CSID Journal of Infrastructure Development

Volume 5 | Issue 1 Article 2

12-31-2022

Integration of Urban Farming into City Infrastructure Development

Ayobami Popoola
SARChI Chair for Inclusive Cities, University of KwaZulu-Natal, South Africa, bcoolay2@yahoo.com

Bolanle Wahab
Department of Urban and Regional Planning, Faculty of Environmental Design and Management, University of Ibadan, Nigeria, wahabbolanle@gmail.com

Hangwelani Magidimisha Chipungu
SARChI Chair for Inclusive Cities, University of KwaZulu-Natal, South Africa, magidimishah@ukzn.ac.za

Lovemore Chipungu
SARChI Chair for Inclusive Cities, University of KwaZulu-Natal, South Africa, Chipungu@ukzn.ac.za

Recommended Citation
Popoola, A., Wahab, B., Chipungu, H. M., & Chipungu, L. (2022). Integration of Urban Farming into City Infrastructure Development. *CSID Journal of Infrastructure Development, 5*(1), 4-20. https://doi.org/10.32783/csid-jid.v5i1.148

CSID Journal of Infrastructure Development (5) 1: 4-14
ISSN 2407-4438

INTEGRATION OF URBAN FARMING INTO CITY INFRASTRUCTURE DEVELOPMENT

Ayobami Popoola[1*], Bolanle Wahab[2], Hangwelani Magidimisha-Chipungu[1], Lovemore Chipungu[1]

[1]*SARChI Chair for Inclusive Cities, University of KwaZulu-Natal, South Africa*
[2]*Department of Urban and Regional Planning, Faculty of Environmental Design and Management, University of Ibadan, Nigeria*

(Received: August 2020 / Revised: March 2022 / Accepted: September 2022)

ABSTRACT

The ability to respond to the need for food is threatened by the scarcity of urban farmers (UF) in the elevation of the urban population. This shows that the availability of food is a cultivated land function, indicating that agriculture is only a mirage when sites are unavailable for farming. Irrespective of these conditions, the sustainability of food production within the city spaces is still the complimentary urban infrastructure enhancing the movement of goods and farmers. Therefore, this study aims to determine the patterns of integrating urban farming into city infrastructure development. In this case, a mixed methods approach was used, with a sample of 236 UF obtained across five local government areas (LGA) of Ibadan metropolis, Nigeria, due to the land availability that ranked first in the urban agriculture (UA) location within the city. Based on interviews with selected farmers and literature reviews, many UF preferred to have their farmlands located along the road for ease of mobility and access. The results showed that old age limited farming travel distance, with several cases of farm produce theft, subsequently detected. To solve these issues, land allocation and water infrastructure provision including irrigation kits were needed for the enhancement of UA and UF, respectively. In addition, comprehensive plans integrating UF infrastructure spaces were suggested.

Keywords: Agriculture; City Spaces; Land Access; Urban Infrastructure

1. INTRODUCTION

Many African countries are endowed with land for food production, although the urban land scarcity for urban farmers (UF) is a common challenge. According to Jayne et al. (2014), some African countries were blessed with farming lands, although had fewer engagement capacities. The emerging and increasing urbanization representing residential, commercial, and industrial land-uses expansion in this continent, has also limited the potentiality of UA (urban agriculture) within its cities. This is due to the decrease in agricultural land, regarding land-use conversion unplanned urbanization and site degradation (Fischer & Shah, 2010; Jayne et al., 2014). Arable farmlands are presently shrinking based on these urbanization and degradation processes. As urbanized land likely to be doubled by 2030 (Seto et al., 2012), Alexandratos & Bruinsma (2012) predicted the development of annual crop yield to be less than 1% over the next decade.

*Corresponding author's email: bcoolay2@yahoo.com
DOI: 10.32783/csid-jid.v5i1.148

It also predicted very limited space for the expansion of arable land. This showed that urbanization, food demand increase, climate change, site degradation, as well as resource decline and pressure were expected to cause a shortage of land in 2050 (Roeffen et al., 2013), indicating a great challenge for agriculture. Based on Headey & Jayne (2014) and Jayne et al. (2014), an analysis of changes in agricultural farm sizes was provided among some African countries. This indicated that the land constrained for farming experienced an average reduction of two hectares across the continent.

In Nigeria, the median farm size declined from 2.5 and 1.4 ha in 1994 and 2010, respectively, to 0.85 ha in 2013 (Headey & Jayne, 2014; FAO, 2017). According to Atu et al. (2012), urban sprawl was a common event and remains one of the greatest threats confronting agricultural lands in this country. Land uses such as residential, commercial, recreational, industrial, institutional, and religious spaces, are also provided with greater priorities when physical development plans are prepared by various planning authorities. In this case, Abiodun and Bayode (2014) asserted that the land development rate in the Ibadan metropolis was fast outstripping the population density, due to excessive site consumption. Between 1990 and 2013, the population of this city approximately increased by 19%, with the land development rate also elevating from 42% (1989) to 61 and 70% in 2000 and 2013, respectively. In addition, the per-capita land consumption has exceptionally increased over three decades, based on the utilization of sites for development initiatives, which emphasized commercial, industrial, educational, recreational, and residential purposes. According to Wahab et al. (2018), 3 out of every 5 UF were displaced from their previous farming locations, due to the urban land scarcity for UPA. This continuous decrease in the availability of UA land is inimical to the sustainable urban agriculture and food security in Ibadan, compared to other developmental activity areas.

These conditions explain the peculiarity of land scarcity, with the choice of farming location often emphasizing city infrastructures. This is due to the relevance of the infrastructures, such as roads, water, and conventional urban farming gadget, to the city's food system functioning. Mougeot (2000) also advocated for innovative and optimal planning for city food system, which is dependent on infrastructure and service. Based on Davies et al. (2021), Steenkamp et al. (2021), and Sesan et al. (2022), city design and governance need to be inclined toward food security. This is essential for a balanced symbiotic relationship between urban farming and city infrastructure development. It is also important in stating the urban agriculture and infrastructure nexus towards sustainable food security within the city center.

2. METHODS

This experiment was carried out in the traditional city of Ibadan, which is one of the major urban centers in Nigeria. The city has a land area of 3,123.30 km², where the urban local government area occupies about 463.33km². It also contains five urban and six peri-urban local government areas (LGAs), respectively. A survey of 236 UF was carried out across the five metropolitan LGAs of Ibadan North, North-East, North-West, South-East, and South-West. Moreover, data was obtained using questionnaires, interviews, and field observation. In this case, the questionnaire was administered to the farmers through mixed methods of purposive, snowball and convenience sampling techniques. After obtaining the sample size of 236 participants, the time frame, ease of UF access, and the clustering of farmers along purposively identified locations were also essentially considered.

The integration of urban agriculture into city planning was carried out using global case study experiences. The deductive reasoning of this planning process was also explored and integrated into the development of inclusive spaces for all land uses. This was conducted through a systematic literature review on cities and food systems. The question guiding this experiment also

emphasized the patterns by which city farming and infrastructure were integrated into an urban configuration, for sustainable food system planning.

3. RESULTS AND DISCUSSION

3.1. Questionnaire Results

Table 1 shows that the majority (92.3%) of the farmers have farmland sizes fewer than 5 ha. From the entire sampled UF, 50.8, 41.5, 3.0, and 4.7% have farm sizes fewer than 1 ha, between 1-5 and 6-10 ha, and over 11 ha, respectively.

Table 1 City Farming Characteristic in Ibadan

Farmland size			**Food production sales**		
Farm size	No. of UF	%	**Do you sell within the city?**	Farmers' response	%
Less than 1 Hectare	120	50.8	Yes	82	34.7
1-5 Ha	98	41.5	No	154	65.3
6-10 Ha	7	3.0	Total Response	236	100.0
Above 11 Ha	11	4.7			

Factors influencing urban agriculture												
Response	**Home environment**		**Nearness to road**		**Nearness to the source of water**		**Availability of land**		**Nearness to market**		**Secured location**	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Agree	173	73.3	127	53.8	155	65.7	201	85.2	118	50	134	56.8
Disagree	63	26.7	109	46.2	81	34.3	35	14.8	118	50	102	43.2
Total	236	100	236	100	236	100	236	100	236	100	236	100

Based on Table 1, 73.3 and 53.3% of the total participants agreed that home and road environment served as factors influencing urban agriculture (UA). A total of 65.7, 85.2, 56.8, and 50% also agreed that nearness to the source of water, land availability, secured location, and market influenced UA, respectively. These results indicated that land availability, home environment, as well as nearness to the source of water, secured location, road, and market were the motivational factors influencing UA location. Regarding the point of sale, 34.7 and 65.3% sold their products within and outside the Ibadan city market, respectively (See Table 1).

3.2. Interview Results

Agriculture is possibly carried out through the possession of cultivated land, where food and farming are not a mirage. In this case, the urban densification causing different utilization of land was no longer innovative. According to Ezendinma & Chikuezi (1999) and Ajadi et al. (2011), the choices of "what, where, and how to produce" was determined by the culture, traditions, market, water supply, rainfall, climate, sun exposure, soil condition, plot size (land), and home distance. This proved that farmlands were often close to residential areas. Based on an interview with one of the farmers, the following was reported: "*…many of us are old, so the difficulty in travelling far is not good for old age… and many of our children are not interested in farming…*"

From this interview, farmers were not willing to travel a long distance from farms to residences. This showed that the closeness of the farm to their homes enabled easier arrival and departure, as well as appropriate monitoring processes. The ease of marketing is a very important factor in farm locations, whose security is also very essential when considering animal husbandry. In addition, the fear of theft and loss of animals to hoodlums is subsequently part of the important

factors influencing animal farmers. In this case, an urban farmer reported the following: *"... I opted for a smaller plot size following the theft of my farm produce in the last planting season."*

According to Tunde & Adeniyi (2012), transport affected agricultural marketing due to being the only medium eligible for farmers to mobilize their products to the market. It indicated that the difficulty in the product mobilization led to multiple on-farm sales as illustrated in Figure 1.

Figure 1 On-farm sales of produce at Eleyele floodplain (2018)

The closeness of farmlands to markets is very important when handling perishable goods and vegetables. For farmers, these sales locations outside Ibadan include Lagos, Osun, Kwara, and Ogun states. In this case, these states' supply choices emphasized the demand of the buyers, which often arrive at the farmland to buy and transport back home. Based on a vegetable farmer and trader, more profits were generated from the street hawking carried out by the children within their residential neighborhoods. For those selling within Ibadan, several factors were identified, namely transportation cost and constraint, farmers' preference based on market knowledge and small-scale production, as well as high product demand. This indicated that supply was often carried out near city neighborhoods when not on-farm, especially in Bodija, Shasha, Gbagi, Ojoo, Sango, and Iwo-road markets.

According to Lanarc-Golder (2013), UF were arguably closer to the market, other farmers, and supportive city organizations. This enabled them to share training and resources, as well as collaborate with others to reach wider audiences. One of the most direct benefits of internal and external food development was the new source of products and valuable people for local communities. Petit et al. (2011) also identified road as a disadvantage to the quality of UF food products. This was observed in city feeding and the additional value provided by urban farming. Furthermore, Taiwo (2013) stated that road access was critical to the maintenance of UF profitability, indicating that farmers cherished the need for easy access to city farms, which were mostly located along vacant plots. Based on FAO (2017) and van Veenhuizen (2014), the development often characterized by cut and fill was temporarily or permanently optimized for urban farming. This proved that degenerated residential, office or industrial areas were demolished, leading to the development of new open spaces liable to remain vacant for a long time. New roads and power lines were also designed, enabling the development of new vacant open spaces. Therefore, these developmental occurrences prioritized the balancing and syncing of city farming and project.

3.3. Sustainable Agriculture within a Sustainable City

A sustainable system is one of the most compelling challenges of the 21st century, where food is an ideal medium for designing manageable urban, rural, or peri-urban locations due to the systematic multi-functional character. In this process, food planning is presently uniting people from a diverse range of backgrounds, including planners, policymakers, politicians, designers, health professionals, environmentalists, farmers, traders, and civil society activists (ISOCARP, 2015). This confirmed that urban planners need to understand the methods and strategies of food production, to achieve a sustainable system and city. Sustainability is described as a dynamic equilibrium in the interactive processes between a population and the carrying capacity of an environment. In this process, the population development expresses its full potential without adversely and irreversibly affecting the reliant environmental capacity (Stivers et al., 1976; Meadows and Randers 2004). It is also a function of ecological, economic, social and technological themes (Hasna, 2007). Moreover, sustainability encompasses environmental (stability of physical and biological systems), economic (capital base, income, and wealth distribution among generations), and social (vulnerability reduction, social and cultural system maintenance, and the ability to withstand shocks) city components (Ciegis et al., 2009).

A sustainable city is a location where citizens are able to meet their needs without endangering the well-being of the ecosystem, as well as the present and future living conditions of other people (Roseland, 1997). Sustainable agriculture also contains environmentally friendly methods of farming, which allow the production of livestock and/or crops without damage to the natural or human systems (Falk, 2013). In this context, a sustainable city provides adequate knowledge and opportunities to promote manageable UA, with urban de-concentration continuously mobilizing into the third century. This emphasized the development of new landscapes to provide healthy living systems, compared to the prevention of urban malfunctions (Grady, 1994). When urbanization is adequately managed, peri-urban agriculture is likely to be preserved. This contributed to strengthening the city's economic base, enhancing social cohesion, and blocking open ecological loops (Tricker, 2012).

According to Andriatiana et al. (2012), the challenge globally confronting agriculture prioritized the production pattern of food for the increasing world population. This was projected to reach nine billion people in 2050 while conserving the environment. In developing a comprehensive and sustainable approach for the African agricultural sector, the nitty-gritty of the problems needs to be nationally understood and addressed (Afolabi, 2004). This explained that the sustenance of a beneficial approach emphasized the intensification of agriculture, which entailed the use of economic and environmental agricultural practices. These conditions were carried out to address the global food insecurity caused by continuous population increase, agricultural land loss, and environmental degradation, which had a long-term effect on the global farming system (Simon et al., 2013).

Based on Lwasa et al. (2011), food production space was one of the major limitations for urban and peri-urban agriculture in densely urbanized areas, especially in slum and squatter settlements. This was either not readily available or limited in the area. In addition, the non-incorporation in city planning and land tenure conflict was major factor for this inadequacy. Pothukuchi and Kaufman (2000) also identified five patterns by which urban planners strengthened the food system, namely (1) Data compilation on community food systems, (2) Relationship analysis between food and other planning concerns, (3) Assessment of the present planning effect on the local food system, (4) Food security integration into community goals, and (5) Future planners' education about food system issues. This proved that food, as a discipline, was inseparable from planning, whose relevance helped in the development and protection of internal and external

spaces (White and Natelson, 2012). Cities were also historically developed around the supply and distribution of food (Steel 2008), due to the dependence on urban infrastructure.

3.4. Urban Infrastructure and Urban Farming

Urban farming remains an integral part of the city landscape, whose relevance is unable to be downplayed as a part of the spatial configuration of cities. Despite this, resilient and sustainable food production remains limited within urban areas, due to the neglected infrastructural planning for farming and urbanization. According to Lin et al. (2017), urbanization was continuously a major limitation of conventional urban farming. This showed that future city expansion should consider the need for UA to be integrated into urban land and green infrastructure planning, with adequate food production within city spaces.

Based on Maxwell (1994), UA formed a crucial coping mechanism for the urban poor, although its impact on the service infrastructure was extensively emphasized. This was to ascertain the extent to which it influenced the failure of such services. Mbusya (2013) also highlighted that uncoordinated UA in the planning or city arrangement led to urban infrastructure decay and service disruption. This identified that a regulated and balanced UA planning was characterized as water irrigation, reticulation infrastructure, fewer transportation interference, electricity, and waste amenities as indicated in Figure 2. Since water is a necessity for UA, urban farmers are subjected to floodplains and several sources, such as illegal irrigation connections, which often destroy the flow lanes. For instance, sewage lines are often distorted to accommodate framing nutrients on farmlands. This prompted a mixed utilization of infrastructure within the land use schemes (Leh et al., 2011).

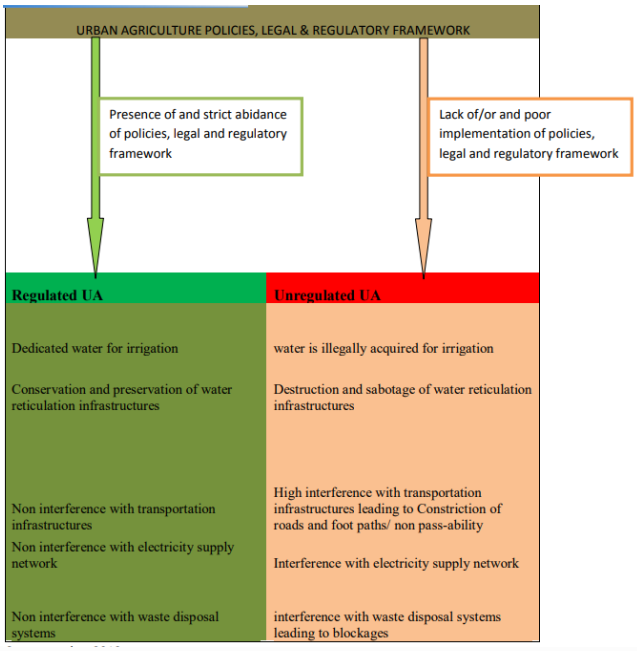

Figure 2 A balanced urban agriculture and city infrastructure planning model (Mbusya, 2013)

According to the Whyfiles of the University of Wisconsin Board of Regents (2017), floodplain and levees management, as well as channel construction were arguably critical to the social inclusion of the farmers. This indicated that close residence to rivers and urban floodplain management are important to farming and food production. Buttressing also emphasizes the need

for UF infrastructure responsiveness towards enhancing urban food security (Bricas and Conare, 2019). In addition, Taguchi & Santini (2019) highlighted cities were promoting vertical farms, as well as stacking layers of gardening and farming activities in a building and underground site. This subsequently enabled the development of tunnel vegetables. In some cases, the vertical economy supporting water harvesting systems and facilities was constructional and infrastructural for urban farming (Despommier, 2019).

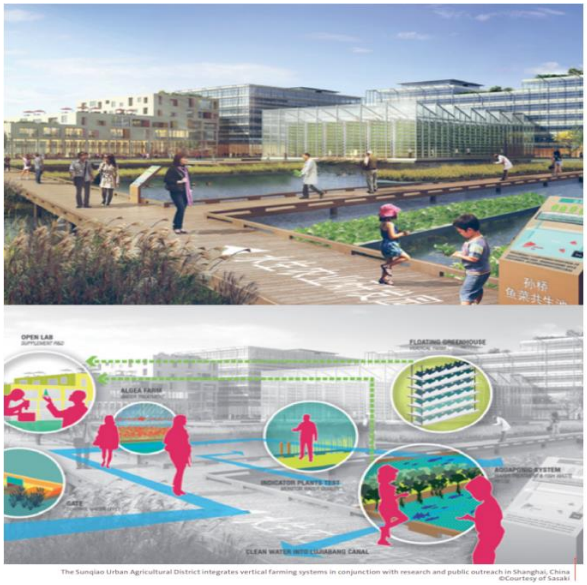

Figure 3 Vertical Farming within the city infrastructure in Sunqiao District, China (Despommier, 2019)

According to Pauleit et al. (2019), city densification and contemporary smart development greatly increased urban resilience and food security in Jakarta and Addis Ababa. The implementation of these strategies led to lower losses of green infrastructure and its ecosystem services, such as food provisioning, the urban heat island effect reduction, and the flooding risk during rainstorms. This indicated that urban planning should concentrate on devising and implementing strategic key measures at city and regional scales, such as the allocation of metropolitan centers and infrastructures, as well as outlining the location of green facility conservation as a lifeline. In this case, the role of integrating and improving coordination was important in achieving urban food production among several professionals, such as agronomy and food engineers, drivers, and managers. This is due to the importance of their cooperation in managing urban food system vulnerability.

Based on Amusat & Amusat (2013) and Wahab & Popoola (2018), farm losses to city disasters were not underplayed. This indicated that farmers lost about ₦350000 (1000USD) to flooding along the urban and peri-urban corridor of Ibadan city. Agbola et al. (2012) also reported that several urban farmers lost many agricultural products, such as fish, poultry, and crops, during the historic flood occurrence in August 2011. This was due to the absence of specific management policies, especially for water channels and the waste disposal behavior of the city residents. It also stated that only the Ogunpa river was channelized in the city, including the dredging and construction of concrete embankments (Agbola et al., 2012). Furthermore, Gould et al. (2020) iterated that coastal flooding contributed to short and long-term farm losses in the United Kingdom, where an average of £255 was lost on a hectare of land (Penning‐Rowsell, 2013). In the Western Massachusetts and Vermont areas of the USA, an estimated 15,400 acres of farmland

with a cost of 20 million US dollars was also destroyed by storm (Warner et al., 2017). This was in line with Dubbeling et al. (2019), where urban flooding, infrastructure, market, food insecurity, neighborhood shocks and coordination were identified as the extreme weather vulnerabilities against urban food production. The need for improved access to water infrastructure, roads, river channelization projects, and integrated urban agriculture masterplan was also imperative towards the reduction of farm loss, due to several city disasters such as flooding.

4. CONCLUSION

Based on the results, the family division of labor existed among urban farming households, as children are often tasked to engage in trading activities. Farmers also preferred to carry out farm activities near their homes, due to security demands and old age considerations. In this context, some threats were identified toward urban farming, regarding the oldness of farmers and the unwillingness of children to engage in farm activities. However, the reasons for these threats were not investigated.

The relevance of water accessibility also led to the need for irrigation support and open field supply by the government, for the urban farmlands along the upland region. From the results, vegetable farmers' quest for land along the floodplain areas, where irrigation farming was easy. To limit the loss and produce monopoly by warehouse traders, a need for the government to control the sale and purchase of the farm products was also observed, to increase UF profits. In addition, an improved allocation of space for urban farming was needed in Ibadan and other cities. The integration of the city towards sustainable production was also achieved through a comprehensive planning process, which supported and identified food cultivation within the urban center. Based on these results, the relevance of urban policy and tools, including UA and UF, is very important for the holistic management of urbanization within the city.

5. ACKNOWLEDGMENT

The author appreciates Prof. Bolanle Wahab, University of Ibadan and Dr. Nunyi Blamah of University of KwaZulu-Natal, for their comments on the initial early draft.

REFERENCES

Abiodun, O., & Bayode, T. (2014). Monitoring and modeling of urban sprawl, case study of Ibadan inner city. *International Journal of Remote Sensing and GIS*, *3*(4), 64-71.

Afolabi, M. (2004). Rural-urban migration and productivity in Nigerian agricultural sector. (MSc Thesis). Canada: Simon Fraser University.

Agbola, B., Ajayi, O., Taiwo, O., & Wahab, B. (2012). The August 2011 flood in Ibadan, Nigeria: Anthropogenic causes and consequences. *International Journal of Disaster Risk Science*, *3*(4), 207-217.

Alexandratos, N., & Bruinsma, J. (2012). World agriculture towards 2030/2050: the 2012 revision. *ESA Working Paper No. 12-03*, Rome: Food and Agriculture Organization of the United Nations.

Amusat, A. S., & Amusat, K. K. (2013). Effects of flood on farmers in peri-urban area of Ibadan, Oyo state, Nigeria. *Journal of Environmental Extension*, *11*, 27-31.

Andriatiana, M., Daddy, I., Nforgang, C., & Saizonou, J. (2012). Sustainable intensification: a crucial revolution. *Spore*, (158), 13-17.

Atu, J., Offiong, R., Eni, D., Eja, E., & Esien, O. (2012). The effects of urban sprawl on peripheral agricultural lands in Calabar, Nigeria. *International Review of Social Sciences and Humanities*, *2*(2), 68-76.

Ajadi, B., Adeniyi, A., & Afolabi, M. (2011). Impact of climate on urban agriculture: case study of Ilorin City, Nigeria. *Global Journal of Human Social Science*, *11*(1), 2.

Bricas, N., & Conaré, D. (2019). Historical perspectives on the ties between cities and food. *Field Actions Science Reports. The journal of field actions*, (Special Issue 20), 6-11.

Ciegis, R., Ramanauskiene, J., & Martinkus, B. (2009). The concept of sustainable development and its use for sustainability scenarios. *Engineering economics*, *62*(2), 28-36

Davies, J., Hannah, C., Guido, Z., Zimmer, A., McCann, L., Battersby, J., & Evans, T. (2021). Barriers to urban agriculture in Sub-Saharan Africa. *Food Policy*, *103*, 101999.

Despommier, D. (2019). Vertical farms, building a viable indoor farming model for cities. *Field Actions Science Reports. The journal of field actions*, (Special Issue 20), 68-73.

Dubbeling, M., van Veenhuizen, R., & Halliday, J. (2019). Urban agriculture as a climate change and disaster risk reduction strategy. *Field Actions Science Reports. The journal of field actions*, (Special Issue 20), 32-39.

Ezedinma, C., & Chukuezi, C. (1999). A comparative analysis of urban agricultural enterprises in Lagos and Port Harcourt, Nigeria. *Environment and urbanization*, *11*(2), 135-144.

Falk, B. (2013). *The resilient farm and homestead: An innovative permaculture and whole systems design approach*. Chelsea Green Publishing Company.

Fischer, G., & Shah, M. (2010). Farmland investments and food security. *Rep. Prep. by World Bank Int. Inst. Appl. Syst. Anal.(IIASA)*, Luxembourg, Austria.

Food and Agriculture Organization. (2017). Small family farms data portrait basic information document methodology and data description. Accessed June 11 2019. http://www.fao.org/fileadmin/user_upload/smallholders_dataportrait/docs/Data_portrait_variables_description_new2.pdf

Grady, C. (1994). "*Cities and natural process".* Routledge, London, New York.

Gould, I., Wright, I., Collison, M., Ruto, E., Bosworth, G., & Pearson, S. (2020). The impact of coastal flooding on agriculture: A case-study of Lincolnshire, United Kingdom. *Land Degradation & Development*, 31(12), 1545-1559

Hasna, A. (2007). Dimensions of sustainability. *Journal of Engineering for Sustainable Development: Energy, Environment and Health* 2 (1), 47-57.

Headey, D., & Jayne, T. (2014). Adaptation to land constraints: Is Africa different? *Food Policy*, *48*, 18-33.

International Society of City and Regional Planners (ISOCARP). (2015). "Hungry city, insatiable metropolis". ISOCARP, Netherland.

Jayne, T.S., Chamberlin, J. & Headey, D.D. (2014). Land pressures, the evolution of farming systems, and development strategies in Africa: A synthesis. *Food policy*, *48*, 1-17.

Pothukuchi, K. and Kaufman, J.L. (2000). The Food System, *Journal of the American Planning Association*, 66(2), 113-124. http://dx.doi.org/10.1080/01944360008976093

Lanarc-Golder, H. B. (2013). The urban farming guidebook: planning for the business of growing food in BC's towns and cities. *Prepared for Eco Design Resource Society (EDRS) and funded by the Real Estate Foundation of BC.* Available at: https://www.refbc.com/sites/default/files/Urban-Farming-Guidebook-2013.pdf

Leh, O., Abdullah, W., Omar, D., Marzukhi, M., Barghchi, M., & Fong, T. (2011), September. Urban farming: Utilisation of infrastructure or utility reserved lands. In *2011 IEEE Symposium on Business, Engineering and Industrial Applications (ISBEIA)* (pp. 447-451. IEEE.

Lin, B., Philpott, S., Jha, S., & Liere, H. (2017). Urban agriculture as a productive green infrastructure for environmental and social well-being. In *Greening Cities* (pp. 155-179). Springer, Singapore.

Lwasa, S., Wahab, B., Mugagga, F., Simon, D., Fragkias, M., Griffith, C., Mukungu, D., Connors, J., & Adeyemi, A. (2011). The role of urban and peri-urban agriculture in enhancing food security and climate change resilience in East and West African cities. *Final project report for 2011 START grants for global change research in Africa*.

Maxwell, D. (1994). Household logic of urban farming in Kampala. In *Cities feeding people: an examination on urban agriculture in East Africa*. IDRC, Ottawa, ON, CA.

Mbusya, G. (2013). *Impacts of Urban Agriculture on Physical Infrastructure in the Informal Settlements Case Study of Kibera, Nairobi* [Doctoral dissertation, University of Nairobi].

Meadows, D., Randers, J., & Meadows, D. (2004). *Limits to growth: The 30-year update*. Chelsea Green Publishing.

Mougeot, L. (2000). Urban agriculture: definition, presence, potentials and risks. *In* N. Bakker, M. Dubbeling., S. Guendel., U. Sabel Koschella., & H. de Zeeuw., eds. 2000. *Growing cities, growing food, urban agriculture on the policy agenda*, 1-42. DSE, Feldafing.

Pauleit, S., Pribadi, D., & Abo El Wafa, H. (2019). Peri-urban agriculture: lessons learnt from Jakarta and Addis Ababa. *Field Actions Science Reports. The journal of field actions*, (Special Issue 20), 18-25.

Penning-Rowsell, E., Priest, S., Parker, D., Morris, J., Tunstall, S., Viavattene, C., Chatterton, J., & Owen, D. (2014). *Flood and coastal erosion risk management: a manual for economic appraisal*. Routledge.

Petit, C., Aubry, C., & Rémy-Hall, E. (2011). Agriculture and proximity to roads: How should farmers and retailers adapt? Examples from the Ile-de-France region. *Land Use Policy*, *28*(4), 867-876.

Roeffen, B., Dal Bo Zanon, B., Czapiewska, K.M., & De Graaf, R.E. (2013). Reducing global land scarcity with floating urban development and food production. In *Conference Proceedings: International Water Week*.

Roseland, M. ed. (1997). *Eco-city dimensions: healthy communities, healthy planet*. Gabriola Island, BC: New Society Publishers.

Sesan, T., Sanfo, S., Sikhwivhilu, K., Dakyaga, F., Aziz, F., Yirenya-Tawiah, D., ... Adamou, R. (2022). Mediating knowledge co-production for inclusive governance and delivery of food, water and energy services in African cities. *Urban Forum*, 33(3), 281-307

Seto, K., Güneralp, B., & Hutyra, L. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences*, *109*(40), 16083-16088.

Simon, B., Garba, A., & Bunu, G. (2013). Determinants of sustainable agricultural land management practices among arable crop farmers in northern part of Taraba State, Nigeria. *ARPN Journal of Science and Technology,* 3 (7), 726-730

Steel, C. (2008). Hungry City: How Food Shapes Our Lives (London: Chatto and Windus).

Steenkamp, J., Cilliers, E. J., Cilliers, S. S., & Lategan, L. (2021). Food for thought: Addressing urban food security risks through urban agriculture. *Sustainability*, *13*(3), 1267.

Stivers, R.L. (1976). *The sustainable society: ethics and economic growth*. Philadelphia: Westminster Press.

Taguchi, M., & Santini, G. (2019). Urban agriculture in the Global North & South: a perspective from FAO. *Field Actions Science Reports. The journal of field actions*, (Special Issue 20), 12-17.

Taiwo, O. (2013). Farmers' choice of wetland agriculture: Checking wetland loss and degradation in Lagos State, Nigeria. *GeoJournal*, *78*(1), 103-115.

Tricker, L. (2012). "Critiques and criticisms of sustainability and sustainable development". Accessed October 21 2018. https://prezi.com/bbkdndvjowfa/critiques-and-criticisms-of-sustainability-and-sustainable-development/.

Tunde, A., & Adeniyi, E. (2012). Impact of road transport on agricultural development: a Nigerian example. *Ethiopian Journal of Environmental Studies and Management*, *5*(3), 232-238.

University of Wisconsin Board of Regents. (2017). *Flood of Evidence: Structural Solution or problem?*. https://whyfiles.org/107flood/5.html

Van Veenhuizen, R. (2014). Introduction, Cities Farming for the Future. In R. Van Veenhuizen, (Ed.). *Cities farming for the future: Urban agriculture for green and productive cities*. RUAF Foundation, IDRC and IIRR.

Wahab, B., & Popoola, A. (2018). Climate-Induced Problems and Adaptation Strategies of Urban Farmers in Ibadan. *Ethiopian Journal of Environmental Studies & Management*, 11(1), 31-42.

Wahab, B., Popoola, A., & Magidimisha, H. (2018). Access to Urban Agricultural Land in Ibadan, Nigeria. *Planning Malaysian: Journal of the Malaysian Institute of Planners*, 16 (4), 161-175.

Warner, B. P., Schattman, R. E., & Hatch, C. (2017). Farming the floodplain: Ecological and agricultural tradeoffs and opportunities in river and stream governance in New England's changing climate. *In Case Studies in the Environment*. DOI: 10.1525/cse.2017.sc.512407

White, H., & Natelson, S. (2012). Good planning for good food: mechanisms within the English planning system to support sustainable food and farming. *In Sustainable food planning: evolving theory and practice* (p. 39). Wageningen Academic Publishers.