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Persist or Perish. The Dynamics of Irrigated Agriculture in Urbanising Dar es Salaam, Tanzania

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Abstract

Dar es Salaam (Tanzania) is one of the fastest urbanising cities in sub-Saharan Africa, which has implications for its food security. Based on ethnographic research that focused on understanding how day-to-day agricultural practices are configured, we study the responses of farmers to a changing urban environment. We describe urban agriculture as an expression of active city-making; something which is uncommon since the agricultural sector is typically presented as passive and helpless in the face of urban growth. This paper shows that farmers, despite not being accounted for in urban narratives, co-shape what the city looks like and how it functions. By crafting networks of provision based on the informal access to land and water, they offer food, employment, and more for the improvement of their lives and the wider citizenry. In opposition to land pressure and water resource degradation, farmers adapt their agricultural strategies to benefit from what they can access while dealing with the uncertainties of changing realities. Based on our findings which reflect the characteristics of everyday urbanism, we discuss implications for theory and governance. With African cities risking to grow hungry, a better representation of urban farmers and their irrigated agricultural production in urban planning and governance reduces uncertainties and risks, both for farmers and the wider city.

Keywords Irrigated urban agriculture · Urbanisation · Urban planning · Everyday urbanism · Water management · Dar es Salaam

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Introduction

Eliza[1] *is preparing bunches of vegetables for sale in the surrounding urban areas. She is one of many who have come to the city in search of a better life. Arriving in Dar es Salaam, she first had a business selling clothes and years later turned to farming. She now grows vegetables on the riverbanks in the city. Over recent years, more and more houses have been built on the agricultural land in this area and several farmers she knows have been forced to leave. 'It will reach a time that if you want vegetables, you have to use buckets and tins to cultivate your vegetables. This is not just what I think, it is the real situation!' (interview, 8 July 2021). The advancing city makes her worried about her future as a farmer.*

The anecdote above is illustrative of the pressure that urban farmers in Dar es Salaam face due to rapid urbanisation. The largest city and *de facto* capital of Tanzania recently counted a population of close to 5.4 million and with an annual urban agglomeration rate of 5.0% from 1990 to 2018, Dar es Salaam is one of a few cities of this size and with this growth rate in Africa (NBST, 2022; UN, 2018). Despite countless efforts to plan and direct this rapid growth, the city has experienced urban sprawl without adequate planning for decades. More than 70% of the residential land can be described as informal, "meaning that they were built upon without planning designation, surveying, land titling, provision of services and building permit" (Hill et al., 2014, p. 167; Murphy & Carmody, 2019; Todd et al., 2019). The city's limited capacity to cater for new urban dwellers leaves many with limited economic opportunities, reinforcing patterns of inequality and putting food security at risk.

As Africa urbanises, a growing number of urban dwellers face the challenge of accessing sufficient food to meet their dietary needs. Being food insecure remained for a long time largely ignored since development initiatives primarily focused on eradicating rural hunger and boosting smallholder agricultural production. Acknowledging the global dynamics of growing cities, there is a shifting focus of the global development agenda towards the urban population and their food security (Crush & Frayne, 2010; Crush & Riley, 2019). The urban metabolism of food systems holds a shaping force in the sustainability and resilience of cities, which means that food cannot remain 'peripheral' to urban planning and governance (Haysom, 2021; Smit, 2016; Sonnino & Coulson, 2021; Steel, 2013). Cities also do not expand into vacuums but encroach into existing natural and agricultural landscapes that contribute to human well-being. Agriculture in and around cities contributes to urban sustainability in ways that extend beyond more traditional understandings of agriculture. Rather than only contributing to food security through production, examples of other urban functions mentioned in literature are beautification, leisure, resource recovery, and urban greening that reduces heat island effects (Ayambire et al., 2019; Contesse et al., 2018; FAO et al., 2022; Gómez-Baggethun & Barton, 2013; Tapia et al., 2021). The loss of land for food production therefore not only raises concerns

[1] Pseudonyms are used for all research participants to protect their identities.

about the ability to cater for growing urban food demands but also about the other ways through which urban agriculture contributes to the sustainable growth of cities (Barthel et al., 2019; La Rosa et al., 2014; Tapia et al., 2021).

Despite the growing competition over land, urban and peri-urban agriculture can be found across sub-Saharan Africa (Lee-Smith, 2013; Orsini et al., 2013; Davies et al., 2021; Zezza & Tasciotti, 2010). While a lot of previous research has focused on documenting the existence of urban agriculture, there is a lack of understanding about the actual responses of urban and peri-urban farmers to a changing urban environment. Our objective is to fill this knowledge gap by studying how agriculture is shaped by (but also co-shapes) the growing city. We selected Dar es Salaam as a case example due to its rapid growth and the known presence of agricultural practices in the city over the past decades (Dongus, 2001; Mlozi et al., 2014; Sawio, 1994; Wessels et al., 2024). We explicitly describe urban agriculture as an expression of city-making; something which is uncommon since the agricultural sector is typically presented as passive and helpless in the face of urban growth and is often considered as a rural activity portraying failed urban development (Follmann et al., 2021; Shannon et al., 2021). Our study shows that urban dwellers (practising agriculture) play an active role in appropriating urban space for their own ends to make a living. We, therefore, believe that the findings in our paper not only contribute to current debates around the role and significance of urban agriculture, but moreover also show how these agricultural practices exemplify the everyday city-making dynamics that are part and parcel of growing African cities.

This study focuses on irrigated agriculture within the city of Dar es Salaam. We see the case of Dar es Salaam as exemplifying other medium and large-sized cities in sub-Saharan Africa where rapid expansion puts pressure on urban land use planning and the urban food geography. We explicitly refer to the irrigation aspect of urban agriculture because (as we will show later) water plays a key role in shaping the interconnection between agriculture and the city. Water remains rather implicit in studies on urban agriculture as it is often regarded as just one of several inputs. In the field of water management, there is more emphasis on this aspect but often with a particular focus on the quality of the water used for irrigation (Drechsel et al., 2022; Ricart & Rico, 2019; Wichelns & Drechsel, 2011). This frequently underscores the challenges associated with urban agriculture, while farmers often have limited control over their water supply (Wessels, 2023). In our selection of study areas, we have primarily focused on practices of irrigated agriculture in urban areas while also supplementing this with fieldwork in peri-urban areas (explained in more detail in the next section). We mostly refer to urban agriculture in this paper without differentiating between the urban and peri-urban, as we consider the urban and peri-urban connected through myriad flows of goods, services, and that these divides are of limited use due to the constant change they are subject to given urban growth.

The paper continues by first describing the conceptual lens and research methodology. We also shortly show the wider sets of ways in which Dar es Salaam's citizens already manage and navigate the city with regard to service provision. After that, we turn to our research outcomes and describe how irrigated urban agriculture is formed by its urban environment and likewise shapes what Dar es Salaam looks like and how it functions. Following this, we describe how farmers respond to processes of urbanisation

through flexibility and mobility. To illustrate this, we finish this section with an example of one of the study areas to show how agriculture changes over time (Box 1). In the discussion, we reflect on the city-agriculture relationship and point out implications for theory and governance. We conclude the paper by summarising our findings and thoughts on engagement with farmers as active city-makers in light of urban food security.

Research Approach

Conceptual Framework

With urbanisation pathways in Africa showing distinctly different from dominant urban planning theory, there is a growing body of scholarly work focused on new understandings of cities that give better right to the context of the cities of the Global South (Harrison, 2006; Parnell & Robinson, 2013; Pieterse, 2011; Robinson, 2016; Watson, 2009). Watson (2009) describes a 'clash of rationalities' in the domain of planning between the logic of governing and that of survival. Planning efforts by the state are responded to in varied ways by those outside of the state and formal business sector who appropriate the city to their own needs in order to survive. "People in their everyday lives engage with the [state-initiated planning] systems in diverse and unpredictable forms – making use of them, rejecting them or hybridising them in a myriad of ways" (Watson, 2009, p. 2269). Since the efforts of ordinary urbanites play an important role in the construction of the African city, emphasis is given to the theorisation of these bottom-up processes of city building. Simone (2004, p. 407) states that "African cities are characterised by incessantly flexible, mobile, and provisional intersections of residents that operate without clearly delineated notions of how the city is to be inhabited and used" and refers to 'people as infrastructure' to describe how Southern cities are made to work through the efforts of people. Pieterse (2008, p. 109) argues that in order to understand the city it needs to be studied "through the eyes of the majority of poor denizens who appropriate the city for their own ends". Bayat (2000, p. 545) uses the term 'quiet encroachment' to describe "the silent, protracted and pervasive advancement of ordinary people on those who are propertied and powerful in a quest for survival and improvement of their lives". Building on this, Swilling (2011) and McFarlane and Silver (2017) distinguish an urbanism 'in its own right' (i.e. slum urbanism, everyday urbanism[2]) in which urban dwellers construct their ways of living despite a lack of access to formally constructed and managed infrastructures.

Building on this understanding of the African city, the theoretical base we use in our analysis is that the city is made to work through the everyday practices of ordinary people. We apply this conceptual lens of an everyday urbanism to the study of agriculture in the city, as we believe that this practice shows similar patterns of urbanity despite often being placed outside of urban narratives. Based on a systematic review of urban and peri-urban agriculture, Follmann et al. (2021, p. 3) describe

[2] Others refer to 'southern urbanism' or specifically 'African urbanism'. See Parnell and Oldfield (2014) for considerations when conceptualising (the study of) Southern cities.

how farmers are "typically presented as passive and helpless in the face of rapid urban growth" and the active responses of farmers to processes of urbanisation are rarely examined. Before studying these farmers' responses to urban growth using this conceptual lens, we first show how Dar es Salaam's citizens already play an important role in the functioning of the city.

Context of the Study

In the interface of state-initiated planning approaches and the everyday lives of a growing urban population largely living under conditions of informality, the reality of urban growth and service provision in many African cities is characterised by diverse and hybrid sociotechnical configurations that act partially within and partially outside state regulations (Hossain et al., 2015; Lawhon et al., 2018; Letema et al., 2014). Dar es Salaam has shown similar patterns of urban growth taking place mainly beyond formal planning. The city's growth along the coastline and the four arterial roads has created distinct differences between the inner city and the suburban areas towards the peri-urban and the urban interstices. These differences in growth patterns (see Fig. 1) have also resulted in service provision disparities. Koepke et al. (2021) show how electricity grid expansion in Dar es Salaam is largely demand-steered based on the mobilisation of resources rather than through proactive planning. This has resulted in an electricity network that is highly diverse in its composition (with social imbalances in access), yet electrifies the city. These infrastructural configurations embody a creative response to a rapidly growing urban society in need of electricity. Similar processes can be observed in the provision of water, where strategies of multiple-sourcing of water and networks of private water vending have appeared as a response to the absence of reliable central water provision (Bender, 2021; Dakyaga et al., 2021; Pastore, 2018; Smiley, 2013). "As much as 50 per cent of the population relies, at least in part, on private vending to secure water. It provides not only for users in poorly serviced formal and informal neighbourhoods, but also wealthier households dissatisfied with their tap water" (Bender, 2021, p. 55). Service provision networks have emerged through the efforts of people in need of basic services but show high levels of fragmentation that are simultaneously structuring people's lives.

Despite the drawbacks of these network configurations (e.g. issues regarding quality and affordability), the amalgamation of formal and informal service providers effectively reaches the many residents of Dar es Salaam. Citizens are able to employ a number of strategies to access services to survive, if not thrive. This process of crafting systems of service provision shows how urban dwellers can make a difference to an urban state of affairs. This urban agency is however bound to the ability people have to effectively act in ways that align with their interests and demands, which raises critical questions about who is able to direct (thus benefit from) urban growth and who find themselves in an insecure position (Briggs & Mwamfupe, 2000). Relating this to urban agriculture, Wessels et al., (2024) show how farmers in Dar es Salaam are confronted with the increasing pressure of a particular ideal of 'progress' that threatens their livelihood. In the

competition over land as a result of urban development, the loss of agricultural land and the displacement of farmers tend to be often overlooked in conversations concerning the planning of African cities (Shannon et al., 2018; Zoomers et al., 2017). We therefore take a methodological approach, which we will now elaborate on, that emphasises studying the day-to-day reality of agriculture in the city,

Methodology

The data presented in this paper is based on ethnographic research in six areas that represent common types of open space cultivation in Dar es Salaam (Fig. 1). The selection of study areas is based on 20 exploratory field visits, a literature study, and expert interviews in the run-up to this fieldwork. The selection of study areas can be subdivided into three categories: open space cultivation in (1) river floodplains; (2) low-lying areas; and (3) developing urban areas. The latter category captures irrigated cultivation in urban areas where plots await development. It was decided not to focus on peri-urban agriculture, as agrarian change is distinctly different there. We also did not consider backyard farming (or home gardens) in our study since, although it is also a common type of urban agriculture, this is more household-oriented rather than related to a more extended urban food system.

A period of fieldwork (by the first author, accompanied by a local research assistant) was conducted between May 2021 and February 2022. Informal conversations, semi-structured individual interviews, and participant observation were combined in all areas. This combination of research methods allowed to experience in-depth how agricultural practices are configured, as well as how these practices are embedded in bigger networks of occupying space, using water, and producing food. Regular visits to the study areas created opportunities to conduct individual farmer interviews and the generation of a shared understanding of how agricultural practices take shape in the city. More than 50 farmers within the six study areas were interviewed at least once, and 37 of them were visited regularly and interviewed several times throughout this period. The fieldwork period was subdivided into three stages with different focuses. The first period aimed to generate a general understanding of the people, practices, and places (e.g. crop choices; irrigation routines; social organisation), while particular attention during interviews was given to changes that had taken place over time. The second period of interviews and field visits zoomed in on marketing strategies and water use arrangements, while the third focused on more sensitive issues such as contamination of irrigation sources, forced relocation, and the public perception of the desirability of agriculture. To better understand the farmers in the urban areas, an exploratory follow-up was conducted in two peri-urban areas using field visits and undertaking 20 interviews. Most interviews were conducted at the farm plot while interviewees were doing activities such as soil preparation, harvesting, or waiting for customers. This strategy of meeting farmers at work (several farmers referred to their plot as their office) helped to better understand the farmers' realities (benefiting from 'show and tell', which adds depth and reliability to the data) and minimised disruption to the farmers' routines. Data analysis was based on a combination of coding and memo writing in the different stages of data collection. This method allowed the design of subsequent data collection based on active engagement with the data already collected. The fieldwork data was supplemented with content analysis to contextualise the research findings.

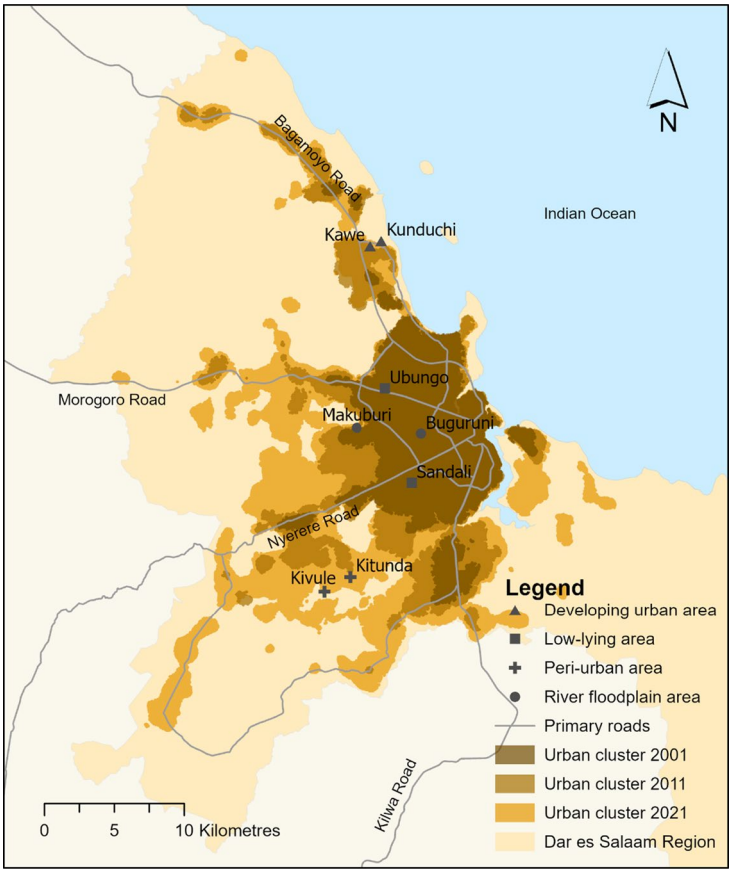

Fig. 1 Study area locations with names of the respective wards. The urban clusters show the expansion of Dar es Salaam between 2001 and 2021, see Wessels et al., (2024)

Results

The socio-material context in which agriculture takes place plays an influential role in its configuration, as farmers actively appropriate the urban space around them in order to make a living. The following section describes (1) how irrigated urban agriculture shows clear imprints of the city in terms of its shape and the services it provides and (2) the active responses to urbanisation that have enabled its persistence. By doing this, we show how agriculture is an intrinsic part of the contemporary urban fabric through the everyday interactions of people around land, water, and food.

Irrigated Agriculture in the City

The commercial production of leafy vegetables is common in open spaces within the built-up areas of Dar es Salaam. Leafy vegetables (especially *mchicha*, i.e.

amaranth) are in particularly high demand since they are part of local traditional diets and need to be grown close to local food outlets to be supplied fresh. Farmers contribute to urban food availability by selling from the farm to street vendors and business(wo)men, with a small part sold directly to consumers. Doing this, they are part of a (largely informal) network of food provision that is adaptive to the urban ecosystem they are part of. This (social) infrastructure of provision not only contributes to the accessibility of food but also provides economic opportunities for a range of people, farmers included. Cultivation on a small patch of land is already financially profitable, especially during the dry season when the supply declines due to water scarcity. Given the short growth periods of leafy vegetables (*mchicha* has an average growth period of just over three weeks), some farmers describe their income cycle as similar to the monthly salaries from other urban jobs. Studies conducted in Dar es Salaam show that urban agriculture contributes to a reliable household income given low start-up costs, high productivity, and short production cycles (Kifunda, 2019; Lee-Smith, 2010; McLees, 2012; Mlozi et al., 2014; Victor et al., 2018).

To access open spaces within the built-up areas, farmers approach those who own or supervise these unused areas. The farmer that turns the area into productive use – for example by clearing bushes and tilling the land – becomes the right-holder of the land. Tenure arrangements are based on the right to use rather than the right to own; customary rights that can be transferred from person to person. Plots can be sold or rented to others while knowing that the opportunity to use the land can be terminated at any moment. Land governance shows to be a complex system with overlapping formal and customary land rights that can also be seen in other urban regions in Africa. Urban densification and expansion go together with land planning and formalisation whereby these formalisation processes enter (peri-)urban interstices or rural areas with existing tenure structures (van Noorloos & Kloosterboer, 2018). In the case of this study, there is a similar intermingling of formal and informal land use plans where farmers make use of urban land based on agreements between the owner and the user (i.e. farmer) to keep the area looked after until development plans materialise. While the number of male and female farmers in this research was found to be fairly evenly balanced, men generally have a stronger hold over land; they are more often first-time users and have access to larger plots.

Most of the urban farmers (92% in this research) are first-generation migrants from different regions of Tanzania. People come to Dar es Salaam in search of opportunities for a better life (many interviewees refer to their motivation as '*kutafuta maisha'*, i.e. 'to find life'). New urban citizens, such as farmers here, require time for experimentation and establishing social ties from which effective connections (although often fragile) with the city emerge. On average, the interviewed farmers have lived in the city for 23 years and relied on farming for 17 years, which implies that it is not an activity that is immediately taken up by recent arrivals nor a short-lived activity. Many farmers worked in the informal economy upon their arrival in the city and turned to farming (leaving other jobs) in order to generate more income and have more stability in their employment. This contradicts the popular notion that taking up agriculture is an act of despair in response to urban unemployment (Hovorka, 2004; McLees, 2011; Schmidt, 2012). Urban farmers do come

from vulnerable jobs (insecure, informal), but their turn to agriculture can likewise be described as a move towards better employment conditions and prospects.

Social organisation is generally limited in the different agricultural areas studied. Wesselow (2019) describes how social heterogeneity and the temporary nature of agricultural locations limit the establishment of solidarity-based interactions among farmers. Existing social organisation revolves around occasional matters, such as collective responses to land being taken (also see Box 1) or the use of irrigation sources. While irrigation, which takes place with petrol pumps and/or by using buckets and watering cans, is generally allocated on a first come first service basis, farmers can negotiate irrigation scheduling and the use of particular sources when water is scarce. These sources often have customary ownership based on the contribution to construction or maintenance; making use conditional at times. The only situation in which collective organisation takes place is around the use of the piped water system. In some agricultural areas within the developing urban areas, farmers make use of metered water points. The amount of water used per individual is recorded in a book and the bill is paid collectively at the end of the month.

The water supply for farmers is woven into Dar es Salaam's water system, which exposes farmers to changes occurring elsewhere in the water system (we return to this point in the next section). Besides (seasonal) rain, different types of water feed the farmers' irrigation sources: groundwater, piped water, and wastewater. Groundwater is drawn from the coastal aquifer, which also supplies water for domestic use through boreholes in the residential settlements. Piped water can be either directly drawn from a tap or indirectly benefited from when water is lost during transmission. There are also different types of wastewater, which can come from domestic or industrial sources (or a mixture) and be raw, partially, or fully treated. The main irrigation sources fed by these different types of water supply are rivers, canals, shallow wells, and water taps. Rivers are a common source of irrigation since flood risks during the rainy season prohibit housing in the adjacent areas; offering opportunities to cultivate. The larger the river system, the more complex the understanding of what types and proportions of water supply it is fed by. Water in the canals is often excess water draining away from residential settlements (mostly rainwater and domestic wastewater). The canals are unlined waterways with in-stream reservoirs that hold back excess flows before draining into the rivers. These reservoirs allow for irrigation when the water supply is limited, increasing the buffering capacity of the irrigation systems. For shallow wells, they fill up with surface run-off during the wet season and return to their natural groundwater level after the rains stop. Finally, water taps are used for irrigation in some areas. Farmers can benefit from the convenience of clean and pressurised water that is available (almost) anytime. However, this is the only source of irrigation for which farmers must pay. This means that the use of this source is strategically chosen and the costs can inhibit cultivation.

In this section, we have shown how unused open spaces within built-up areas are temporarily used as an opportunity for cultivation; thereby contributing to the improvement of the lives of the farmers as well as the wider urban citizenry. These practices provide locally grown food for the city, offer employment, and contribute to keeping unused land looked after. Agricultural practices are not only shaped by the urban context, but the farmers themselves also construct the urban in this way by establishing

employment opportunities, utilising urban land and water resources, and contributing to the city's food geography. Despite the rapid growth of the city which puts pressure on agriculture within the city, agriculture continues to exist and people still turn to farming for their livelihood security. In the following section, we show how urban agriculture responds to urban development in order to survive and stay of relevance.

Agricultural Responses to Urban Growth

The expansion and densification of built-up areas comes at the cost of the diminishment of existing agricultural areas in and around Dar es Salaam. Houses are built on agricultural fields or companies come in and redevelop the land for commercial purposes. For some farmers, beacons that demarcate planned property have already been placed in the middle of their fields; a reminder to them of the temporary nature of their land use (see Fig. 2). As we show in Box 1, complete areas can be taken for development purposes; leaving farmers landless and looking for new opportunities. Farmers do not have the power to oppose land acquisition, are not entitled to compensation in this process, and are confronted with modernist convictions about how urban agriculture is regarded as backward urban development (Bourque, 2000; Halloran & Magid, 2013; McLees, 2012; Mkwela, 2013). Wessels et al., (2024) show a disconnect between agricultural planning ideals and the embodied reality of agriculture in Dar es Salaam. A broader antagonism towards urban agriculture has "rendered urban farmers largely invisible amidst the growing global competition for Africa's urban land" (Shannon et al., 2021, p. 735). As the city becomes denser, the right to use land is withdrawn. Farmers lose the opportunity to tap into the urban food system through cultivation, so they search for new areas to reactivate their practice. By relocating to new urban or peri-urban locations for production, they reconfigure their practices to stay connected to the opportunities that are present.

With the reduction of arable land, the urban food geography changes and shows a stronger dependency on long-distance food relations. Leafy vegetables have become one of the few crops that are still attractive for urban cultivation. Staple crops (e.g. cassava, maize) used to be common in the past, but it is nowadays necessary to focus on high-value (and fast-growing) crops in order to gain a livelihood from smaller plots. Fruits and vegetables (even to some extent leafy ones) are increasingly imported from outside the city. While there has always been a supply of fruits and vegetables from other regions, interviewees indicated that the import of (leafy) vegetables has become more significant and constant over the years. Trucks come from other regions of Tanzania to sell at the market at low prices and urban farmers are forced to lower their prices if they want to sell at the market. Despite more fruits and vegetables being brought to Dar es Salaam over larger distances, leafy vegetables remain a profitable crop choice. Their perishability requires the supply chain to be short and is therefore more persistent compared to other fruits and vegetables.

Besides the impact of urbanisation on land use and the food system, access to water for irrigation is also subject to change. During the wet season, increased direct runoff (caused by the soil being sealed by construction) results in agricultural land

Fig. 2 Field with a concrete beacon placed by surveyors to demarcate the boundaries of a property, exemplifying the temporary nature of the area as agricultural land (photo taken by the first author, 29 July 2021)

along the banks of rivers or in low-lying areas being submerged for longer periods (thus prohibiting cultivation). During the dry season, farmers benefit from an increase in water availability when their agricultural areas are directly fed by water from residential areas (i.e. reusing urban water). These flows become more reliable because domestic water use (and therefore disposal) increases. Leakages from piped water networks, which have increased due to a lack of maintenance or network ageing also contribute to these flows. At the same time, infrastructure or development projects can reduce access to water. For example, there are areas where leakages have decreased because of piped system upgrading. Likewise, there are examples in several areas where water supply has been cut off or redirected due to construction projects. Farmers in these areas switch to alternative irrigation sources, are forced to reduce the number of irrigated plots, or relocate to new areas.

Although the extent to which the water quality has changed is context-specific, the water quality overall has deteriorated due to an increase in the number of industrial and domestic discharges upstream. These water quality changes are generally not described as detrimental to growth, but farmers do voice their concerns about how the general public perceives their practices. Publicity in the past around water contamination has damaged the image of urban farmers, who have been unable to object to the conclusions drawn (Wessels, 2023). Farmers are rarely in a position to express their concerns about upstream water pollution, since their use of these water flows is not formally acknowledged. This creates a hesitancy to talk about these concerns or raise them at the local government level, because local government

authorities hold the power to respond in ways that may not align with the needs of the farmers. This reflects the situation in many cities in the Global South, where residents have little confidence in the provision of public authorities, benefit from the state's inability to provide, or are afraid that state interventions will lead to the loss of existing opportunities. The capacity of urbanites for self-help often eclipses the role of the state and renders it unnecessary (Jaglin, 2016; Roy, 2005; Simone & Pieterse, 2017). In this case, minimising nuisance in order to continue irrigation means accepting the additional risks due to the upstream intensification of water use.

Although farmers indicate that they are flexible to take up other employment opportunities if and when they arise, most feel that the commercial production of vegetables gives them (and their families) security that they have not found in other types of urban employment. This characterises how urbanites are constantly on the lookout for opportunities while bearing the uncertainties that characterise Southern cities. Only when agricultural land is taken for construction are urban farmers forced to reconsider their options. When this happens, some turn to other (often agriculture-related, such as vegetable selling) jobs while searching to secure a new plot. Others can directly move to agricultural areas on the urban periphery or just outside Dar es Salaam region. Most of the urban farmers we interviewed expected to continue farming although not in the same location.[3] This shows how farming persists but moves outwards in order to do so. When losing their land, farmers relocate to areas where the pressure on land is less acute. This can be in the peri-urban areas of the city or in the adjacent rural districts that have good road connections with markets in the city. Besides this, the process of 'moving outward' can also mean that farmers move into more marginal spaces within the city.

Access to land and (irrigation) water is key to the survival of the practices and prosperity of farmers facing the pressure of urban growth. In opposition to land pressure and water resource degradation, farmers adapt their agricultural strategies to maintain their position in the city. When farmers lose access to land, they are mobile and search for new locations to reactivate their practices. They are also flexible and switch to alternative water sources or are sometimes confronted with the consequences of water use by others. Urban growth reconfigures agricultural practices according to the availability of land, water, and markets; all of which bring new balances of benefits and risks. This shows how infrastructures of provision (e.g. food, incomes) are pragmatically built by urban individuals. The attractiveness of agriculture as an urban livelihood practice – as well as the demand for its services– results in an 'infrastructure' that is constantly reconfigured to be made fit to the urban ecosystem.

[3] The existence of an inter-generational transition from agriculture into more formally-constructed parts of the city's economy have not been explored.

Box 1. Example of dynamic reconfigurations in a growing city: TAZARA-Mchicha

TAZARA-Mchicha is a well-known agricultural area in Dar es Salaam that has existed since the 1980s (see Halloran and Magid (2013) and McLees (2011)). The area (located in Sandali Ward, see Figure 1) is owned by TAZARA, the railway authority linking the seaport of Dar es Salaam with Zambia. The total area has decreased over time because of construction, but approximately 12.5 ha was under cultivation in early 2021 (own calculations). Early mornings (as well as *jioni*, i.e. the end of the afternoon until sunset) a lot of activity can be seen in the area. Farmers irrigate and harvest their plots while customers (especially women) come to buy vegetables to sell either in the direct neighbourhoods or at the market. A wholesale and smaller retail market can be found nearby attracting business purchasers to the area. Three streams (with in-stream reservoirs) and a small number of shallow wells provide sufficient water for farmers to irrigate their leafy vegetables. The streams pass through the upstream residential areas and are described as having different reliabilities and qualities.

In June 2021, a contractor arrived and started excavating trenches for the construction of a wall. Although the local government office received prior notice, the news was not yet relayed to the farmers. TAZARA had come to an agreement with a large energy and transportation company wanting to construct a dry port. This came as a surprise not only to the farmers, but also to the surrounding community (the valley connects two neighbourhoods, and many people pass through it every day). The community (where farmers are a part of) showed resistance by backfilling the trenches and demolishing the stacks of delivered building blocks. Construction came to a halt, but the farmers realised that this would only be temporary. They organised as a group and requested compensation for land to be lost and prior notice of construction to be able to harvest their last crops.

A month later, construction of the dry port restarted. Agriculture slowly ceased to exist in this valley, leaving farmers with mixed emotions. Some farmers acquiesced and emphasised that they knew about the temporary nature of the agreement from which they had reaped benefits over the years. Others felt let down by the loss of the land and their livelihood security. The interests of high-value development outweigh the agricultural function of an area like this. Farmers cannot claim any legal rights from their histories of agricultural production when the land owner decides to develop the area. As a local leader from the area described: 'It is not easy to stop a person with money if you don't have anything in your pocket' (interview, 27 July 2021). The only option for farmers is to accept their losses in one place and start looking for another location. This is what most farmers have done: moving to the peri-urban areas of Dar es Salaam or to rural areas along the main roads heading towards the city. In a matter of five months, the area had been transformed into a fenced commercial property with no signs of the agricultural activities that had once taken place there.

Juma is one of several farmers we followed through this process. He got access to a plot through his father in 1998 and has been farming it ever since. Every morning he arrived at his field by bike and worked on the farm while waiting for customers. Water for irrigation was taken from a canal that used to be connected to the drainage system of the nearby main road. This stormwater supply was cut off in 2015 because of the construction of a smaller dry port between his plot and the main road. Since then, most of the year he took water from a shallow well that was collectively constructed in response. With eviction approaching, he started looking for a plot in one of the peri-urban areas of Dar es Salaam. After losing his plot, he relocated to this new location. This shift resulted in a change of location (more than 25 km further outward), a different source of water (a small spring), and a new market location. While his agricultural practice has changed, his contribution to urban food security remains.

Discussion

In the previous section, we have offered an empirical account of agriculture as part of a growing city. We have shown how irrigated agriculture is embedded in the urban ecosystem and dynamically moves along with urban growth in order to 'stay alive'. Changes in access to land, water, and markets create different embodiments of a practice that proves persistent, despite not being formally planned for as part of the city. In this section, we draw conclusions on the responses of urban farmers to processes of urbanisation and indicate the respective implications for theory and governance.

First, this research has shown that farmers take an active role in the urban (food) geography through the production of perishable vegetables, income generation, and maintaining open spaces. The mobile and non-destructive character of irrigated urban agriculture (no on-site infrastructure needed and crop production with short growth cycles) provides different services by utilising flood-buffering and to-be-developed areas. In this way, farmers actively participate in the configuration and reconfiguration of a growing city. The presence of urban agriculture shows not to be a transitional phase, but rather a continual part of what the city looks like and how it functions. People continue to turn to agriculture and urban agriculture is responsive to processes of urbanisation by reconfiguring their practices and relocating in order to persist. In this way, the locations where urban agriculture can be observed might perish due to urban growth, but the practice itself shows persistent (see Box 1 as an example). Agriculture and the growing city interact in a symbiotic way where farmers continue to find urban and peri-urban land to provide for the city in different ways. Although we have shown the agency that farmers have in the configuration of agricultural practices and their responses to urbanisation, this agency is bounded contextually. Farmers take part in an urban space where the changes that occur (e.g. upstream water pollution or forced relocation to marginalised spaces) result in a redistribution of benefits and risks over which they often have limited control. As such, these agricultural practices are best understood as interlinked with other forces of city-making, be they physical or political.

Second, agriculture has stayed largely 'peripheral' to the understanding of cities as it opposes popular convictions about the modern city (Bourque, 2000; McLees, 2012; Shannon et al., 2021). This paper, however, offered a detailed empirical account of how agriculture is intrinsic to the city of Dar es Salaam, actively contributes to the production of the city's socio-material space, and is expected to continue to do so by finding value in vacant spaces. Despite generally not being accounted for in urban narratives, this show how farmers actively co-shape the city in the way it looks and functions. By constructing (and reconstructing) networks of provision, they offer food, employment, and more for the improvement of their lives and the wider citizenry. These social infrastructures (and their associated flows) are important constitutive parts of how urban life is structured and evolves. In this way, farmers effectively find their security of living in the opportunities that can be found beyond formalised systems and the state's reach. This paper therefore argues that these agricultural practices can be regarded as an example of everyday

urbanism. In light of Africa's urban future (specifically how future cities are going to be fed), agricultural dynamics should be studied (and theorised) as an urban phenomenon in its own right in order to better understand the role food production plays in the sustainability and resilience of cities.

Third, the dynamic character of irrigated urban agriculture enables the practice to endure but also creates difficulties regarding governance engagement. Mobility (making way when needed) and informality (limited engagement with state actors) are strategies adopted to survive, but also make it hard to capture (i.e. describe in its appearance or quantify) and regulate these agricultural practices. This quasi-invisibility can be regarded as part of the farmers' strategy of persistence. Concealment and continual mobility are effective strategies to survive for a diverse array of practices in the informal sector. Since urban agriculture is merely tolerated in many African cities (including Dar es Salaam) as long as it does not become a 'nuisance' (Wessels et al., 2024), limited engagement with authorities is a way to be of limited disturbance while continuing agricultural production and income generation. Although we support existing policy recommendations to formally incorporate agriculture in urban planning, formalisation and regularisation of urban agriculture have shown to be a challenge for a long time already (Wessels et al., 2024). As a result, irrigated urban agriculture persists (and will likely continue to do so) by informally and temporarily filling up the voids of urban space. In this light, incremental approaches of tenure (e.g. assigning interim tenure rights to farmers as part of urban planning approaches) might be better suited to address the diversity of demands of the city (today and in the future). Also, the recognition and involvement of informal actors in urban planning and governance can strengthen the collaboration around service provision in the city in order to balance benefits and risks that also exist around the use of urban land and water for food production. Embracing the informal into planning and governance implies the acknowledgement that cities and urbanisation processes are shaped by a bricolage of top-down and bottom-up forces of development.

This paper has provided insight into how farmers are embedded in and respond to the growing city. Foregrounding the agricultural identity of the urbanite here has automatically resulted in backgrounding other identities farmers carry. Farmers are also urban dwellers who have a multitude of other connections regarding urban living, consumption, recreation, etc., that we have not touched upon. In some cases, farmers in this research were even participating in other types of jobs that could be seen as conflictive (e.g. farming and working as a day labourer to do masonry in the same area). Urban actors have multiple identities, which makes the understanding of urban space non-monolithic and, at times, divergent. This means that urban practices may be surrounded by negotiations and contestations about what the city does (and should) look like that cannot be understood by only looking at one of these identities. Studying these (interaction of) multiple identities and how they direct people's connection to agriculture (or perhaps the transitioning out of agriculture) needs to be studied in further detail and is therefore recommended as a relevant field of further research.

Conclusions

Urban growth puts pressure on the future of agriculture as an urban land use practice. This paper studied irrigated agriculture in Dar es Salaam, Tanzania, to understand how these practices respond to urban growth. Where the disappearance of agricultural sites can be observed, we showed how irrigated urban agriculture persists due to its flexibility and mobility. Farmers build on temporary land use agreements, tap into different urban water sources, and cultivate short-cycle crops for the surrounding urban areas. Doing this, farmers claim their (informal) right to the city and commercially cultivate open spaces until the city (i.e. construction) takes over. The changes in access to land, water quantity, water quality, and markets have obvious implications for farmers both practically and in normative terms. Since agricultural land use and urban irrigation are not planned for and not formally acknowledged, farmers benefit from what they can get access to while dealing with the associated uncertainties of changing realities. These agricultural configurations represent a network of (service) provision that functions independently from systems of the state and is responsive to urban advancement. In this respect, this study of irrigated urban agriculture is valuable in showing the everyday dynamics of urban living and the heterogeneity of the African city; reflecting the characteristics of everyday urbanism. Ordinary people continue to find ways to access land and water for the improvement of their lives and that of the wider citizenry. The continuation of the practice shows that it is not a 'passing phase' towards the modern city, but rather an informal practice in its own right. Practices are built (and re-built) based on its socio-material environment and form dynamic infrastructures that supply food for the city. With African cities risking to grow hungry, an active scholarly engagement with urban agriculture as an expression of urbanity is important. To support these social infrastructures in light of urban sustainability, we recommend recognising farmers as active city-makers (which also implies integration in urban planning, possibly through incremental approaches of tenure) and acknowledging the temporal presence of agricultural configurations as a continuous contribution to the (social and spatial) fabric of African cities.

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