Review paper
10.7251/AGRENG2201048K
UDC 631-027.541(620)

URBAN AND PERI-URBAN AGRICULTURE IN EGYPT

Islam Mohamed KAMEL, Hamid EL BILALI*

International Centre for Advanced Mediterranean Agronomic Studies – Mediterranean Agronomic Institute of Bari (CIHEAM-Bari), Valenzano (Bari), Italy
*Corresponding author: elbilali@iamb.it

ABSTRACT

Around the world, urban and peri-urban agriculture (UPA) has evolved into a new socio-political manifestation that can endorse social solidarity, environmental education, and leisure activities. It is also a way to support the urban poor in middle and low-income counties and ensure food sovereignty and self-sufficiency. Furthermore, global shocks, pandemics, and crises (e.g., food crisis 2008, COVID-19, climate change) have illustrated the vulnerability of the global food supply chain, as well as the need for resilience in cities' long-term food security, shedding more light on UPA's multiple functions in densely populated areas, offering an alternative land use and greater genuine value. Considering the present worldwide governmental push to promote urban agriculture and contemplate its consequences on urban dwellers and their environs, it is vital to investigate Egypt as one of the world's most populous countries, with densely packed cities and significant poverty rates. Using a systematic literature review, this article studies the impact of UPA in Egypt. Data were gathered using the Scopus database and supplemented with information from grey literature. The findings demonstrate that UPA can perform a wide range of socio-economic and environmental roles, including aesthetic urban design, waste management, circular economy, energy use efficiency, microclimate control, preservation of cultural heritage, biodiversity conservation, and health and well-being promotion. However, there is possible apprehension concerning soil erosion, extensive use of fertilizers and pesticides, contamination from wastewater resulting from the poor implementation. Finally, while UPA can make a beneficial difference in Egypt, socio-political, cultural, and technical hurdles may stymie its growth.

Keywords: *urban agriculture, sustainability, food security, sustainable cities, Egypt.*

INTRODUCTION

Ancient Egyptian and Roman civilizations managed to build self-sufficient and sustainable cities that have lasted for thousands of years (Groening, 2016). Unfortunately, nowadays the majority of cities especially in developing countries confront several challenges in terms of urban planning and development. These concerns have a major influence on their socio-economic and environmental performance. Egypt's cities are no exception since they have been experiencing

rapid urbanization and industrialization in recent years (Hegazy, Seddik and Ibrahim, 2017). Egypt's current population is 104,412,590, of which 43.0% live in urban areas. Cairo is the most populated city in Egypt with about 21,322,750 inhabitants. Nearly all of the country's population resides in Cairo, Alexandria, or other cities near the Nile River and the Suez Canal. Cairo and other large cities in Egypt are among the world's most densely inhabited areas (WPR, 2021). Moreover, air pollution resulting from industrial activity and the huge number of cars (estimated to exceed 2.3 million in Cairo alone), inadequate waste management, and high concentrations of hazardous and radioactive substances (e.g., lead and promethium) have grown (Zakey *et al.*, 2008).

Egypt's poverty rate is estimated to cross 29.3% in 2021 (Statista, 2021). Besides, unemployment has reached 37% among youth in 2016; this figure is expected to be even higher considering the impact of the COVID-19 pandemic. Egyptian youth are still misled and confused; demands for equality, social justice, and better livelihood are the most pressing issues confronting the Egyptian people (Mansour, 2016; Nasr-Allah et al., 2019). Food insecurity, malnutrition, gender-based inequality, and climatic shocks are among Egypt's long-standing development difficulties (WFP, 2021). Furthermore, within the upcoming 15 years, the present phenomenon of urban growth will confront tremendous demand on lands, putting urban and rural communities under unprecedented strain. The present policies and approaches cannot deal with the future challenges regarding the direction of urban development. Many researchers, on the other hand, argue that distinctive innovations might have a positive impact on urban planning that should be examined and incorporated within the Egyptian setting (Mahmoud and Divigalpitiya, 2015).

Many studies have suggested that adopting agricultural practices within urban and peri-urban areas can contribute to addressing urban food insecurity, poverty, malnutrition, and health problems, and mitigate different environmental and social challenges (Zezza and Tasciotti, 2010). UPA is a process involving horticulture, animal husbandry, aquaculture, and other activities for generating fresh food or other agricultural goods in urban districts and their surroundings (peri-urban). It is defined as "*an industry that produces, processes and markets food and fuel, largely in response to the daily demand of consumers within a town, city or metropolis, on land and water dispersed throughout the urban and peri-urban area, applying intensive production methods, using and reusing natural resources and urban wastes, to yield a diversity of crops and livestock"* (UNDP, 1996). Moreover, it encompasses all persons, groups, activities, sites, and economies that focus on primary production in a spatial environment in addition to its positive externalities and co-benefits on the environment and society (Skar *et al.*, 2020). Notwithstanding the importance of UPA, few studies have investigated its importance in the Egyptian context, yet it did not touch all its dimensions or provide a comprehensive view of UPA and its impacts. Therefore, the objective of this paper is to assess the current situation of UPA in Egypt and investigate its impact on mitigating the current sustainability challenges in Egyptian cities.

MATERIAL AND METHODS

Data were collected through a systematic literature review on the Scopus database on the 15th of June, using different search keywords to grasp every piece of information about UPA in Egypt. Different sets of keywords were used such as Egypt AND "urban agriculture"; Egypt AND "urban farming"; Egypt AND "urban gardening"; Egypt AND "urban horticulture"; Egypt AND "vertical farming"; Egypt AND "urban animal husbandry"; Egypt AND "urban aquaponics"; Egypt AND "hydroponic". After removing duplicates, the search yielded 177 publications, which were filtered by title and abstract according to their relevance to the study as illustrated in figure 1. Finally, 23 publications including original research papers and book chapters were selected. Furthermore, data from grey literature (e.g., institutional statistics and reports) were included.

The following two sections will discuss the main results, conclusions, and recommendations for the different forms of UPA including aquaponics, roof gardening, livestock, and dairy production besides, their pros and cons within the Egyptian cities.

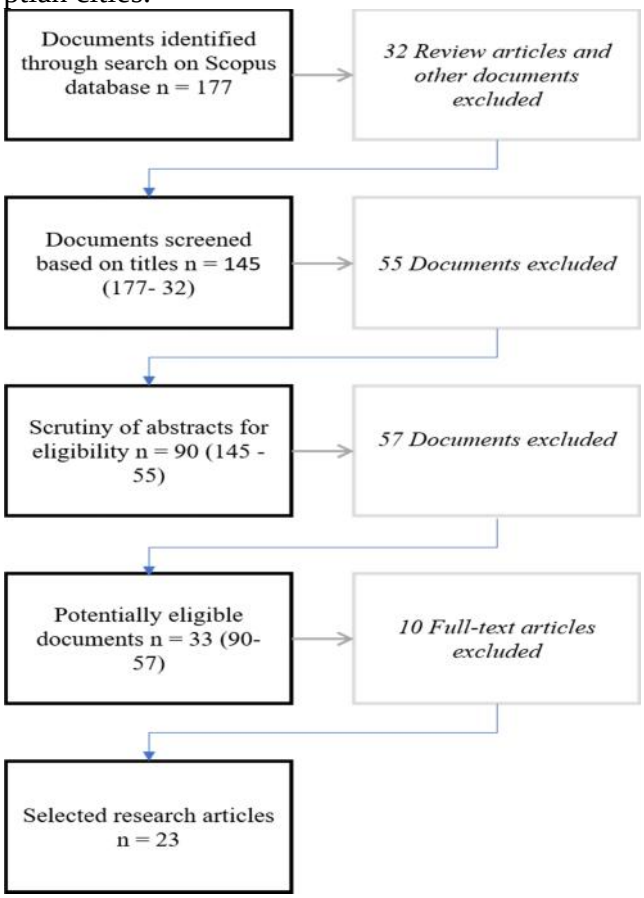

Figure 1. Process and steps of the systematic review.
Source: Adapted from Moher *et al.* (2009).

RESULTS AND DISCUSSION

Major worldwide changes are taking place rapidly, altering people's wellbeing, productivity, and livelihood. Challenges that represent a threat for Egypt include water shortages and food insecurity, combined with a substantial increase in population especially in the major cities as a result of migration from rural to urban areas. That has resulted in the extensive increase of informal settlements in urban areas. Cities such as Cairo, Alexandria, Kafr Elsheikh, Sohag, Asyut, and El-Beheira are experiencing rapid population growth and are showing a keen interest in lateral population expansion, which is causing loss of agricultural land and increasing the threat of food insecurity (Elbeih et al., 2011; Mahmoud and Divigalpitiya, 2015; Nassar and Elsayed, 2018; Afifi and Darwish, 2018; Mohamed and Yacout, 2019; Salem et al., 2019). Moreover, this expansion is jeopardizing the infrastructure and deteriorating the cities' ability to absorb the rising population (Mohamed and Yacout, 2019). It also impacts the agri-food production and consumption market and poses major complications to the country's agricultural sector (El-Essawy, Nasr, and Sewilam, 2019).

The revolutionary implementation of Egypt's new cities is based on achieving three key aspects: housing, employment, and providing services to meet people's needs. However, this is not enough, as Egypt faces numerous sustainability problems; growing air, water, and soil pollution, nonrenewable energy usage, and water shortages (Sheweka, 2012). Indeed, these disasters are a consequence of the last three decades' misleading and corrupted Egyptian national policies. In this sense, the most often discussed subject in developing cities throughout the world is sustainability (Hegazy, Seddik, and Ibrahim, 2017). Several schemes have shown that UPA can change our living conditions into one that is both environmentally sustainable and healthful. Moreover, it could contribute to energy use efficiency, natural resource conservation, ecological biodiversity, and cost savings in urban and peri-urban management (Ibrahim and Elariane, 2018). Urban agriculture takes various forms, and it is frequently a component of city planning authorities' responsibilities. It includes gardening in schoolyards, public roadside and community gardens, urban farms, rooftops and balcony gardens, hydroponic, aquaculture, and vertical gardening, keeping small livestock (e.g., hens, rabbits), beekeeping, greenhouses, permaculture design in parks, edible landscaping, public orchards or food forests, and agriculturism (Martin and Wagner, 2018).

Systems like aquaponics are becoming increasingly essential as vertical agriculture is getting more fashionable and feasible in urban areas. It's a low-input, low-waste, and sustainable food production system that uses circular economy concepts and a biomimetic natural system to decrease waste. An aquaponic system is a blend of two primarily farming systems: circular aquaculture, which involves the farming of fish in a tank, and hydroponic agriculture, which involves the growing of vegetables in a soil-less medium. Each of these techniques is popular throughout the world for its production, quality, and food safety. It is an efficient mechanism that perfectly integrates intensive agriculture with sustainable growth (Wirza and Nazir, 2021). Aquaponics is a long-term resolution to several challenges since it

offers new business and start-up opportunities while also displaying promising results for urban food supply especially for developing countries like Egypt (El-Essawy, Nasr and Sewilam, 2019). The awareness among youth about urban farming is increasing since many entrepreneurial activities in Egypt are taking place by initiatives such as "Grow Your Own" in Cairo governorate, "Your Roof Is Your Paradise" in Beheira governorate, "Shagara Roofs" in El Abour City, and the "Egyptian Switchers Community" to encourage urban gardening (Groening, 2016).
Giro et al., (2016) investigated the impact of a simplified hydroponic system to produce vegetables for the locals at the city of the Dead called Al Quarafa, one of the poorest slums in Cairo, whose people are suffering from malnutrition and extreme living conditions. The soil in that area is polluted with heavy metals as well as airborne impurities that can contaminate the produce. The research team advised the locals to use palm boxes, which are available materials in the area for cultivation, as a good compromise between efficiency and production cost. The study showed that aquaponics can provide an output free of contaminants since it does not use the polluted urban soil that is prevalent in slum areas. It also can provide vegetables, scarce food items due to their perishability and high cost. Residents of Al Quarafa consume a Mediterranean diet rich in grains and legumes, thus including vegetables in their diet will help them overcome malnutrition. According to the findings, hydroponics can help cities better their condition and satisfy the needs of individuals living in disadvantaged areas. While aquaponics offers more economic and ecosystem services than drawbacks, there are technical and behavioral restrictions that must be taken into account when adopting it. The most significant issue is the high requirement for surveillance, control, and technical expertise. Aquaponics' initial startup expenses are excessive when compared to traditional agriculture and land reclamation, making it difficult for entrepreneurs and start-ups to compete with large investors. Furthermore, aquaponics is hampered by a scarcity of qualified specialists and laborers on the market (El-Essawy, Nasr, and Sewilam, 2019). In addition, the reuse of polluted, untreated irrigation water from urban streams poses a health concern. UPA's heavy use of fertilizers, pesticides, and fungicides may result in agrochemical residues in crops or groundwater. The danger is most prevalent in places where commercial urban farming is practiced (Chatterjee, Debnath, and Pal, 2016).
Another example of UPA is animal husbandry, which may take many different production forms whether for livestock fattening or dairy processing. Production systems are diversified, with a variety of players making a living at various places along the value chain. Urban livestock is typically maintained in backyards or allowed to scavenge due to land scarcity, while peri-urban farms may be extensive and very commercial. The most common type of agriculture in Egypt is polyculture-livestock family farming, which accounts for the majority of agricultural output, with a considerable amount produced in urban or peri-urban regions. Simultaneously, commercial agriculture is expanding, both for domestic consumption and exportation (Daburon *et al.*, 2018).

A survey was done in two low-income neighborhoods in Egypt; Zabaleen area, an existing informal settlement in Agouza city, and Masaken Osman in the 6th of October city; to study the feasibility of urban animal husbandry (Ibrahim and Elariane, 2018). Poultry and lambs are raised by 50% of Zabaleen inhabitants while pigs are raised by 31.3%. Moreover, about 76.2% of those at Masaken Osman, on the other hand, rear chicken. In Zabaleen and Masaken Osman, accordingly, 68.8% and 95.2 % raise animals for personal use. Moreover, for those who do not own any type of animal or poultry, there are a few options; about 34.6% believe they have negative effects, while 44.2% believe they have good ones, 59.6% support raising them versus 34.6% that do not. Despite the contradiction of opinions, urban animal husbandry can be a viable option since it frequently produces profitable goods. Furthermore, for the reason that some species sustain themselves by scavenging, they may be kept even without specific territory, such as in backyards. This type of production is generally done in parallel with other activities and involves tiny creatures that are inexpensive to buy, sell, multiply fast, and maybe by fed domestic waste (Moekti, 2020).

However, animals can cause issues such as odor, risk of infection linked with poor sanitary conditions, contamination of rivers, and waste from abattoirs, or neighbor disputes when they enter and destroy gardens, causing the unpleasant smell, dust, and noise, as well as devastation to ornamental plants. Furthermore, concerns about overgrazing of metropolitan gardens, space requirements, wayward animals and traffic issues, animal welfare, production of a small portion of total dietary needs, unregulated marketing, aesthetic preferences, and fears about property value are all issues that need to be addressed (Mantovani, 2004). Despite their benefits in supplying food and guaranteeing improved income levels for impoverished urban households, there are no official regulations involving urban agriculture and animal husbandry in Cairo during the colonial era or later in the independence period (Ibrahim and Elariane, 2018). This would have an impact on the future sustainability of various urban farming techniques that should be encouraged to combat urban expansion, which divides huge open spaces, lowering agricultural land by nearly 80% by 2030 (Robson *et al.*, 2012). Thus, highlighting the critical need of developing regulations and monitoring procedures to minimize any negative consequences of such activities while still maintaining their economic relevance is crucial (Robson *et al.*, 2012). Appropriate governance at the local level is required so that national environmental plans can have long-term effects and offer a coherent strategic vision for green technology diffusion and urban development. Moreover, before creating a project, it is critical to address the environmental factors and conduct an ecological life cycle assessment. It is also central to involve the public in environmental choices to focus on public health, poverty alleviation, and ecological sustainability (Hegazy, Seddik, and Ibrahim, 2017). Furthermore, it is critical to develop new programs or alter current ones, to set new priorities and dedicate resources to sustainable causes as well as raising environmental consciousness among Egyptians through education and the mass

media. Improved waste management and the use of biodegradable products that have a lower environmental impact are critical (Sheweka, 2012).

CONCLUSION

The growing world population is increasing the pressure on natural resources and food insecurity has become one of the major threats to the existence of the human race especially in developing counties. Egypt is one of the most populated nations in the world, with heavily populated metropoles and extreme poverty rates. This study aimed to investigate the impact of UPA as a way to mitigate socio-economic and environmental issues in Egypt. The study showed that there are some entrepreneurial models of UPA in Egypt including urban farms, rooftop and balcony gardens, hydroponic, aquaculture, dairy, and animal production. These models have demonstrated strong ability in supporting poor and marginalized communities, ensuring food security and self-sufficiency, health, and wellbeing. UPA can also provide attractive urban design, better waste management, green economy, energy usage efficiency, and biodiversity conservation. However, there may be concerns about soil degradation resulting from overgrazing and limited land area, the heavy use of mineral fertilizers, and pesticides. Nevertheless providing appropriate local governance and long-term policies as well as a coherent strategic vision for green technology dissemination and urban development is necessary to prevent any negative repercussions of such activities while retaining their economic relevance. Finally, while the UPA can make a positive effect in Egypt, sociopolitical, cultural, and technological barriers may impede its expansion.

REFERENCES

Afifi, A. A. and Darwish, K. M. (2018) 'Detection and impact of land encroachment in El-Beheira governorate, Egypt', *Modeling Earth Systems and Environment*, 4(2), pp. 517–526. doi: 10.1007/s40808-018-0462-9.

Chatterjee, A., Debnath, S. and Pal, H. (2016) 'Implication of Urban Agriculture and Vertical Farming for Future Sustainability', in Ruano, P. et al. (eds) *Urban Horticulture - Necessity of the Future urbanization*. IntechOpen: London. Available at: https://www.intechopen.com/books/advanced-biometric-technologies/liveness-detection-in-biometrics.

Daburon, A. *et al.* (2018) 'Urban and peri-urban agriculture, the dairy farms of Cairo, Egypt', in Bosc, P.-M. et al. (eds) *Diversity of Family Farming Around the World: Existence, Transformations and Possible Futures of Family Farms*. Springer: Netherlands, pp. 29–42. doi: 10.1007/978-94-024-1617-6_4.

El-Essawy, H., Nasr, P. and Sewilam, H. (2019) 'Aquaponics: a sustainable alternative to conventional agriculture in Egypt – a pilot scale investigation', *Environmental Science and Pollution Research*, 26(16), pp. 15872–15883. doi: 10.1007/s11356-019-04970-0.

Elbeih, S. F., Belal, A. A. B. and Zaghloul, E. S. A. (2011) 'Hazards mitigation and natural resources evaluation around Sohag - Safaga highway, Eastern Desert,

Egypt', *Egyptian Journal of Remote Sensing and Space Science*, 14(1), pp. 15–28. doi: 10.1016/j.ejrs.2011.01.001.

Giro, A., Ciappellano, S. and Ferrante, A. (2016) 'Vegetable production using a simplified hydroponics system inside City of Dead (Cairo)', *Advances in Horticultural Science*, 30(1), pp. 23–29. doi: 10.13128/ahs-18698.

Groening, G. (2016) 'Urban horticulture – Gardens as elements of an urbanizing world', *European Journal of Horticultural Science*, 81(6), pp. 285–296. doi: 10.17660/eJHS.2016/81.6.1.

Hegazy, I., Seddik, W. and Ibrahim, H. (2017) 'Towards green cities in developing countries: Egyptian new cities as a case study', *International Journal of Low-Carbon Technologies*, 12(4), pp. 358–368. doi: 10.1093/ijlct/ctx009.

Ibrahim, A. A. M. and Elariane, S. A. (2018) 'Feasibility tools for urban animal husbandry in cities: case of greater Cairo', *Urban Research and Practice*, 11(2), pp. 111–138. doi: 10.1080/17535069.2017.1298000.

Mahmoud, H. and Divigalpitiya, P. (2015) 'Part II Innovative Technologies: Modeling Future Land Use and Land-Cover Change in the Asyut Region Using Markov Chains and Cellular Automata', in Bisello, A. et al. (eds) *Smart and Sustainable Planning for Cities and Regions*. Springer: Switzerland, pp. 3–13. doi: 10.1007/978-3-319-44899-2_1.

Mansour, A. M. H. (2016) 'Sustainable youth community development in Egypt', *Alexandria Engineering Journal*, 55(3), pp. 2721–2728. doi: 10.1016/j.aej.2016.05.019.

Mantovani, A. (2004) *Urban Veterinary Hygiene in Developing Countries*. Available at: https://www.vin.com/apputil/content/defaultadv1.aspx?pId=11181&catId=30088&id=3852227 (Accessed: 15 June 2021).

Martin, W. and Wagner, L. (2018) 'How to grow a city: Cultivating an urban agriculture action plan through concept mapping', *Agriculture and Food Security*, 7(1), pp. 1–9. doi: 10.1186/s40066-018-0186-0.

Moekti, G. R. (2020) 'Industrial livestock production: A review on advantages and disadvantages', *IOP Conference Series: Earth and Environmental Science*, 492(1), pp. 1–22. doi: 10.1088/1755-1315/492/1/012094.

Mohamed, M. Z. and Yacout, D. M. M. (2019) 'Assessing the impact of urban encroachment on agricultural land in Kafr El-sheikh governorate using GIS and remotely sensed data', *Current Applied Science and Technology*, 19(1), pp. 57–65. doi: 10.14456/cast.2019.5.

Moher, D. *et al.* (2009) 'Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement', *PLoS Medicine*, 6(7), pp. 1–6. doi: 10.1371/journal.pmed.1000097.

Nasr-Allah, A. *et al.* (2019) 'Employment generation in the Egyptian aquaculture value chain: implications for meeting the Sustainable Development Goals (SDGs)', *Aquaculture*, 520, pp. 1–60. doi: 10.1016/j.aquaculture.2020.734940.

Nassar, D. M. and Elsayed, H. G. (2018) 'From Informal Settlements to sustainable communities', *Alexandria Engineering Journal*, 57(4), pp. 2367–2376. doi: 10.1016/j.aej.2017.09.004.

Robson, J. S. *et al.* (2012) 'Spatial disintegration and arable land security in Egypt: A study of small- and moderate-sized urban areas', *Habitat International*, 36(2), pp. 253–260. doi: 10.1016/j.habitatint.2011.10.001.

Salem, M., Tsurusaki, N. and Divigalpitiya, P. (2019) 'Analyzing the driving factors causing urban expansion in the peri-urban areas using logistic regression: A case study of the greater Cairo region', *Infrastructures*, 4(1), pp. 1–14. doi: 10.3390/infrastructures4010004.

Sheweka, S. M. (2012) 'New Egypt with a new hybrid skin: A new hybrid architecture vision for the Egyptians' development corridor', *Energy Procedia*, 18, pp. 449–457. doi: 10.1016/j.egypro.2012.05.056.

Skar, S. L. G. *et al.* (2020) 'Urban agriculture as a keystone contribution towards securing sustainable and healthy development for cities in the future', *Blue-Green Systems*, 2(1), pp. 1–27. doi: 10.2166/bgs.2019.931.

Statista (2021) *Egypt_ projected poverty rate 2018-2021*. Available at: https://www.statista.com/statistics/1237041/poverty-headcount-ratio-in-egypt/ (Accessed: 15 July 2021).

UNDP (1996) *Urban agriculture: Food, jobs and sustainable cities*. New York: UNDP.

WFP (2021) *Egypt | World Food Programme*. Available at: https://www.wfp.org/countries/egypt (Accessed: 15 July 2021).

Wirza, R. and Nazir, S. (2021) 'Urban aquaponics farming and cities- a systematic literature review', *Reviews on Environmental Health*, 36(1), pp. 47–61. doi: 10.1515/reveh-2020-0064.

WPR (2021) *Cairo Population 2021 (Demographics, Maps, Graphs)*. Available at: https://worldpopulationreview.com/world-cities/cairo-population (Accessed: 15 July 2021).

Zakey, A. S. *et al.* (2008) 'Seasonal and spatial variation of atmospheric particulate matter in a developing megacity, the Greater Cairo, Egypt', *Atmosfera*, 21(2), pp. 171–189.

Zezza, A. and Tasciotti, L. (2010) 'Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries', *Food Policy*, 35(4), pp. 265–273. doi: 10.1016/j.foodpol.2010.04.007.