systems, low-cost drip irrigation with easy implementation, and mulch, among others, are direct effects of optimal water consumption in urban agriculture. By using a 3 mm sheet per square meter,

irrigation systems optimize 95% of water used for production. This simple technology has been adopted by urban farmers to improve resource efficiency and the quality of the produce. Since the water used to irrigate is potable, these savings become even more important. Spreading the knowledge of these innovations among the population allows for urban agriculture in the city to continue to progress.

As a general rule producer's lack of access to appropriate capacities are often one of the main barriers for sustainable urban agriculture to gain scale. AGRUPAR has provided constant capacity-building support to the target populations, by disseminating sustainable urban agriculture practices and innovations throughout several trainings and knowledge building activities. In 2019, AGRUPAR supported training and technical monitoring for the cultivation and handling of small animals and food processing in more than 1,800 urban orchards (see [Table 2](#)). Currently, the program supports more than 2,200 urban orchards and aims at increasing this number by 200 urban orchards per year.

Food processing is given as an option to save food (when products do not meet the size, shape, color, or appearance for fresh marketing) and to offer longer conservation of products, while adding value through processing, thus becoming an interesting line of business in local bio-fairs. The Census of the AGRUPAR project, also was determined that food processing represents 15% of the entrepreneurial options of farmers. Farmers process 82 types of products of the total volume sold at fairs. Processed products represent 14.87% in relation to weight (kilos) and 29.24% in relation to sales generated in dollars.

AGRUPAR has 15 bio-fairs (with 19 weekly frequencies, an average of 850 bio-fairs take place per year) for the direct sale of surplus production, where more than 105 types of products are offered while also reducing the distance that products need to travel and creating shorter circuits (see [Figure 1](#)).

However, the scale in which urban agriculture shows the greatest contributions to the city, is at the neighborhood level. This article defines neighborhood as a subdivision of the urban territory that presents its own identity, which is historical, cultural, and urban, and gives a sense of belonging to its inhabitants, without having a specifically defined territory or population. Yet, in a neighborhood, various food neighborhoods can coexist, nucleated around, or connected to public food markets, or through the relationships established by their inhabitants, regardless of political or administrative differences. Today, urban orchards are considered an important component of food neighborhoods as it provides access to affordable and fresh and nutritious food locally produced.

AGRUPAR also distinguishes the scales of intervention. An activity such as urban agriculture typically has positive consequences at the food-neighborhood level by providing food to its population. However, it must be noted that on a larger scale, for example on a parish or metropolitan level, that is insufficient.

Currently, one of the challenges of urban agriculture, based on the type of agroecological approach that is implemented in Quito, such as developing creative solutions with a holistic, nature-based approach to agriculture. There is evidence of additional benefits such as erosion control practices which are used to recover degraded urban soil that does are not typically used for agriculture. This could be achieved by conserving the fertility and soil biota (considering the soil as a living being that can be restored, maintained, and improved), using urban organic waste for compost and humus production, or utilizing the soil as a base for "hotbeds." Additionally, minor animal farming in permitted areas of the city allows a regular supply of compost for the maintenance of soil fertility.

For food production in spaces that do not have soil available, such as balconies, patios, and terraces, it is essential to guarantee the supply of organic inputs with an agroecological base. These spaces have led individuals and communities to find practical and simple solutions, such as using boxes, bottles, tires, vertical PVC tube modules, among other alternatives. However, these solutions require external contributions of organic fertilizer. Combating weeds, pests, and diseases in crops, without putting public health at risk, requires the use of alternative means such as bio inputs and controlling invasive species by natural means.

These organic inputs are preferably made in the production unit itself, exchanged between farmers, or acquired externally. If acquired externally, these products must be compatible with organic regulations or certified. All in all, agro-ecological production has created alternatives that resemble the normal function of nature and thereby, enables circular economies.

For production practices, the use of seeds, seedlings, and dissemination training materials (please refer to [Table 1](#)) must respond to specific geographic conditions, seeking the rescue, preservation, and multiplication of own/native varieties, in addition to considering others that may initially be from an external provider, but necessary to increase agrobiodiversity from the urban farm and contribute to a diversified diet. Under no circumstances does AGRUPAR accept the use of genetically modified organisms ([Rodríguez, 2018](#)).

AGRUPAR represents an important source of income and savings for urban farmers. It is also an urban sustainability strategy that contributes to improving peoples' living conditions, enables nutrient recycling, develops water management, and promotes biodiversity. AGRUPAR also has a positive impact in the reduction of deserts and food swamps, increasing the availability of food in situations of chronic stress or of severe disruptions of the agri-food system due to environmental, political, or socioeconomic events.

Since 2002, AGRUPAR has been promoting the self-production of food by taking advantage of vacant, unproductive, or underutilized spaces in the city as a strategy to effectively increase food security with sovereignty and improve food and urban resilience. At a neighborhood scale, AGRUPAR improves the availability, access, and quality of food consumed

TABLE 1 AGRUPAR training topics.

Training provided by AGRUPAR	
Topic	Content
Urban Agriculture	Food safety, installation of the urban orchard, production of organic fertilizers, planting, crop management, pest and disease control, harvest, post-harvest, planting, and the phases of the moon.
Productive Infrastructure	Construction of greenhouses and installation of drip irrigation systems.
Poultry Farming (quail, chicken, and posture birds)	Facilities, feeding, and reproductive and sanitary management.
Beekeeping	Installation of the apiary and management of hives.
Guinea Pig Breeding (animal protein for the Andean region)	Facilities, feeding, and reproductive and sanitary management.
Therapeutic Use of Food	Medicinal use of food grown in orchards.
Healthy Food Habits	Promotion of adequate nutrition to avoid chronic non-communicable diseases.
Food Processing	Add value through the processing of production surpluses: snacks, baked goods, meat, food preservatives, and dehydrated food.
Production Costs	Elaborate costs of crops that are implemented in the orchard to define sale prices and profits.
Quality Certifications	Compliance with local regulations.
Seed and seedling system	
AGRUPAR's Role	Acquires the necessary material for the beneficiaries in quantities that fulfill a didactic purpose for learning and allows for the first plantings.
Beneficiaries' Role	Acquire and/or generate their own seeds for Andean crops (12 h of light and 12 h of darkness, and not having four seasons). The main objective is to have local varieties from the Andes, such as potato, oca, mashua, melloco, quinoa, amaranto and complemented with products from other origin centers, such as fruits and vegetables and medicinal plants. AGRUPAR does not allow for GMO as it has an agroecological base. Women farmers have been trained to form micro-enterprises with certified production of seedlings, subsequently acquired by AGRUPAR, to be used by other farmers safely.

Source: AGRUPAR.

by neighbors, while respecting the diversity of options typical of a multicultural society. Quito's urban orchards have a production capacity of 1.35 million kilograms of healthy food each year, of which 57% (769,000 kilograms) is consumed by producers and their families and 43% (581,000 kilograms) is sold *via* various short supply chains. Each week, about 11 tons of fresh and healthy food are destined for the city's most vulnerable neighborhoods.

Under a gender lens, according to a study (unpublished), "Growing More Than Food: Urban Agriculture & Empowerment, A Summary of Findings," by Kate Oviatt from the University of Colorado, 2016, in terms of empowerment, the results of urban agriculture are positive. Regarding the economic independency of women, 88% of women expressed they have control over their own money and 11% noted they share control with their husbands. In reference to food literacy, it was determined that 89% of urban farmers have learned about healthy eating and 99% believe that urban orchards have improved their family's nutrition. In fact, 91% of urban farmers found that they were eating more fruits and vegetables. Additionally, 93% of these farmers noticed that they are more active during the day and 98% say that the quality of the food

their family consumes has improved. In conclusion, 83% of urban farmers say that their overall health has improved.

Furthermore, researchers in Ecuador found a direct association between women's empowerment in agroecology and their diet. Women involved in agroecology are able to build social and human capital through their engagement in local markets and barter. These women also recognize that diversity in the farm is reflected in the diversity on their plate (Deaconu et al., 2019). Related to this, a study developed in the Peruvian highlands demonstrates a clear association between farm biodiversity and dietary improvement among women (Jones et al., 2018).

Urban agriculture, urban resilience, and food resilience

The generation and adaptation of food production systems to the urban ecosystem face fundamental challenges that go beyond urban farming and must be faced with broader sustainable food policies. To achieve the success of agricultural production in the urban area it is necessary to reflect on

TABLE 2 Processed products in Quito.

Type of processed products	%
Meat	26.47
Preserved Food	21.76
Snacks	20.00
Baked Goods	17.06
Dairy	14.71

Source: AGRUPAR's census 2020.

possible shocks and the effects of climate change. Accompanying measures must be applied to maintain stable and diversified food systems to improve the resilience of urban orchards, and in a larger extent, contribute to the food resilience of neighborhoods, first, and of the city, later. As of today, in the context of urban and socio-economic development in Quito, achieving food security with sovereignty means strengthening the city's capacity to face severe disruptive events of environmental, social, economic and political nature. Quito is no stranger to these types of disruptions that severely impact the nutrition and well being of the population.

In October 2019, indigenous organizations, and a large part of the population, protested in response to harsh economic measures established by the Executive Power. Such measures included the elimination of the fuel subsidy and cuts to public spending. Tens of thousands of people mobilized, blocking the access roads and the main roads of the city. After 14 days of blockades, the shortage of fresh food was notorious, especially in the low-income neighborhoods in the south and north-west of the city. This is not the only example of a social mobilization blocking Quito's streets and causing severe food shortages. Similar situations took place in 1997, with protests that culminated in the resignation of President Abdalá Bucaram. In 2000, President Jamil Mahuad resigned after an economic crisis that resulted in the dollarization of the country. In 2005, President Lucio Gutiérrez was also removed after deep social unrest. Today, the COVID-19 pandemic, once again, has tested the capacity of urban agriculture to contribute to food security with sovereignty, especially in the low-income sectors. These events have left us with important lessons.

Based on the urban resilience concept proposed by Meerow et al. (2016), we know that food resilience is a property of complex systems which exist when the socio-ecological and socio-technical networks that constitute the city (at different temporal and spatial scales) manage to maintain or can quickly return to previous functions, guaranteeing availability and access to sufficient and nutritious food for all people permanently.

Thus, it is the ability of a system to adapt to a changing context that can affect its operation. However, Quito's agrifood system is particularly vulnerable since only 5% of the goods consumed in the city are produced within the city's limits. This

production is continuously threatened by the real estate and housing market. As a result today the concentration of supply goods occur in two opposite points of entry in the city that, in turn, connect with large areas of the country that are highly exposed to natural hazards. In this scenario, during the response to face political disruptions or the sanitary emergency, Quito's urban orchards were able to reconfigure some of its food outlets to offer solutions to the food provision problems at various scales and without losing the ability to provide healthy, uninterrupted, and diverse food for producing families. AGRUPAR assisted in the scarcity of food with surplus produce.

Surplus produce was sold *via* four channels:

- Occasional sales as crops are ready for harvest (a few bundles of radishes, a few kilos of tomatoes or potatoes, a couple of heads of broccoli, cabbage, lettuce, and chicken, among others).
- Weekly sale of baskets of 10–15 seasonal varieties (possibly including chicken, pork, or eggs) to families in the neighborhood or in nearby towns; transactions which take place in the garden.
- Sale of a fixed quantity and selection of produce *via* collaborative supply chains. Transactions are made through a third party, who establishes contact with consumers, assembles baskets by collating surplus produce from various producers, and delivers them to homes.
- Barter.

One of the best ways to increase the resilience of a population is to reduce the socio-economic vulnerability in the city in a sustained way to avoid increasing food risk, especially among the poorest. This is possible as shown above. However, it is important to remember that urban agriculture must be considered a constituent part of a much broader agri-food system. Its role and scope are essential and contribute to forming strategies that help to address challenges at different scales, and this should be incorporated into urban planning instruments and policies. Doing this, amplifies the city's response capacity and scale to a socio-economic vulnerability.

It is imperative to understand the role of the different actors in the system. In 2017, the Agri-Food Pact of Quito (PAQ) was created, where different representatives expressed their commitment to developing a sustainable and resilient agri-food system to guarantee the provision of healthy food for the entire population, especially for the most vulnerable (Santandreu et al., 2019). This organization created multiple synergies and thus, an opportunity to advance in the governance agenda in favor of further public policy planning and response capacity to face disruptive events.

Based on the Trajectories of Change approach (Santandreu and Betancourt, 2019), which starts by recognizing previous actions implemented by communities to identify problems and

solutions, the Food Action Plan, as part of the Agri-Food Strategy of Quito, proposes key policies that cover at different scales the entire value chain and strategic dimensions of the agri-food system.

A conceptual framework, known as food hubs, aims at uniting the human right to food, the right to the city, and the sovereign approach to food security, as components of a sustainable food environment without degrading it (Cohen-Shacham et al., 2016). This framework is a result of a previous study carried out in Quito and differs from other studies of food hubs by going beyond a simple analysis of food distribution in cities (Argüello et al., 2017). This plan relates different components of the food value chain in a systemic understanding to plan for the improvement in the operation of the whole system (Jácome-Pólit et al., 2019a). The study identified food hubs as one of the food public policy actions most likely to strengthen food resilience by connecting, at the food neighborhood scale with a great diversity of actors in the agri-food system.

Examples of these include urban orchards, markets, bio-fairs food distributors (formal and informal), stores, supermarkets, hotels, restaurants, food programs, public food infrastructure, and consumers. Under this approach, urban agriculture has the potential to promote strong relationships between people and institutions on a local scale therefore improving the social fabric and the capacity for a collective response to a disruptive event. Although their contribution in the quantity of food is not significant at a city scale, their contribution to the connection between people in different components of the food system is extremely significant and increasingly necessary (Jácome-Pólit et al., 2019).

Later, understanding the environmental and social impacts that occur at each stage of this interconnected system is possible by identifying the links between production (urban agriculture and rural food production), transport and storage (logistics and urban mobility), marketing (in markets, fairs, stores, warehouses, supermarkets, hotels, and restaurants), consumption (by people, social organizations, and institutions such as schools), social programs (provide food), food reuse, and waste management programs.

To a greater extent, the Quito Agrifood System Resilience Strategy (a work in progress) proposes food hubs as centralities connected at a metropolitan scale (see Figure 2). As a mechanism, neighborhoods, urban and peri-urban areas, and rural agricultural landscapes, should be considered by the institutions that formulate public policies at different governmental levels to manage the whole system. In this context, food hubs are planned territorially and function as a distributed network that permanently offers accessible sociocultural-relevant foods, especially where they are most needed (see Jácome-Pólit et al., 2019b). A food hub has a level of autonomy, but at the same time, it can jointly work with other food hubs, creating an increasingly self-sufficient system. This is,

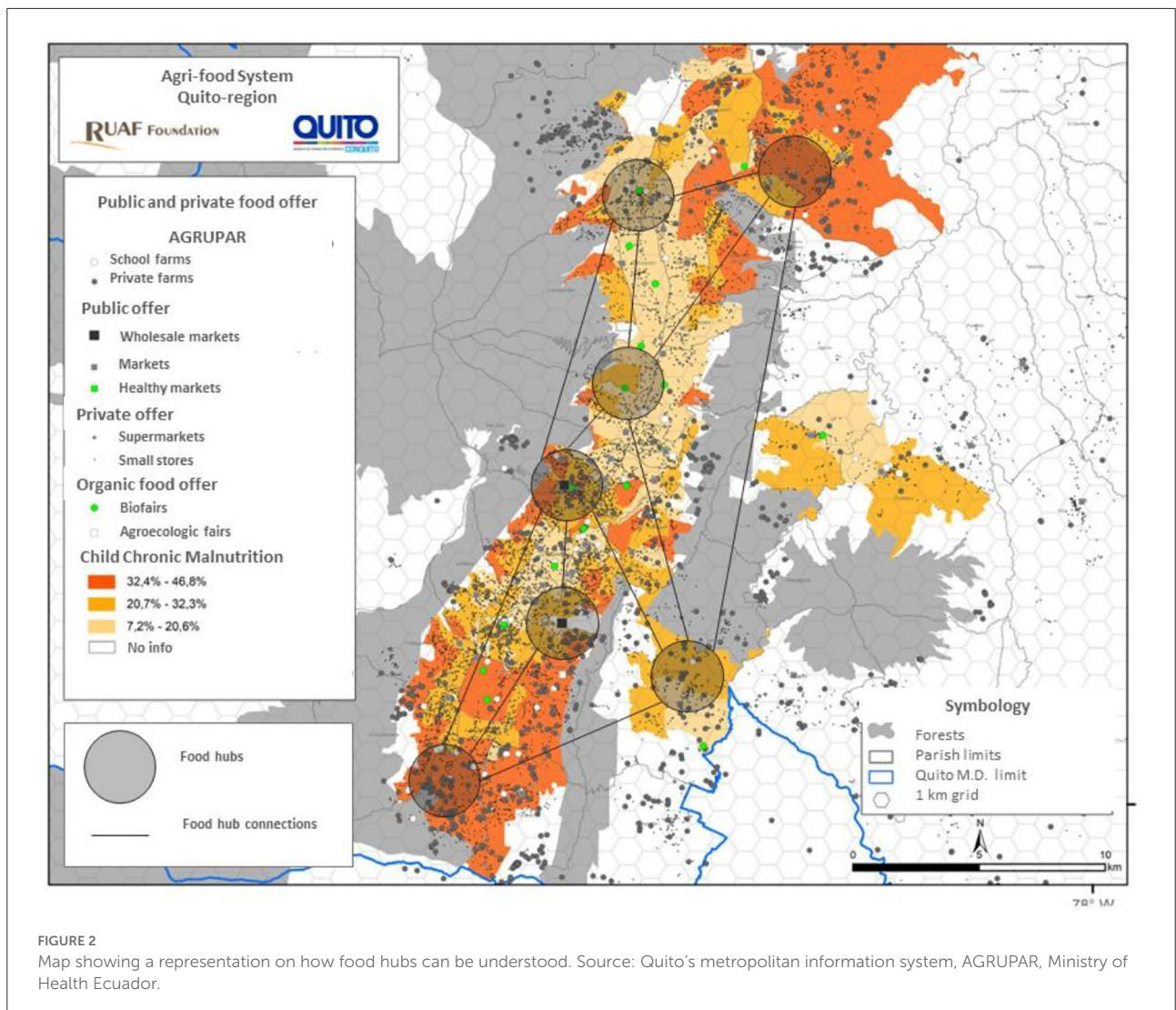
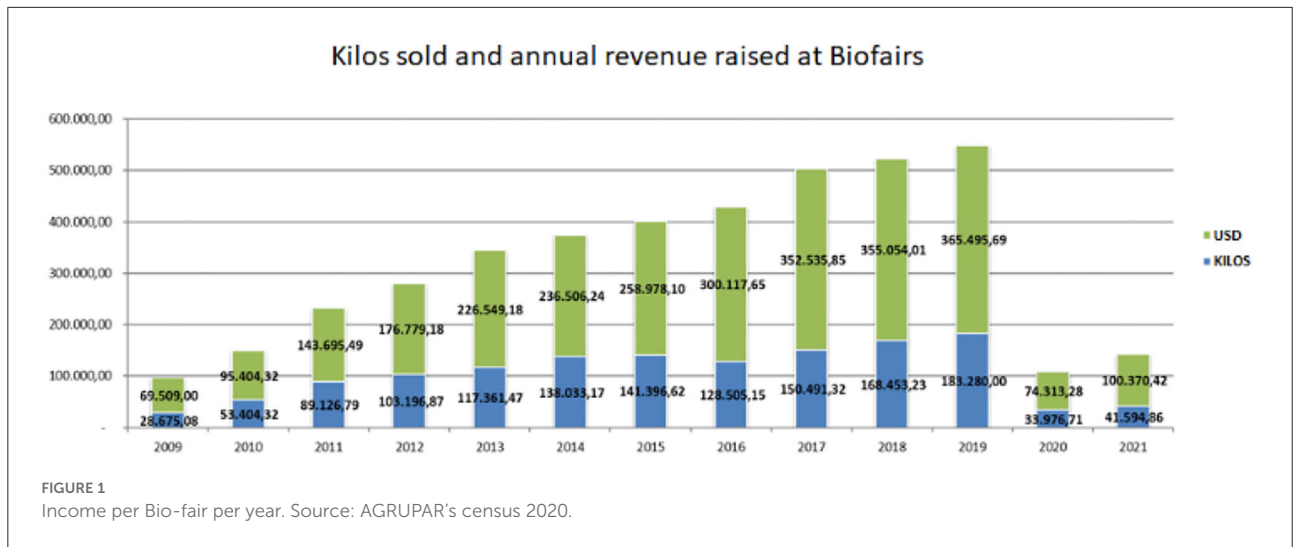
arguably, the most important aspect that builds resilience into the city's food system.

This is where urban food production with an agro ecological base takes a different dimension. For this reason, the inclusion of food hubs as urban planning tools, that includes urban farming, is necessary. People are encouraged to produce healthy food locally, thereby responding to the need to expand the program which includes the development of urban agriculture, use of land, and work. These benefits are extended to other areas of urban management, and help create suitable and healthy food environments by taking advantage of the 13 sq. per capita of green areas available in the city that could offer local and fresh produce for more people.

Furthermore, in a recent study, Paredes (2019) analyses urban agriculture as a mechanism of climate change adaptation, but its effectiveness depends on the scale it intends to support (Adger et al., 2005) and recognizes its positive contribution at a neighborhood scale (Dubbeling and de Zeeuw, 2011). The contribution of this practice lies mainly on reducing vulnerability in social and economic dimensions (FAO, 2014) and, therefore, also reducing the risk posed by climate threats amplified by climate change. However, this capacity is closely related to the system's ability to adapt which in turn is determined by links and feedback loops with other parts of the system.

In the case of AGRUPAR, the reduction of vulnerability as a result of urban agriculture is highly evident at the household and food neighborhood levels. This results partly from strengthening capacities and implementing individual and community urban orchards with direct and continuous technical support for farmers, many representing a highly vulnerable population (Dubbeling and Rodríguez, 2016). The economic independence of female farmers, their improved eating habits, and the empowerment of women are among the documented benefits that show a reduction in vulnerability (Papuccion de Vidal, 2011). Additional factors are the inclusion of other vulnerable actors in decision-making, the developing and strengthening of social networks, personal satisfaction and trust, among others (Oviatt, 2016). Yet, on a metropolitan level, contribution to climate change adaptation and the strengthening of municipal food resilience is lesser.

As a response, urban agriculture has been included in the Climate Action Plan 2015-2025 (and its update to 2050), the Resilience Strategy, and the Agri-Food Strategy of Quito. These strategies, together with the Milan Urban Food Policy Pact signed by the Mayor of Quito in 2016, are all important steps toward a greater understanding of food as a systemic and complex phenomenon that has urban agriculture as one of its touchstones. In 2021 the Land Use and Development Plan, an instrument that guides and organizes the Municipality of Quito's actions allows for budget allocation, placed food security as the foundation of an inclusive and ecological development of the



city, and strategic guidelines to scale AGRUPAR's operation have been included. Nevertheless, this is still not sufficient.

Positive contributions on neighborhood and community scales are largely defined by the availability of resources for logistics, which in turn, provide localized assistance to farmers. However, these regulation need to extend to the peri-urban and rural realms, especially when roughly 12% of the area in the Metropolitan District of Quito is considered urban. Until now, these demands for regulations and actions at planning levels go beyond the scope of the program. So far, urban and peri-urban agriculture programs and projects to scale and amplify the capacities of the local government to this end and have yet to be designed and implemented.

Furthermore, AGRUPAR's success shows that it has managed to meet the particular needs of urban farmers and families. This program also benefits from conditions such as the existing agricultural vocation of the population. Traditional and local knowledge that benefits the practice, and the social dynamics of associativism are prevalent in the communities enabling families to adopt AGRUPAR's plans and systems. Yet, the low occurrence of the project as a measure for adaptation to climate change and the city's food resilience shows a deficient capacity to formulate policies and programs that allow amplifying its benefits. This speaks to the complexity of the administrative system of the city and the country.

Relevant actors in the city planning processes have identified a lack of vision, political will, knowledge, and techniques when it comes to incorporating climate change measures in urban development policies. Similarly, in Quito there is evidence of risk management practices that are focused mainly on the response to face disruptive events, leaving prevention and mitigation aside, not to say that the food agenda is usually overlooked. Overcoming these barriers presents an opportunity to strengthen urban agriculture as a measure for climate change adaptation transcending the neighborhood scale. This will also help projects to advance beyond the socio-economic agenda and contribute to the environmental agenda as a possible climate change mitigation and adaptation strategy.

It has been recognized that sustainable and healthy food access impact in different ways all the sustainable development goals¹ and that efforts improving nutrition extend beyond SDG2 and contributes to other SDGs, such as SDG3 improving health and SDG1 working to end poverty², which in turn can contribute to close socioeconomic and spatial gaps in

cities. This can have important consequences when managing risks in cities like Quito and others by improving the capacity to access and/or replace dwellings (see Hallegatte et al., 2017). In this light, multidisciplinary collaboration is required to contribute simultaneously to different agendas, such as climate change adaptation and mitigation, drastically reducing biodiversity loss and tackling malnutrition in all of its forms.

Evidence indicates that important synergies can be created by designing interventions that support the nexus between biodiversity, sustainable production practices, reduced levels of malnutrition and enhancing the resilience of the communities. This systemic approach puts food at the center as the strongest lever to optimize human health and environmental sustainability while ensuring social equity, especially for the most vulnerable (FAO, 2021).

Conclusions

Urban agriculture allows us to envision a renewed relationship between cities and agri-food production while strengthening food security with sovereignty and resilience. This is the objective of The Urban Agriculture Program in Quito (AGRUPAR). The programme has managed to leverage the city's long-standing history with agriculture, its remaining practices to promote and support urban agriculture, and more recently, the construction of an agri-food public policy. For more than 20 years, AGRUPAR has promoted social cohesion, healthy nutrition, the adoption of agroecological principles, and a social and solidarity-based economy, all of which demonstrate important results reducing vulnerability at a neighborhood scale. Nevertheless, considering that Quito is prone to disruptive events, which will be exacerbated in climate change scenarios, AGRUPAR seeks to expand the impact of its practices to a metropolitan scale, triggering food resilience-building processes. These have positive consequences in different manners, among them: by becoming a valid alternative to a process of rapid urbanization that hinders the capacity of the city to produce food within its limits; by strengthening the capacity of quiteñas and quiteños to produce local, agroecological, diverse and nutritious food; and by conserving the fertility and soil biota while creating circular economy processes, among others.

Achieving food security with sovereignty requires important efforts on various points of the food chain such as, addressing underlying and multidimensional structural problems that make current food systems operate erroneously and contribute to the creation of vulnerability in the population. Multiscale analyses of the agri-food system demonstrate that urban agriculture is an important component that strengthens the social fabric and bring institutions and people closer. However, it must be part of broader actions and must accompany

1 A new way of viewing the Sustainable Development Goals and how they are all linked to food, available online at: <https://www.stockholmresilience.org/research/research-news/2016-06-14-the-sdgs-wedding-cake.html>.

2 NUTRITION AND THE INTERLINKS WITH ALL GLOBAL GOALS, available online at: <https://www.powerofnutrition.org/nutrition-and-the-sustainable-development-goals/>.

other strategies. In this context, the concept of food hubs is presented as a viable option to strengthen food resilience by connecting various actors of the agri-food system, forming collaboration between actors, and organizing systems. Quito's Agrifood System Resilience Strategy proposes that food hubs be planned and connected territorially and have the capacity to be self-sufficient on a higher degree, yet also work jointly with other food distribution centers building resilience into the city's food system. Together with this, and understanding that the urban periphery and rural area of the Metropolitan District of Quito is large and has a major agricultural production component, the program seeks to scale up urban agriculture and the proposed food hubs serve to take advantage of urban agriculture in a wider territorial scale, for example by promoting productive reconversion of land in peri-urban areas (such as green belts); the creation and management of legal figures for the protection and promotion of agricultural soils (such as urban and peri-urban "soils"), the promotion of agricultural educational parks and the further integration of urban agriculture into the city landscapes. The development of land management policies and secure access to land are fundamental for the sustainability of the local food system and have been included in the Development Plan of the city, yet they remain to be implemented.

Although the amount of food produced under the program may seem insufficient on a metropolitan scale, the adoption of urban agriculture as a means to reconnect people, nature, and cities, is key. Urban agriculture is pivotal in the development of a metropolitan resilient agri-food system and the establishment of food hubs in the city. The success and continuity of AGRUPAR has allowed it to build a strong network across the food chain and lead important public policy processes such as the construction of the Agri-Food

Strategy of Quito and the inclusion of urban agriculture in the city's Climate Action Plan, compounding important steps toward the much-needed transformation of the system and the city's future.

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DJ-P and AS developed theoretical formalism. AR and DP contributed extensively with field research and analysis. AR, DP, DJ-P, and AS authors contributed to the final version of the manuscript. All authors discussed the results and contributed to the final manuscript.

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