

The role of urban agriculture in climate change mitigation and adaptation in Ghanaian cities

D. Anafo^{1*} G. A. Akolgo²

Abstract

Urban systems the world over are rarely sustainable. The adverse impacts associated with urban systems will be further compounded by climate change and its intricate relationships with poverty and food sovereignty. Cities at various levels and scales are therefore exploring innovative, place-based solutions to these emerging challenges. One such innovative approach to building the resilience of cities to the threats of climate change and enhancing adaptation options is the recourse to urban agriculture. This study examined the unique case of urban agriculture in Ghanaian cities. The study establishes that urban agriculture in Ghana is faced with challenges such as difficult access to land for farming; inadequate access to water resources; lack of extension services and credit support among others. Notwithstanding, urban agriculture may help reduce the impacts of flooding, improve water infiltration and environmental sanitation. It is therefore recommended that appropriate policy measures be put in place to address the challenges associated with urban agriculture with a view to maximising the gains.

Keywords

Climate change, Food sovereignty, Resilience, Urban agriculture and Urban systems

¹Department of Environmental Management, University of Energy and Natural Resources, P. O. Box 214, Sunyani, Ghana; Email: david.anafo@uenr.edu.gh

²Department of Mechanical and Manufacturing, University of Energy and Natural Resources, P. O. Box 214, Sunyani, Ghana; email: gilbert.akolgo@uenr.edu.gh

*Corresponding author D. Anafo. Email: david.anafo@uenr.edu.gh

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1. Introduction

Cities in the global south are expanding rapidly and it is estimated that by 2020, 75 percent of all urban dwellers and eight of the anticipated nine megacities in the world will be in developing countries in Africa, Asia and Latin America [1, 2 and 3]. The rapid urbanisation of cities in the developing world poses significant challenges for urban governance and exacerbates the already precarious living conditions. Common challenges include rising unemployment, poor management of urban solid and liquid waste, urban poverty, hunger and food insecurity and a rising incidence of slum dwelling. Indeed it is estimated that more than 1 billion of the world's urban population live in slums, unrecognised and un-serviced by municipal services [4]. The situation is compounded in sub-Saharan

Africa where it is estimated that three-quarters of all urban residents are slum dwellers [5].

These urban challenges will be most likely worsened by the direct and indirect impacts of climate change. It is envisaged that climate change will increase the frequency and magnitude of extreme events such as flooding, hurricanes, storms, constraints on water supply, rising temperatures and heat waves and other climate-induced health risks [6]. But equally critical is how to ensure food security and preserve ecosystem services in the urban sphere [7]. This is the niche that urban and peri-urban agriculture including forestry is seen to hold promise. It is indicated that urban and peri-urban agriculture can help improve resilience and adaptation to climate change through the reduction of "food miles" due to the production of food close to urban markets; reducing fertiliser and energy use based on re-use of urban organic wastes; improving rainwater infiltration; increasing access to better diets, urban food security, jobs and income among others [8].

Given the rather important roles that urban agriculture can play in improving resilience and enhancing adaptive capacity, various national and municipal governments are designing and implementing innovative urban agricultural interventions. Often supported by international and local non-governmental organisations these interventions span different world regions and cover a variety of interventions.

While some have been implemented with relative ease and chucked moderate successes significant bottlenecks have been reported elsewhere. This study, therefore, examines urban agriculture as it is practised in Ghana to identify possible ways by which it can contribute to climate change mitigation and adaptation. It is important to do so because while urban agriculture is not the only way to deal with climate change and the urbanisation challenge, it can be part of a constellation of measures to help make urban landscapes ecologically sustainable. Again, understanding the merits and demerits of urban agriculture from the Ghanaian perspective may help in resource allocation such that potentially more climate-friendly interventions are not overlooked.

This review of the secondary literature provides an overview of the documented climate change related benefits of urban agriculture as it pertains to Ghana. The paper is divided into three sections. Following the introduction is an examination of the term “urban agriculture”, in all its fundamentals, nuances and details. This section will also seek to delve into the climate change debate and the nexus between climate change and urban agriculture. Section three discusses urban agriculture in Ghana by examining its characteristics and contributions to climate change mitigation and adaptation, leading to a conclusion.

2. Urban Agriculture

Urban agriculture is not an entirely new industry, although it has been expanding since the 1970s due to rapid urbanization, ineffective agricultural policies, crippled food distribution systems, withdrawal of subsidies, reduction of wages, inflation, unemployment, lax urban regulations, civil strife and droughts [9]; and more recently climate change. Urban agricultural practices are traced to the early Incaic, Aztec and Mayan cities, early Javanese and Indus settlements, and towns of the Tigris and Euphrates [9]. Although contemporary urban agriculture is said to be widely practised in Asian countries it is gradually penetrating places as disparate as Dar es Salaam, Montreal, Belo Horizonte, Rosario, Moscow, Cagayan d’Oro and Cape Town among others.

While there is dearth of data on the successes or otherwise of urban agriculture, it is pointed out that a number of cities, including Kathmandu, Karachi, Singapore, Hong Kong and Shanghai produce between 25 – 85 percent of their vegetables and fruits requirements from urban farms while Hong Kong, Kampala and Singapore raise between 70 and 100 percent of the poultry they consumed [9]. It is further argued that some cities even manage to export produce from urban farms to other countries. Studies carried out in the 1990s in East Africa also showed that 17–36 percent of the urban population grow crops and/or keep livestock [10]. Again, a

global survey commissioned by the United Nations Development Programme (UNDP) in 1996 indicated that about 800 million people worldwide were engaged in some form of urban agriculture [11]. It is currently estimated that about a fifth of the world’s food comes from urban farms (<https://www.greenbiz.com/article/urban-farms-now-produce-15-worlds-food>; last accessed, 08/06/1017).

Urban agriculture has a number of important common dimensions which encompass economic activities, location, areas, scale and products destination [12]. Within the realm of economic activities, the emphasis is often placed on agricultural production, with special consideration for food produced for consumption by either humans or animals. In some instances, ornamental and agro-industrial activities are also considered [12]. Another commonly discussed element of urban agriculture is location. Ordinarily, it is indicated that the location of urban agriculture may be intra-urban or peri-urban in character. With regards the areas, the focus has often been on whether urban agriculture is practised on home-plot areas or on off-plot, opens space locations [13]. Scale as an element in the definition of urban agriculture looks basically at a level on which production takes place. This may be at the individual/family micro, small and medium enterprises, as opposed to the large, national or transnational level of production. In the West African sub-region, the actors often include urban shifting cultivators, household gardeners and peri-urban market producers [14]. Finally, products destination is concerned with the end use point of urban agricultural production. Most definitions embody both the production for household consumption as well as the trade [13].

The multiplicity of the elements/dimensions of urban agriculture makes it difficult to put together a definition that encapsulates the different viewpoints. Notwithstanding, urban agriculture is defined as “the production of crop and livestock goods within cities and towns” [15]. Various, however, urban agriculture is taken to mean a range of activities including vegetable and fruit tree cultivation, as well as other specialized medicinal and ornamental crops, wood production, small-scale animal rearing, beekeeping and aquaculture [16, 17]. Also, urban agriculture is defined by a number of important elements that distinguish it from rural agriculture. These include: it takes place near market centres; occurs in limited urban spaces; depends on city water and recycled organic wastes, and there are low levels of organisation among farmers [13]. Distinguishably, urban agriculture is an activity that makes use of locally available resources to produce various food and non-food products for local consumption. Conclusively therefore that urban agriculture can be distinguished from rural agriculture by virtue of the integration of the former into the urban economic and ecological fabric [12].

3. The Science of Climate Change

The climate system is one of the most complex natural phenomena. In most socio-cultural settings across Africa, it is so simplified that it is sometimes misconstrued as precipitation, surface temperature, humidity or any such related variables. In most Ghanaian societies natural phenomena such as the physical earth, water bodies, rainfall and changes whose nature and characteristics defy human logic are seen to be creations of some divine force [18]. According to [19], however, the climate is composed of the atmosphere, land surface, snow and ice, oceans and other bodies of water, and living things. Notwithstanding, the climate system is defined by atmospheric elements and is often described using the "mean and variability of temperature, precipitation and wind over a period of time". The climate system is influenced largely by its own internal dynamics as well as external intruding factors that range from a multiplicity of naturally occurring elements to anthropogenic variables [19]. As initially indicated, this scientific understanding of the climate differs significantly from the local worldviews of Africans and for that matter Ghanaians.

Climate change, on the other hand, refers to increases in global surface temperature resulting from the excessive concentration of greenhouse gases in the atmosphere. Known generally as the greenhouse effect, it is deemed a prerequisite for life on earth [20]. While the issue of carbon concentration has been given widespread scientific exploration since the 1950s, it was only until the 1970s that scientists came to some consensus that excessive carbon concentration in addition to water vapour, clouds and other minor atmospheric gases were having a warming effect on the atmosphere; gaining political currency only in the late 1980s [20]. Climate change, therefore, is defined as "an alteration in the pattern of climate over a long period of time and may be due to a combination of natural and human-induced causes" [21]. Even though the evidence about climate change is overwhelming, it is not in tandem with the belief systems and culture of Ghanaians.

Three key variables are often examined in the climate change debate. These include global surface temperatures; the rate of sea level rise; and responses of the physical and biological environment to the global warming phenomenon [22]. It is argued that the earth's surface is experiencing record temperatures due to the presence of greenhouse gases in the atmosphere, which prevents long wave radiation coming from the surface. Commonly known as the greenhouse effect, the most influential greenhouse gases are water vapour and carbon dioxide [19]. Human activities are identified as the main drivers of the increasing release of greenhouse gases. The case is made that carbon dioxide concentration in the atmosphere increased by some 35% in the industrial era, attributing the

increase to the combustion of fossil fuels and deforestation [19].

Natural scientists have categorised the drivers of climate change into increases in atmospheric carbon dioxide and other long-lived greenhouse gases; increases in short-lived greenhouse gases; changes to land cover; increases in aerosols; solar fluctuations; and volcanic eruptions. It is concluded that while solar fluctuations and volcanic eruptions are purely natural all the other drivers of climate change are human-induced and have been dominant over the past century [21]. While the science of climate change may embody several other complex scientific nuances, of fundamental concern to this paper, is the tacit consensus that climate change is a human-induced phenomenon, with potentially catastrophic outcomes. And given that many African countries, including Ghana, are already suffering the adverse impacts of climate change, it is important to examine some of the measures that can help improve mitigation and adaptation practices. This review, therefore, explores the relevance of urban agriculture to climate change mitigation and adaptation in Ghana.

4. The Nexus between Climate Change and Urban Agriculture

Urban agriculture is put forward by its advocates as an intervention that helps promote public health and economic wellbeing, builds social capital and ensures purposeful use of vacant land. The major contribution of urban agriculture to climate change, however, lies in the variety of ecosystem services and climate change mitigation that are associated with the practice [23]. As such, urban agriculture is now widely practised in different world regions, including Africa. The Ghanaian government, through the Ministry of Food and Agriculture, pledged its support for urban agriculture in a Vision Statement and actually initiated various measures to ensure safer practices in urban Accra [24]. Similar efforts are taking place in Bamako, Mali [25], Niamey, Niger [26], and in other major urban areas across Africa. The local ecosystem services associated with urban agriculture include: "increased biodiversity, including provision of habitat for pollinators; reduced air pollution through filtration of particulates by vegetation; micro-climate regulation through transpiration processes; increased rainwater drainage, reducing the risk of flooding, groundwater contamination, and depleted groundwater levels; and recycling of organic waste (e.g., through composting)" [23]. In terms of climate change mitigation, [14] observes that urban agriculture performs functions that range from reduction in greenhouse gas emissions associated with food transportation, to carbon sequestration by vegetation and crops; reduction in the energy and resource inputs – and waste outputs – associated with food production; and maintenance of collective

memory of food production, protection of urban green spaces and upholding cities' capacity to produce food in times of crisis. This is particularly the case for the West African sub-region where [14] indicates that a broad range of ecosystem and climate change mitigation services are provided by the practice of urban agriculture.

Some of the ecosystem services and/or climate change mitigation effects of urban agriculture reported in the literature, particularly for the global North but supported by recent evidence from West Africa and other developing countries [14] range from the abundance of native bee diversity in areas where urban agriculture is practiced relative to other areas of the built environment [27, 28], to pollination related to arthropod populations and linked to management practices, institutional rules, and garden structure [29]. Stormwater infiltration is also reported to improve in urban areas where agriculture is commonly practised due to increased porosity of the soils that have been fertilised using organic matter [30].

It has been argued [31] that urban agriculture results in the continuous reproduction of social and ecological memories amongst members of the practice. It is further indicated that such practices have relevance for good ecosystem stewardship, leading to enhanced ecosystem services and resilient urban spheres. Similarly, it has been observed that efforts at community greening, including urban agriculture projects such as community gardens can potentially contribute substantially to the resilience of cities to disasters provided they “integrate natural, human, social, financial, and physical capital in cities, and... encompass diversity, self-organization, and adaptive learning and management leading to positive feedback loops” [32]. It has been established in a study carried out in the city of Rosario, Argentina in 2013-14, that temperatures were 8-10°C lower on average throughout the year for areas covered with street trees and urban gardens relative to other areas [8].

Urban agriculture is without controversy, however, as high concentrations of nitrogen, phosphorus, and potassium, in soils are reported across the West African sub-region and linked primarily to the widespread use of fertilizers or compost in urban agriculture, thereby polluting urban stormwater runoff or groundwater [33]. Furthermore, nutrient mining is widely reported in many urban centres across Africa where urban agriculture is practised. This is so because the population of these urban centres are exploding, resulting in intensified land use and production systems, reduced fallow cycles and opening up of marginal lands [14]. Whatever the arguments are for or against urban agriculture, it is important to state that the evidence so far suggests, that in spite of some reported concerns, the practice can play significant roles in climate change mitigation and adaptation, thereby improving urban resilience.

5. Urban Agriculture in Ghana

There is scant literature on the practice of urban agriculture in Ghana. Notwithstanding, commercial vegetable gardening, small-scale processing of food and community-based catering services which had some semblance of urban agriculture begun in Accra in 1877, following the elevation of the city to the capital town of Ghana [34]. The history of the expansion of urban agriculture to other cities and towns in Ghana is traced to the 1970s, when the country was faced with severe droughts, mounting external debt stock and soaring food prices, particularly in the major cities [35]. The government intervened by introducing a policy christened “Operation Feed Yourself” (OFY), which encouraged urban residents to engage in various forms of urban agriculture as a way of responding directly to the food shortages of the era [35]. During that period, laws prohibiting the practice of urban agriculture were relaxed [36] and the practice has since remained a major part of the urban life of Accra and other urban areas in Ghana.

Since then, a number of urban agricultural initiatives have been implemented at various scales. For instance, in 1921, the Achimota Forest Reserve covering about 3.195 square kilometres (319.526 hectares) was demarcated and was gazetted and fenced in 1930. Again the Town and Country Planning Department, working in collaboration with the major governmental and traditional authority stakeholders planned and demarcated a “Green Belt” area within the Accra-Tema Metropolitan area in 1991. The belt which composed of arable and non-arable lands, hills and forests and was meant to serve as buffer zone had no legal backing and has since remained a proposal [34]. Increasingly, urban agriculture has become a way of life in towns and cities in Ghana and is widely practised in metropolitan capitals such as Accra, Kumasi and Tamale and in many other smaller towns. The main farming systems include irrigated vegetable, backyard farming, mushroom farming, floriculture, seasonal crop production, aquaculture, dairy farming, small ruminants farming, poultry farming and grasscutter farming. Table 1 provides some more information on the typologies of urban and peri-urban farming in Tamale although it is a fairly good picture of the Ghanaian situation.

Urban agriculture in Ghana enjoys support from a range of governmental as well as non-governmental actors. Commonly, they include research institutions, government ministries and departments, local associations, regional programmes/donors. The research institutions involved include the International Water Management Institute, Centre for Scientific and Industrial Research and Universities and other academic institutions. The main governmental ministries and departments include the Ministry of Food and Agriculture (MoFA), Ministry of Fisheries and Aquaculture, Ministry of Trade and Industry, Ghana Wa-

Table 1. The two major categories of urban and peri-urban crop farming in Ghana

Farm type	Spatial characteristics	Irrigation	Usufruct
Open space intra-urban sites	Contiguous plots used by different farmers.	Located around an irrigation source such as a gutter, a commercial pipe or a reservoir.	Usually not legally owned by the cultivator, although traditional usufruct may be assumed.
Open space peri-urban sites	Contiguous plots used by different farmers, a commercial pipe or a reservoir.	Located around an irrigation source such as a gutter,	The user usually has traditional usufruct rights.
Intra-urban backyard farms	Isolated plots located between houses, for example on undeveloped building sites or intersitial wasteland.	May or may not have access to irrigation.	Owned by the cultivator.
Isolated farms in intersitial intra-urban spaces	Isolated plots located between houses, for example on undeveloped building sites or intersitial wasteland.	May or may not have access to irrigation.	Not owned by the cultivator.
Formal peri-urban irrigation schemes	Peri-urban system of contiguous fields.	Arranged around a formally provided irrigation canal system, sourcing water from a reservoir.	Allocation of plots by the irrigation authority may be based on traditional usufruct or as a result of the application.
Peri-urban non-irrigated farming	Farming on contiguous fields in villages around the metropolis, linked to urban inputs and output markets. Some villagers also cultivate on isolated fields close to the houses, analogous to backyards.	Non-irrigated	The user has traditional usufruct rights.

Source: Bellwood-Howard et al. (2015, p. 9)

ter Company, Irrigation Development Authority, Ghana Standards Authority, the Export Development and Agricultural Investment Fund, Metropolitan and Municipal Assemblies among many others. The main local associations are producer associations, market women, fishers, poultry farmers association and vegetable farmers association. The Food and Agriculture Organisation, The German International Cooperation and Enterprise Works, Peoples Dialogue, World Vision, Catholic Relief Services, Adventists Development and Relief agencies are the main donors and non-governmental organisations supporting urban agriculture [34].

Urban agriculture contributes variously to the development of Ghana. These include urban food supply, employment and livelihood support, gender relations and social networking and contribution to the improved environment. Urban agriculture supports household’s main employment through income from sales of surpluses and savings on food expenditures. It is estimated that about 50 percent of urban residents in Ghana maintain backyard gardens where food, ornamental plants or small ruminants are farmed for household consumption. Urban vegetable production, it is observed has become the main source of employment for many poor urban residents [38]. Open-space vegetable farming accounts for 80 percent of spring onions and lettuce consumed in Accra and supports the livelihoods of about 1,000 farmers who are able to earn a monthly income per farm well above the per capital General Net Income of US\$27/month in Ghana [38].

In terms of climate change, urban agriculture is also making diverse contributions towards mitigation and adaptation in metropolitan cities in Ghana. Within the Tamale Metropolis, for instance, it is indicated that while climate change poses a significant challenge to land availability, the cultivation of crops on areas liable to flooding improves the water retention and infiltration capacity, thereby helping mitigate against the effects of climate change [37]. In the larger context, it is argued that the production of foodstuff within the metropolis reduces the use of fossil fuel in the transportation process [37]. In the case of Accra and Kumasi, as well as other urban centres in Ghana where urban agriculture is practised, the use of urban organic waste for soil improvements helps improve environmental sanitation. It is observed that wastes such as poultry manure, cow dung, market/household waste, human waste are used for landscaping and gardening [39]. Urban vegetable farmers also use wastewater from gutters to irrigate their crops. These practices help improve the flow of runoff as gutters are desilted. Urban agricultural activities which help green the environment are said to play an important productive and ecological role in Ghanaian cities as it helps improve family nutrition through fruit trees, provide medicines, as well as recreational and aesthetic benefits. It also helps pu-

rify micro-climate in Ghanaian cities and impacts on the water cycle and water conservation [39].

In spite of the benefits of urban agriculture in Ghana, the sector faces several challenges. Among them are issues of difficult access to land for urban farming; inadequate access to water resources; lack of services and credit support; health and environmental issues resulting from the use of pesticides and non-treated organic waste and wastewater among others; and poor institutional framework in support of urban agriculture.

6. Conclusion

Urban agriculture has become a way of life in most Ghanaian cities, making substantial contributions to the livelihoods of urban residents. While most contributions have been socio-economic thus far, this review indicates that moderate gains have been chucked, intended or otherwise, with respect to the environment and for climate change mitigation and adaptation. Given the rather high rate of urban growth in Ghana vis-à-vis the marauding impacts of climate change, it is important to fashion appropriate approaches for using urban agriculture to help mitigate against climate change, improve adaptation and urban resilience. In the Ghanaian context, this will entail measures to improve land access for urban agriculture, ensure access to water resources, and improve access to credit services, while equally dealing with the health and environmental issues emanating from the practice of urban agriculture. When combined with appropriate policy directions, appropriate institutional support and coordination, urban agriculture can become a vehicle that contributes substantially to climate change mitigation and adaptation in Ghana.

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