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Geographisches Institut, Humboldt-Universität zu Berlin

Maria-C. Velte / Antonia Segieth / Albert C. Nyiti / Neema A. Munuo / B. Makau Kitata / Juliana Eggers / Nestory E. Yamungu / Sabine Fuss (Hrsg.)

Exploring Urban Agriculture in Global North and South

Results of two international study and teaching projects as part of the East African German transdisciplinary University Network on rural-urban transformations (EAGER Trans-Net)

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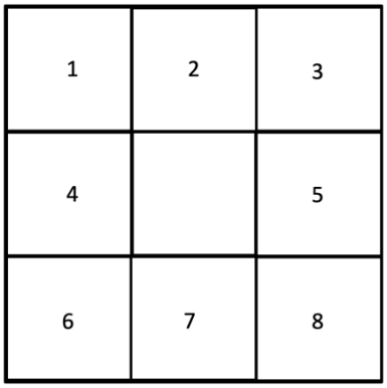
Figure Reference:



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Editorial

Exploring Urban Agriculture in Global North and South

Maria-C. Velte, Antonia Segieth, Albert C. Nyiti, Neema A. Munuo, B. Makau Kitata, Juliana Eggers, Nestory E. Yamungu, Sabine Fuss [1]

Urban agriculture (UA) is at the core of the sustainable development agenda (see NICHOLLS et al. 2020). In the Global South, food security is a prime goal with shortened transportation routes and reduction of post-harvest losses (SHEAHAN/ BARRETT 2017). In the Global North, the focus shifts more towards responsible consumption, strengthening links between city and nature, promoting social cohesion, and fostering health (see a.o. DOBELE/ ZVIRBULE 2020; PINHEIRO/ GOVIND 2020; TORNAGHI 2014). In the face of climate change, UA can even be part of an adaptation strategy. Current global research on UA displays the focus on urban food production, urban green space, and the general management of these practices to reach economic, environmental, and social aspects that support healthy cities (YAN et al. 2022). Most of this literature is based on case studies where the definitions of UA vary depending on the local context and study purpose, which leads to limited possibilities for quantitative comparisons between studies (DOBELE/ ZVIRBULE 2020). Furthermore, the geographical distribution of research on UA shows a clear focus on Global North, where five countries (United States, United Kingdom, Germany, Canada and Australia) contribute 58% of total publications of the final data set, whereas the share of research on the Global South is low and further research is needed to understand the lack of representation of the Global South in peer-reviewed research (PINHEIRO/ GOVIND 2020, 166). With this publication, we want to present studies from both the Global North and South, looking at common and different trends, impacts, challenges, strategies, and future approaches. Moreover, it was our concern to overcome the prevailing modernist perception of UA in studies carried out in the Global South as a backward self-help survival strategy of the poor and marginalised that needs to be overcome in the course of modernisation (GRAY et al. 2020:869) by focusing on innovative, sometimes even subversive practices, the multifunctionality of UA, as well as political questions of land use planning. Future research should focus on the resilience, sustainability, and versatility of UA in order to ensure the sustainable development of the global food systems (YAN et al. 2022).

This publication contains a series of articles resulting from two international study and teaching projects that took place in the years 2021 and 2022 at Humboldt-Universität zu Berlin. The projects

[1] As the following reports are independently written by students taking part in the seminar and staff members from the partner universities, the content, literature used, and conclusions drawn are often based on their context-specific expertise, but not necessarily represent the opinion of the editors.

have been joint collaborations within the East African German Transdisciplinary University Network on rural-urban transformations (EAGER Trans-Net). Together with University of Dar es Salaam, Ardhi University (Dar es Salaam), University of Nairobi, Karatina University (Kenya), and Chuka University (Kenya), and Humboldt-Universität zu Berlin, staff, student, and scientific exchange was carried out, mainly financed by European Union funds (Erasmus+). The network is working trans- and interdisciplinarily and involves among others the departments of Geography, African Studies, Human Settlement and Environmental Studies, as well as Agricultural Economics. As a future objective, practical actors should also be increasingly involved in the cooperation. For the two projects on UA in Global North and South, students were jointly supervised from staff members from the partnering Universities to enable joint international, interdisciplinary, and intercultural (field) research and scientific exchange among students and staff at Humboldt-Universität zu Berlin.

The results achieved within the framework of these projects address some of the research gaps identified above with a geographical focus on Berlin, Dar es Salaam and Nairobi, using a wide set of methodologies. In the first part of the volume, the articles focus on the **distribution of UA** in Berlin **and its social effects**. ZENS & STEINMEIER (2022) identify possible clusters and variables that are directly related to the distribution of urban gardening projects in Berlin using GIS-based cluster analysis and correlation and regression analysis. The results of the cluster analysis show that the urban gardening projects distribution throughout Berlin is not purely random. The identified variables for this distribution are the number of gardening projects and inhabitants per planning area, the social status index, the dynamics index, the urban density, the average standard land values, the green provision index and the number of youth leisure facilities per planning area. While the research results do not allow for the establishment of causal relationships, the correlations provide valuable insights for planning and indicate the need for further research. Linked to the previous research, STEINMEIER et al. (2022) also conduct a case study in Berlin-Neukölln based on guided interviews with experts to analyze the impacts of urban gardening projects on the local environment and well-being of city dwellers. Additionally, they focus on the recognition of urban gardening in urban planning. They uncover many benefits of urban gardening such as the creation of a new form of community in the neighbourhood, the positive effect on social cohesion as well as many health benefits. Moreover, the mental and physical well-being are being strengthened and the urban gardens also have a positive effect on the local microclimate.

The second part of the volume directs the focus onto **the role of informality and subversiveness in UA practices** using the examples from Kenya and Tanzania. For the case of Dar es Salaam, MKWAWE & YAMUNGU (2021) draw on Lefebvre's ideas on the production of space to examine how land is accessed in a context of informality. The author's findings show that the land allocated for UA is far too little. Through a mixed methods approach they discover that less than a quarter of the city's area required for UA is available and that the households depending on farming practices for their livelihoods must either apply modern farming techniques to small-scale land parcels or obtain land in the rural areas near the city.

KITUKU & KITATA (2021) explore urban farmers` resilience and subversion strategies within different cases of *guerilla farming* in Nairobi. In this form of UA, farming is practiced informally and in active resistance to state and private actors and changing the environment by planting crops (HUNG 2017). In their study, the authors state that on paper the county government does in general encourage UA through the 2015 promotion act. However, qualitative interviews show that in

reality, farmers growing and selling their products along motorways in Nairobi, struggle with displacement, threats, intentional destruction, blackmail and corruption. They argue that *guerilla farming* is essential for livelihoods as well as enhancing green cover for open spaces and needs to be acknowledged much more by research as well as political urban planning and executive administration.

In the third part of the volume, the articles deal with the **challenges and coping strategies in UA beyond informality**. As case studies were conducted in both the Global North and the Global South, we can look at the similarities as well as the differences in these different settings. MARKEN & VON BRUNN (2021) explore the origins of the political challenges of the community gardening collective *Prinzessinnengarten* in Berlin with an Actor-Network Analysis. They discover that the most influential actors involved in the political challenge of lacking available spaces for urban community gardens in Berlin are the Berlin Senate UVK and the District Agency of Neukölln. Hence, they conclude that the most influential stakeholders are indispensable allies but simultaneously the ones who are most difficult to activate. Conflicts with the "Umwelt- und Naturschutzamt Neukölln" (UNA) and other authorities, as well as the opportunity of using increasing fallow land found at cemeteries for community gardening are also discussed. Evidently, the cultural context matters significantly in the context of such proposals and the reuse of cemeteries in e.g., Kenia and Tanzania would be difficult to implement in the opinion of local experts. Nevertheless, consistent with the research of STEINMEIER et al. (2022) and MKWAWE & YAMUNGU (2021), MARKEN & VON BRUNN (2021) also confirm that the lack of available space is the most persistent challenge for urban community gardens. This again leads STEINMEIER et al. (2022) to the conclusion that stronger networking between initiatives is needed to exert more influence at the city level, and not only at the local level.

RIETZL'S (2022) qualitative study sheds light on how Berlin gardeners develop UA strategies to cope with climate change. Through in-depth interviews with gardeners, she could establish that all are aware of climate change with the main effects mentioned being heat, drought, extreme rainfall and changing agrophenological seasons. Most gardeners furthermore resort to irrigation and improved access to (rain-)water to adapt to climate change and mitigate the impacts.

MUNUO (2021) examines the challenges facing small vegetable farmers through a case study in two sub wards of Goba Ward in Dar es Salaam City. Based on a mixed methods design, she ascertains that most vegetable farmers struggle due to lacking access to land, markets, agricultural inputs, farming knowledge and skills, as well as financial capital. These shortcomings hinder the expansion and sustainability of urban farming practices and have a negative impact on the security of tenure and use of water for irrigation. Furthermore, the author concludes that farmer organisation has a lower priority among vegetable farmers. MUNUO (2021) advocates that the government needs to act by providing land and markets for vegetable production to support farmers who face challenges and draw more attention to the importance of safe and quality vegetables for the city.

In the concluding fourth part of the volume, **the needs of future planning approaches for UA in Global North and South** are discussed. MWENDENUSU et al. (2022) want to contribute to sustainable planning in Dar es Salaam with the help of six selected criteria crucial for sustainable agricultural practices. In a GIS analysis, these physical (slope, aspect, soil type), urban (population density, road network) and social (unemployment rate) factors act as layers of evidence in generating a geospatial model that indicates potentially suited areas for urban leafy vegetable

production in the city. The analysis reveals that highly suitable areas offer steeper slopes that ensure constant sunlight, good access to road connectivity to ensure supply of materials, a high unemployment rate and high population density. The suitability map shows that high suitable zones cover 27% of Dar es Salaam city which is a sizable fraction, considering that a similar amount (28%) of surface area has a low suitability rate. Those zones with a high suitability are mostly located in the north and north-west of the city, but there are also a few in the east and centre of Dar es Salaam. However, moderately suitable zones predominate with 45%. They conclude finally that despite the increase in population, these particularly suitable areas should also be given priority in the implementation of urban agriculture in order to ensure food sustainability and minimise unemployment.

With a multiple case study approach, MANKE et al. (2022) work out the influence of urban planning tools, regulations, and practices on typologies of UA sites in Berlin, Shanghai, and Dar es Salaam. They put up for debate which instruments, regulations and practices need to be newly established, adapted, abolished or strengthened in order to improve planning of UA. Among other outcomes this study shows that in Dar es Salaam informal land use practices predominate in contrast to those in Berlin and Shanghai, where mostly formal urban planning tools are being applied. As an innovative approach, it is brought into the discourse that the informal land use for UA in Dar es Salaam could serve as inspiration for highly regulated planning contexts in Germany or the PR China.

NYITI & GENES (2023) look at urban planning versus UA in Dar es Salaam by investigating how UA has been included in the city's master plans since Tanzania's independence in 1961. By using qualitative methods, they uncover the presence of a significant disjuncture between urban policy and practice. Furthermore, UA has had limited meaningful inclusion in the master plans. The current plan (2016-2036) provides UA a zoning with the least amount (2%) of the city's proposed land use, possibly leading to an increase of informal farming practices along roads, rivers, railroads and under power lines, creating similar challenges and problems as the ones mentioned by MKWAWE & YAMUNGO (2021), MUNUO (2021) and KITUKU & KITATA (2021). Similar to MARKEN & VON BRUNN (2021) and STEINMEIER et al. (2022) in the case of Berlin, NYITI & GENES (2023) call for future master plans of Dar es Salaam that include effective programmes to promote UA.

The results elaborated and discussed in this volume in the context of interdisciplinary research-based learning can be understood as a departure point of an East African-German academic exchange that will further advance the understanding of the development of UA in cities of the Global North and South as well as the cooperation between the partnering universities. We would like to thank all the authors for their collaboration in the past two years and their contributions in this joint volume. We are grateful to all other actors who made and still make this instructive cooperation possible.

Figure 1: Study project 2021 (FUSS 2021**)**

Figure 2: study project 2022 (SEGIETH 2022**)**

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Part I: Distribution of urban agriculture and its social effects

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Urban Gardening in Berlin: GIS-based analysis of the spatial distribution of gardening projects in Berlin and potential determinants

Leon Zens & Till Steinmeier

1. Introduction

Urban gardening has been a component of urban areas since the existence of cities (CALVET-MIR/MARCH 2019, p. 97). While it was an essential part of a city's food supply in earlier cities, urban gardening projects have changed through modernization, with new purposes and activities representing a reinvention of the concept that follows the overarching goal of creating sustainable cities (SWENSEN et al. 2022, p. 513). Today, urban gardening not only refers to food growing, but also to various other aspects, such as strengthening the human-nature relationship (ARTMANN et al. 2021, p. 968). Urban gardening has positive effects on the physical and psychological well-being of city dwellers, as well as on the social cohesion and communication of a neighbourhood. It provides the supply of healthy food and it creates the opportunity for learning in nature (ibid.). In the same way, urban gardening projects represent an attempt to reclaim cities as spaces for active democratic engagement (MERKEL 2015, p. 124). In cities of the Global South, where urban gardening often plays a crucial role in the food supply of cities, the boundary between urban and rural is not always very clear. This is different in cities of the Global North, where the division between the urban and the rural is more pronounced. Although food production in the Global North takes place in cities to a small extent at best, there has nevertheless been a sharp increase in urban gardening projects in cities in recent years (CALVET-MIR/MARCH 2019, p. 98).

This is accompanied by various changes, so that in the long-term urban gardening could even be a driver of socio-political change in a city (DEMAILLY/DARLY 2017, p. 334). Simultaneously, it could also be that where there is already a high level of social engagement, more urban gardening projects will successfully establish themselves. Therefore, a close study of urban gardening is essential to understand its importance for urban development and planning. There is a growing body of research examining how urban gardening projects affect factors such as a city's climate, health, or communities. However, there is a lack of research examining what spatial patterns these projects follow in their development. The aim of this study is to understand whether there is spatial correlation, what patterns emerge, and whether there are factors that influence the emergence of such gardening projects. It thus serves as a first step towards a research design that investigates causal relationships.

2. State of research

LOSSAU & WINTER (2011) note that urban gardening projects bring both environmental and social benefits. Often, such projects are located in densely populated areas and provide access to green spaces. In addition to providing general access to green spaces, they also have positive effects on the local microclimate: this is shown by LIN et al. (2018), who demonstrate in their study that such gardens reduce local temperatures and provide shade, clearly counteracting the urban heat island

effect (LIN et al. 2018, p. 574). Positive effects of green spaces on urban climate are also described by SUSCA et al. (2011), LI et al. (2014), ANGUELOVSKI (2015) and SCHRAM-BIJKERK et al. (2018). SUSCA et al. (2011) state that green spaces can have a crucial impact on urban climate and reduce the urban heat island effect (SUSCA et al. 2011, p. 2125). ANGUELOVSKI (2015) describes how urban gardens increase the environmental quality in a neighbourhood by mitigating stormwater runoff, increasing air and water quality, reducing the local heat island effect, and minimizing soil erosion (ANGUELOVSKI 2015, p. 225). SCHRAM-BIJKERK et al. (2018) recognise further positive socio-ecological effects on the health of city dwellers. The urban gardens provide space for exercise, have a stress-reducing effect and promote community cohesion (SCHRAM-BIJKERK et al. 2018, p. 869). They also offer the opportunity for residents to consume home-grown and locally produced food (ibid., p. 869).

According to STEINMEIER, ZENS AND BESELER (2022), urban gardening projects are primarily social spaces that can have a positive impact on the development dynamics in their respective neighbourhoods (STEINMEIER et al. 2022, p. 31). This matches the findings of PETROVIC et al. (2019), who assume that social motivations often play a central role in engaging in urban gardening and that community gardens thus function as a space for networking within a community (PETROVIC et al. 2019, p. 46). The connection between community gardens and positive neighbourhood development is also described by MEYER-SOYLU & WAITZ (2020), who particularly emphasise neighbourly help and learning from each other (MEYER-SOYLU/WAITZ 2020, p. 56). ANGUELOVSKI (2015) also assumes that urban gardening projects strengthen social relationships in a neighbourhood (ANGUELOVSKI 2015, p. 225). In addition, many urban gardens also have a focus on environmental education, offering young and old the chance to learn the basics of gardening and how to properly interact with nature (STEINMEIER et al. 2022, p. 18). FEINBERG et al. (2020) also state that education is an important factor in urban gardening projects (FEINBERG et al. 2020, p. 25). In addition to the ecological and social impacts, urban gardening also has economic effects (TAPPERT et al. 2018, p. 69). Urban gardening projects have the potential to increase the attractiveness of a city and thus contribute to an increase in economic value (ibid., p. 70).

It is unclear, however, whether garden projects directly influence and promote rent prices and standard land values and the imminent gentrification of an urban area, or even an entire city. Moreover, it is uncertain whether they emerge primarily where these variables are still low, or possibly resist these dynamics (MARCHE 2015, p. 9). KIM & WU (2021) recognize in their study that passive, natural, and medium green spaces reinforce gentrification in New York City (KIM/WU 2021, p. 373). ANGUELOVSKI (2015) suggests that community gardens in cities such as Delhi, New York and Boston are already increasingly being managed by recently arrived higher-income residents, while the proportions of low-income gardeners and people of colour are decreasing (ANGUELOVSKI 2015, p. 225). MAANTAY & MAROKO (2018) also identify links between urban gardening projects and rising incomes in the neighbourhoods surrounding these gardens in New York City (MAANTAY/MAROKO 2018, p. 13). On the other hand, they cannot prove that urban gardens are actually triggers for rising incomes in the neighbourhoods or whether there are other reasons (ibid.). However, contrary to other studies, CHENARIDES et al. (2020) state that low-income households are the main participants in urban gardening projects in Phoenix and Detroit (CHENARIDES et al. 2020, p. 154).

That being said, some cities are making use of urban gardening as a measure of urban development. For example, in San Francisco, a city that is growing and experiencing rising land values, informal gardening projects are tolerated and even encouraged in order to attract the creative class described by Richard Florida, thus using urban gardening as a driver of urban development (MARCHE 2015, p. 2). However, it can happen that, due to the competition for space in a city, areas that are becoming more densely built up also end up losing green spaces and the proportion of green space per capita (TAPPERT et al. 2018, p. 69). Especially in Australian and Asian cities, but also (to a lesser extent) in European and North American cities, trends can be observed where the share of green

spaces is decreasing (ibid., p. 71). It is often difficult for measures that serve climate mitigation and adaptation, which also include urban gardening, to keep up against high rents and expensive land prices, a lack of housing, as well as a lack of space in general (WAGNER et al. 2019, p. 2). MCCLINTOCK et al. (2016) also identify differences in the socio-spatial distribution of gardening projects, which is why it is important that planners and decisionmakers give consideration to an equal understanding and distribution of urban gardening projects in the future (MCCLINTOCK et al. 2016, p. 13). The research cited shows that urban gardening projects can have multiple socio-economic, environmental, as well as social impacts on their neighbourhoods. Nevertheless, the question which factors are causal for the distribution of urban gardens in a city remains largely unexplored. This paper represents a first attempt to identify relevant determinants and to provide a methodological basis for future research.

3. Methodology

The study area is Berlin, the capital of Germany, where approximately 3.6 million people live. Berlin was chosen because it is a city where urban development has always been strongly influenced by the "temporary" (LOSSAU/WINTER 2011, p. 224)[2].As a result, there are both many vacant inner-city spaces that can be used for urban gardening projects and creative and young residents willing to use the spaces (ibid.). To analyse the research question, quantitative research methods in the form of cluster analysis, as well as correlation and regression analyses are used. For the cluster analysis, *QGis* (a geographic information processing software) and *Geoda* (a geospatial data analysis software) are used. Correlation and regression analyses are carried out using the statistical programming language *R*.

The city of Berlin has 12 districts. However, since urban gardening projects have a particular influence on socio-spatial development at the local level (STEINMEIER et al. 2022), the planning areas (LOR) are used as the unit of investigation. The subdivision of the city of Berlin into 448 planning areas enables improved data analyses and makes various dynamics and cause-and-effect relationships more clearly identifiable (SENSW 2020, p. 5). Although the planning areas were readjusted in 2021 due to dynamic population development and growth, most of the freely available data sets are tailored to the "old" planning areas. In addition, many urban gardening projects emerged in the years prior. Therefore, the hotspot and cluster analyses as well as the correlation and regression analyses are based on the old planning areas.

The interactive map of the platform "Produktives Stadtgrün" currently shows 227 garden projects within Berlin's city limits (PLATTFORM PRODUKTIVES STADTGRÜN n.d.). Of these 227 projects, 16 are listed as "completed". These projects are not included in the study. The spatial data of the remaining 211 active garden projects is exported so that the distribution throughout the city can be displayed with *QGis*. Based on this, the number of urban gardening projects per Berlin planning area is now calculated.

The generated shapefile is used for cluster analysis with the program *Geoda*. The cluster analysis examines whether a data set has "homogeneous" classes (FROMM 2012, p. 191). The dataset of Berlin's gardens offers a wide range of data with 211 active projects in 448 planning areas. Therefore, a hierarchical cluster analysis offers the possibility to uncover whether the data is related (ibid.). Cluster analysis involves a local analysis of spatial autocorrelation. Autocorrelation means that the values of a variable in one planning area (the number of urban gardening projects) are

[2] Temporary refers to a temporary use and means that a building or site is used for a purpose other than that for which it was originally intended. All stakeholders involved need to know about the duration of the use. Temporary use often refers to brownfield sites or abandoned buildings, which are then used in most cases for catering purposes, as community gardens or sports facilities (LOSSAU /WINTER 2011, p. 222).

related to the values of the same variable in neighbouring spaces, i.e. they form clusters (GREKOUSIS 2020, p. 208). Since it is unlikely that spatial processes are homogeneous throughout the study area (in all of Berlin), spatial autocorrelation is examined at the local level of planning spaces using Local Moran's I. "Local" means that a value is generated separately for each spatial object (ibid., p. 210). Thus, the Local Moran's I can be displayed cartographically. Spatial clusters, which would not be visible at a higher level, can thus be identified at the local planning area level. The results of the cluster analysis are exported and presented cartographically using *QGis*.

The second part of the thesis examines the question which variables could determine the distribution of urban gardening projects in Berlin. First, multiple variables that could influence the distribution are identified through a literature review. The literature search is limited to peer-reviewed scientific articles and textbooks in order to ensure a high degree of confidence. Only data to which there is free access is considered in the analysis to ensure maximum reproducibility and transparency.

The most important tool in data acquisition is the Fis-Broker of the Senate Department for Urban Development and Housing in Berlin, as a wide selection of maps and data for Berlin is made available online here. Most of the data used in the analysis is available at the planning area level. However, data such as the standard land values are available in higher resolution, so that average values are first calculated for the individual Berlin planning areas.

The variables are processed in *QGis* and linked with the data set of the urban gardening projects per Berlin planning area, so that a data matrix is formed which can be exported. This data matrix is the basis for the correlation and regression analysis with the program *R*. First, the selected variables are checked for correlation with the variable "number of gardens per planning area". For metrically scaled variables whose values are not normally distributed, the Spearman's rank correlation coefficient is calculated (UNIVERSITY OF ZURICH n.d.). The effect size here is the correlation coefficient R itself (KUCKARTZ et al. 2013, p. 216). A weak effect is assumed for a coefficient of 0.1, a medium effect for a coefficient of 0.3, and a strong effect for a coefficient of 0.5 and above (COHEN 1988, pp. 79 - 81). The p-value 0.05 is taken as the significance threshold. Next, a multiple linear regression model is calculated. First, the prerequisites are checked (MITTAG/SCHÜLLER 2020, p. 296):

1. A linear relationship can be roughly identified between the variables. For this purpose, the distribution of the variable values is shown with boxplots.
2. The dependent variable (number of urban gardening projects per planning area) is metrically scaled, and the independent variables are at least dichotomous.
3. The independent variables do not correlate strongly with each other (no multicollinearity)
4. There are no outliers that bias the model.
5. The residuals of the variables are approximately normally distributed.

If a causal relationship is to be inferred from the regression analysis, it must be theoretically justified (UNIVERSITY OF ZURICH n.d.). Variables that do not meet the necessary requirements are not included in the regression model. The calculation of the model and the evaluation follow.

4. Results

a. Cluster analysis

Here, the results of the cluster analysis are presented textually as well as graphically. First, the spatial distribution of urban gardening projects in the different planning areas of the study area is determined: the 211 active urban gardening projects are unevenly distributed in Berlin (see figure 1). The planning area with the most projects is Neukölln-Rixdorf (n = 6). This is followed by the

planning areas Oranienplatz (Friedrichshain-Kreuzberg), Rehberge (Mitte), Alt-Marzahn (Marzahn-Hellersdorf) and Hasenheide (Neukölln) with four projects each. A concentration of urban gardening projects can already be seen in Neukölln, Friedrichshain-Kreuzberg, Tempelhof-Schöneberg and Mitte. However, there is also a higher number of projects in parts of Lichtenberg and Marzahn-Hellersdorf (especially in the planning areas Lichtenberg-Weitlingstraße, Dorf Wartenberg and Alt-Marzahn).

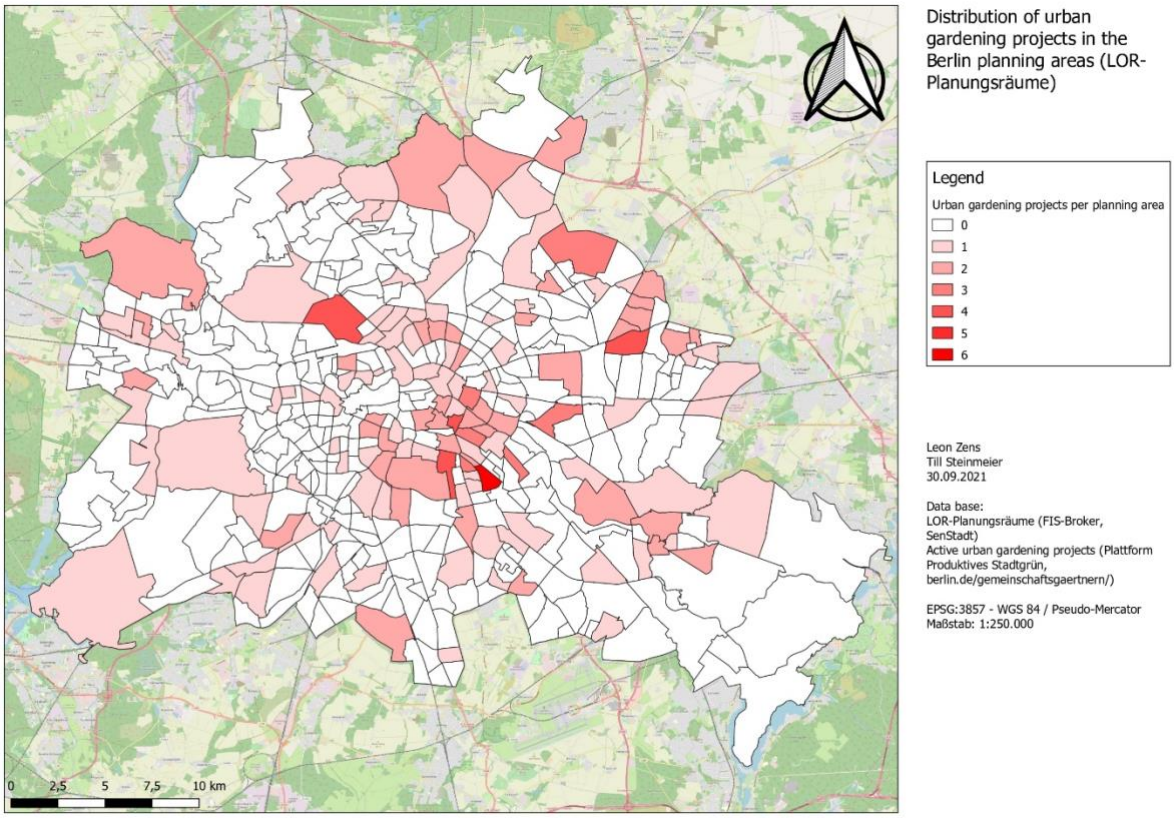

Figure 1: Distribution of active urban gardening projects in Berlin

When analysing the study area by means of a point density map (figure 2), it becomes evident that the urban gardening projects are not randomly distributed in Berlin, but that there are local clusters. Darker areas have a higher number of projects than lighter areas. The darkest areas include the Heine-Viertel Ost in Mitte; Lausitzer Platz, Oranienplatz and Reichenberger Straße in Friedrichshain-Kreuzberg; and Reuterkiez, Donaustraße, Flughafenstraße, Rixdorf, Rollberg and Körnerpark in Neukölln. However, there are also indications of clusters in parts of Tempelhof-Schöneberg, Wedding and Marzahn-Hellersdorf.

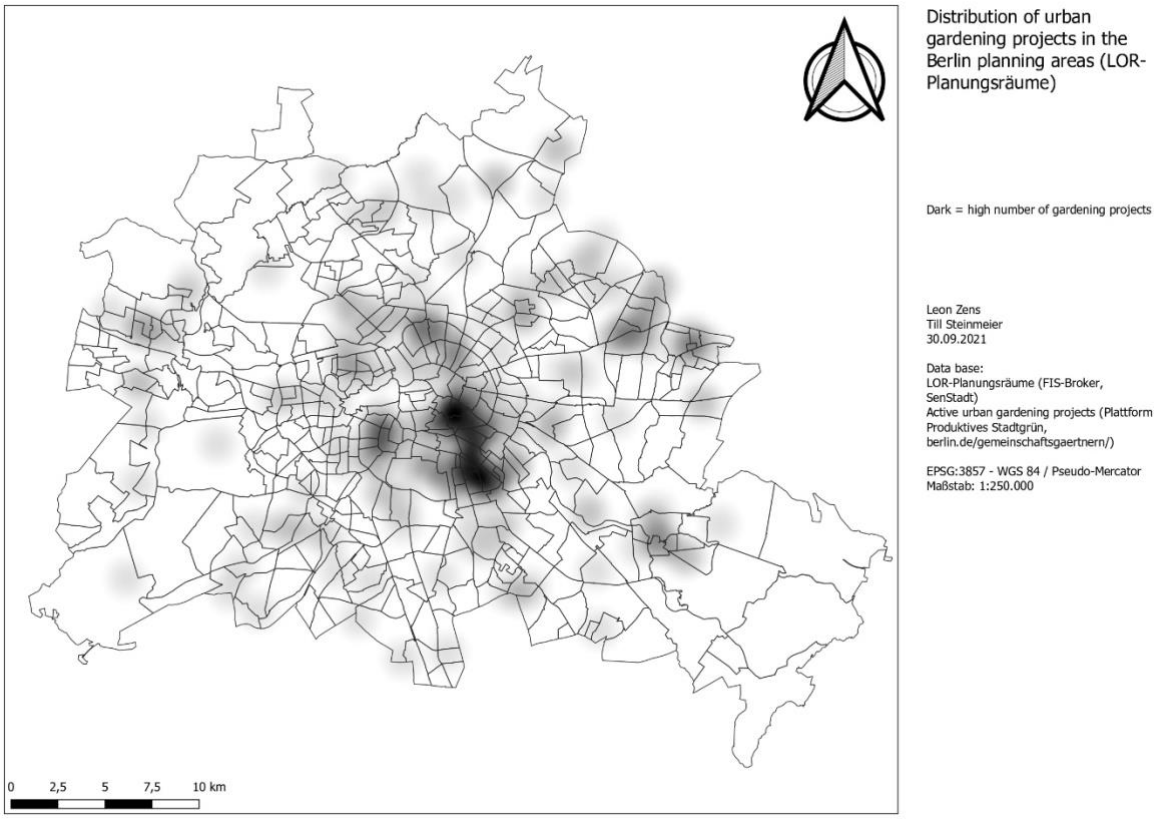

Figure 2: Point density map of active urban gardening projects in Berlin

This is now tested with a cluster analysis. The null hypothesis is: there is no positive autocorrelation, i.e. the urban gardening projects are randomly distributed in Berlin. The alternative hypothesis is therefore that the projects are not randomly distributed but are spatially autocorrelated. Figure 3 shows the results of the cluster analysis. According to this, there are clearly local urban gardening clusters in Berlin. Dark red clusters (high-high) show planning areas with many urban gardening projects that are surrounded by other planning areas with many projects. There are 25 of these in Berlin.

Dark blue areas (low-low), on the other hand, show planning areas with few projects that are surrounded by other planning areas with few projects. There are three of these in Berlin. Planning areas coloured light red (high-low) are areas with many urban gardening projects that are surrounded by areas with few projects (n = 16). In contrast, light blue areas (low-high) show spaces with few projects that are surrounded by spaces with many projects (n = 26).

The results are significant in planning areas with $p <= 0.05$. Thus, the null hypothesis can be rejected for a total of 70 planning areas. For these planning areas, the alternative hypothesis can be accepted that the urban gardening projects are not randomly distributed but are spatially autocorrelated, i.e. form clusters. In contrast, in the remaining 378 planning areas, where the p-value is greater than 0.05, the null hypothesis cannot be rejected. Here it must be assumed that there is no spatial autocorrelation.

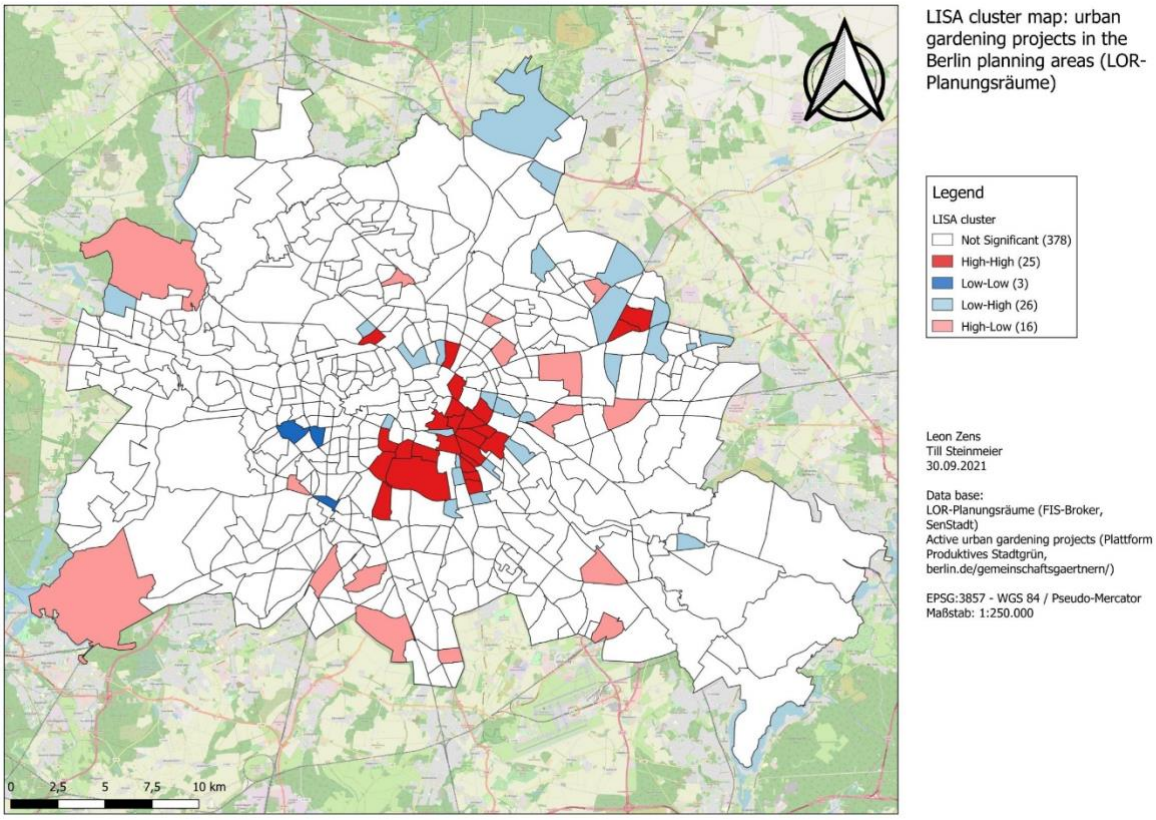

Figure 3: LISA Cluster Map of urban gardening projects in Berlin

Figure 4 shows how significant the results are. The p-value is shown for each planning area. The central high-high cluster, which extends from Heine-Viertel Ost in Mitte via Lausitzer Platz in Friedrichshain-Kreuzberg southwards to Neuköllner Körnerpark, has a significance of p <= 0.01. This cluster is almost congruent with the darkest area of the point density map (figure 2). The assumption that a cluster with many urban gardening projects is located here can thus be clearly confirmed. To the west of this, another large high-high cluster is discernible, comprising the planning areas Chamissokiez and Viktoriapark in Friedrichshain-Kreuzberg and the planning areas Dennewitzplatz, Schöneberger Insel, Neu-Tempelhof and Lindenhofsiedlung in Tempelhof-Schöneberg. For this cluster, the significance is somewhat lower and lies between 0.01 and the critical value of 0.05. The previously mentioned local high-high cluster in Marzahn-Hellersdorf, which is already indicated in figure 1 and 2, is also confirmed by the cluster analysis. With a significance of p <= 0.05, the planning areas Ringkolonnaden and Marzahner Promenade form a cluster with a high number of urban gardening projects.

In contrast, the two planning areas Preußenpark and Halensee in Charlottenburg-Wilmersdorf form a low-low cluster with a significance of p <= 0.05. The same applies to the planning area Markelstraße in Steglitz-Zehlendorf, meaning clusters of planning areas with few or no urban gardening projects are clearly located here. Furthermore, the 16 high-low clusters all have a significance of p <= 0.001. Thus, these are undoubtedly planning areas with many urban gardening projects surrounded by planning areas with few or no projects.

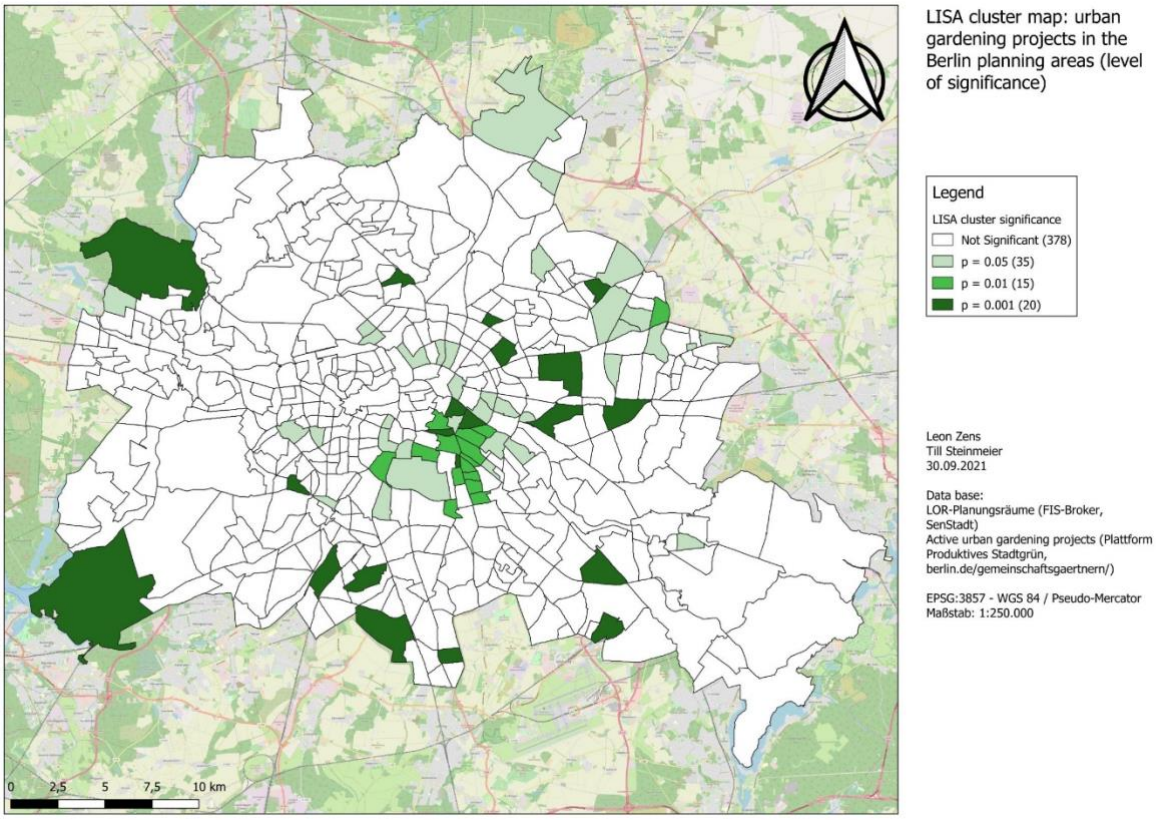

Figure 4: Significance of the individual urban gardening clusters

b. Correlation and multiple linear regression

After the cluster analysis has confirmed the thesis that the urban gardening projects are not distributed randomly in Berlin but that there are clusters of planning areas with particularly many or particularly few projects, it is now examined which variables could determine the distribution of urban gardening projects. Table 1 shows the variables considered in the analysis and in each case the assumption as to why the variables were selected.

Variables	**Assumption**	**Sources**
Area size	Larger planning areas could have more urban gardening projects.	NIKOLAIDOU et al. 2016, STEINMEIER, ZENS & BESELER 2022
Inhabitants	There could be a correlation between the number of residents and the number of garden projects.	NIKOLAIDOU et al. 2016
Status index	There could be a correlation between the number of garden projects and the social status of a planning area.	MCCLINTOCK et al. 2016 CHENARIDES et al. 2020 PETROVIC et al. 2014
Dynamics index	Planning areas with positive social dynamics could have	ANGUELOVSKI 2015, MARCHE 2015,

	more urban gardening projects.	MEYER-SOYLU / WAITZ 2020, STEINMEIER, ZENS & BESELER 2022
Urban density	There could be a correlation between urban density and the number of garden projects in a planning area. On the one hand, there could be fewer garden projects in more densely built-up areas due to the shortage of space. On the other hand, there could be more community gardens (as green compensation sites) especially in those areas. Such projects could, for example, also be set up only temporarily as intermediate uses.	LOSSAU/WINTER 2011, NIKOLAIDOU et al. 2016,
Green provision index	In planning areas with poor green provision, there could be more community gardens (as places of compensation and recreation).	LIN et al. 2018, SCHRAM-BIJKERK et al. 2018
Average standard land values	The higher the average standard land values, the fewer community gardens.	KIM / WU 2021 MAANTAY / MAROKO 2018
Proportion of fallow land	In planning areas with many brownfield sites, there could be more community gardens (e.g. as interim uses).	LOSSAU/WINTER 2011, NIKOLAIDOU et al. 2016
Number of youth leisure facilities	In planning areas with many youth recreation facilities, there could be more garden projects, as: a) many garden projects are also designed as educational gardens and b) youth leisure facilities can also be an indicator of the commitment and creative potential in a neighbourhood.	FEINBERG et al. 2020, STEINMEIER, ZENS & BESELER 2022

Table 1: Overview of variables

Table 2 shows the results of the correlation analysis. A significant correlation can be found with seven variables ("inhabitants", "status index", "dynamics index", "urban density", "green provision index", "average standard land value" and "youth leisure facilities per planning area"). For five of the variables, the correlation is very weak; only for the number of inhabitants and the youth leisure

facilities is it somewhat stronger. There is no correlation for the variables "area size" and "proportion of fallow land".

Variables	R	p-value	Meaning
Area size	0,09	0,04879	No connection
Inhabitants	0,3	1,141e-10	Medium, positive correlation
Status index	0,1	0,03879	Weak, positive correlation
Dynamics index	-0,16	0,0006405	Weak, negative correlation
Urban density	0,16	0,0006346	Weak, positive correlation
Green provision	-0,12	0,02002	Weak, negative correlation
Standard land values	0,1	0,03404	Weak, positive correlation
Proportion of fallow land	0,038	0,4205	No connection
Number of youth leisure facilities	0,28	1,209e-09	Weak to medium positive correlation

Table 2: SPEARMAN'S rank correlation coefficients

The correlation analysis only confirms that there is a relationship between the variables, but not in which direction it is directed. In order to explain the observed, dependent variable (number of gardens per planning area) in more detail by the independent variables, multiple linear regression is therefore used. The prerequisites for this must also first be checked.

The first step is to check whether there is a linear relationship between the variables. For the variables "area size" and "proportion of fallow land", a relationship with the number of gardens per planning area could previously be ruled out by calculating the Spearman's rank correlation coefficient. These variables are therefore not used for the regression model. For the variables "inhabitants", "youth leisure facilities per planning area", "urban density (floor area ratio)", "average standard land values [EUR/m²]" and "dynamics index", a linear relationship can be roughly assumed, as the following boxplots show (see figure 5).

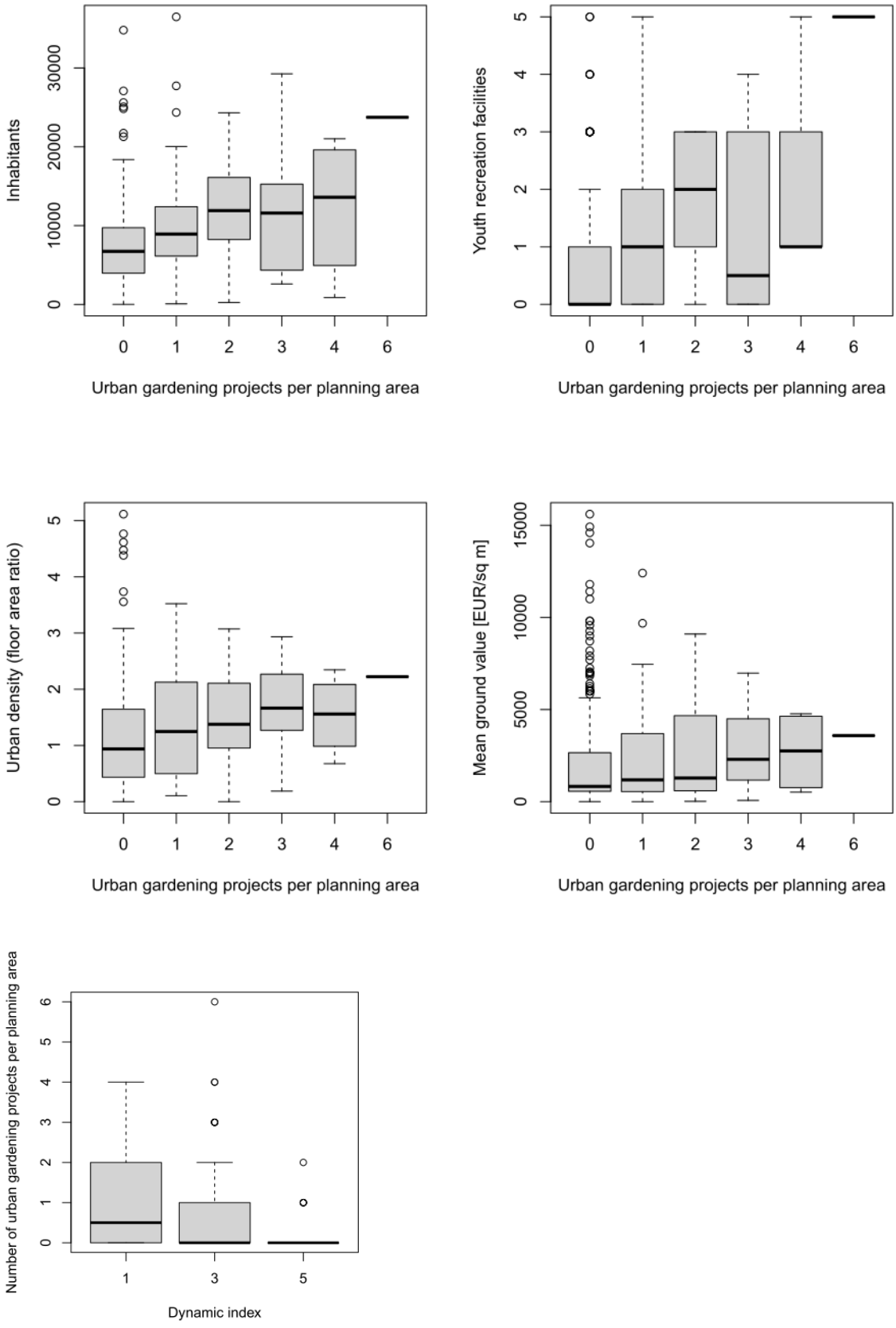

Figure 5: Visualization of the variables with boxplots: linear correlation can be assumed

In the case of the variables "status index" and "green provision index", on the other hand, a linear relationship can already be ruled out visually, as figure 6 shows. These variables are therefore also excluded from the regression model.

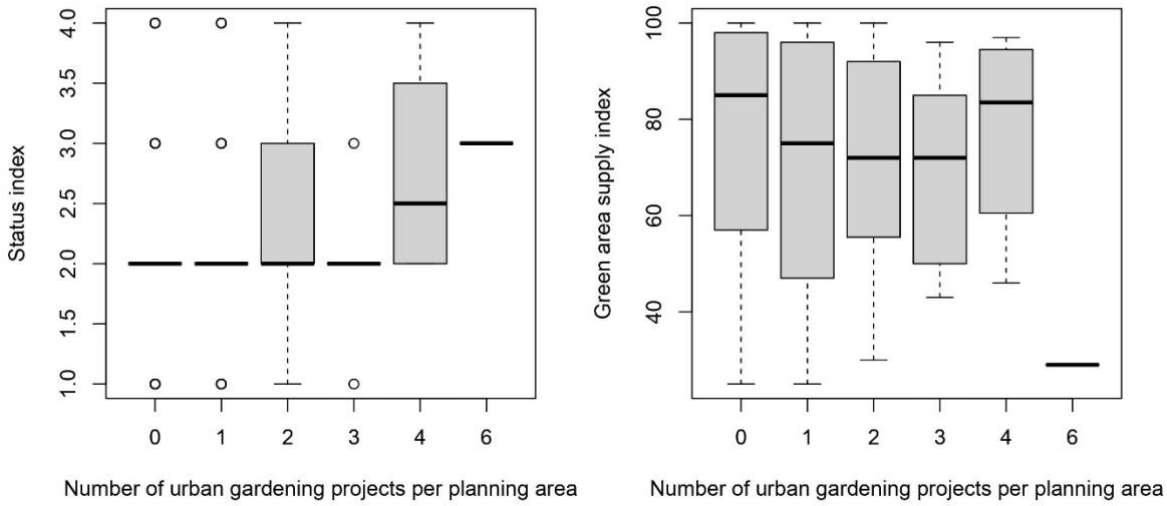

Figure 6: Visualization of the variables with boxplots: linear correlation can be ruled out

The regression model alone does not provide evidence of causality. If a causal relationship between the variables is to be inferred from the model, it must be theoretically justified: dense development, high population figures and high average standard land values could theoretically be the reason why more urban gardening projects are found in a planning area, as access to green and open spaces tends to be more difficult there and urban gardening is practised by residents as a recreational opportunity and provides shared spaces for compensation, for example (SCHRAM-BIJKERK et al. 2018, p. 869).

Furthermore, there could be a causal relationship between positive social dynamics index values and the number of urban gardening projects per planning area. Figure 7 shows the dynamics index values for each Berlin planning area. It is evident that especially the planning areas in Mitte, Friedrichshain-Kreuzberg, Neukölln and Tempelhof-Schöneberg, which have a high number of urban gardening projects, also show positive dynamics index values (cf. figure 7 and figures 1 & 2).

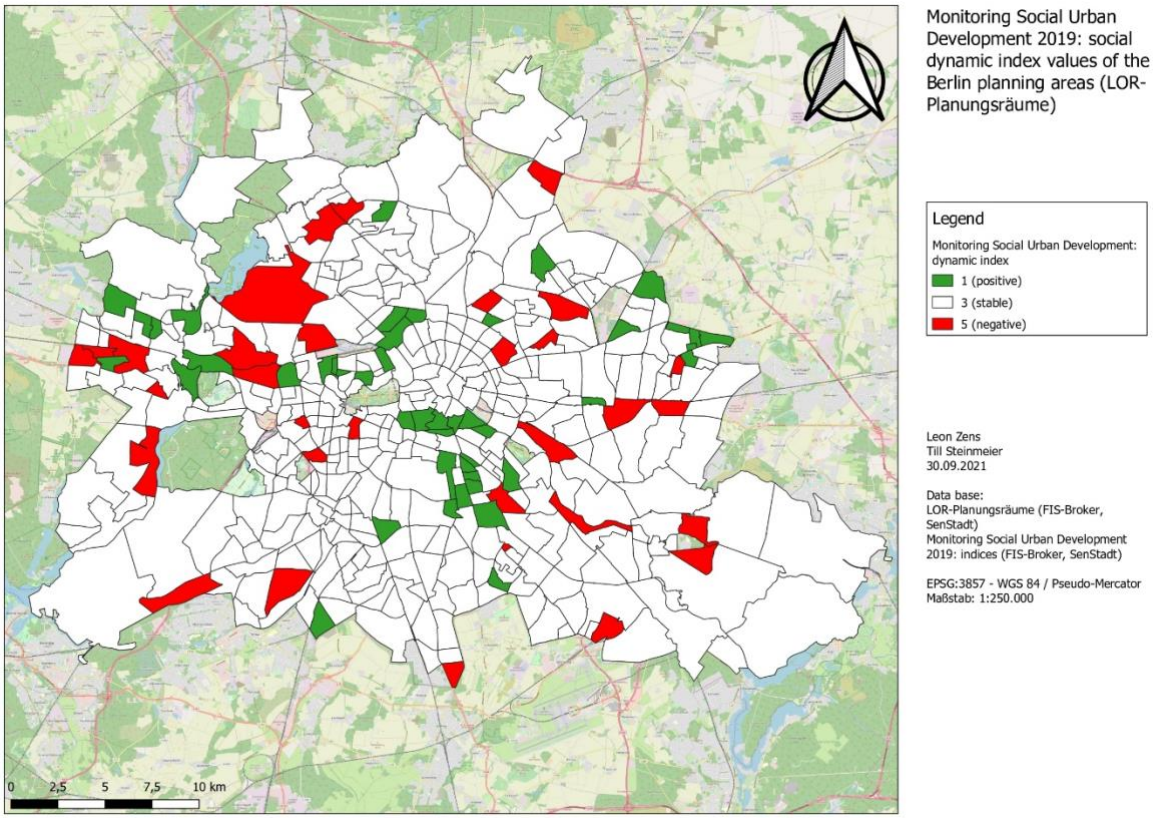

Figure 7: Social dynamics index values in the Berlin planning areas

Theoretically, there could also be a causal relationship between the number of youth leisure facilities and the number of Urban Gardening projects per planning area: figure 8 shows that the point-density map of youth leisure facilities in Berlin shows a very similar distribution as the point-density map of urban gardening projects (figure 2).

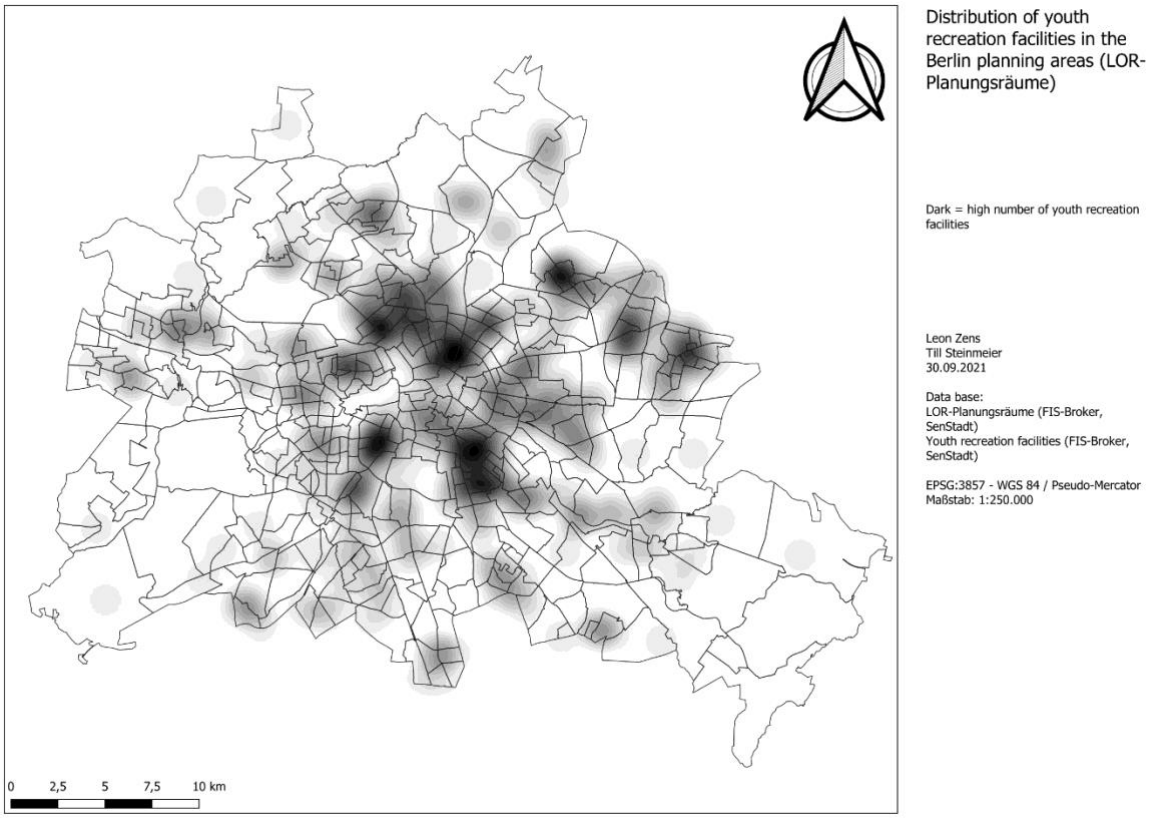

Figure 8: Point-density map of the distribution of youth leisure facilities in Berlin

According to MITTAG & SCHÜLLER (2020), further conditions that need to be checked are: both the dependent variable and the independent variables are interval-scaled. The independent variables do not correlate strongly with each other (no multicollinearity). There are no outliers that would distort the model. Therefore, after the prerequisites have been checked, the calculation of the multiple linear regression can proceed. The multiple linear regression model shows a **significant linear relationship** between:

1. The number of urban gardening projects and the number of inhabitants per planning area. Here, however, the regression coefficient runs towards 0.
2. The number of urban gardening projects and the social dynamics index from the monitoring of social urban development. Here, the regression coefficient is -0.13 (with a confidence interval of -0.22 - -0.04), with a probability of $p = 0.005$.
3. The number of urban gardening projects and the number of youth recreation facilities per planning area. Here, the regression coefficient is 0.17 (with a confidence interval of 0.09 - 0.25), with a probability of $p < 0.001$.

As the result (table 3) shows, the accuracy (R^2) of the regression model is 0.156 or 15.6 percent. 16 values were deleted as missing.

	GAERTEN		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	0.43	0.10 – 0.76	**0.011**
EINWOHNER	0.00	0.00 – 0.00	**0.001**
DYNAMIKINDEX	-0.13	-0.22 – -0.04	**0.005**
DICHTE_GFZ	-0.01	-0.16 – 0.14	0.874
BRW_MEAN	0.00	-0.00 – 0.00	0.407
JUGENDFREIZEITEINRICHTUNGEN	0.17	0.09 – 0.25	**<0.001**
Observations	432		
R^2 / R^2 adjusted	0.156 / 0.146		

Table 3: Regression table

5. Discussion

The results clearly show that the urban gardening projects in Berlin are not distributed purely at random but that there are clusters with particularly many or particularly few projects. The question which factors determine the distribution, on the other hand, cannot be answered unequivocally. However, several variables can be identified for which there is a significant correlation with the number of gardens per planning area. The correlation analysis shows that there is a relationship between the number of gardens per planning area and the number of inhabitants, the standard land values and the green provision index. Against the background of the cited literature describing the positive effects of urban gardens on the urban climate (e.g., LIN et al. 2018), it can be assumed that more urban gardening projects tend to emerge in densely populated neighbourhoods close to the city centre, where there are hardly any other natural, green compensation areas. Furthermore, there is a correlation between the number of gardens per planning area and the social status index values. It could be assumed that in areas with a lower social status, garden projects are more often created in order to positively influence the neighbourhood. For example, this assumption is also made by PETROVIC et al. (2019), who assume that social motivations are a central reason for engaging in garden projects and that these gardens function as a space for networking within a community (PETROVIC et al. 2019, p. 46).

It is important to note, however, that correlation does not automatically imply causality. Just because the above variables were found to be correlated with the number of urban gardening projects per Berlin planning area does not mean that they also causally influence the distribution of urban gardening projects. Furthermore, it is not clear in which direction the correlation is directed (i.e., which variable influences which). It is also possible, for example, that a third, unknown influencing factor is responsible for the correlation.

The regression model is suitable for explaining the influence of the independent variables on the dependent variable (number of garden projects) in more detail and for showing the direction of the relationship. A significant linear relationship can be found between the number of inhabitants and the number of urban gardening projects, between the social dynamics index and the number of gardening projects, and between the number of youth leisure facilities and the number of gardening projects per planning area. In the case of the dynamics index, the regression coefficient is negative. This means that the lower the dynamics index, the higher the number of urban gardening projects per planning area. The dynamics index takes values between 1 (positive), 3 (stable) and 5 (negative).

Low values thus indicate positive dynamics in the respective planning area. This means that planning areas with positive social dynamics also tend to have more urban gardening projects than planning areas with negative dynamics. It seems reasonable to assume that community gardens are more frequently established in areas with positive social dynamics, as people there tend to get involved in the neighbourhood together with their neighbours. Thus, positive dynamics index values could be the reason why there are more garden projects in some planning areas than in others. The connection between urban gardening projects and positive neighbourhood development has already been made by STEINMEIER et al. (2022) using the example of Berlin-Neukölln. The quantitative analysis of the distribution of community gardens throughout Berlin presented in this paper has now shown that there is not only a particularly large number of projects in Neukölln but that there is also a clear relation between positive social development dynamics and the number of gardens (and not only in Neukölln, but also in other neighbourhoods).

Regarding the number of youth leisure facilities per planning area, the regression model shows that planning areas with a higher number of youth leisure facilities also tend to have more urban gardening projects than areas with few youth leisure facilities. This can possibly be explained by the fact that some community gardens are also designed as educational gardens (e.g., the Neukölln "Prinzessinnengärten"), where children and young people can learn how to deal with nature and the basics of gardening. This has also been shown by the study of Steinmeier, Zens and Beseler, in which the focus of many garden projects on education was pointed out (STEINMEIER et al. 2022, p. 18). FEINBERG et al. (2020) also found that education is an important factor in urban gardening projects (FEINBERG et al. 2020, p. 25).

In the case of the number of inhabitants, the regression analysis shows a significant linear relationship. Planning areas with more inhabitants therefore also have a higher number of urban gardening projects. However, the regression coefficient runs towards 0 here. The actual influence is therefore to be regarded as very small in the context of the study area. That being said, even the regression model cannot provide definite proof of causality between the variables. The question which variables are really causal for the distribution of urban gardening projects in the study area can therefore not be answered definitively in this paper. Nevertheless, the study creates a methodological framework for future studies. These could include, for example, a time series analysis for variables *before* and *after* the introduction of urban gardening projects, or even qualitative methods of social research in the sense of a mixed-methods approach. The accuracy of the regression model is relatively low with a value of 0.156. This means that only 15.6 percent of the variance in the empirically measured data (the number of urban gardening projects per planning area) can be explained. It can be assumed that there is a large number of other variables that have an influence on the distribution of urban gardening projects in Berlin. In this work, only variables that are freely available on the internet were used. Further variables would have to be researched and included in the model as part of other research work in order to increase the accuracy of the model.

6. Conclusion

This study has investigated the question whether there are spatial patterns in the distribution of urban gardening projects in Berlin, and if so, which variables determine the distribution of urban gardens throughout the city. The thesis that urban gardening projects are not distributed randomly in Berlin, but that there are clusters with particularly many or particularly few projects, was clearly confirmed by the cluster analysis. Two large high-high clusters are evident in the city centre, consisting of planning areas in Mitte, Friedrichshain-Kreuzberg, Neukölln and Tempelhof-Schöneberg. In addition, there are several small high-high clusters in Pankow, Wedding, as well as in Marzahn-Hellersdorf near the city boundaries. There are also areas that stand out because there are few or no urban gardening projects (e.g., Preußenpark, Halensee and Markelstraße).

The next step was to try to find variables that determine the distribution of urban gardening projects in Berlin's planning areas. Through a correlation analysis, a connection with the number of inhabitants, the social status index, the dynamics index, the urban density, the average standard land values, the green provision index and the number of youth recreational facilities per planning area could be determined. While the correlation analysis can only prove a correlation between the variables, but no direction and no causal relationships, the multiple linear regression model provides a better contribution to the explanation of the number of gardens per planning area. According to the model, there is a significant linear relationship between the number of urban gardening projects per planning area and the number of inhabitants, the social dynamics index and the number of youth recreational facilities. In particular, the relation between the social dynamics index and the number of gardening projects per planning area is worth emphasising against the background of other current research. Planning areas with positive social development dynamics tend to have more urban gardening projects than areas with negative dynamics. Furthermore, planning areas with a higher number of inhabitants, as well as more youth leisure facilities, also show more urban gardening projects.

However, even the regression model does not provide definite proof of causality. Causal relationships can be theoretically justified but would have to be investigated more closely in future studies using other methods. For such studies, this paper offers a first methodological framework. Even though the distribution of urban gardening projects in Berlin's planning areas cannot be conclusively explained with the determinants presented in this paper, the variables can at least make an explanatory contribution. In the context of further research, additional variables would have to be researched in order to make the correlation and regression models more precise.

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Local effects of urban gardening projects on neighbourhoods

Impacts on the local environment and well-being of city dwellers and recognition in urban planning - A case study in Berlin-Neukölln based on guided interviews with experts

Till Steinmeier, Leon Zens, Lucas Beseler

1. Introduction

Cities have always been changing, which is why urban planning has to constantly adapt and look for solutions; both in large-scale urban development and in small-scale design at the neighbourhood level. In this context, urban gardening as growing food in urban spaces offers a long-standing practice that is now having a stronger impact on cities again (CALVET-MIR & MARCH 2019, p. 98). Originally, the term comes from North America (ROSOL 2011, p. 243) and describes urban community gardening projects that take forms of "container gardening, indoor gardening, [...] roof gardening and community gardening" on public or private open spaces (LINDEMANN-MATTHIES/BRIEGER 2016, p. 33, TORNAGHI 2014, p. 558). While there were eight urban gardening projects across Germany in 2002, the number in Berlin alone increased to over 100 projects by 2013 (WUNDER 2013, p. 1) and now reaches a number of 211 active gardens (ZENS/STEINMEIER 2022, p. 6, SENUMVK 2022). Due to growing interest, urban gardening is also gaining attention against the background of climatic challenges in urban planning (CALVET-MIR & MARCH 2019, p. 98). In this context, social and political changes in particular are influencing the development of urban gardening projects.

This study examines two different dimensions that play a role in urban gardening in the city. On the one hand, the overarching urban planning and political frameworks in the city of Berlin are explored, and on the other hand, challenges and positive effects at the local neighbourhood level are analysed on the basis of three projects in the study area. While numerous scientific studies examine large-scale processes that result from urban gardening projects for cities, there is a lack of work that deals specifically with the local effects of urban gardening projects on the local environment and well-being of city residents. It is intended to examine how specific the effects are at the local level and what potential they offer. In addition, it is investigated to what extent urban planning and urban policy have recognised the potentials and how they can influence them.

In the following section, the literature on characteristics and impacts of urban gardening will be reviewed. Next, the methods of this paper will be outlined leading to a presentation of the results of the interviews with different stakeholders of urban gardening in the following chapter. Finally, the results will be discussed giving an overview of the effects of urban gardening in Berlin and presenting ideas on what could be changed to better promote those projects and integrate them further into neighbourhood planning.

2. State of research

Numerous scientific studies show how urban gardening shapes the modern cityscape. Urban gardening is not a new phenomenon in our cities: before industrialisation, urban life in Europe was interspersed with urban agriculture. Pre-industrial city dwellers could grow their own vegetables and even keep animals. It was only with industrialisation, the high degree of densification and the displacement of inner-city agriculture that today's contrasting understanding of city and urbanity on the one hand and village and rurality on the other became established (KARGE 2015, p. 43). However, this rural-urban divide is increasingly being challenged today. Currently, many cities in the Global North are developing a feedback loop between cities and their food systems. According to GORGOLEWSKI (2015), this is aimed at breaking away from a dependence on remote food sources, as these could be susceptible to supply shortages, armed conflicts, droughts or floods and further increases in energy prices in the future (GORGOLEWSKI 2015, p. 42).
Although urban agriculture in the Global North has the potential to sustainably change the food systems of cities (cf. BOHN 2015, GORGOLEWSKI 2015 and KARGE 2015), it's main focus is not the production and distribution of food in and around the city. Urban gardening has been an expression of people's resistance in the cities of the Global North since its beginnings: resistance to globalised, industrialised food production (cf. HALLOCK 2013), resistance to environmental pollution and food waste (cf. TAYLOR 2018 and HALLOCK 2013), resistance to urban decay and the neglect of their neighbourhoods (KARGE 2015, p. 53), and last but not least, resistance to the dismantling of social services and the resulting food insecurity. The movement as we know it today began in New York in the 1970s, which was hit hard by deindustrialisation and structural change, when activists began to green derelict land and revalue their neighbourhoods (KARGE 2015, p. 54, HU-BERLIN 2018). Community gardens contrasted with the negative image of run-down inner cities with high vacancy rates, high unemployment, high crime rates, and "food deserts"[3]. Community gardens can thus be seen as a form of combination between participatory urban development and criticism of social structures (LEITNER 2019, p. 39). In urban gardens, topics such as the appropriation of the city, participation, emancipation and democratisation are expressed. These are critically discussed with the processes of a neoliberal urban development (ibid.).
Today, the urban gardening movement has arrived in many major cities of the Global North and is partly recognised and promoted by urban planning. The city of Vienna, for example, supports urban gardening projects in order to promote social cohesion, community and sustainability in the neighbourhood (LEITNER 2019, p. 40). Such projects emerge simultaneously *bottom-up* and *top-down*, as activists in search of suitable land and the district administration in search of a group find each other (ibid.). Sometimes, initiatives apply elements of so-called tactical urbanism to achieve change in the neighbourhood quickly and unbureaucratically. Tactical urbanism is described as "small-scale, unsanctioned, community-led urban interventionist activities" (MOULD 2014, p. 530). One form of this is the so-called guerrilla gardening, where not the municipal level but neighbourhood advocates take action at street level (ibid., p. 532). In San Francisco, for example, they use so-called "Parklets", which provide high beds and benches to sit on, to reclaim parts of the streets in the neighbourhood (ibid., p. 534).
Researchers see urban gardening as playing a key role in social integration, health care and improving air quality, as well as in water management, access to green spaces and sustainable construction (GORGOLEWSKI 2015, p. 42). Green spaces, such as urban gardening projects, are water reservoirs and have a cooling effect on cities (SCHRAM-BIJKERK et al. 2018, p. 866).

As HORST et al. (2017) state, urban gardening projects can have an impact on participants learning about the natural environment and food cultivation and thus raise the awareness for a healthier way of living and eating, even though poorer communities might suffer from health risks because of soil, water and air pollution (HORST et al. 2017, p. 282).

[3] The term describes an area that has limited access to cheap and healthy food (STORY et al. 2008, p. 259).

Overall, urban gardening can be understood as a challenge to the modern, common cityscape. It not only breaks down the urban-rural dichotomy, but also the understanding of public and private activities, as it moves gardens to public spaces and makes formerly private gardening work public (KARGE 2015, p. 46). Community gardens represent a "novel, hybrid use of urban gardens and communal open spaces" (ibid., p. 49). Thus, urban gardening also touches on our understanding of space use and stands for communal rather than individual open space use, as well as the establishment of "places of collective creation" (AWAN 2015, p. 32). Furthermore, urban gardening also challenges urban anonymity and urban individualism (cf. BOHN 2015/ KARGE 2015). Nowadays, a distancing from each other can be observed, especially in urban spaces. The return to neighbourly help and learning from each other can be seen as an attractive counter-model to the increasing anonymity of urban spaces (MEYER-SOYLU/WAITZ 2020, p. 56).
In the same context, the return to the neighbourhood as an everyday place and living environment for city dwellers should be mentioned: in large cities, it can be observed that neighbourhoods represent an essential perspective for many households (SCHNUR 2020, p. 45). This can be explained by the fact that in an increasingly connected world and the associated "de-anchoring" (ibid., p. 46), people long for local points of reference that have a certain continuity and meet their needs (ibid.). The neighbourhood is people's sphere of action, which they can influence. Here, activities can take place in a spatially concentrated manner, which enables exchange and inspiration and can lead to a motivating atmosphere in the neighbourhood (WAITZ et al. 2020, p. 43). Changes on such a small scale, for example through urban gardening projects, often have an immediate effect, can be directly experienced by the residents and thus have a greater influence on the everyday life of the residents or the way they are perceived (ibid.).
One of the few studies that specifically identifies the effects of urban gardening projects on the neighbourhood level is the work by WAITZ et al. (2020). The authors write that the creation of attractive, shady seating areas can increase the quality of stay in neighbourhood-related open spaces and contribute to a better microclimate through planting (WAITZ et al. 2020, p. 43). LIN et al. (2018) found similar positive effects on the local climate as they demonstrate in their study that urban gardens reduce the temperature on site, provide shade and thus clearly counteract the urban heat island effect (LIN et al. 2018, p. 574). LEHMANN (2014) states that urban roofs can also bring a new approach to urban greenery as they have the potential to function as roof gardens. According to LI et al. (2014) and SUSCA et al. (2011), green roofs in general can have positive effects on the local urban climate as well (cf. SUSCA et al. 2011 and LI et al. 2014).
According to LEITNER (2019), two different levels can be distinguished when analysing the effects of urban gardening projects: the reconceptualization of agriculture and the city (cf. BOHN 2015, GORGOLEWSKI 2015 and KARGE 2015), as well as participation in the design of the city form the superordinate macro level, while the activity of gardening itself can be interpreted as the micro level (LEITNER 2019, p. 41). Leitner writes that the reasons for the impulse and motivation to participate in urban gardening projects lie primarily at the level of the individual rather than the collective. The desire for gardening activity, for a balance to everyday life, which is often characterised by a lack of exercise and work on the computer, but also learning how to grow food and regaining independence are in the foreground. However, the participants also value the opportunity to work together as a group on projects that would not be possible alone, e.g. the joint design of an area that is open to everyone, including those outside the association. This in turn suggests that the intention is to strengthen the community (ibid., p. 48.)

Despite all the opportunities and potential of urban gardening projects on the well-being and living environment of city dwellers, it is also important to examine possible negative effects. For example, it is questionable whether urban gardening accelerates the so-called green gentrification. MARCHE (2015) discusses the possible effects of urban gardening projects on gentrification processes. Using San Francisco as an example, Marche assumes that there are some gardens that accelerate gentrification, while others merely occur as a concomitant of gentrification, and still others can be seen as resistance to gentrification processes (MARCHE 2015, p. 9). However, HORST et al. do not

see such a connection (HORST et al. 2017, p. 283). All in all, a clear link between urban gardening projects and gentrification could not be identified in the literature so far. Another important point that HORST et al. (2017) analyse is that disadvantaged groups or socially less connected people are excluded from the projects (HORST et al. 2017, p. 283).
While many effects become apparent on a small-scale local neighbourhood level, the larger urban planning scale is important for the implementation of urban gardening projects. Open spaces represent spaces that are increasingly negotiated. New urban policies therefore treat open space as places for diverse uses, addressed by "participatory governance" and "collaborative planning" (NIKOLAÏDOU et al. 2015, p. 5). Urban gardening projects represent such a new form of urban practice, as a large number of urban gardening projects are emerging on abandoned sites in the city (ibid., p. 7). Thus, they promote civic engagement, collective empowerment, and community building (ibid., p. 5). As freely available public spaces in cities are rare, urban gardening projects are increasingly in conflict with other uses such as residential or commercial areas (ibid.). As green spaces will be of central importance for ecosystems and living conditions in the future, they play a more important role in the use of public spaces, which is why higher-level urban planning is also crucial in the coordination of these spaces (ibid.). NIKOLAÏDOU et al. (2015) found that planning should come from a two-way collaborative process, in that the city or municipality allows temporary uses in a quick and unbureaucratic way, but at the same time is able to restrict or prevent the use of abandoned spaces (ibid., p. 16). That is why a cooperation between "local and policy level" could be important to induce change on "future landscapes and synergies" (ibid.) Currently, however, planning approaches are rather characterised by a top-down approach (ibid., p. 5). Crucial for the development of urban gardening projects is therefore the question of what priority is given to them by urban planning.

3. Conceptual framework

Part of the conceptual framework of this paper consists of a well-being approach. The concept of well-being can be used as a connecting point to see how urban gardening unfolds at the micro level. There is evidence that urban gardening increases well-being when it is connected to people and space (cf. BAILEY 2016). Well-being, according to VANDERWEELE (2019), is relevant not only at the national level, but also at the local level, such as in neighbourhoods. While there is an ongoing debate about the definition of well-being (see DODGE et al. 2013), we would like to use the term as a bridge between the different levels of our research and divide it into two categories: mental well-being and physical well-being in connection to urban gardening, as shown in the study by BAILEY & KINGSLEY (2020). Mental well-being can be improved through urban gardening because, on the one hand, it is linked to a value chain (in this case, food production) that is upgraded and people who participate gain tenure and control, while, on the other hand, the mental health of people who regularly or occasionally participate in urban gardening is strengthened (MIDDLING et al. 2011; BOOTH et al. 2018). Physical well-being is promoted by green environments such as community gardens. Studies found that greener spaces can lower the mortality risk (CROUSE et al. 2017). It has also been demonstrated that well-being is sustainably improved by food perception (WAKEFIELD et al. 2004). Community connections and well-being are highlighted by DUELL (2013), who emphasises the need to include diverse groups to overcome barriers to participation. People from disadvantaged backgrounds, in particular, can benefit from participating in urban gardening while using the social network for their well-being (VEEN/EITER 2018).
The following figure is derived from the state of the research (fig. 1). It shows both the two-level system of macro- and micro-level described by LEITNER (2019) and the different actors that shape the design of urban gardening projects (cf. NIKOLAÏDOU et al. 2015). While the general reconceptualisation of agriculture in urban spaces can be described as the macro-level, gardening itself takes place on the ground at the micro-level in each case. If the effects of urban gardening

projects on the well-being of people are to be explored, the focus is therefore on the micro-level. Nevertheless, the macro-level must not be ignored for the purpose of placing the urban gardening projects in the larger picture of urban development.

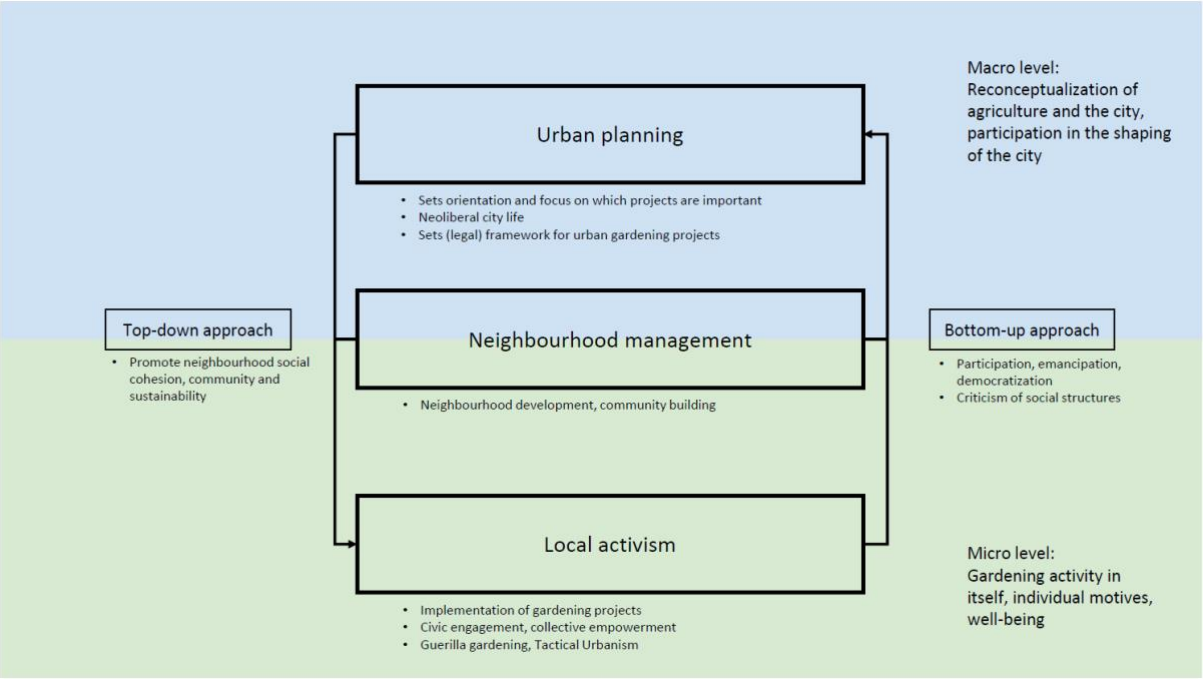

Figure 1: The two-level system of macro- and micro-level and relevant actor fields (own illustration based on LEITNER and NIKOLAÏDOU et al.)

According to our figure, we have considered each field of actors in the selection of our interviewees. Thus, we analyse the field of urban planning, the field of neighbourhood management, as well as selected local grassroot projects. It turns out that urban gardening is characterised by a dualism of top-down and bottom-up processes. While the administration pursues a new strategic approach to urban development along sustainable, green guidelines at the macro level, the focus at the micro level is more on the gardeners' individual motives to promote well-being. An integration of all actor fields and levels of action has so far taken place only rudimentarily.

4. Methods

The research is based on a mixed-methods approach consisting of qualitative methods of guided interviews with experts, as well as quantitative methods of mapping and quantitative content analysis. An explorative approach was chosen in order to "gain first impressions of a certain subject area" (BAUR/BLASIUS 2014, p. 136). For initial research, a literature review was conducted. Relevant keywords such as "urban gardening", "city gardening/farming", "community garden", "urban gardens" or "urban gardening Berlin" were searched on search engines such as Google Scholar, Base and OAlster. On this basis, initial knowledge on urban gardening topics in urban planning was collected and stakeholders who could be considered for the interviews were identified.

The study area is the Neukölln borough of the Berlin district Neukölln. The borough borders the borough of Britz to the north and is the largest borough of the district of Neukölln with approximately 164,000 inhabitants (BEZIRKSAMT NEUKÖLLN 2020). Due to various well-known urban gardening projects, such as the *Prinzessinnengärten*, the *Allmende Kontor* community garden or

the *Klunkerkranich*, as well as the high density of community gardens, the area represents a relevant study area for the research question (cf. ZENS/STEINMEIER 2022).
Subsequently, questionnaires for the guided interviews with experts were developed. Guidelines serve as a guide through the interview. In expert interviews, the selection is made "through the special selection and status of the interviewees" (BAUR/BLASIUS 2014, p. 559). The interviews cover the actor fields displayed in figure 1: the administrative level of Berlin in form of the Department of Open Space Planning and Urban Greening of the Berlin Senate Department for the Environment, Mobility, Consumer and Climate Protection (SenUMVK), the level of the local neighbourhood management Donaustraße-Nord, as well as the local, activist level (founder of the *Prinzessinnengärten*, participant *Allmende Kontor Garten*). Thus, the opportunities and potentials that arise from urban gardening, as well as the challenges and problems that many garden projects face, can be illuminated from the perspective of the Berlin Senate Administration, the local neighbourhood management office, as well as from the perspective of the participants from the neighbourhood.
Following the interviews, the data was coded using the software *MaxQDA*, as quantitative content analysis is particularly useful for open-ended questions (MAYRING/FENZL 2014, p. 548). In such coding, "words and phrases are defined" which are attributed to different categories (BAUR/BLASIUS 2014, p. 717). For the evaluation of the interviews different main topics were determined: the most important topic is "Urban gardening in urban planning". The positive effects of urban gardening on the local neighbourhood are mentioned nearly as often. Current trends, such as vertical farming or Berlin as an "edible city", are mentioned third most frequently. The fourth focal point is the topic "Challenges and problems", followed by the block "Prospects for the future". The prerequisites for urban gardening projects and the question of financing are also addressed. However, these topics tend to play a subordinate role in the interviews. Furthermore, the different urban gardening projects of the study area were recorded and visualised with *QGis*, a software for geo-information processing.

5. Results

5.1. Map and pictures of the study area

In the study area of the borough Neukölln, 17 active urban gardening projects could be located (figure 2). The map shows where the projects are located in the study area. Most of the projects are community garden projects that are publicly accessible and pursue an educational mission. The collage of pictures of different garden projects is meant to give the reader an insight into the diversity of Neukölln's community gardens (figures 3-8).

Figure 2: Map of urban gardening projects in the study area (own illustration)

Figure 3: Local shop of Prinzessinnengärten In Neukölln (Steinmeier et al. 2021)

Figure 4: Prinzessinnengärten in Neukölln (STEINMEIER et al. 2021)

Figure 5: Kiezgarten Donaukiez in Neukölln (STEINMEIER et al. 2021)

Figure 6: Vollguter Gemeinschaftsgarten in Neukölln

Figure 7: Gemeinschaftsgarten Allmendekontor in Neukölln (STEINMEIER ET AL. 2021)

Figure 8: Gemeinschaftsgarten Prachttomate in Neukölln (STEINMEIER et al. 2021)

5.2 Evaluation of the interviews

Urban gardening in urban planning

First of all, it can be stated that the topic of urban gardening has not been present in urban planning for very long. According to the SenUMVK, most of Berlin's garden projects have been developed on fallow land that dates back to the post-reunification period. Initially, there was no consideration or even promotion by the city planning. This is also confirmed by the activist and founder of the *Prinzessinnengärten* (the *Prinzessinnengärten* also came into being in 2009 at Moritzplatz, an area that had previously lain fallow for over 60 years).

> *I mean back then, when it started at Moritzplatz [...]. Everything was still called 'interim use'. They [the urban planners, editor's note] still saw it as something that could happen somewhere for a year or two and then go away again when something more important happened. (Interview with the founder of the Prinzessinnengärten, p. 2).*

But the more garden projects emerged in Berlin, the clearer it became that urban gardening would not simply remain a short trend. And today, from the activists' point of view, it has also arrived as a category in urban planning: "Right now there's this community garden program of the city of Berlin [...] and it's already arriving as a term and is also being thematised [...]. Yes, it has a positive connotation." (Interview with the founder of the *Prinzessinnengärten*, p. 3). According to the SenUMVK, especially the policy of the Red-Red-Green coalition in Berlin during the last five years has helped to promote urban gardening projects more. In contrast to the previous Senate, the topic of urban gardening now has political "backing" (interview with the SenUMVK, p. 2). In addition, the activism of citizens in general has nowadays become more important in the administration:

> *I believe that the understanding of urban development - at least if you look at research and pioneering concepts - is now that not only [the] administration provides everything, or some institutions, [but that] at least the people who live in the city also want to do something themselves, can do something and should do it. (Interview with the SenUMVK, p. 3).*

In terms of urban gardening, this means: "People take care of the urban green. That is the approach that my colleagues, my superiors and so on have. And they think it's great that people are getting involved." (ibid., p. 6). From the interview with the SenUMVK, three overarching goals of urban planning in relation to urban gardening can be derived. These are firstly, to bring the topic of urban gardening into the administration and politics and to promote novel uses of open space (i.e. uses of open space that were not previously seen in the context of the administration). Secondly, to develop concepts and strategies (i.e. to integrate urban gardening as part of urban green space into open space planning). Thirdly, to create synergies with other departments: urban gardening is to be anchored as a topic in the administration that touches on several areas (e.g. in addition to open space and green space planning, also the topics of environment, nutrition and consumer protection). In this way, professional exchange is also to be promoted.

In order to come closer to these goals, various measures have been implemented: in addition to the creation of an officer for urban gardening of the SenUMVK, as well as the founding of the platform "Produktives Stadtgrün" to connect the now over 200 urban gardening projects in Berlin, the financial support of community gardens is also one of the measures. Last year, for example, the administration funded the *Prinzessinnengärten* (ibid., p. 3). In addition, there is funding for projects that open community gardens in allotment gardens. However, the administration also faces some challenges and problems regarding the promotion of urban gardening. According to the SenUMVK, it will still take a while until the topic has really fully arrived and is anchored in urban planning. In their opinion, the administration could definitely open up a bit more and experiment more. Other German cities are already further along in this respect, as they take a more "pragmatic" approach and support the involvement of citizens in their local environment more strongly (ibid., p. 3).

Berlin, on the other hand, does not even have a planning sign for urban gardening in the planning sign ordinance, which means that no areas can be explicitly designated for urban gardening in the

land use plan or in the development plans. Different positive examples can be derived from other cities in Europe. In Paris, urban gardening is politically determined and Madrid, for example, uses informal arrangements to engage people in gardening in urban parks (interview with the SenUMVK, p. 3).
Another problem in Berlin is that the 12 Berlin districts actually need their own contact persons for the urban gardening initiatives. The districts are for the most part the owners or administrators of the land. Although the Senate Department develops cross-district strategies, the final decision-making power lies with the districts, according to the SenUMVK. The development of strategies and concepts for urban gardening in cooperation with the many initiatives is also a very time-consuming process that requires more resources than the administration currently has at its disposal.
In addition, many initiatives still have reservations about institutionalisation, fearing that the administration could impose certain conditions on them. This was the case in New York, for example, where community gardens suddenly had to introduce minimum opening hours in order to become part of a city urban gardening programme (ibid., p. 6). On the other hand, according to the SenUMVK, there are also neighbourhoods in Berlin where the residents have reservations about shaping their living environment themselves (e.g., in the form of urban gardening). As an example, they mention a project in the Gropiusstadt borough of Neukölln. There, many people have been used to their housing association or the district/city taking care of everything for 30 or 40 years. Therefore, it is perceived as strange when suddenly something has to be done by oneself. Here, other processes are needed than the "squatting" processes in the inner city, where the initiatives arise on their own and the administration only tends to accompany and mediate.
Finally, the financial support of urban gardening projects is also a challenge: the COVID-19 pandemic has put a heavy strain on the budget of the city of Berlin, so that according to the SenUMVK it is still unclear how much money will be available after the pandemic. In the next chapter, the specific positive effects of urban gardening projects on the local neighbourhood and well-being of the residents will be examined.

Positive effects on the neighbourhood

Urban gardening projects often have an impact on the micro-level of a city. Many projects have a direct impact on the surrounding neighbourhood. When examining the answers of the interviewees for positive effects on the well-being of the people in the neighbourhood, different categories were created during the coding process: urban climate and biodiversity, free space/room for self-realisation, local and sustainable food, social and community and, lastly, education.

Social and community

Urban gardening has many positive effects on the local neighbourhood. Workshops and events, simple meetings in the "collective" and mutual help (interview with a gardener of the *Allmende Kontor* community garden) or "watering godparents" (interview with the neighbourhood management Donaustraße-Nord), who take care of the greening, ensure that the space of the urban gardening projects does not simply remain a space for greening, but becomes a space where people meet and get involved professionally or privately and where something happens on a social level.

> *And such a space is not just a bit of greenery, but [...] people meet here, they somehow meet people professionally, they meet people privately, they meet new people they have never seen before. There are events here, there is culture. So, this is a multidimensional space. (Interview with the SenUMVK, p. 4).*

This multidimensionality goes even further, because urban gardening can also be understood as an inclusive space that offers neighbourhood dwellers a possibility of networking and "home" (interview with the SenUMVK). In this way, groups of refugees or older people can also become

part of the urban gardening projects and find a connection. Additionally, the issue of loneliness, which has been brought into focus by the Covid-19 pandemic but is still treated marginally, can be addressed. The *Prinzessinnengärten* are also increasingly focused on projects that deal with refugees and diversity, and thus engage in a kind of "social work". By not requiring barriers such as entrance fees or memberships, the garden projects, like the *Prinzessinnengärten*, also remain an open, inclusive space for everyone. The absence of the economic focus on profit makes this space possible.

> *I think [...] there is a huge potential in the neighbourhood and I can't stand it at all [...] if we start monetising the neighbourhood now. Companies, for example, offer help to people and lend out drills for money. Why don't you go to your neighbour and borrow your drill and create places where people can meet? Then it will happen by itself. Whether they meet at a vegetable garden or at a coffee party or somewhere else; what is important is that there is no compulsion to consume, no primarily monetary place, and the rest will take care of itself. (Interview with the founder of Prinzessinnengärten, p. 5).*

Local and sustainable food

From the interviews it emerges that food production is not the main focus of the community gardens in question. According to the SenUMVK, various regulatory frameworks stand in the way of the goal of an "edible city". In addition, according to the founder of the *Prinzessinnengärten*, the type of production in urban gardening projects is not as efficient as conventional agriculture. However, the city of Havana in Cuba, where the majority of the food consumed is grown locally, shows that there is definitely potential. The crucial factor there, however, is that land is not allowed to be traded, according to the founder of the *Prinzessinnengärten*. The urban gardening projects in Neukölln, on the other hand, produce mainly for their own use. Only the *Prinzessinnengärten* offer some of the produce for sale in their own small shop.

Education

Instead of food production, according to the interviewees, it is more about educational work and about interested parties and those involved gaining an understanding of agriculture, urban development and political issues. One gardener from the *Allmende Kontor* community garden states that it is less about harvesting and more about a return to nature and an understanding of working with the earth, which is increasingly lacking in urban areas today. This is also the case in the *Kiezgarten* project in Donaustraße, which is very positively received, especially by pupils from the elementary school across the street. The educational work does not only have to refer to the immediate neighbourhood but can also address residents of other districts of Berlin.

Room for self-realisation

Community gardens are spaces for self-realisation. The SenUMVK states that it is not at all a matter of gardens having to be creative in order to function. The mere fact that urban gardens provide a space in the city where people can create something themselves and thus fulfil themselves is an essential function of the garden projects (interview with the SenUMVK, p. 4).

Urban Climate and Biodiversity

Urban gardening projects provide a green space for the city which have positive effects on the local climate and biodiversity. Even though the growing of food can be unattractive due to vandalism, the areas can still provide a space for flowers or insects, such as bees (interview with a gardener of the *Allmende Kontor* community garden, p. 1). According to the neighbourhood management Donaustraße-Nord, the temporary raised beds can provide an opportunity of green spaces to the neighbourhood since it's lacking such spaces (interview with the neighbourhood management Donaustraße Nord, p. 1). The idea of the edible city would also have a big impact on the biodiversity of a city since there would be more fruit trees in addition to city trees (interview with the SenUMVK, p. 7). All in all, more green spaces provide a good tool for climate adaptation measurements. Especially intensive greening of roofs could strengthen the effects (ibid.). In the following chapter, the specific challenges and problems the urban gardening projects are facing are analysed.

Challenges and problems

All urban gardening projects in question face specific challenges and problems. Problems mentioned by the respondents include: organisational difficulties, vandalism and theft, lack of diversity, green gentrification, noise, pollution and other nuisances, exaggerated hype, lack of political support, touristification, planning security and, lastly, land shortage.

Land shortage

In the interviews, the problem of the shortage of land is repeatedly mentioned: apartments, schools and daycare centres are needed more urgently than a garden project, which is why garden projects often lose out to the more urgent planning projects in the planning process (interview with the SenUMVK, p. 9).

> *Even if we had a planning sign in the ordinances; we wouldn't be able to make it work in planning that we would still find an area where we would then write on it: here, this should be a community garden. That's just incredibly difficult. (Interview with the SenUMVK, p. 9).*

According to the Senate Department, many of Berlin's community gardens are located on endangered sites. The *Prinzessinnengärten* were also always threatened by construction projects at their old location at Moritzplatz (interview with the founder of the *Prinzessinnengärten*, p. 1). According to the founder of the *Prinzessinnengärten*, they moved to the current location in Neukölln out of a sense of responsibility towards the city gardeners, as they would have greater planning security there (ibid.). In neighbourhoods where space is contested and areas for alternative projects are scarce, initiatives apply elements of so-called guerrilla gardening and tactical urbanism to achieve change quickly and unbureaucratically (cf. interview with the neighbourhood management Donaustraße-Nord). The hope is that the changes will be perceived as positive by local people and that the projects will be perpetuated.

Touristification and exaggerated hype

The garden projects have an ambivalent relationship to the touristification of Berlin: on the one hand, the visitors help the projects, but on the other hand, a mass tourist rush can also harm the initiatives. At the time, broad public interest made it possible for the *Prinzessinnengärten* to maintain their space at the Kreuzberg location and collect signatures.
Conversely, this attention also led to the project appearing in numerous travel guides. On the one hand, according to the founder, the project benefited from this, as the tourists helped to finance the full-time employees and the restaurant through consumption. On the other hand, however, it

was problematic because the project was "overcrowded" and one constantly got "mobile phone[s] in one's face" (interview with the founder of the *Prinzessinnengärten*, p. 4).
In his view, this is not the point of community gardens, as gardening does not work this way (ibid.). In contrast, such tourist hype no longer occurs at the new location of the *Prinzessinnengärten* in Neukölln, which is welcomed by the founder of the gardens. He describes that this garden project is actually mainly used by local residents (ibid., p. 4).

Vandalism, theft

Vandalism and theft seem to be a problem for many community gardens. One of the gardeners from the *Allmende Kontor* reports: "You have to expect that things will be stolen. Because it is so public here and all people have access. Sometimes people are not so correct and take things" (interview with a gardener of the *Allmende Kontor* community garden, p. 8). For this reason, some of the gardeners refrain from growing fruit and vegetables and prefer to cultivate flowers instead. This is also the case in the neighbourhood garden in Donaustraße, even though no negative experiences have been made there in this regard (interview with the neighbourhood management Donaustraße-Nord, p. 5).

Noise, pollution and other nuisances

The founder of the *Prinzessinnengärten* reports that young people, in particular, frequent the project sites in the evenings and at night, causing noise (interview with the founder of the *Prinzessinnengärten*, p. 23). The neighbourhood management Donaustraße-Nord also describes something similar. This also leads to pollution and "other nuisances" for the local residents (interview with neighbourhood management Donaustraße-Nord, p. 5). In order to prevent pollution, more rubbish bins were placed. According to the neighbourhood management, this is having an effect, because the rubbish is "quite well contained" (ibid.).

Green gentrification

By adding value to the neighbourhood and giving it a green, sustainable image, urban gardening projects could potentially contribute to the gentrification of the neighbourhood (green gentrification). For example, real estate companies use urban gardening projects specifically to promote neighbourhoods (interview with the SenUMVK, p. 4). However, the Berlin Senate Department assumes that gentrification is too complex a process for there to be a causal connection with urban gardening projects (ibid.).

Lack of diversity

One point of criticism that some of the initiatives repeatedly face is a lack of diversity. According to the SenUMVK, the overwhelming majority of activists used to be white, German and academics (interview with the SenUMVK, p. 5). It is particularly difficult for disadvantaged population groups to found community gardens, as this requires time, capital and a good social network. In addition, there are legal uncertainties, especially at the beginning (e.g. lack of vending licences), which has a deterrent effect on already disadvantaged groups (ibid.). Nevertheless, according to the SenUMVK, many initiatives today are trying to become more diverse. The *Prinzessinnengärten* also make an effort to create a space for disadvantaged groups:

> *We also do work with refugees, work on diversity. We do social work in green spaces. [...] Anyone can come in, doesn't have to pay anything, doesn't have to become a member, can chat with us, can join in. (Interview with the founder of the Prinzessinnengärten, p. 4).*

Lack of political support and planning security

In the interview with the founder of the *Prinzessinnengärten* it becomes clear again and again that it is a challenge for many community gardens to plan for the long term. This is due to the fact that the initiatives usually only get short-term contracts for their leased areas. At the same time, however, urban gardening is becoming increasingly popular, which means that the initiatives are responsible for more and more employees. The founder of the *Prinzessinnengärten* would like to see more political support in the form of financial support or long-term leases from the city in order to create more planning security for the initiatives and the committed urban gardeners. In the next chapter, current trends in the context of urban gardening, which could be observed during the interviews, are presented.

5.3 Current trends

Criticism of capitalism

Since the beginnings, urban gardening projects in the cities of the Global North have been an expression of people's resistance against the globalised, industrialised food production with its negative side effects (e.g. mass food waste). An anti-capitalist stance, which is directed against profit-oriented food production, as well as a stance against the "monetisation" of neighbourhood (interview with the founder of the *Prinzessinnengärten*, p. 5), is also repeatedly evident in the interviews. The founder of the *Prinzessinnengärten* describes community gardens as places which do not primarily follow a monetary logic and where there is no "compulsion to consume" (ibid.). In this way, the awareness of the participants for a more sustainable food production and the desire for a more conscious consumption could be strengthened.
A gardener of the *Allmende Kontor* community garden sees it similarly: "This idea of being aware of how difficult it is to harvest. And then it becomes more clear what you consume for example" (interview with a gardener of the *Allmende Kontor* community garden, p. 2). Nevertheless, the interviewees state that urban gardening alone cannot manage to revolutionise the whole economic system. Especially in Berlin, where the pressure on the real estate and land market is so enormous, community gardens that do not follow the profit-oriented, capitalist logic would hardly have a long-term chance (cf. interview with the founder of *Prinzessinnengärten*). Therefore, the SenUMVK argues that the urban gardening projects should produce more, but at the same time use their potential for a more sustainable economy.

Vertical farming

In order to do that, urban gardening projects could also resort to new, more efficient cultivation methods in the future. One method that stands out in particular is the so-called vertical farming[4]. However, the interviewees are critical of the method: "Of course, this should not be viewed uncritically. Somehow, lettuce or herbs are grown under laboratory conditions" (interview with the SenUMVK, p. 7).

[4] This refers to the cultivation of fruit and vegetables in vertical space, which is supposed to lead to higher yields with a shorter ripening period at the same time (BIRKBY 2016, p. 1). Companies, such as the Berlin-based start-up Infarm, use vertical farming to produce leafy vegetables and herbs in high-tech, computer-monitored greenhouses and then sell them at a high price - with labels such as "local", "sustainable" and "green".

The founder of the Prinzessinnengärten also does not see vertical farming as a suitable method to produce more sustainably. In the end, it is just another form of industrialised food production, according to him, especially since currently only products such as leafy vegetables, herbs or sprouts can be produced:

> *As long as we are still throwing away 51 percent of our food, there is much easier potential to somehow work more sustainably. Technical solutions, see industrialised agriculture, [have] never really brought more sustainability, historically speaking. [...] If all people want to eat is sprouts and BabyLeaf - even then it wouldn't be enough. (Interview with the founder of the Prinzessinnengärten, p. 5).*

Edible city

Another clear trend in the context of urban gardening is the model of the edible city. This means a city in which fruit, vegetables or herbs are offered and grown free of charge for the city dwellers at different places on a seasonal basis. According to the interviewees, one example of such a city is Andernach (interview with the founder of the *Prinzessinnengärten*, p. 3). Although there is a cooperation between the *Prinzessinnengärten* and the EU's edible city funding programme, critical views can also be heard in the interviews. The SenUMVK states that the model from Andernach would be difficult to transfer to Berlin simply because of the sheer size of Berlin. In addition, the topic also involves questions of insurance, the care of fruit trees in the city and, last but not least, the topic of water consumption, since said fruit trees would need much more water than other trees. The founder of the *Prinzessinnengärten* also finds clear words against such a project in Berlin. He emphasises that such projects would not develop organically in the neighbourhood and thus cohesion would not be given, which would raise consequential problems such as the question of liability (interview with the founder of the *Prinzessinnengärten*, p. 4). The neighbourhood management Donaustraße-Nord, on the other hand, is open to the idea and sees the positive aspects and possibilities of the idea. However, the feasibility of the concept is also a problem: "I think we have planted flowers and so on for practical reasons [...]." (interview with the neighbourhood management Donaustraße-Nord, p. 1). Lastly, prospects for the future, that could be deduced from the interviews, are presented.

5.4 Prospects for the future

Steadiness through multi-coding of land

For most of Berlin's garden projects, the question arises as to how a steady continuation of the projects in public space can succeed. One possibility is the so-called multi-coding, i.e. multiple use, of spaces. The *Prinzessinnengärten* are located on the grounds of a still active cemetery in Berlin Neukölln, where - as with other cemeteries - a large part of the space is no longer in use. However, a rededication of the cemetery grounds and a building development is not possible in most cases. At the same time, the cemeteries sometimes carry high costs due to the maintenance of the areas. This is exactly where the *Prinzessinnengärten* project comes in: the gardeners take care of the maintenance of the unused areas and at the same time something positive for the neighbourhood is created.
Another example of a possible multi-coding of areas is the topic of green roofs which can also serve as a tool for climate adaptation. In Berlin-Prenzlauer Berg, for example, the gardening project "Piece of Land"" is threatened by the construction of a gymnasium, which is why discussions are taking place at this location about planting a garden on the roof of the future gymnasium (interview with the SenUMVK, p. 9). According to them, however, the discussion is currently only taking place at this one location, while gyms like the one in Prenzlauer Berg are being built all over the city without any discussion about multi-coding. Football pitches also offer simple opportunities

for multiple use. According to the SenUMVK, there is almost always the possibility of creating raised beds or other forms of urban gardening (ibid.).

Steadiness through institutionalisation

A stronger institutionalisation could strengthen the projects, which would especially support the educational work of the gardens (cf. interview with the founder of the *Prinzessinnengärten*, p. 3). However, many of the grassroot projects have reservations about institutionalisation. For example, according to the founder of the *Prinzessinnengärten*, there is increasing conflict amongst the urban gardening initiatives in understanding whether the primary concern is soil or education. The interests are so different that it is difficult to imagine a superordinate lobbying association (ibid., p. 3). In addition, many activists fear that membership in an association or organisation could be linked to certain requirements.

6. Discussion

It is becoming clear that urban gardening in cities of the Global North is less about increasing the food production in general, but more about strengthening communities, environmental protection, resilience and social justice. As HORST et al. (2020) also stated, the interviews show that education also plays an important role: urban gardening projects offer the chance for young and old to discover how to interact with nature and raise awareness for a more sustainable lifestyle. This participatory process of urban gardening can increase mental and physical well-being. Information gleaned from our interviews supports claims made by researchers such as BAILEY & KINGSLEY (2020), MIDDLING et al. (2011) and BOOTH et al. (2018).

In the study area, there are now 17 community gardens, which have numerous positive effects on the well-being and living environment of the residents. In the interviews it becomes clear that they are first and foremost social places where people from the neighbourhood come together. Thus, they are also places that counteract the loneliness of people in the anonymity of the big city, especially during the COVID-19 pandemic. This effect is also highlighted by BOHN (2015), KARGE (2015) and MEYER-SOYLU/WAITZ (2020). There is strong evidence that especially people from disadvantaged backgrounds can benefit from participating in urban gardening while using the social network for their well-being (cf. VEEN/EITER 2018). As the interview with the founder of the *Prinzessinengärten* shows, such urban gardening projects can also help to integrate refugees into society. Furthermore, they are green oases that have positive effects on the local microclimate and air quality and are places of recreation for many residents. The interviews support the argument that urban gardening has positive effects on the microclimate and biodiversity, as it is also shown by LIN et al. (2018) who demonstrate in their study that urban gardens reduce the temperature on site, provide shade and thus clearly counteract the urban heat island effect (LIN et al. 2018, p. 574). Ultimately, urban gardening projects also offer the possibility of self-sufficiency with sustainably produced food for the committed local citizens.

The interviews show that urban gardening was initially used by activists to put fallow land to a new use in a bottom-up principle. Today, however, urban gardening is also recognised by the Berlin administration as an important instrument of urban and neighbourhood design. The commitment of the citizens is appreciated. In this respect, urban gardening also contrasts with previous top-down approaches to urban planning. This underlines an important step towards "participatory governance" or "collaborative planning", as NIKOLAÏDOU et al. (2015) mention it. So, in this regard, the city of Berlin is taking a progressive approach by allowing temporary uses in a quick and unbureaucratic way while still remaining in control of the use of abandoned spaces.

Nevertheless, the city of Berlin could do much more to promote community gardens and integrate them more into planning. In each district, the administration would need its own respective contact person for the numerous garden projects. Another challenge is the conflict with other uses of the

open spaces (NIKOLAÏDOU et al. 2015, p. 5). In Berlin, for example, the zoning ordinance lacks a separate planning symbol for community gardens, which could be used to explicitly designate land for urban gardening, as explained by the SenUMVK.
The *Prinzessinnengärten*, for example, rely on a regulation of the cemetery law. By using the old cemetery space, they do not have to compete against other monetary interests since the land cannot be built on. In addition, the concept of so-called multi-coding, as the interview with the SenUMVK shows, could be used much more to make greater use of the green potential of areas (e.g., in the case of football pitches that also serve as rain catchment basins). According to the interviewee, the planting of roofs could be mandatory for new buildings in the future as green roofs are repeatedly associated with positive effects on the local urban climate, as described by SUSCA et al. (2011) and LI et al. (2014). The multi-coding of land could also help to permanently perpetuate community gardens on endangered spaces in the future.
HORST et al. (2017) describe the possible negative effects that urban gardening projects can have indirectly on a neighbourhood in the form of excluding disadvantaged groups or socially less connected people (HORST et al. 2017, p. 283). In Berlin-Neukölln, the projects in question strive to ensure that this does not happen. The Kiezgarten in Donaustraße, for example, provides support services for disadvantaged residents (in the form of boxes for donations and a bulletin board for exchange and communication).
The impact of urban gardening projects on gentrification is not clear, as the literature states (MARCH 2015, HORST et al. 2017). The Berlin administration is certain that gentrification is too complex a process for the projects to contribute significantly to it (cf. interview with the SenUMVK). Nevertheless, displacement processes could possibly be prevented if there was an even distribution of urban gardening or green spaces and recreational areas in general in the city.
Regarding food production, the urban gardening projects in question also mainly have an impact at the local neighbourhood level. In most cases they only produce enough to supply the local gardeners, but not the neighbourhood or even the entire city (although even here only the seasonal cultivation of fruit, vegetables or herbs comes into consideration, and not complete self-sufficiency). In contrast to Berlin, cities like Havana are already much further ahead: thanks to the generous allocation of open spaces to producers, more than two thirds of the fruits and vegetables consumed nowadays grow within the city boundaries of Havana. This is also praised by the founder of the *Prinzessinnengärten*, although such a scenario is not considered realistic for Berlin. It is true that through new cultivation methods, such as vertical farming, the garden projects in question could potentially increase their production. However, the interviews also show that the interviewees are rather sceptical about such methods, as they - in contrast to start-ups - do not want to work according to the principle of profit maximisation. On the one hand, methods like vertical farming could help in fulfilling the plan of self-sufficiency and a breaking away of dependence on remote food sources, as GORGOLEWSKI (2015) states. But, as shown by the interviews, those methods are in contrast to the elementary motives of the urban gardening projects, such as resistance against the globalised food production and against the neglect of neighbourhoods.
In order to have a positive impact at the city level, the projects would need to be more closely connected with each other. In addition, they would have to be more present in public space in order to reach more people. However, it is precisely when it comes to networking and integration into urban planning that a tension arises between the activists on the one hand and the administration on the other. From the interviews it becomes clear that in many garden projects resistance to institutionalisation is found, out of fear that this could be linked to certain requirements.

This seems logical when one considers the origins of the urban gardening scene in the protest movement and squatter scene (cf. KARGE 2015, HALLOCK 2013). But, as NIKOLAÏDOU et al. (2015) describe cooperation between the local and the policy level are important since the implementation and existence of projects depend on the policy level (NIKOLAÏDOU et al. 2015, p.16).

Tension also arises from the relationship between urban community gardens on the one hand and the system of industrialised, globalised food production on the other. At the moment, urban gardening cannot supply the whole city, because the focus is clearly on the local neighbourhood level. However, through greater promotion on the part of urban planning, it could be possible for urban gardening to eventually become a natural part of the food system of cities in the Global North, similar to cities in the Global South. Nonetheless, evidence shows that participants' awareness of food production and mental and physical well-being increases when they participate in urban gardening projects on an occasional or regular basis (WAKEFIELD et al. 2004, MIDDLING et al. 2011).
Without more financial help or land to facilitate urban gardening, the initiatives in question have to find other ways to shape the urban space. The neighbourhood management Donaustraße-Nord, for example, uses elements of the so-called tactical urbanism. This is a concept which - starting with streets, blocks of houses or individual plots of land - shows that small, concentrated improvements can often be most effective in bringing about change in the city. This allows new concepts to be tried out on a localised scale before being deployed across the board or attracting major financial support. It also allows for truly place-based solutions to emerge (GORGOLEWSKI 2015, p. 48-50). Temporary seating and flower boxes are intended to make a part of the Donaustraße neighbourhood more liveable and to create a meeting place. Here, too, the aim is to make the *Kiezgarten* permanent. The hope is that, starting from such small projects, a change will eventually take place in the entire city.

7. Conclusion

Urban gardening takes place on two levels: while the general reconceptualisation of agriculture in urban spaces can be described as the macro-level, gardening itself takes place on the ground at the micro-level. Here, the focus is on the gardeners' individual motives to promote well-being. This study investigated the local effects of selected urban gardening projects in Berlin on the well-being and local environment of the residents of the respective neighbourhoods. It is shown that urban gardening projects are first and foremost social spaces that create a new form of community in the neighbourhood. The gardens are alternative places that do not follow a capitalist logic. Mutual help and learning from each other are clearly in the foreground. The opportunities for self-fulfilment in the fresh air, contact with neighbours, and the possibilities of self-sufficiency with fresh food, that result from urban gardening, prove to be beneficial for many neighbourhood dwellers, especially during the COVID-19 pandemic. In addition, many gardens are educational places where children and young people can learn about nature and the basics of gardening and strengthen their mental and physical well-being. The increase in well-being through urban gardening can be confirmed and especially people from disadvantaged backgrounds can benefit from participating in urban gardening and thereby improve their well-being. Furthermore, urban gardens have a positive effect on the local microclimate and create places of recreation.
However, the interviews also revealed many challenges and problems that the projects face. In a growing city like Berlin, the increasing shortage of space in particular proves to be a danger. For a long time, there was also a lack of political support for the projects. Today, however, the Berlin administration has recognised the benefits of urban gardening and is trying to integrate the projects more strongly into urban and neighbourhood planning. In this way, the gardens are to be promoted and the citizens' commitment to their neighbourhoods strengthened. In the future, the multi-coding of areas can play an important role, which can lead to urban gardening and other types of land use coexisting. Other means of facilitating urban gardening include financial help, the allocation of public land and the appointment of urban gardening officers in each of Berlin's districts.

In order for the projects to have an effect not only at the local level, but also at the city level, there is also a need for stronger networking of the initiatives. Since there are clear reservations against institutionalisation in parts of the scene, networking can only succeed in dialogue with all relevant actors involved. Through greater promotion and consideration of urban gardening in urban planning, as well as new, more efficient cultivation methods, it might even be possible for urban gardening to become a natural part of Berlin's food supply at some point in the future.

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Part II: The role of informality and subversiveness in urban agriculture practices

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Informal urbanization and access to land for urban agriculture in Dar es Salaam, Tanzania

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1. Introduction

In recent years, urban agriculture has drawn the attention from the research community because of its importance in ensuring food security for the rapidly growing urban population (MARTELLOZZO et al., 2014; UNITED NATIONS, 2015; UN-HABITAT, 2016). Urban agriculture mainly involves cultivating vegetables and perishable crops, such as tomatoes and spinach. The production of these crops in urban areas saves someone from incurring costs in transporting the same from distant rural settings. Although urban agriculture helps to ensure food security in urban areas, the ever-growing population and the ever-increasing housing densities constrain the level of access to land for urban agriculture (MCLEES, 2011). It also reduces the amount of space in which to practice urban agriculture. MARTELLOZZO et al. (2014) suggest that urban agriculture requires approximately one-third of the total urban area to meet the global vegetation consumption level for urban dwellers. However, this suggestion does not consider the challenge of obtaining land and the suitability of the land obtained for urban agriculture (MARTELLOZZO et al., 2014).

The availability of land for urban agriculture varies across countries as well as in large and small urban centres, depending on the type of urban agriculture practiced and whether it is practiced in planned or unplanned urban contexts (MCLEES, 2011; MARTELLOZZO et al., 2014). This paper draws on Henri Lefebvre's ideas on the production of space to examine how land is accessed in a context of informality (JONES, 2020; TSAVDAROLGOU, 2020). Lefebvre's insights are used here to analyze the production of space for urban agriculture in Dar es Salaam, a city that is highly characterized by informal urbanization (LEFEBVRE, 1991). Urban space can be perceived, conceived, or lived in (LEFEBVRE, 1991; MWATHUNGA, 2014). This phenomenon affects spatial practices and the associated representation of space (LEFEBVRE, 1991; MWATHUNGA, 2014). With this idea in mind, we examined how land for urban agriculture is produced in a context where over 70% of the city dwellers live in unplanned settlements.

2. The context: informal urban development in Dar es Salaam

Dar es Salaam is Tanzania's main commercial city and one of the rapidly urbanizing cities in sub-Saharan Africa. According to the projections by the United Nations, the current population is estimated to be six million (SCHMIDT, 2011; UNITED NATIONS, 2015). The rapid urbanization of Dar es Salaam is associated with informality; informal settlements are occupied by about over 70% of the population (UN-HABITAT, 2009, 2014). In this context, the rapid population growth creates a need to expand urban agriculture, while informal urbanization reduces greatly the availability of land for urban agriculture (SCHMIDT, 2011; MARTELLOZZO et al., 2014). Urban agriculture is legal in Dar es Salaam, but there is very minimal land that has been set aside for that purpose (MCLEES, 2011; URT, 2020). Thus, the land on which urban agriculture is practiced is produced and accessed

informally. According to DONGUS et al. (2009), urban agriculture occupies 5% (16.8 square kilometers) of the city's total area. This is proportionately low, compared with the suggestion by MARTELLOZZO et al. (2014) of allocating one-third of the city's total area to urban agriculture.

Urban agriculture is practiced in open spaces in the developed areas and peri-urban areas. MCLEES (2011) found that some private and public institutions had allowed farmers to illegally use their land to do urban agriculture. This form of access to land provides a temporary solution, as the land is likely to be required for its designated use, whenever the owner decides to use it. MCLEES (2011) notes that urban agriculture is practiced on hazardous lands, such as in road and railway reserves, as well as in lands unsuitable for house construction. The land is accessed through informal mechanisms; farmers negotiate with landowners for land. As the city urbanizes, there are constant land-use changes. Thus, the production of space for urban agriculture occurs as a continuous process in the context of informal access to land (JONES, 2020; TSAVDAROLGOU, 2020). The factors influencing land-use changes and the continuum of production of space for urban agriculture are summarized in Table 1.

No.	Land-use area	Area description	Influence for change
1	Peri-urban area	The transitional zone between the urban proper and the neighboring rural area.	It is constantly developed for residential, recreational, institutional, industrial, and commercial purposes.
2	Hazardous area	Areas with unfavorable development conditions.	Access can sometimes be denied on account of the nature of vulnerability.
3	Infrastructural wayleaves	Areas reserved for roads, railways, and high voltage electricity lines.	Diminishes as roads are expanded and strict management is instituted.
4	Land unsuitable for house construction	Natural landforms, i.e valleys, hills, creeks, etc.	It may be set aside for appropriate uses under strict management.
5	Open space	Undeveloped plots in settlement areas	It is constantly developed by owners or designated users.

Table 1: Space-related constraints on accessing land for urban agriculture (Source: Author's summary of the literature)

3. Methods

The study was conducted in two wards of Ubungo Municipality, namely Kwembe and Kibamba. The two wards are located in the peri-urban area, where urban agriculture is mainly practiced. The study adopted a case study research design to understand strategies used for accessing land for urban agriculture in the context of informal urban development. According to YIN (2014), case-study research draws on critical realistic theories to provide the basis for a detailed investigation of local realities. This study examined multiple variables on quantity of land used for urban agriculture, location of farms, land use change as well as farmers perceptions regarding access to land (BABBIE/MOUTON, 2009). A mixed-methods research approach was adopted to complement qualitative and quantitative methods (CRESSWELL, 2009). The study analyzed three types of data, namely qualitative, quantitative, and spatial data. Qualitative data were collected through a review of documents and in-depth interview while quantitative data were obtained through geospatial analysis. Geospatial mapping using GIS and remote sensing involved analysis of remote sensed data (Landsat 5, Landsat 7 and Landsat 8) obtained from United States Geological Survey (USGS).

Field observation (ground-truthing) was used to verify results obtained from geospatial analysis. Content analysis, geospatial analysis, and thematic analysis were used to analyze the data.

4. Results

Dar es Salaam is one of the rapidly urbanizing cities in sub-Saharan Africa. In 2021, its population was estimated to be close to seven million. The city is managed through five local government authorities out of which four are municipal councils and one city council. In Dar es Salaam, urban agriculture is informally practiced in the peri-urban areas. The Dar es Salaam master plan for 2016-2036 shows that, by 2016, urban farming covered 18.3% of the city's total area, while the plan has designated 2.07% of land for urban farming for 20 years period. This means 88.7% of the area currently used for urban agriculture was obtained informally, while 11.3% is designated. Urban agriculture is proposed to be undertaken in the peri-urban areas, where the population density is low. Again, land for urban agriculture is not provided for in some municipalities. The non-designation of land for urban agriculture has been the common development practice in Dar es Salaam. Consequently, farmers have devised informal mechanisms for accessing land for urban agriculture.

The farming activities include horticulture, poultry farming, livestock keeping, as well as crop farming. This paper focuses on horticulture and crop farming, which are grown seasonally. The horticultural crops grown are mainly irrigated with a small proportion of rainy water. The vegetables grown are green paper, spinach, cabbage, tomatoes, ladies finger, eggplant, potato leaves, and cassava leaves. Some fruits grown include pawpaws, mangoes, and oranges. Also grown are sweet potatoes, cassava, and paddy.

4.1 Land use and trends in land-cover change

Land-use changes result from rapid urbanization in Dar es Salaam. In the peri-urban areas, land-use changes involve land changing from agriculture to residential. The results on land-use changes indicate that, in the last two decades, the size of residential land has consistently increased, while the size of agricultural land has decreased (Figure 1). In addition, the same results also indicate that the areas under forestry and grassland have also diminished in size.

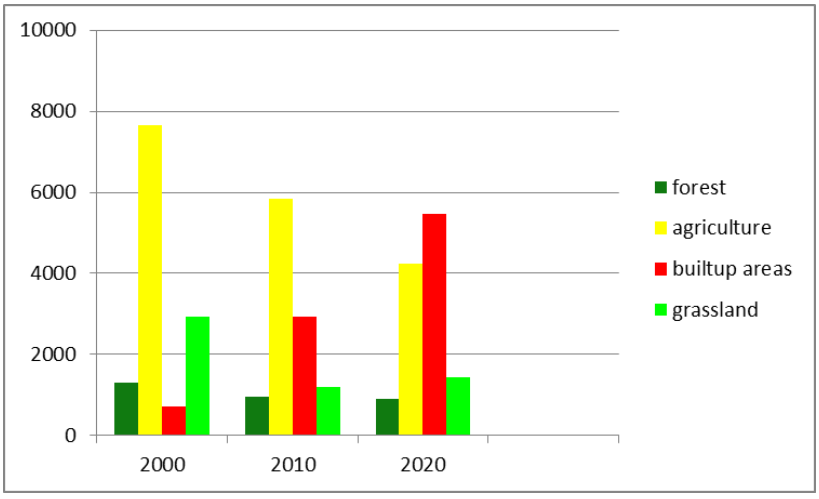

Figure 1: Trends in a land-use change in Dar es Salaam (Source: Spatial analysis based on Landsat images)

The expansion of residential land, which was previously set aside for agriculture and forestry, and as grassland, reduces the availability of land for urban agriculture. It is likely that the transformation

of other categories of land into residential land will continue due to the high urbanization rate in Dar es Salaam, which is estimated at 4.9% per year. This rate of urbanization and associated urban development activities will heavily impact the availability of land for urban agriculture in the city.

4.2 Strategies for accessing land for urban agriculture

In the context of rapid urbanization and low designation of land for urban agriculture, land for urban agriculture in Dar es Salaam is obtained by purchasing, renting, inheriting, as well as squatting on the land that is not suitable for houses construction and infrastructural wayleaves (Figure 2). Renting is the main strategy used to obtain land; the farmers rent vacant plots temporally, cultivating vegetables and crops like cassava and sweet potatoes in the plots. The rented, purchased and inherited land is used for farming until it is used as planned or is converted to other, suitable uses other than farming. In that case, some farmers opt to farm in areas reserved for roads and electricity lines, hazardous areas, and the land found along riverbanks and valleys.

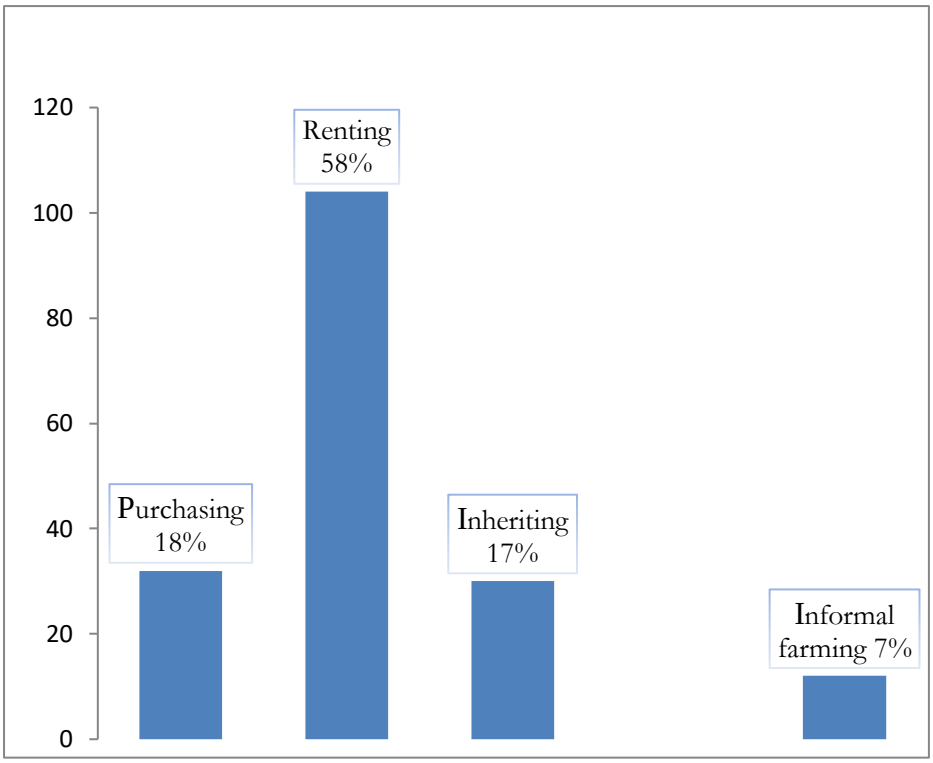

Figure 2: Strategies for obtaining land for urban agriculture (Source: MKWAWE & YAMUNGU, 2021)

5. Conclusion

This paper set out to find out how land for urban agriculture is obtained. It draws on the theory of the production of space to determine how the urban farmers in Dar es Salaam access land for urban agriculture in the context of informal urbanization. It has been established that the land set aside for urban agriculture is insufficient. Consequently, land for that use is obtained by purchasing, renting, inheriting, as well as squatting on land that is not suitable for house construction and infrastructural wayleaves. These practices inform farmers' perception of land and conception of realities and form their experience in trying to access land informally. Besides, it is rapid urbanization that makes land for urban agriculture unavailable in the city, as the size of residential land is increasing at the expense of that of the land set aside for uses. Less than a quarter of the city's area required for urban agriculture is available. Thus, the households depending on agriculture

for their livelihoods must either adopt modern farming techniques that allow for the cultivation of small pieces of land or obtain land in the rural areas found near the city.

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Guerilla Farming in Nairobi: A case of Urban Farmers' resilience and subversion

George Kituku & B. Makau Kitata

1. Introduction: Historical Background on Urban Agriculture in Nairobi

Urban Agriculture is deeply entrenched in Nairobi and has developed since the 1980s, especially among the urban poor, who suffer from the increasing rate of unemployment and high food prices (FOEKEN & MWANGI, 1998). Guerilla Farming is a form of UA in which farmers informally grow crops or raise animals in an insurrectionary manner on private or public open spaces and unused land that they do not own, and without the permission of the rightful owners and/or the authorities (HUNG 2017). Historically, Nairobi has seen a myriad of land-use policies that date back to the colonial times. According to the 1948 Master Plan of Nairobi City, the British Colonial Administration designed the preservation of ample open spaces and green parks (WHITE et al, 1948). However, this unutilized land was to remain for recreational purposes only devoid of any form of agricultural practice on it. By and large, UA was outlawed and discouraged since the colonial era (ibid.). UA has consistently been practiced in Nairobi unabated despite its illegitimacy, which has seen subjective negative perceptions on urban farmers as being retrogressive and poor (FOEKEN/ MBOGANIE-MWANGI, 1998). It was not until recently in 2015 that the Nairobi County effected a legislation that explicitly promotes UA (GOVERNMENT PRINTER, August 27, 2015). Nevertheless, the negative stereotype on UA as previously imposed on urban farmers is yet to change.

The focus on guerilla farming was chosen because it has been instrumental in improving the greening of open spaces, especially along the city's main roads, which not only has aesthetic value but is also crucial in mitigating the effects of climate change (FOEKEN & MWANGI, 1998). Furthermore, the present literature on UA in Nairobi does not explicitly delve in guerilla farming as a major aspect of research. Since a large share of urban agriculture in Nairobi is informal there is not much literature specifically on guerrilla gardening. The term comes from the Global North as something "new" and "subversive" (see a.o. TORNAGHI 2014). In the case of the Global South, it is seen as something backward that must be overcome in the course of modernisation (GRAY et al. 2020; WINKLERPRINS 2017).

This study, therefore, aims at studying guerilla farming with a focus on understanding the farmers' motivating factors to pursue the practice. In essence, the main subject on farmers is to get the subversive narratives on how they have perpetually dodged the authorities to remain resilient despite the calls by authorities to vacate the farming sites. The scope of the study is based on guerilla farmers who grow vegetables, seedlings, flowers, and trees for commercial purposes within the Nairobi Metropolitan Area.

Figure 1: Research areas along Nairobi-Mombasa Highway, and the Nairobi-Namanga Highway (Source: GOOGLE MAPS)

This project is organized in the following manner. The first segment tackles the introduction and historical background on UA. The second part is concerned with the state of the research, which critically provides a literature review on the current knowledge of guerilla farming. The third segment entails the theoretical framework, which gives the conceptual arguments on which the study is grounded. In addition, the research questions for the study are articulated in this segment. The fourth segment deals with the methodology that guides the study, such as data collection and analysis methods, as well as the challenges of the same. The fifth segment concerns itself with the research findings. The empirical report on the study outcome is outlined in detail. The sixth and the last segment is the conclusion part, which gives a summary of the project report and gives recommendations on the need for further research.

2. Literature Review

LADO's (1990) historical work on informal UA in Nairobi depicts guerilla farming as a major means of supplementing the needed nutritional value of food to poor Nairobi residents and contributing to enhanced food security in the city. Due to the rapidly changing landscape of Nairobi, this indicates a research gap on guerilla farming. The scholar overlooks the subversive force of these farmers who, in most cases, are hounded by authorities for tilling in illegitimate parcels of land. HARDMAN and LARKHAM (2014) look at the motivations of guerilla farmers in their unstoppable desire to make a produce in oftentimes illegal parcels of land. They argue that guerilla farming is a

good thing that should be encouraged to make unused land more productive. The authors, however, avoid discussing the challenges and subversive efforts that the "guerillas" undergo to stay afloat, which the current research attempts to cover. Another work by HUSSAIN (2018) on guerilla gardening postulates that the city of Nairobi can be reclaimed by massive practice of guerilla farming to provide the aesthetic value and alleviate on challenges of food accessibility to Nairobians. However, the author does not delve into the hurdles that the city guerilla farmers face in their quest to reclaim Nairobi in the hands of authorities. This paper thus attempts to focus on the challenges of guerilla farmers and the subversive means they employ to beat the authorities.

3. Theoretical Framework

GRAY et al. (2020) argue that despite the existence of extant studies on UA in Global North and Global South, there is a „dichotomized view of UA which recreates an antiquated, stereotypical, even neo-colonial view of urban processes in the GS vis-à-vis the Global North" (ibid, p. 870). In a developmentalist discourse, research on UA in the Global South is often conceptualized „as something that is a necessary process on the way to more 'modern' ways of urban living, including the purchasing of food in supermarkets" and which should „in the long term […] be eliminated" (WINKLERPRINS 2017, p. 3). At the same time, in the Global North, UA is understood as a form of cultural distinction with emphasis on its subversive, "radical", transformative potential and as "alternatives to the capitals neoliberal organisation of urban life"(TORNAGHI 2014, p. 552). WINKLERPRINS (2017) finds this very problematic and point out that differences regarding the practice and motivation of UA are lessening whereas conceptions in literature remain separated (WINKLERPRINS 2017). Following these conceptual arguments, the current study aims to research on the idea of subversion of guerilla farmers in the Global South and the means they employ to surmount to the challenges faced. The main overarching research question in this study is about how guerilla farmers in Nairobi subvert against the authorities. The second question is on what the challenges of farming in an illegitimate piece of land are. And finally, the third question is on how the County Government of Nairobi incentivizes and supports guerilla farmers.

4. Research Methods

This study followed a qualitative research design, with the central theme being to capture the subversive narratives of the farmers. The data collection methods used are key informant interviews and observation (HOMBURG, 2012) Informants were roadside farmers who work along the Nairobi- Mombasa and the Nairobi – Namanga Highways. After a short introduction to establish the context of the interviews, they were willing to participate in the research. Since it is a student research project, they agreed to offer information free of charge. Photography is used illustratively. The photographs do not focus on the human subjects for purposes of protecting the identity of the informants. This anonymity considers objectivity in research. The sampling method is purposive sampling (TONGCO, 2007) which would help identify only guerilla farmers in the study area along the motorway in Mlolongo located along the Nairobi-Mombasa Road between Nairobi and Athi river and Namanga Road in Kitengela within metropolitan Nairobi (see Fig. 1). The decision for these locations was made because most of the agricultural activity takes place on areas designated road reserves along the highway. The data analysis method was the "narrative turn," which banks on the narratives of research participants from their own personal experiences (GOODSON, 2011). The interpretation of those narratives helps to construct knowledge, which is obtained qualitatively from the subjects themselves. We had to deal with the problem of trust since the farming on the roadside is viewed as criminal by Kenyan authorities.

5. Research Findings

Following the data collection exercise in Nairobi's Mlolongo, Sabaki, Athi River and Kitengela (Fig 1), areas on guerilla farmers, interesting perspectives on guerilla farming emerged. Key informant interviews and purposive sampling in the area of study focused on five guerilla farmers and one agricultural Extension Officer from Nairobi County. The central argument from the interviewed guerilla farmers paints a picture of resilience and subversion. Operating from designated road reserves of the highways, the farmers shared narratives of perpetual problems of occupancy from the Roads Authority, commonly known as the Kenya National Highways Authority (KeNHA). Additionally, the guerilla farmers are constantly embroiled in problems from the authority in-charge of environment, called National Environment Management Authority (NEMA). Whereas KeNHA tries to evict the guerilla farmers from the road reserves of the highways, NEMA, on the other hand, tries to implement the national ban on the use of plastic bags, which the farmers popularly use to grow their seedlings. Nevertheless, the farmers interviewed depicted a strong sense of subversion to outsmart these authorities and thereby continue with their farming unshaken. The respective farmers' narratives are described in the subsequent paragraphs.

Case A

A guerilla farmer based in Kitengela along the Nairobi-Namanga Highway, elicited a narrative of immense resilience and subversion because he is constantly facing problems from KeNHA. He narrated that at one point, the KeNHA officials flattened his farm overnight using a bulldozer, which was a culmination of prior notices and warnings from the authority for him to vacate. This eviction made him rock into massive losses as property (seedlings, vegetables, flowers, and trees) worth 150,000 Kenya Shillings (approx. 1.150 Euro) was destroyed. He however subverted against KeNHA by relocating to his present location along the same highway where he grows new seedlings (Fig. 2). Even though he faces new eviction threats from KeNHA officials, he said he is adamant and resilient that he will not go anywhere unless evicted again, in which he will still relocate. This illustrates the resilience of UA in Kenya as a continuous process of negotiation between those who use it as a source of livelihood it and the authorities who outlaw the practice.

Figure 2: New guerilla farm in Kitengela on Nairobi-Namanga Highway. (Source: KITUKU 2021)

Case B

A guerilla farmer based in Athi River along the Nairobi-Namanga Highway, grows flowers, vegetables, and tree seedlings next to the road for commercial purposes (Fig 3). His narrative exposed a new dimension of corruption and bribery depicting him and some errant KeNHA officials. His story explained the way the officials use blackmail strategy (of imminent eviction) to solicit bribes amounting to 1,000 Kenya shillings (about 10 Euro) after every two months to "buy" his existence in his farm. He termed his venture as an "undercover dealing" with the corrupt KeNHA officials, and said he is very much comfortable with that arrangement, and he does not want any help whatsoever regarding his emancipation from extortion by the KeNHA officials. Ideally, he has remained resilient in his farm through corruption, which he uses to circumnavigate the KeNHA system, and thereby remain subversive.

Figure 3: Flowers, vegetables, and tree seedlings next to the road for commercial purposes. (Source: KITUKU 2021)

Case C

A guerilla farmer practicing his farming in Athi River along the Nairobi-Namanga Highway. His narrative centres around the subversion against the NEMA officials. Kenya outlawed the use of plastic bags in 2017 (NEMA, 2021). It became problematic for the farmers who entirely depend on these plastic bags for their farming. Despite the ban, NEMA allowed factories and consumers to clear-up the old stocks of the plastic bags that had been produced before the ban came into effect. Currently, it is very hard to acquire these plastic bags because these bags are no longer in the market. Case C said that he has been able to subvert against NEMA by acquiring the same plastic bags albeit surreptitiously for his tree seedlings anyway. He disclosed that he places orders for these plastic bags from neighboring countries such as Uganda, which are shipped to Kenya as a top secret. Case C also explained that he has been able to dodge the NEMA officials who do routine inspection on the plastic bags by claiming that he is still clearing the old stock of plastic bags that he had stocked from 2017 before the bags were outlawed.

Figure 4: Seedlings in plastic bags despite plastic bags ban. (Source: KITUKU 2021)

Case D

A farmer practices his farming in Sabaki area along the Nairobi-Mombasa Highway. His narrative interestingly argued that the KeNHA officials have never threatened to evict him or extort money from him. However, the officials have severally warned him not to keep too close to the road the tall tree seedlings to avoid blocking the pedestrians' pathway (Fig 5). He said that he has subverted against this warning from KeNHA officials because he complies only when he spots the officials but moves his seedlings back closer to the road once the officials are gone. He argued that when placed further from the road, his customers hardly spot the tree seedlings. He also narrated that one of the challenges of farming in an illegitimate land is theft of his seedlings. Having no fence to secure his merchandise, he said that he rakes into losses when he sometimes finds some tree seedlings, flowers, and vegetables missing. Nevertheless, he expressed great resilience in soldiering on, and particularly by refusing to stay away from the road.

Figure 5: A farm on the pedestrian pathway (Source: KITUKU 2021)

Case E

A guerilla farmer based in Mlolongo area along the Nairobi-Mombasa Highway. Her narrative on resilience is depicted on the idea that she has been evicted twice from her former guerilla farms. In the first instance, she was evicted by a private developer in liaison with KeNHA officials to pave way for construction of a fuel station. She explained that she subverted that eviction by moving her farm next to the constructed petrol station, and in the middle (island) of a one-way traffic on the Nairobi-Mombasa Highway (Fig 6). In the second instance (Fig 7) she explained that she has recently been evicted from a private land in which she had been growing her merchandise. According to her, the landowner only issued a 7-day notice for her to vacate, which was a short duration for her to move all her tree seedlings, vegetables, and grass. Soon afterwards, she said that the private developer fenced-off the entrance to the land using a metallic fence, effectively making it impossible for her to access her merchandise. She said she lost property worth nearly 300,000 Kenya shillings (nearly 2.300 Euro) after being evicted from the private land. However, she has been subversive by preparing a portion of land for tilling on the entrance of the fenced-off land.

Figure 6: A farm in the middle of a one-way traffic. (Source: KITUKU 2021)

Figure 7: A previous guerilla farm recently been fenced-off by a private owner. The farmer is preparing to set-up seedlings in front of this metallic fence. (Source: KITUKU 2021)

Case F

An agricultural Extension Officer of the Nairobi's Kibera area opined that Kenyans have a penchant of utilizing urban spaces through informal farming. She also confirmed that the idea of subversion on the part of these guerilla farmers is true, as the farmers majorly subvert through relocation after being evicted. She explained that the negative perception on UA is gradually fading in the wake of the 2015 Act by the Nairobi County to support and promote UA. She argued that not all urban farmers are guerilla farmers, as some are allocated land by Nairobi County officials-albeit informally. Additionally, the County Government has attempted to enhance extension services to urban farmers, although she acknowledged that the operationalization of the same has since remained quite a challenge. She also remarked that guerilla farmers help to make land reserves safer by clearing-up bushes and enhancing the aesthetic value of the city. Since to guerilla farmers, the County Government has not so far disturbed their existence, it points a finger indicating that the local authority supports guerilla farming. She said that she could not agree or disagree with this inference.

6. Conclusion

This study was focused on guerilla farming in Nairobi as a type of UA. It acknowledges that the County Government of Nairobi supports and promotes UA, courtesy of a recent legislation on the same of 2015. The ACT shows a significant level of acceptance of farming activities along the motorways of Nairobi and the agricultural Extension Officer in Nairobi applauds guerilla farming for its aesthetic value and the bid the farmers make to clear bushy road reserves for cultivation. Nevertheless, lived reality deviates strongly and it becomes clear that guerilla farmers need recognition and security to make their activity safe and viable for a growing city. The narratives of the farmers agree that guerilla farming on road reserves and privately-owned lands require resilience and subversion if success in the farming is anything to go by. In addition, the narratives showed the challenge of theft of tree seedlings and vegetables as the security of the goods on the road is not guaranteed. This study therefore adds new knowledge that guerilla farming in Nairobi, which has previously been overlooked largely by scholars as an important type of UA, is essential for securing livelihoods and enhancing green cover for open spaces, which contributes to climate change mitigation despite its historical illegitimacy. Legislative tolerance could revolutionise agricultural activities and change the perception of farmers as illegal actors in Nairobi's green environment. Further research is needed to establish how the County Government of Nairobi may collaborate with KeNHA and NEMA to help legitimate the farming through legislations and transparent land approvals to the farmers.

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Part III: Challenges and coping strategies in urban agriculture beyond informality

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Political Challenges of Urban Community Gardening Projects: Exploring the origins of the challenges at *Prinzessinnengarten* in Berlin with an Actor-Network Analysis

Marieke Marken & Alexandra von Brunn

1. Introduction

The attention on urban community gardens has experienced a sharp rise in the last decades. A lot of the research focuses on the beneficial attributes of such garden projects. The goal is often to ensure the social and ecological potential of the urban green space in the long run. The increasing number of community gardens popping up in urban settings can especially be detected in Berlin. In 2019, more than 200 community gardens were registered in Berlin (ALMENDE KONTOR, 2021; NOMADISCH GRÜN, 2020a; ROTE BEETE, 2021; SENUVK, 2021). Along with this development, multiple challenges arise with the gardening projects. These challenges are often of political nature, since many different interest groups are involved in the decision-making process. Foremost, the structure of Berlin being divided into several boroughs adds up to that since many actors are part of management processes on the city as well as the borough level. One of the most pressing political challenges is the lack of available public space in Berlin where community gardens can evolve sustainably. With many interest groups involved in the allocation of spaces for community gardens, different interests may collide and lead to conflicts. At this point, our analysis ties in to analyse the origins of this challenge. We will take a closer look at the most influential involved actors. Exemplary, we will look at the *Prinzessinnengarten* (PG) Kollektiv in Berlin Neukölln as a case study and apply an Actor-Network Analysis (ANA). First, the theoretical background including the benefits and challenges of urban communities will be delineated. Subsequently, the specific challenges of the case study will be explained. After a short explanation of the methods, the results from the ANA will be presented. The following part will discuss the results and potential solutions as well as validate our hypotheses. The paper will end with a short conclusion.

2. Theoretical Background

2.1 Benefits of urban community gardens

Urban Agriculture (UA) is a practice that has evolved next to rural agriculture in countries under the increasing pressures of food production and urbanization. UA can be defined as 'the production, process and distribution of food and other products by plant and/or livestock raised in and around cities to meet local needs' (ARMANDA et al., 2019, p. 13). The concept comprises of many forms of gardening that may include e.g. small-intensive urban farms, food production, rooftop gardens, schoolyards gardens, allotments or balconies (TORNAGHI, 2014). A broad range of the literature about urban community gardening projects treats the manifold benefits of the community gardens (ARMANDA et al., 2019; ARMSTRONG, 2000; ROSOL, 2012; SONNINO, 2009; TORNAGHI, 2014; VEEN et al., 2016; WINKLERPRINS, 2017). Those include environmental benefits

such as improved air quality, reduced heat islands, climate change adaptation as well as food security (SONNINO, 2009). The ecological impacts are closely linked to public health benefits (ARMSTRONG, 2000) provided by urban green spaces as well as topics like social cohesion (VEEN et al., 2016). While benefits as food resilience and security that reduces economic pressures are majorly emphasized in UA research in the global south, environmental benefits and social cohesion or the increase of social capital is emphasized in research in the global south (ARMANDA et al., 2019; WINKLERPRINS, 2017). In general it is notable that UA is seen as a tool to alleviate many pressures that occur in urbanized centers as poverty reduction, community health and grassroot urban development, environmental benefits, empowerment of women or urban beautification (ARMANDA et al., 2019; ROSOL, 2012; WISKERKE, 2015).

2.2 Challenges of urban community gardens

Besides the benefits of urban community gardens, some more critical aspects of urban community gardens show that they might also foster neoliberalist practices (BRENNER/THEODORE, 2002), turning the garden spaces into exclusive projects in favor of the economic perspective instead of the social or ecological functions (MAYER, 2003). Within this context, the management of urban community gardens faces many challenges. The community gardens are often instrumentalized by policymakers, real estate actors or researchers in the discussion about the ownership and usage of urban public spaces (BRÓDY/DE WILDE, 2020). The conflicts over usage rights of limited urban spaces can be identified as one of the biggest challenges in Berlin. Additionally, urban planning agendas often favor economic development projects and housing over community garden projects (ROSOL, 2012; SCHMELZKOPF, 2002). Another challenge of volunteer-based community gardens is to meet adequate funding needs (SMITH/KURTZ, 2003). It can easily be comprehended that in the urban context of community gardens a huge variety of stakeholders is involved in such projects. The differing interests of these urban actors can lead to conflicts and competition among them.

2.3 Case *Prinzessinnengarten* Kollektiv Berlin

The project PG was founded at Moritzplatz, Kreuzberg, in 2009 by the carrier organization *Nomadisch Grün GmbH* as a mobile community garden. In 2019, *Nomadisch Grün* moved to a new location to a partial area of St. Jacobi Cemetery in Neukölln while the detached organization *Common Grounds* stayed at the initial location. At the new location in Neukölln, the PG has been rebuilt as a community garden space surrounded by mostly expiring and some still in-use graves (NOMADISCH GRÜN, 2020a). The main goal of the community garden is the offering of environmental education through collective learning about biodiversity, urban ecology, climate adaptation and the enhancement of local participation. Regular open gardening days invite neighbors to participate inclusively in the garden work (ibid.). Apart from that, the Kollektiv also builds offshoot gardens for external organizations such as schools, companies, or cultural institutions in and out of Berlin. These external projects depict one source of financing of the PG. Other streams come from the garden coffeehouse and vegetable sales to restaurants. On top of that, the Kollektiv regularly files applications for funding programs provided by the city or the borough (NOMADISCH GRÜN, 2020b).

Building on the research of other community gardening projects in Berlin, we identified the conflicts about available spaces as the most pressing challenge for the case of PG Kollektiv (CLAUSEN, 2019; JOSWIG, 2020). Our interview with a representative of the project confirmed this insight. The primary PG at Moritzplatz exemplifies the conflict about maintaining the space. Only after massive pressure from residents and a successful public petition in 2012, the area was signed over to the borough and became public. Thus, the selling and privatization of the land could be prevented. However, the borough could give the usage rights to other non-profit institutions such as schools in the future. The space in Neukölln is privately owned by the Protestant Church and the Cemetery Union of Central Berlin is the administrator of the space. The Kollektiv rents the

partial area through a usage agreement which gets extended every five years until 2035, however, the Kollektiv is dependent on the continuation of the contract. The Church independently decides who will use the area. This illustrates again the competition between the PG and different public, private or non-profit institutions for available spaces. Other challenges for the Kollektiv include usage restrictions by the Office for the Environment and Nature Protection Neukölln (UNA Neukölln). This conflict will be explained more in Chapter 4. Furthermore, the maintenance of the calm cemetery environment for visitors was challenging for the Kollektiv in the beginning. Lastly, the representative stated that the Kollektiv experiences chronic underfinancing, as most other community gardens. Concerning this, the Senate's Administration for the Environment, Traffic and Climate Protection (Senate UVK) has recently established a program to facilitate the funding process for community gardens (SENUVK, n.d.). The interviewee confirmed that the reception of funding is less of a problem for community gardens in Berlin than the provisioning of available spaces. Thus, we will focus our analysis on the challenge of conflicts about available spaces.

3. Methodology: Actor - Network Analysis

On the basis of the background research and our identified challenges in UA, this study treats the origins of political challenges of the urban community gardening project 'PG Kollektiv' in Berlin. Specifically, we will focus on the challenge of land-use conflicts on available spaces between the involved stakeholders. We chose the PG Kollektiv as a representative case study to analyze origins of political challenges since it has been established more than one decade ago, there is a good amount of literature available on the political conflicts of the space and the challenge about long-term contracts with the Senate of Berlin has re-emerged recently in 2019. Our objective is to identify the involved stakeholders who are part of the political contractual challenge and who have different points of views. Thus, our research question is: *Who are the most influential actors for the community garden PG Kollektiv (Neukölln)?*

In order to identify the most influential actors for PG Kollektiv we will use a mixed method approach that covers an analytical approach of the Actor-Network Analysis (ANA) that will be supported by an interview. The methodology of an ANA foresees to analyze values, interests, relations and dependencies of actors around an issue to solve (ENSERINK, 2010). The methodology of the ANA follows six steps according to ENSERINK (2010): (1) The formulation of the problem as the point of departure, (2) the mapping of all stakeholders involved, (3) the mapping of formal relations between actors, (4) the mapping of interests, objectives and problem perceptions, (5) the mapping of interdependencies and resources of actors, and (6) determining implications and consequences for the problem statement. To verify the problem statement, the actors involved, and their interests and dependencies, this study uses an interview with a representative of the case study to support the methodology of the ANA. Building on our literature scan and the Berlin case studies, we came up with three preliminary hypotheses:

H1: There are only a few key stakeholders involved in the challenge about available spaces.

H2: The origins of the political challenges are presumably related to profit-driven interests.

H3: The key stakeholders' interests are rather opposing to each other.

4. Results

(1) Formulation of the problem as a point of departure

As a point of departure, the formulation of the problem is the first step of the ANA. That includes the identification of the problem owner, the cleft and the cause of the cleft (ENSERINK, 2010). The PG Kollektiv can be identified as the problem owner. The cleft of the problem is the lack of available spaces for urban gardening projects in Berlin. If community garden members are able to find a suitable space, the remaining problem is often the lack of long-term usage contracts with the owner of the space. The cause for this cleft is the presence of a huge variety of interest groups in the city of Berlin for the limited number of vacant urban spaces. That leads to the dilemma that the environmental and social function of the PG in its significance as a community garden is endangered. The problem statement, cause and resulting dilemma was confirmed by the interview partner.

(2) Create Inventory of actors involved

For the second step, the creation of the inventory of involved actors, basic principles from policy analysis are used (ENSERINK, 2010). The goal of this step is to identify ten to twenty actors with a relatively balanced set of interests and goals. Further, the resulting actor network should be in line with the chosen level of the problem analysis. In this case that is the local level since we look at the specific gardening project in Neukölln. There are different techniques to make a first selection of involved actors. Most of those methods are complementary. For this analysis, the imperative approach was used in combination with the reputational approach (ENSERINK, 2010; MITROFF, 1983). For the imperative approach, one could firstly ask which actors can *influence* important factors of the situation and secondly, who has an *interest* in or is affected by the problem situation or possible solutions. Those are actors who feel strongly about a certain issue and are willing to act upon it in their interest. The reputational approach asks key actors who are well informed about the policy problem about other potential interest groups. This was applied during our interview. The inventory list is structured according to the actors' roles and positions in the governance system and is illustrated in the system diagram in Figure .

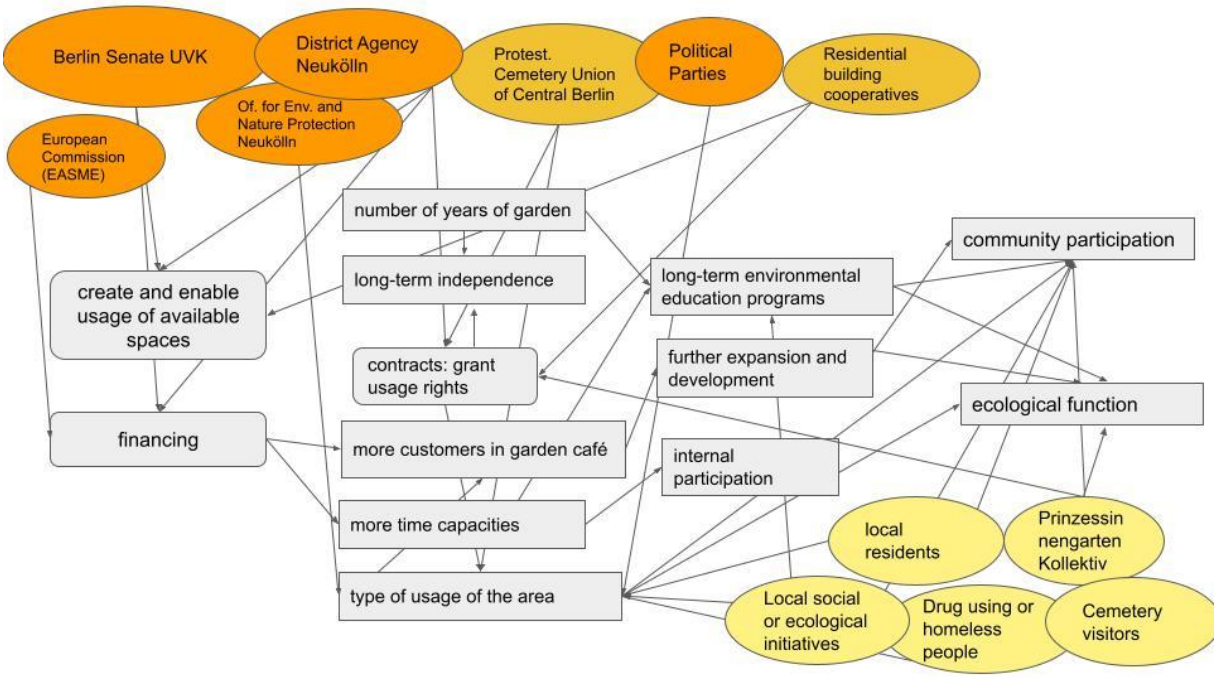

Figure 1: System diagram Prinzessinnengarten Kollektiv (Own illustration)

The governance authorities include the Executive Agency for Small and Medium-sized Enterprises (EASME) as part of the European Commission (EC), the Berlin Senate's Administration for the Environment, Traffic and Climate Protection, the District Agency of Neukölln ("Bezirksamt Neukölln"), the Office for the Environment and Nature Protection Neukölln and various political parties on the borough level. The EASME as part of the EC was added by the interviewee to the actors list and can influence the provisioning of financial resources for urban community gardens. The Senate UVK has an influence on and interest in the creation and allocation of available spaces in Berlin as well as on the provisioning of funding means for community gardens. The District Agency of Neukölln can influence the allocation of available spaces and grants funding resources. Further, it has an interest in who gets the usage rights of free spaces in case the land is owned by the Agency, for example at the garden at Moritzplatz. The UNA Neukölln has an influence on and interest in how the area of the garden is used in compliance with the nature usage regulations. The political parties on the local level in Neukölln have shown an interest in the type of usage of the area by positioning themselves in favor of or against the activities of the Kollektiv. The next actor group of private and semi-public institutions includes the Protestant Cemetery Union of Central Berlin and residential building cooperatives. As the administrator of the area, the Cemetery Union influences the establishment of rent contracts and has a huge interest in the type of usage of the space. The building cooperatives can be seen as a competitor for rent contracts of the available spaces in Berlin. The next actor group is represented by the local interest groups which include the PG Kollektiv and various local social or ecological initiatives. The Kollektiv itself has an interest in and influence on the ecological and social function - expressed as community participation in Figure - which are basically connected to most factors connected to these two outcome functions. The Kollektiv also holds a special interest in getting long-term usage rights for the area. Several other local initiatives are allowed to use parts of the area for their own gardening activities such as the Association Flamingo cultivating female medicinal herbs, the Association Mellifera practicing beekeeping or an organic farming initiative, as narrated by the interviewee. The last group consists of unorganized individuals such as residents, cemetery visitors and drug-using or homeless people. These individual actors were added to the inventory list by the interviewee. They all have an interest in the type of usage of the space to maintain the calm, recreational atmosphere of the cemetery, although with different motives.

Figure 2: Interest-Power-Grid of actors (Own illustration)

Figure 2 illustrates the different actors from the inventory list in an interest-power-grid to identify the most relevant actors for the further analysis. Up to this point of the analysis, the players and the context setters are considered the most relevant actors. As a last task, we identified the core

values, the perceptions of the problem and the resources of the relevant actors to expand their characterization.

(3) Mapping of formal relations

As the third step of the ANA the formal relations between the players and the context setters are mapped in Figure . The goal of this step is to identify hierarchies between the actors and map the effects of legislation in place. The map starts at the top with the European Union legislation level and descends to city level and then borough level legislation (ENSERINK, 2010). Figure shows that the position of the EASME at the top is to grant a certain budget for the EU project "Edible Cities Network" (SENATSVERWALTUNG FÜR STADTENTWICKLUNG UND WOHNEN BERLIN, 2021) to the Kollektiv. On the city level, the Berlin Senate UVK has created a program for community gardens in Berlin which is supposed to support, connect, and fund community gardens in the city and create new gardening spaces. This facilitates the process, information about and availability of funding resources (SENUVK, n.d.). Part of this program has been the establishment of the interactive online platform 'Produktives Stadtgrün'. Apart from setting the context of the activities of the Kollektiv, the Senate UVK also granted funds to the PG through the program 'Berliner Fonds für Nachhaltige Entwicklung' (BENE) in the development stage in 2018 and 2019, as explained by the interviewee. Furthermore, the enacted legislation on nature protection by the Senate UVK affects the assignation options of the UNA Neukölln on the borough level. Within this scope of action, the UNA Neukölln can directly put up conditions for the PG in order to comply with the nature protection legislation. The Cemetery Union has the power of disposition over the usage rights of the area. In addition, the Cemetery Union could also sell parts of the areas to the District Agency and pass on the allocation of usage rights.

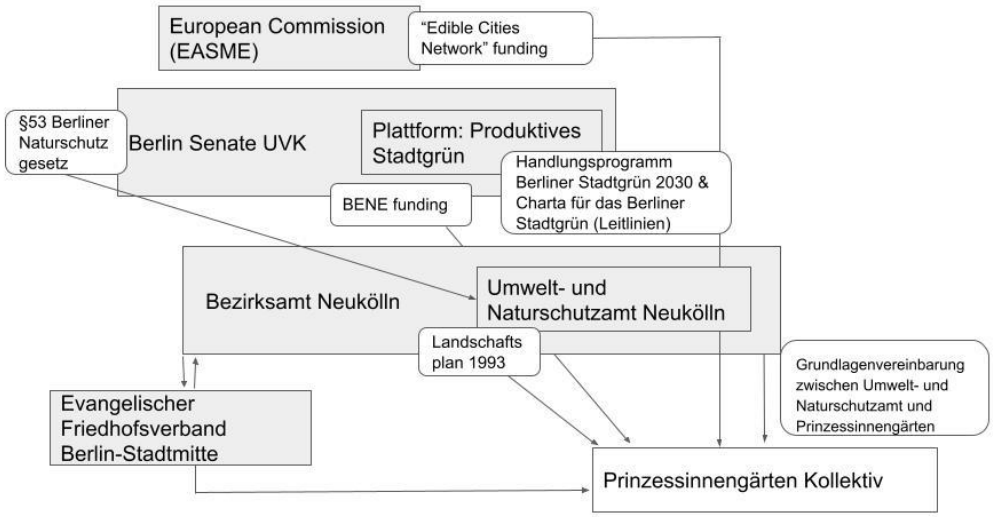

Figure 3: Map of formal relations and legislation (Own illustration)

(4) Inventory of interests, objectives and problem perceptions

After we identified and mapped the formal relations between the actors, step four included drafting the problem formulation of all actors, which included their specific interest, objectives and the problem perception. In contrast to the initial problem formulation in step 1, in this step we consider

not only possible problem formulation of one actor but for all critical actors as depicted in Table 1.

Actors	Interests	Desired situation/ objectives	Problem formulation	Cause	Possible Solutions
Problem Owner: Prinzessin-nengarten	Maintenance of social function of garden	Long-term security for space	Lack of available spaces	Many interest groups	Prioritized role in city planning/ support by city
Berlin Senate UVK	Access to green and sustainable mobility and infrastructure, fair and equal access to public services	Transformation into a sustainable city, distributing space fair and according to all needs	Lack of available spaces	Too many interest groups	Less privately owned space, more city owned spaces and influence
District Agency Neukölln	Providing public services equally (education, health, living space etc.)	Distributing services fair and equally in diminishing space	Lack of available spaces	Too many interest groups	Less privately owned space, more city owned spaces and influence
Cemetery Union	Maintain cemetery and green space with transforming 'funeral culture'	Safe usage of graves, long-term maintenance of 1/3 of green space that is publicly accessible, community activities	Financial and functional maintenance of space	Increase of urn funerals	Cooperation with urban garden projects as PG
UNA Neukölln	Enforce compliance of environmental regulation	Compliance with 'Landschaftsplan 1993'	Non-compliance of law by Prinzessin-nengarten	Lack of communication	Compliance and increased communication
EASME (European Commission)	Establishment of participatory network of cities that realize edible city solutions	Addressing social challenges through Edible Cities Network Project (funding)	Increased challenges in cities	Social inequality	Financial support for edible city solutions

Table 4: Inventory of Interests, Objectives and Problem Perceptions (Own illustration)

The *interests* of the actors are viewed as stable and helps to find out whether the actor will perceive a specific objective or solution as acceptable. To identify the interests, we asked: Why do actors want to achieve things, why do they care and how are they affected by the problem? In contrast the objective of an actor is directly linked to the problem formulation and seeks to formulate what an actor aims to achieve in a certain situation. To find out more about *objectives* we asked: What and when does the actor want to achieve in the problem situation and which costs and benefits are connected to the situation or possible solutions? Lastly, we seeked to specify the perception of *problem formulation* of each actor, that implied their individual view based on the selected information or social background of an actor. For the identification of perceptions we posed the question of the perceived problem for each actor, the causes and possible solutions.

When looking at the results of Table 1, it can be seen that interests, objectives and problem formulation are diverse for all actors. The local administrations in Berlin (Berlin Senate UVK and District Agency of Neukölln) aim to provide a fair access of public services, which is shaped by compromise due to the lack of space and many interest groups in Berlin. However, they support the existence of the garden due to climate protection and the social function, as the interviewee explained. Further, the interview partner showed that the cemetery union aims to maintain the green space, space for cemetery visitors and community activities despite their financial insecurities and changing funeral culture by cooperating with the PG (TREUSCH, 2021). The UNA Neukölln seeks to ensure the compliance of the landscape plan 1993 (Landschaftsplan 1993) and maintain flora and fauna in the city, which displays another insight from the interview. Lastly, the EASME aims to establish a participatory network of cities and address social challenges through edible city solutions (SENATSVERWALTUNG FÜR STADTENTWICKLUNG UND WOHNEN BERLIN, 2021). A detailed description can be seen in Table 1.

(5) Mapping out interdependencies between actors by making an inventory of resources

After step 2, 3 and 4, we are now aware of the hierarchies, roles and resources of the different actors and further of their specific interest and preferred solution in the problem formulation. On the basis of this information we are able to conduct step 5 in which we mapped out the interdependencies between the actors. The final matrix (Table 2) depicts the dependency of the problem owner (PG Neukölln) to the actors in his environment which is determined by the importance of actors' resources, their dedication in the problem solving and their (conflicting) interests. We first looked at the players and context setters, that were identified in step 2, and subsequently added also 'Subjects' identified in step 2, to complete the matrix (Table 2). Firstly, we identified critical actors in order to identify if the problem owner is dependent on the actors (ENSERINK, 2010). The critical actors were analyzed through mapping out the resources of actors and if they were important/not important and replaceable/not replaceable. Those actors that hold highly important resources that are not replaceable/ have a low replaceability are considered critical. Possible resources of actors that were included are: information, knowledge (and skills), manpower, money, authority/ formal power, position in the network (support from or access to other actors), legitimacy, organization (ability to mobilize and use resources effectively and efficiently. In a second step we looked at the dedication of each actor: Does the actor have an intrinsic interest to get involved into the issue/ problem? Actors were divided into dedicated and non-dedicated actors. The aspect of 'dedication' is influenced by the actors' willingness to use their resources (ibid.). Further, if an actor is influenced by costs or benefits of problem solving, those actors will likely to be dedicated (ibid.) Those actors that are not influenced, thus non-dedicated, will be less 'threatening' for the problem owner but for those actors it will be also harder to mobilize resources for active support (ibid.) The detailed table on the analysis if actors are critical and critical or not can be found in Table 3.

	Dedicated actors		Non-dedicated actors	
	Critical	Non-critical	Critical	Non-critical
Similar/ supportive objective	**Strong allies:** Protestant Cemetery Union of Central Berlin	**Weak allies:** Political Parties Local Residents Local Initiatives	**Indispensable allies that are hard to activate:** Berlin Senate UVK District Agency Neukölln	**Actor that does not have to be involved (initially):** European Commission (EASME)
Conflicting interests and objectives	**Strong opponents (biting dogs):** Office for Environment and Nature Protection Neukölln	**Potential critics (barking dogs):** Political parties Residential Building Cooperatives	**Potential strong opponents (Sleeping dogs):** None	**Actors that need little attention (stray dogs):** Cemetery Visitors

Table 5: Final Matrix: Dedication, Importance, Objective/Interest (Own illustration)

Table 2 summarizes our findings on the dependencies of the PG on other actors. The Cemetery Union was identified as a 'Strong Ally' to the problem owner, as their resources as a landlord are highly important and irreplaceable to the PG. The Cemetery Union is also highly in line with the objectives of the Kollektiv as they both draw synergies and benefit of each other's existence and are therefore also dedicated. Another actor that has been identified as dedicated and critical for the PG but has shown conflicting interests when advancing the deconstruction order of the PG in 2020 is the Office for Nature and Nature Protection Neukölln and is therefore identified as a 'Strong Opponent (/biting dog)'. The UNA holds important resources as they can decide over action of space, which is why the PG are dependent on their decisions. The authority mandated to remove construction on the PG in 2020 as it did not comply with the mentioned landscape plan from 1993. Looking at the non-dedicated actors, we found the local administration, the Berlin Senate UVK and the District Agency Neukölln to be critical 'Indispensable Allies that are hard to activate'. They hold resources as formal power that would be very useful for the PG, but that hardly available. This is also confirmed in the interview, in which the representative pointed out the ambiguous relation with the local administration that say to support them but real support is happening rather slowly. We did not identify any non-dedicated, critical actors with conflicting interests. Actor that are found in the matrix as non-critical will need less attention in the ANA as they hold low resources to influence the situation of the Prinzessinnengärten, which are the political parties, local residents, local initiatives, residential building cooperatives, the EASME and cemetery visitors. Political Parties are simultaneously 'Weak Allies' and 'Potential Critics' as different parties pursue different goals. Due to the scope of this work the non-critical actors are not discussed in-depth.

Actors	Berlin Senate UVK	District Agency Neukölln	Cemetery Union	UNA Neukölln	European Commission (EASME)	Political parties	Residential Building Cooperatives	Local Residents	Local Social/ Ecological Initiatives	Cemetery Visitors
Resources	Authority/ Formal Power, Organization, Money	Authority/ Formal Power; Organization, Money	Authority/ Formal Power, Position in Network, Access to Other Actors; Information	Authority/ Formal power, Organization; Position in Network; Information	Authority/ Formal Power; Money	Money, Position in Network	Position in Network, Organization, Money	Man-power	Legitimacy, Moral authority, Position in Network, Knowledge	Legitimacy
Importance of Resources?	High	High	High	High	Low (in our case)	Low	High	High	Low	Low
Replaceability of Resources?	Low	Low	Low	Low	Low	Low	High	High	High	High
Critical Actor?	**Yes**	**Yes**	**Yes**	**Yes**	No	No	No	No	No	No
Dedication?	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No

Table 6: Interdependencies of actors (Own illustration)

(6) Determining implications and consequences regarding problem formulation

Step six aims to connect the findings of the matrix to the problem owner's problem formulation and draw implications for the PG based on the findings of influential actors. The assessment of the problem formulation and actor dependencies can provide helpful insights when looking at the origins of the space issue for the urban garden. Conclusions, threats and opportunities that were identified in the ANA and are represented in the matrix have consequences and implications for three dimensions: (1) for the problem (re)formulation (2) for the interactions with actors and (3) for research activities and questions.

Regarding the first point (1) on consequences for the problem formulation, it is found that the problem formulation was mainly framed correctly. In the interview and in the ANA it was clearly found, that there is a lack of space and the process of finding a suitable place for urban gardening projects can be challenging. However, a minor aspect that needs to be adjusted in the problem formulation is the missing long-term contracts and the challenge of maintaining the space. During the analysis it was found that with the Cemetery Union the PG have found a reliable partner that are also interested in the long-term collaboration. However, the PG is still exposed to uncertainties in the contract to the hierarchical position of the Cemetery Union, in case they may find a 'better' partner or make different plans. Regarding the second point on the interactions with actors, it can, firstly, be stated that opposing to our prior assumptions, the PG can count many (strong or weak) allies that share goals and objectives regarding the gardening activities, and there are few opponents of the projects. The many allies of the PG are presumably also the reason the garden exists today. However, there are also allies that are critical for the support of the Kollektiv (due to their position and resources of authority, formal power and position in network) that are seemingly supporting the garden, but are not actively engaged (or 'dedicated) in the realization and insurance of maintaining the garden. Those 'Indispensable allies that are hard to activate' are the local administrations in Berlin: The Berlin Senate UVK and District Agency Neukölln. They politically support the community garden by creating the network of urban gardens in Berlin and providing a strategy that aims to promote the urban gardens but in truth are not working enough to support the PG. This describes well the ambiguous relation the garden has with the local administration

which was also confirmed in the interview. Implication from these findings are to involve and engage the local administration more in the activities and also promote communication between the parties. The UNA Neukölln has proven to be an opponent in the past. The conflict, however, was resolved by the two parties by a clearer communication on what exactly the PG will and can built on the area, as explained by the interviewee. Political Parties, Residential Building Cooperatives and Cemetery Visitors are considered as opponents, that are, however, non-critical, which is why they currently do not need high attention but should be considered in future actions as potential opponents. Lastly, regarding new research activities and questions, it would be especially interesting to investigate in how to further engage the indispensable allies, thus the local administration, in order to promote further support for ensuring space for the community garden.

5. Discussion and Limitations

The following will shortly discuss if, firstly, our assumptions that were formulated in three hypotheses can be verified, secondly, what improvements of actor engagement are suggested by the interviewee and how they align with our findings, and lastly limitations of the study and method will be discussed. Our first hypothesis states that there are only few key stakeholders/actors involved in the challenge about the available spaces can be verified, as only the Cemetery Union plays a major role in the contract and the local administration has indirect influence on the space as they can distribute space and make land-use plans. The second hypothesis, that origins of the political challenges are presumably related to profit-driven interest has proven to be wrong in our case study. In this case conflicts are not of profit-driven cause but are rooting in the space-distribution challenges the city deals with for other demands as education or housing. Profit-oriented actors, as investment firms for real estate, did not play a role in our case. However, for this is would be interesting to look at other case studies and look at their challenges with profit-driven actors. Lastly, the third hypothesis, that the key stakeholders' interests are rather opposing to each other can only be partly confirmed: In this ANA it was found that there are more actors that support the idea and there are only few opposing actors. As depicted in the results the agreement is there, however the action of support missing by the administration as there is an internal conflict on space in Berlin that is competing for schools and housing space.

Implications of the findings suggests strongly that those actors that are indispensable but hard to activate, need to be involved and engaged more. The interview with the representative confirms these findings and the person suggests that the situation of the Kollektiv and also other urban gardening projects could be improved if communication between them and the administration would be improved; exchange should be held on a regular basis with a fixed contact partner. The representative particularly suggests a position for urban gardening for each district agency in Berlin for better coordination. The person further points out that the most challenging issue is not financing – which is provided through different funds for the PG – but rather provision of space which needs to be ensured by the public administration.

Lastly, there are several limitations that are connected to the method and this study. First of all, it is important to acknowledge, that this ANA is just a snapshot in time, which is why this study should be updated and revised regularly for reliable results (ENSERINK, 2010). An actor network can be very dynamic, including the perspectives and objectives of actors, which is why allies can be opponents tomorrow or vice versa. Further, actors are assigned to be supporters or opponents, or to be dedicated or not dedicated. However, in reality, actors are often in the middle, which was not considered in our study. Lastly, it is to mention that results are only reliable with trustworthy information used in the analysis. This study was missing – due to its scope – further in-depth interviews of actors other than the problem owner.

6. Conclusion

This paper analysed the political challenge of lacking available spaces for urban community gardens in Berlin. The goal was to identify the most influential actors involved in this challenge with the PG Kollektiv. The ANA showed that more allies than opponents are involved in this case. More precisely there are many weak allies concerned by the problem statement who support the Kollektiv but are not considered influential actors. These are the non-critical but supporting actors (cf. Table 2) which consist of the political parties, residents, and local initiatives. The critical actors are considered the influential actors which include the Cemetery Union of Central Berlin, the Office for the Environment and Nature Protection Neukölln as well as the Berlin Senate UVK and the District Agency of Neukölln. As the most influential actors we identified the Berlin Senate UVK and the District Agency of Neukölln. Thus, the indispensable allies are the most influential stakeholders but at the same time the ones most difficult to activate.

Furthermore, the initial problem formulation was confirmed as the interviewee approved the lack of available spaces as the most pressing challenge for urban community gardens.

Another finding points to the importance of more engagement and interaction with the indispensable allies. This is the conclusion from the actor identification (cf. Table 2) and the Interview. This finding is well illustrated by the conflict with the UNA Neukölln which shows how continuing and inclusive communication can result in acceptable solutions for each side. In addition, another interesting finding from the interview was that more community gardens in Berlin may make use of the freed-up spaces ("Überhangsflächen") at cemeteries due to the changing funeral culture. Both the cemetery owners and the community gardeners could benefit from synergies through the maintenance of the green space.

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Berlin gardeners and their strategies to cope with climate change – a qualitative study

Judith Rietzl

Figure 1 & 2: Urban Gardening in Berlin (Source: RIETZL 2022)

1. Introduction

Heat-storing cities are particularly feeling the effects of climate change (REUSSWIG et al. 2016, p. 29, 65). What determines whether someone or a group of people is vulnerable to climatic changes is whether it is possible to cope with the negative impacts (MCCARTHY et al. 2001, p. 6). This report aims to understand how urban gardeners cope with climate change effects. To this end, before conducting and analysing qualitative in-depth interviews, the main manifestations of climate change in Berlin are first analysed with the help of a literature review. Thereafter, the consequences on urban gardening and possible coping strategies will be examined by using the same method. The available literature is detailed and insightful, but presents some gaps regarding wind predictions, changes in agrophenological seasons as well as changes in ecosystems.

The interviews are intended to determine which effects of climate change the gardeners perceive and which challenges they consider relevant for their gardening practice. This question is asked to make sure that the effects are not only measured but also experienced, and to be able to include further changes and challenges that might be missing from the literature review. Finally, the interviews will answer the question of how urban gardeners in Berlin cope with the perceived climate changes.
Coping is used in the sense of, if possible, adaptation to climate change and, if this is not possible, dealing with the negative consequences of climate change at the individual level of the gardeners. Whether coping strategies are used or are necessary depends on whether the negative impacts described in the literature are in fact perceived by the gardeners.
In doing so, the focus is exclusively on non-profit oriented gardens that concentrate on plants without animal husbandry.

2. Climatic changes and their impacts on gardens

In the following, the effects of climate change in Berlin and its impacts on Urban Gardening will be analysed by means of a literature review.

2.1 The effects of climate change in Berlin

Since the age of industrialization starting in the later 19th century, the average temperature in the Earth's atmosphere near the ground has been rising due to the emission of anthropogenic greenhouse gases (GHG) emissions (IPCC 2022, p. 10, REUSSWIG et al. 2016, p. 1, 14). At that time, the share of GHGs in the atmosphere was about 270 ppm (parts per million); today we have a share of over 400 ppm – a level not reached during the last 800,000 years (ibid., p. 25).
Berlin's mean temperature has already risen and will continue to rise (REUSSWIG et al. 2016, p. 2). Predictions indicate yearly variations, but overall, extreme heat events will occur even more frequently (ibid., p. 29-30). Harsh winters will increasingly give way to mild winter months with temperatures above zero degrees Celsius (ibid., p. 30-34). This development will be intensified by the *Urban Heat Island effect* (ibid., p. 29, 65). In the area inside the *Berlin ring*, i.e., the inner city of Berlin, one can measure temperatures of about 5° C higher than in the outskirts of the city (ibid., p. 64).
In addition, the mean annual precipitation will rise, with higher precipitation values in spring and winter, whereas in autumn and summer, there may be more dry periods (REUSSWIG et al. 2016, p. 38). Extreme rainfall will happen more often, predominantly during spring and winter (ibid., p. 38). With regard to wind velocity and storm events, no clear trend toward an increase or decrease has yet been identified, which doesn't mean, however, that the possibility of change is impossible (REUSSWIG et al. 2016, p. 1, WALTHER/LÜDEKE 2020, p. 7).

2.2 Climate change and Urban Gardening

The increase in the CO_2 concentration in the air itself favours the growth of plants – but only in conjunction with a sufficient water supply (FOOS et al. 2017b). The decrease in precipitation in spring can lead to nutrition deficiencies and thus trigger diseases in plants (JÄCKEL et al. 2017). The combination of rising temperatures, faster evaporation, and longer periods without rainfall impact the hydration of plants negatively (FOOS et al. 2017a). Soil hardens and condenses during dry periods, reducing its water absorbing capacity and making them susceptible to erosion due to wind and heavy rainfall, which washes away nutrients and eventually causes plants to die (REUSSWIG et al. 2016, p. 6, 90).
Additionally, the composition of the soil changes due to alterations in temperature and precipitation. In particular, Berlin's light, sandy soil with low water-holding capacity shows a high vulnerability to extreme events (UMWELTATLAS BERLIN 2015). With sufficient water supply, the increase in temperature initiates the activity of the organisms in the soil to speed up and thus

ultimately also the mineral availability for the plants to increase (FOOS et al. 2017b). Certain conditions, however, such as warmer winters in combination with precipitation, can accelerate mineralization (ibid.). Drought during periods of low rainfall affects the organisms living in the soil and reduces the rate of decomposition of organic matter, which in turn leads to a decrease in humus content and nutrient availability of soil (ibid.).
Moreover, higher temperatures lead to changes in the agrophenological seasons that affect both plants and animals. The vegetation period lengthens (CHMIELEWSKI et al. 2017), allowing warmth-loving plants to grow earlier and subsequent crops to be sown earlier (ADELPHI et al. 2015, p. 228). The earlier start of the vegetation period increases the risk of damage from late frost (OLKUS 2020, p. 37). Even though plants have more time to grow: pests produce more generations per year and new pests manage to survive in the milder temperatures (CHMIELEWSKI et al. 2017, JÄCKEL et al. 2017).
There is a variety of measures that gardeners can take to cope with these changes. Explanations why the measures are recommended can be found together with the list in both interview languages in Appendix 1. This list is the basis for the measures to be discussed during the interviews.

Identified coping strategies:
Soil maintenance: - Compost organic material - Keep soil covered - Do not dig deeply, only loosen superficially - No mineral fertiliser - No peaty potting soil - No chemical-synthetic pesticides - No sealing and compaction
Water & heat - Water as early as possible, without sunlight - Water sparingly: Low evaporation, drip irrigation, micro irrigation, watering rim - Collect and use rainwater - Select heat and drought tolerant species - Create a garden pond - Cooling through greenery - Recycling (reuse of grey water, grey water tower, constructed wetlands) - Creative approaches such as self-watering high beds
Plant health - Promoting beneficial insects - Trunk painting of young trees against sunburn and frost damage

Table 1: The coping strategies to be assessed with the interviewees (based on JÄCKEL et al. 2017, FOOS 2020, p. 35, FOOS et al. 2017a, FOOS et al. 2017b, OLKUS 2020, p. 37, WACHTMANN 2020a, p. 50, 53).

3. Method: in-depth interviews

Starting from the literature review, a questionnaire (see Appendix 1) was deduced in English and German to conduct in-depth interviews with urban farmers in Berlin on the organizational structure of their gardens, their motivation, their perception of climate change, their implemented coping strategies, and challenges in the implementation. The questions on the organizational structure and the motivation were included to see whether it made a difference on the use of coping strategies.

For the selection of interview partners, several gardens listed in the *Berlin garden map* (RICHTER 2013) and the map of community gardens in Berlin on the city's website (PLATTFORM PRODUKTIVES STADTGRÜN n.d.) were chosen arbitrarily and then contacted. However, attention was paid to the fact that the gardens have different organizational structures. In addition, some gardeners were approached spontaneously in their gardens. In this case, gardens in an arbitrarily selected area were visited one after another. In all gardens open at that time, an interview was conducted. Anonymity was guaranteed during the interviews so that gardeners felt free to share negative aspects, e.g., regarding conflicts with authorities. Sometimes, the interview had already ended, but in the subsequent farewell conversation, further aspects were mentioned. These were noted on paper and added to the interview and marked as *added later*.
The interviews were transcribed according to the rules set by KUCKARTZ (2016, p. 167-168) and then analysed using the MAXQDA programme according to the method of qualitative content analysis by MAYRING (2022) with the aim of structuring the material (ibid., p. 96-99). The category system used for the coding can be found in Appendix 2.

4. Results

A total of five interviews were conducted. One was excluded from the analysis because the gardener almost exclusively had information about a garden project in Brandenburg. Interview number 1 was conducted with the chairperson of an allotment garden association (*kleingartenverein).* Interview partner number 2 was a gardener in another *kleingartenverein*. Interview number 3 was with a volunteer from a community garden. The last two interviewees gardened in their own area in a community garden. Gardens 3 and 4 planted almost exclusively in high beds due to the soil conditions on site (e.g., contaminations). Gardens 1 and 2 partly use them to avoid sandy soil and for not having to bend down when working. The transcription of the interviews including more information on the gardens can be found in Appendix 3.

	Organisational type of garden	**Gardening experience in Berlin**	**Use of high beds or ground soil**	**Focus**
Garden 1	Allotment garden association	15 years	High beds and ground soil	Gardening for fun and design opportunities Planting mostly wildflowers and domestic fruit Preserving the association and fending off real estate interests
Garden 2	Allotment garden association	2 years	High beds and ground soil	Social responsibility for residents using the association as a recreational area Planting bee friendly plants, fruit trees and vegetables
Garden 3	Community garden	2 years	High beds	Vision of a transition from a petroleum-based to a post-petroleum-based lifestyle and to a circular economy Ecological thinking and exchange between people Limited planting of vegetable and fruit because of theft risk

				Honeybees and wild bee promotion
Garden 4	Community garden with individual autonomy	6 years	High beds	Creating a favourable garden for biodiversity. Heat-resistant berry bushes and herbs

Table 2: Details about the interviewees regarding the organisational type of garden, the gardening experience, the soil, and the focus (own figure).

4.1 Perceived climate change

By far the greatest change was noted in heat and drought. All interviewees agreed that the phenomena are extreme, and some interviewees agreed that they had become more extreme. Heavy rainfall was noticed, but not as a damaging factor for the gardens. No one had the urge to talk about experiences with wind. Either it did not occur to the interviewees, or they did not feel the need to talk about it in detail when asked about it.
Gardener 2 noticed strong changes towards milder winters, whereas gardener 1 was not sure if the frost incidence was any different in the past. The others did not mention the issue. However, changes in agrophenological seasons were noted: less frost, warmer temperatures, and longer warm seasons allowed for the growth of new plant species and different flowering patterns.
Changes in soil quality were either irrelevant for most interview partners as they used high beds, were not noticed or there was little time of gardening time to notice them. Further changes that were noticed were damages to plants due to strong insolation, less bee activity and thus less pollination due to heat, and more favourable conditions for pests and higher susceptibility of plants to them. No one saw any positive aspects of climate change. Supposedly positive changes like the thriving of Mediterranean plants were mentioned sarcastically. There was a consensus on the need to adapt.

4.2 Implemented coping strategies

As expected, all interviewed gardeners irrigate their plants. All of them have a connection to the public water network and some collect rainwater – especially those with garden houses and thus rain gutters. However, the barrels mostly were not full this summer. The others have gotten rid of their barrels because of plastic reduction and the danger of drowning of birds and children in publicly accessible gardens. They try to irrigate economically by using automatic systems, by deciding against watering certain areas and letting them dry out and/or planting more drought resistant species. Water recycling is carried out.
Two gardeners have garden ponds to encourage frog habitation, have fun, and give water to the bees. One of them would like to have a larger pond for cooling, but it is not possible to dig into the ground due to the conditions on site. Cooling by mulching and/or shady trees is used by all the gardeners. Those who have trees susceptible to sunburn paint the trunks. Creating favourable conditions for wildlife is a high priority for all gardeners, whether by planting valuable plants for insects or providing nesting opportunities. Pesticides are generally not used.
All gardeners take measures to care for the soil. They follow the recommendation to dig only superficially, mulch, fertilize naturally and avoid peaty potting soil and sealing/compaction. 3 out of 4 use composting.
Further measures could be identified. These include mixed cultivations, and research cooperations regarding e.g., phenological monitoring.

	Garden 1	Garden 2	Garden 3	Garden 4
Soil care	Sealing of paths only No chemical-synthetical pesticides No peaty potting soil No mineral fertilizers Limited mulching (because of snails) Limited use of compost (soil low in nutrients either way) Superficial digging only	Sealing only on the area occupied by seating group Soil analysis in the future conceivable (to confirm effects of soil care measures) No chemical-synthetical pesticides No peaty potting soil Plant- and urine-based fertilizers Mulching Composting Only superficial digging	No sealing No chemical-synthetical pesticides No peaty potting soil Plant- and animal-based fertilizers and help of worms for compost Composting Superficial digging only	No sealing No chemical-synthetical pesticides No peaty potting soil Plant-based and animal-based fertilizers incl. terra preta and bokashi Mulching & keeping all areas plant-covered according to the permaculture principle Straw to avoid soil drying Superficial digging only
Water & heat	Recycling of the water used for washing hands Cooling through fruit trees Garden pond Implementation of economic watering systems Collection of rainwater	Keeping all areas plant-covered No watering of the lawn Collection of rainwater	Planting heat resistant plants No watering of lawn Watering in the morning	Planting domestic heat resistant plants Watering with rainwater (will be changed to drinking water)
Plant health	Participation in research projects on resistant plants No pesticides Insect hotels Trunk painting	Planting warmth-loving vegetables No pesticides Bee pastures Bird boxes and insect hotels Glue rings on trees Mixed crops	No pesticides Taking care of captured honeybees (not used for human advantage) Bee pastures	Drinking pond for bees No pesticides Planting beneficial plants for insects and birds

Table 3: Implemented coping measures (own figure).

4.3 Challenges

A challenge that has been identified by several gardeners is missing knowledge among fellow gardeners. Additionally, the high beds that many must use due to unsuitable ground conditions dry out quicker than ground beds. Further challenges include the lack of information about plant species that are recommendable to use in terms of heat resistance and adaptation to the new conditions. Besides, there is a struggle regarding balancing water-saving irrigation and the uptake of heat resistant invasive species. The biggest challenge for the future is, in unanimity, the accessibility to water to irrigate plants and the accessibility for trees to ground water. Some already

feel overwhelmed with the amount of irrigation that is necessary and would like to have better access to collected rainwater.

	Challenges
Garden 1	- Benefits for rabbits by hedgehog promotion - Not all gardeners are willing to participate in informational events - No sufficient access and research needs regarding plant species recommendations - Insufficient irrigation if a restriction on water usage was implemented - Trees might not be able to reach the ground water during extended dry periods
Garden 2	- Disinterest/disinformation of gardeners in implementing good practices
Garden 3	- Heat resistant invasive species that displace less resistant domestic plants - Access to water decisive
Garden 4	- High beds dry out quickly but are necessary due to special soil conditions in the area - Disinterest and malpractice of gardeners - Worried about the garden's switch from rainwater to public drinking water connection - Access to water decisive

Table 4: Challenges in coping with the effects of climate change (own figure).

5. Discussion

The gardeners experienced almost all of the previously identified conditions, especially extreme heat and drought. Awareness of changes in soil composition is not very pronounced, but in the cases of raised beds it is not particularly relevant either. Also, all gardeners implement coping strategies in varying complexity independently from their organizational structure and experience. However, it was difficult for some to determine whether climatic conditions had worsened, as memory is deceptive. Some of the extreme events have occurred on and off, and annual fluctuations occur despite existing trends. Also, the strong mention of dry seasons could be influenced by the hot summer in which the interviews were conducted, as the perception of this phenomenon was the most recent. In addition, some coping strategies have been used as general care measures for plants independently from climate change effects.

Interviewer effects might of course have appeared, but the fact that only one person conducted the interviews reduces the interviewer variance. *Intercoder reliability* (MAYRING 2022, p. 119) is not present in these cases, as there was only one coder. However, the coding includes very few, if any, interpretations, so this is tolerable.

Of course, a certain degree of organizational complexity is required to be part of the sample. E.g., the gardens must be reachable by email, so some gardens might have been excluded from the sample. This problem was reduced by contacting the gardeners directly. Also, the gardens who responded are more likely to show an interest in the topic. Gardens with less interest may not have responded. In addition, active gardeners who spend more time in their gardens are more likely to be approached. Particularly in the allotment garden clubs, some gardeners were seen relaxing, e.g., sleeping on a garden lounger. In order not to disturb them, they were not approached. This could be the reason why only very climate aware gardeners were interviewed, sharing their concern about climate change or taking action in general.

6. Conclusion and outlook

This study explored the question of how urban gardeners in Berlin perceive climate change and how they cope with it. It could be shown that all gardeners interviewed are aware of climate change. The main effects mentioned are heat, drought, extreme rainfall and changing agrophenological seasons. However, there is often uncertainty about the extent to which the phenomena have actually changed in recent years. The need for irrigation is assessed as very high. Together with the access to (rain-)water, it is identified as a crucial point in the adaption capability to the further changing of climatic conditions.

As the interviews have been conducted during the dry summer, it might be interesting to conduct further interviews during other seasons of the year. Also, it might be enlightening to specifically approach gardeners who do not implement the identified coping strategies in order to identify the reasons, be it misinformation, use of the garden for purely recreational purposes, or conflicting views on gardening.

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Challenges Facing Smallholder Vegetable Urban Farmers: A case of Goba Ward in Dar es Salaam

Neema A. Munuo

1. Introduction

Demand for vegetable growing has been increasing in developing countries. The demand has been attributed to increased awareness of the associated health and dietary benefits (KIDUANGA/SHOMARI, 2017). Smallholder urban farmers have seized this awareness as an opportunity to invest in urban agriculture, and particularly vegetable farming, for economic purposes and home consumption (ALAMERIE et al., 2014). This could be an opportunity for smallholder vegetable farmers, given that about 50% of the world's population lives in cities (UN, 2019). The need to feed cities' population is critical, leading to over 800 million people around the globe getting involved in urban and peri-urban agriculture (HAILU/DERBEW, 2015). Hence, it is not surprising that the importance of urban agriculture is increasingly being recognized by International Organizations like the United Nations Conference on Environment and Development (UNCED), Agenda 21, UNHCR, FAO (World Food and Agriculture Organization) and CGIAR (International Agricultural Research Centres) (UN, 2012). This suggests that the significance of urban agriculture and particularly vegetable growing will continue being critical for dietary needs, and other associated benefits for the growing urban population in most countries.

Besides the associated dietary and health benefits of urban farming, there are other advantages for the farmers, market vendors and the environment. According to OCHIENG et al., (2018) urban agriculture was acknowledged to have the potential to contribute to the socio-economic livelihoods and environment of Sub-Saharan African (SSA) cities (EBERT, 2014; MWAJOMBE/MLOZI, 2015). As socio-economic livelihood, urban farmers and vegetable vendors earn a living from selling vegetable produce. Environmentally, vegetable growing facilitates water retention in the water catchment areas, thus making good use of land in cities (BADORA et al., 2023). Furthermore, from a broader point of view, proper and adequate dietary habits contribute to a healthy population and reduction of the expenses that could arise from treating diseases. In turn, this lessens a country's health budgetary burden which is crucial for poor nations (NGOWI et al., 2007). With all the associated benefits of urban farming to populations and countries, the sector also faces various challenges in SSA countries, which is at the centre of interest of this study.

Dar es Salaam, being the fastest growing city in SSA and becoming a mega city by 2030 (WB 2017), was chosen as a case study. A major problem associated with the rapid urbanisation includes the risk of food insecurity (NGOWI et al., 2007; SCHMIDT, 2011). Recognising this, Tanzania has established some urban farming regulatory guidelines aiming at supporting and managing urban agriculture in cities. One of the notable initiatives is the Urban Planning (Urban Farming) Regulations (2018) which states that farming shall be permissible in urban areas for the purposes of providing household food security, alleviating poverty, and creating employment. Additionally, the Land Policy of 1995, section 6.6 and the National Human Settlement Development Policy of 2000, section 4.3.7 indicate the need for practising urban agriculture as a source of livelihood activity and employment (URT, 1995; URT, 2000). Despite the existence of an enabling policy

environment, absence of clear policies and regulations for governing urban agriculture has been reported to bring challenges to urban farmers (MKWELA, 2013).

Vegetable farming is practised in homesteads (on-plot or off-plot), on private land (owned, leased), on public land (parks, conservation areas, along roads, streams, and railways), or semi-public land (school and hospital yards) (KATERA, 2021). The size of the land for vegetable farming in Dar es salaam city, particularly in high-density areas, is estimated to be $40m^2$ to $80m^2$ (MKWELA, 2013).

A number of studies on urban agriculture in Dar es Salaam have been conducted (KATERA, n.d.; KIDUANGA/SHOMARI, 2017; MKWELA, 2013; MWAJOMBE/MLOZI, 2015) but with little focus on challenges facing vegetable growing. For instance, KIDUANGA/SHOMARI, (2017) talks about access to land and examination of conditions for expansion of land for vegetable production. While NGOWI et al., (2007) focused on the use and handling of pesticides by smallholder vegetable farmers. The significance of focusing directly on challenges facing vegetable farmers stems from the fact that in Dar es Salaam, vegetable farming is carried out throughout the year. This entails that farmers have to deal with varying weather conditions across the year, necessitating them to be well equipped with enough and relevant information to solve the associated challenges.

In the following sections, the question on what barriers smallholder urban vegetable farmers face in Dar es Salaam and their possible solutions is to be answered. To this end, the methods used are outlined shortly, before the results of the study are presented and discussed. Finally, recommendations are made to improve the situation of urban farmers and vegetable production.

2. Methods

The study was conducted in Goba Ward, Kinondoni Municipality. The ward is located at Latitude 6.732738^0 and Longitude 39.158878^0 and is bordered by Makongo, Mbezi, Saranga, Mbezi-Juu and Wazo wards. Two sub-wards namely, Kibululu and Muungano were selected for exploring challenges facing smallholder vegetable farmers. Goba is located 20 km away from the Dar es Salaam city centre, as shown in Figure 1. The ward has a population of 42,667 people and occupies an area of about 4716.5HA, with a density of 903 h/km^2 (URT, 2013). The ward also comprises 8 sub-wards namely: Kinzudi, Tegeta A, Kibululu, Matosa, Goba, Muungano, Kulangwa and Goba Kunguru.

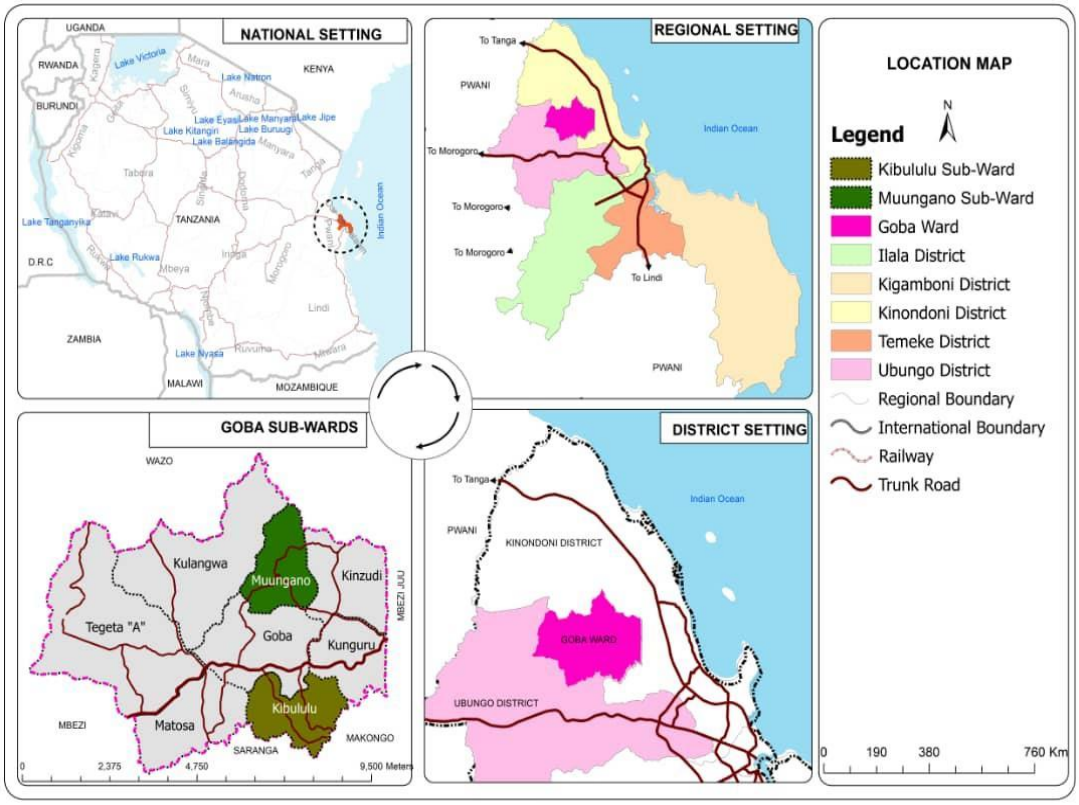

Figure 1: Location map of Kibululu and Muungano subwards (Source: Adopted and revised from MUNUO/MATINDANA, 2022)

Kibululu and Muungano sub-wards were selected because they have been a hub of vegetable farming activities for a long period. Both secondary and primary data collection methods were employed. Primary data and information were gathered through mixed-methods and in-depth qualitative interviews, focus group discussions and observation. A total of 31 (n=31) vegetable farmers were purposely selected to participate in the interviews and focus group discussion. Participating farmers in the study were identified by the help of local leaders and extension officers. Additionally, expert interviews were held with two Extension Officers and four local leaders of Kibululu and Muungano sub-wards (Ward Executive Officers and Sub-ward leaders). These facilitated getting more information on the challenges faced by small scale vegetable farmers as they usually help them with technical and advisory services. Two vegetable association leaders were also purposely selected from UTULIVU KIMWAO and KIMWA respectively. The goal was to hear from them if and how the associations were able to help farmers with their problems and to find out more about the reasons.

In accordance with CRESSWELL and CRESSWELL (2017), focus group discussions were employed to capture an in-depth understanding of the challenges facing vegetable farmers. The gained insights were helpful in triangulating the information received from the individual interviews with the farmers. This method followed recommendations from methodological scholars, including YIN, (2009) for enhancing the reliability and validity of data. Interviews and focus group discussions facilitated the capture of perceptions, opinions, and attitudes of vegetable farmers while specifically focusing on their everyday urban farming challenges. Two group discussions with 12 people (3 men and 3 women per group) were conducted in both Kibululu and Muungano sub-wards. The purpose of having men and women farmers was to examine the varying challenges that may exist between genders. This was informed by the notion that women tend to engage in vegetable farming to ensure food security at home, while men practise vegetable farming mainly for commercial purposes; hence, their problems are believed to be different (SCHREINEMACHERS et al., 2017).

Observations were conducted at farming sites, where photos were taken to capture activities and the realities of vegetable farming.

One of the limitations of this study is the insufficient representation of farmers due to the limited capacity in terms of time and resources to reach out to more farmers. However, it is important to note that the study was designed to be predominantly descriptive to explore the in-depth views of farmers, and not the statistical magnitude of their challenges. To complement field data, legal and policy guidelines were therefore reviewed. Other reviewed documents included relevant journal articles, books, and reports. The extensive literature reviewed added a more historical perspective to the practice of urban agriculture in Dar es Salaam. Data and information collected were analysed through thematic and content analysis whereby emerging issues were categorised and grouped to associate meanings.

3. Findings

Characteristics of respondents

Understanding the characteristics of the farmers was critical to the study because it provided a broader understanding of their status and capabilities in carrying out farming activities. The study established that vegetable farmers in the study area were between 25 and 50 years old. While 70% of the farmers relied solely on vegetable farming, 10% were retirees, and the remaining 20% worked in fields other than farming. The findings suggest that the majority of farmers in both sub-wards are women. This was the case as 99% of the vegetable farmers at Kibululu were women aged between 35 and 55, and 90% of the same in the Muungano sub-ward were women aged between 20 and 45. These are low-income women seeking to earn a living for subsistence and economic purposes. The education level of the majority of farmers ranged from informal to primary. The low education level was one of the setbacks that limited farmers' ability to effectively navigate good farming practices as well as accessing farmer information and associations.

Farmer organisations and associations

Muungano has two organisations, namely KIMWA and UTULIVU KIMWAO. These organisations have been helping farmers access credits from financial institutions and market their produce on an online platform called the M-Kilimo website. The leaders of the associations informed the study that organisations play a significant role in addressing farmers' problems in relation to credit, technical knowledge, and marketing of produce. However, they revealed less support for agricultural inputs. It was also noted that farmers who are members of these organisations can access better marketing services through the identified website. This in turn increases farmers' access to information, capital, and technology, enabling them to earn more money than non-members of the identified organisations. Despite the several benefits associated with being members of the farmers' organisation, there were some challenges that hindered offering effective support to farmers. These included credit and cash flow problems due to the inability of members to pay back their credits. The leaders also complained that there was low participation by members in the organisations' programs, such as farmer training and periodic meetings. In addition, it was also revealed that the organisations had inadequate financial capacity to support farmers with agricultural inputs for better yields.

Land access for vegetable farming

It was necessary to investigate land access at Kibululu and Muungano in order to gain a more comprehensive understanding of available land for vegetable growing and its implications for year-round vegetable availability. Kibululu and Muungano sub-ward farmers asserted that they had little security of tenure because most of their farming took place in temporary areas. In this regard, 70%

of the land currently used for vegetable expansion is obtained through negotiations and informal arrangements with landowners who have yet to utilise their land. 30% of Kibululu vegetable farmers access free land from military areas and individually owned land areas along the River Mbezi. The permission to use military land was granted after discussions between the farmers and the army about the size of the land and the types of vegetables that would be grown in the area we agreed upon. Currently, most landowners do not impose any charges on farmers, as this is merely a temporary arrangement. The size of farms at Muungano varies typically from $50m^2$ to $70m^2$, while those at Kibululu are less than $50m^2$. The farms at Kibululu are mainly used to grow a variety of vegetables, including amaranth, Chinese cabbage and sweet potato leaves, while those at Muungano grow potato leaves, pumpkin leaves, and Chinese cabbage, respectively.

Vegetable farming challenges

The findings suggest that Muungano sub-ward's vegetable farmers are relatively more hit during the dry season. This is because the production of vegetables drops due to the shortage of water that could be used for irrigation. In order to cope with this challenge, farmers grow vegetables that require less water for irrigation, such as sweet potatoes and Chinese cabbage. Moreover, the study revealed that vegetable farmers from both sub-wards generated low income due to the limited production resulting from their small farm sizes, poor farming technology, and inadequate skills. See Plate 1, which depicts a lack of inputs for tomato vegetables, and Plate 2, which illustrate yellowing of amaranth vegetables due to water scarcity in Kibululu.

Figure 2: Tomato farming at Muungano (Source: MUNUO 2021)

Figure 3: Amaranth farming at Kibululu **(**Source: MUNUO 2021)

From the testimonies collected in the focus group discussion and interviews, it was estimated that vegetable growers earn a monthly average of USD 10. However, 80% of respondents argued that this amount was inadequate to cater for other basic needs such as food, health expenditures, and paying for their children's education. At Kibululu, vegetable produce sales are mainly made from passers-by along farm sides, vegetable retailers who come and buy fresh vegetables from farms, and vegetable wholesalers who prepare bundles of vegetables to be sold to various retailers in food markets found in Goba and neighbouring wards like Makongo, Changanyikeni, Mbezi Juu and Mbezi Luis. Muungano farmers, on the other hand, sell most of their produce at food markets in Goba, and neighbouring wards like Kimara, Mbezi Luis and Wazo. The study established that only 30% of the produce from the two sub-wards are sold at the Goba market, with the remaining 60% elsewhere. The price for a bundle of vegetables ranges between USD 0.064 and USD O.129, depending on the type of vegetable.

4. Discussion and Conclusion

The study indicates that limited land access has created uncertainties that contribute to low vegetable production. Land access is not only a challenge for smallholder vegetable farmers in Dar es Salaam but also in other cities in SSA. Studies suggest that the rate of incorporating urban agriculture in land use zoning is very low, resulting in only a few areas being allocated for urban farming (EBERT, 2014; MCLEES, 2011). This creates a scarcity of land for practising urban farming and leads to informal land access with no security of tenure (URT, 2016). Informal land access puts farmers in a vulnerable position as they are only temporary users of the land. This means that they can be vacated from their farms at any time if the land is needed by the owner, regardless of the stage of farming they are in at the time the land is taken away from them (MWAJOMBE/MLOZI, 2015). These findings from the Goba sub-wards align with other findings from Zimbabwe and Ethiopia, where the lack of agricultural inputs has also contributed to low production (MUKARUMBWA et al., 2018). The survey also notes that Kibululu farmers, who sell their products at low prices that can only meet their essential needs, have severe concerns about the need for a more dependable and sustainable market for their produce. As it stands, Kibululu farmers incur higher production costs with limited market information. The study highlights the significance of farmers' organisations and their associated challenges brought about by low participation among members. Farmers' organisations have been reported to assist farmers in addressing the challenge of limited market information for improved income generation (ANTWI/SEAHLODI, 2011; MAGESA et al., 2014).

Furthermore, the research identified that more women engage in vegetable farming than men. This makes urban farming a very sensitive land use in cities, as women are the caretakers of their families. With insecurity of tenure, the risk of destabilising families is even further aggravated (ASFAW et al., 2012). On the contrary, in Kumasi, Ghana, men dominate vegetable farming activities while women dominate vegetable marketing (DARKEY et al., 2014). Despite urban farmers in Goba facing a shortage of water for irrigation, the National Irrigation Act of 2013, article 34 (1), in line with the village general assembly, only emphasises the allocation of irrigation schemes for rural areas (URT, 2014). In this context, a lack of political effort to establish irrigation schemes for urban areas in the national legal framework is particularly evident. There is an urgent need for including urban irrigation plans for the majority of "informal" farms to significantly improve the situation of urban farmers and vegetable production by 2030.

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Part IV: (Future) planning approaches for urban agriculture in Global North and South

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A geospatial analysis of potentially suited areas for urban leafy vegetable production in Dar es Salaam

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1. Introduction

1.1 General Introduction

Acknowledging the dynamics of growing cities around the globe, Urban agriculture is attributed to a potentially beneficial role in the urban economy, urban food supply, and urban development in general (SMIT et al. 1996). Despite the spatial challenges posed by the growing real estate sector, urban agriculture is stressed to play an essential role in creating resilient and sustainable food systems through production, employment, and income diversification (VAN TUIJIL, 2018). This income can be realised directly through the sale of crops or indirectly because less food has to be bought by the urban farmer (VAN TUIJIL, 2018). At the city level, urban agriculture contributes positively to providing affordable food for poorer urban dwellers despite the planners perceiving it as a messy business with health risks due to increased air, soil and water pollution (VAN TUIJIL, 2018: LAL. R, 2020). On a similar note, urban agriculture provides the inputs for firms in other industries for further processing and value addition (ADENLE, 2019). This not only has a significant impact on the farmer's income generation but also on the supply chain and trade where the government raises revenue through tax and duties particularly when the product is sold at the market.

Though urban agriculture has been in existence for a long time, its felt economic significance to urban dwellers is increasingly appreciated. Urban agriculture was long taken as a form of recreational activity but lately, it has been deemed an economic necessity, particularly in Sub-Saharan Africa (BADAMI, 2015). Crop and livestock production as a way of living was traditionally the prerogative of rural dwellers. Urban areas were not designed to accommodate farming or livestock keeping at any scale of operation. The land that is within urban areas was customarily zoned out to accommodate residential areas, central business districts, industrial sites, road and railway construction and recreational facilities. etc. Any piece of land that was not utilized for the above purposes was ideally supposed to be left out for aesthetic purposes and/or to maintain a green environment. However, during the past two decades or more, the African region has witnessed the insurgence and recognition of urban agriculture (CISSÉ et al. 2005; ORSINI et al.., 2013).

Urban agriculture in Tanzania has been in existence for many decades (MVENA, 1999: HALLORAN, 2013: CHARI, 2022). The Tanzanian government defines urban agriculture as "the cultivation of crops, horticulture, floriculture, dairy farming, keeping of pigs, poultry and aquaculture in areas designated 'urban' by the United Republic of Tanzania under the Town and Country Planning Ordinance CAP. 378 of 1956 reviewed in 1991" (MLOZI 2001c: 1). Despite land and water-related challenges, presently urban agriculture is both extensive and intensive (ibid). Urban farmers come from all walks of life. From highly placed government civil servants to the most disadvantaged informal settlement dwellers (MLOZI, 1995: TITS, 2019). Despite the challenges faced by urban

farmers in accessing marginal land and water, they dynamically adapt to urban expansion to persist. Meanwhile, cities continue to expand on valuable agricultural land that could otherwise guarantee their food security (HALLORAN, 2013: GÜNERALP, 2020).

Urban agriculture offers to open the possibility of food security and food sovereignty, and it is anticipated that it will grow in the future, helping to create a low-carbon economy by reducing the quantity of fossil fuels consumed in transportation and shortening supply chains (FERREIRA et al., 2018). Urban Agriculture can play a pivotal role and has the potential to deploy win-win situations by closing loops within the urban areas, helping to solve pervasive and enduring urban problems such as the disposal of organic waste, treated wastewater, and whenever possible the use of grey water (DEELSTRA, 2000: MHACHE, 2019: WESSELOW 2020). Therefore, upgrading agricultural activities through a supportive policy framework in the cities and surrounding areas is more prominent, particularly for urban dwellers. It allows for the improvement of key features for the functioning of urban ecosystems that are expected to increase the performance of environmental services provided by the Green Urban Infrastructure (AZUNRE et al., 2019).

Producing leafy vegetables which are highly prone to heavy metal contamination, particularly within polluted urban areas can improve the environment and thus, provide an excellent opportunity to improve the present-day and future sustainability of cities. Local food production and consumption can reduce greenhouse gas emissions and increase rates of carbon sequestration (KULAK, 2013). Leafy vegetable farming can provide crucial ecosystem services related to macro and micro climatic conditions. It acts as an agent for reducing the urban heat island effect, resulting in lower air conditioning costs. Leafy vegetable farming further absorbs dust and clean the air, as well as control noise. It not only supports environmentally friendly practices such as the reuse of kitchen waste can be reused as fertilizer, resulting in less waste collection costs and landfill deposition. Also, leafy vegetable farming has the potential to reduce the problems associated with stormwater runoff, since rainwater can be redirected to these areas; promoting water recycling and reuse solutions (KUMAR, 2019). For this matter, the identification of suitable land for best urban agricultural practices is needed to ascertain its sustainability both for food security as well as environmental protection (YACAMÁN, 2020).

1.2 Statement of the Problem

Recent trends suggest that Dar es Salaam city is expected to become a mega city by 2030 (TODD, 2019). A sustainable approach to food security is crucial to coping with the ever-growing city's demand for leafy vegetables which outweighs the current production. A geospatial analysis of the areas for urban agriculture that is supported by several infrastructural, social and environmental policy strategies is essential in meeting the leafy vegetable needs of town dwellers. To make the city one step more sustainably food secure, detailed investigations have to be done to propose the best sites for practising Urban Agriculture. This study utilized geospatial methods to suggest the best sites for practising Urban Agriculture, particularly leafy vegetables to make the city sustainably food secure.

1.3 Research objectives

1.3.1 Main objective

1. To perform Geospatial analysis for Urban Agriculture Sustainability in Dar es Salaam.

1.3.2 Specific objectives

1. To identify possible criteria for agriculture practices suitable for Dar es Salaam city

2. To integrate different criteria in a Geographical Information System platform and evaluate it based on Analytical Hierarchy Process methods.
3. To determine the various leafy vegetables farming zones in Dar es Salaam by synthesising the soil type, slope, aspect, population density, road infrastructure and unemployment.

1.4 Structure of content

This study consists of five chapters. The first chapter is an introductory part that presents the research problem, the aim of the study, the research questions, and the overall organization of the thesis. The second chapter presents the literature review and the theoretical and conceptual framework which guided this study. The third chapter points out the methodology of the study. It entails the methods for data collection and analysis, challenges encountered in research, and the validity and reliability of data. The fourth chapter presents the findings and the discussions which are put forth in answering the research questions in chapter one of this thesis. The final chapter five entails the conclusion and recommendations for policy action

2. Literature review

2.1 Sustainable urban agriculture in developing countries.

The rural-urban migration has increasingly been observed in both developed and developing countries across the globe (SELOD, 2021). This trend leads to a lot of problems like; decreasing agricultural production efforts, rapid urbanisation, informal settlements, food shortage and unemployment (D. LISTYA, 2016). Simultaneously with the availability of idle land, unemployment and the growth of cities, a new type of agriculture has emerged; namely, urban agriculture (STEENKAMP, 2021). The functions of urban agriculture are multi-functions based on economic and social roles such as providing industrial inputs and employment simultaneously. The potentiality of urban agriculture in the essence of counteracting the current situation the following can be described; (1) Agricultural activity will continue to be a strong contributor to urban households. Currently, differences between rural and urban livelihood households appear to be decreasing. (2) Urban agricultural production includes aquaculture, livestock and Floriculture (F. ORSIN et al, 2016: LI, 2021). The commonest crops are perishable leafy vegetables, particularly in our region of Dar es Salaam, Tanzania. These vegetable industries have short marketing chains with lower price differentials between farmers and consumers than longer chains (W. MAGIGI, 2013: THOMAS, 2022). In Dar es salaam vegetables are not transported long distances unless they are sold around the street in the afternoon whilst carried in big baskets called "Matenga". This project resembles the study that has been done in Oakland, USA, whereby the city food supply function is one of the various roles and objectives of urban agriculture. The study noted that leads there has been an increasing dialogue between urban dwellers, city authorities and farmers (HUBERT et al, 2010). This study also refers to the study of (SCHMIDT 2011) which has been done in Sub-Saharan Africa, particularly Kenya whereby; urban agriculture, which includes both crop production and livestock raising, has been recognised as serving an important role in the economic, social, and dietary life of many cities.

In addition to being an important source of fresh leafy vegetable produce, meat, and dairy products for consumers, it plays a vital economic role as a source of income for producers and distributors and also serves as a socialising function for farmers, communities, and neighbourhoods (DE ZEEUW, 2011). Urban In addition, urban agriculture has several secondary impacts, including reducing food transportation costs and providing environmental benefits (ZULFIQAR et al., 2019. Any kind of agriculture is supported by the landscape and climatic conditions. In so doing, conventional agriculture is done depending on the season. Urban Agriculture in Dar es Salaam is

still conventional in greater percentage than modern technological methods used (B. BERSAGLIO et al, 2014).

2.2 Soil type, Slope and Wetland in Urban Agriculture for leafy vegetables

The rainfall seasons in Dar es salaam affect can automate urban agricultural activities meanwhile soil types with different components have great impacts on the cultivation of leafy vegetables. Due to water scarcity in this town, many farmers like to use the lowlands as the best area for farming leafy vegetables (S. SCHMIDT, 2012). Many sold vegetables that you can find in the markets of Dar es salaam have been cultivated in the existing gardens within valleys along riversides, larger peri-urban plots and a bit of ground not built on around the city (M. WEIGERIF, 2014). The soil analysis and preference should be considered before cultivating in urban agriculture particularly on leafy vegetables as stated in the study conducted by (NABULO et al, 2012) in Kampala City Uganda. There was considerable variation in metal uptake between vegetables against soil components properties. Washing leafy vegetables reduced chromium and lead concentrations but exogenous contamination of leaves also depended on the vegetable type. The soil type assessment, and the aspect of due to rapid vertical and horizontal growth of urban areas, are very important when we prefer the site of urban agriculture. Some types of soils are more resilient to toxic pollution whereby it prevents toxic metals and other hazards on leafy vegetables. This project employs NABULO et al, theorisation (2012), for the soil analysis and preference. However, Dar es Salaam is facing great land pollution and space-owning conflicts, which led to the challenges of soil type analysis but more mitigations have a loophole to take part comprising huge land conflicts and grievances. The invasions of buffer areas and open spaces have deteriorated the City planning Map and this is a great challenge in infrastructure development particularly in the transport sector.

2.3 Population density and road infrastructures in Dar es Salaam

Dar es Salaam's urban spatial expansion and residential area growth have been affected by transportation demand and infrastructure growth. It also found that enormous spatial expansion has caused dramatic changes in the daily share of travel modes and that these disparities have occurred concerning urban growth and transport. This project study refers to the study of (MKALAWA et al., 2014) that said "Development initiatives and policies over time have not successfully solved this problem", It is still a problem that needs alternatives. Some areas in Dar es salaam can't be outreached by road access. It has squatter plots and informal settlements. For that matter, it is needed to include transport and road access as criteria in determining sites of urban agriculture in Dar es Salaam. This project adapts the study of MKALAWA et al, (2014), study as a literature reference to achieve urban site outreach and leafy vegetable transportation. Tanzanian cities, particularly Dar es Salaam, have urban agriculture practised poorly and at a subsistence scale despite the activity in other cities of the world playing significant roles in urban populations (MHACHE, 2019). Engagement in the activity at a large scale depends on many factors. It has been observed that land administration practices create an impediment to the expansion of urban agriculture in the city of Dar es Salaam. This has been explained in the study of (KIDUGA et al, 2016).) both theoretical and empirical issues of land administration in relation to vegetable growth in Dar es Salaam city. The real situation that challenges Urban Agriculture in the case of the geographical landscape in Dar es salaam is about regulations of land ownership. The regulation is overwhelmed by political interest and entails ignorance of understanding governmental laws among the dwellers. These situations lead to informal settlements everywhere and invasion of the buffer zone. This project employs KIDUGA et al., 2016 as the literature reference of this project study. Dar es salaam has a coverage area of 1590 kilometre square that is divided into Urban and per-urban (J. BRIGGS,1991). Due to the challenges of Informal settlements and the rapid growth of impervious landscapes, needs GIS use to analyse suitable areas for Urban Agriculture.

2.4 Urban Agriculture and Unemployment in Dar es Salaam.

Unemployment as a global threat is at an alarming state affecting people, especially the youth despite them being vibrant assets. Youth made up about 60% of the unemployed people in Africa in the last decade (KWEKA/FOX, 2011 PP1). Reports reveal only 60000 annual formal jobs are created out of 900000 incomings in Tanzania (SHINDIKA/DAUDI, 2020) Urban agriculture plays a vital role in generating new employment opportunities in various parts of the world hence improving the social status of the people (KWEKA/FOX, 2011). People in the closest proximity to the city can benefit directly or indirectly through their participation in urban agriculture. As for Dar es Salaam, there is an intense rural-to-urban migration of the youth. The motive behind their migration is searching for better pastures in the city as Dar es Salaam is a premier metropole city in the country. They face challenges in the city since they are socially and economically unstable (MBONILE, 2018). This gives a call for the increased unemployment number in Dar es Salaam. This research envisaged exploring the unemployment status in Dar es Salaam and proposing an alternative to their unemployment status by performing urban agriculture.

2.5 Integration of geospatial analysis

Just like conventional agriculture, urban agriculture utilizes geospatial tools for impressive applications (WEERAKOON, 2014). Geospatial tools like Geographical Informational Systems (GIS) and remote sensing have provided urban agriculture with a wide range of applications mainly to allocate suitable areas for performing urban agriculture. Physical parameters such as aspect, slope, lithology and soil types can be mapped with better accuracy with the aid of remote sensing (HERNANDEZ 2020). Not only strictly confined to physical parameters, anything with a spatial component and has a value in one way or another in urban agriculture, can be analysed in GIS. Hence, the integration of geospatial analysis in urban agriculture is a robust technology which is unequivocally applied with significant results (APPEANING, 2010).

2.6 Conceptual Framework

HERNANDEZ (2020) generated a conceptual framework of a model to perform suitability analysis for land allocation using Multicriteria Evaluation (MCE). MCE combines information from various criteria for decision-making intention. Hence, the input is the informational criteria and the output is the resultant decision. This study utilized physical factors such as soil types, aspects and slope to allocate individual suitable physical conditions of Dar es Salaam. This means, soil types, aspect and slope are classified according to their suitability in Urban agriculture. Moreover, urban factors such as road networks and population density are considered. Road network has a direct effect on the distribution of products while population density affects the labour-power in Urban agriculture. Getting to the unemployment rate as a social factor has a direct impact on ensuring direct labour-power by the unemployed people opt for urban agriculture for living and well-being. The inputs to the model include physical factors, urban factors as well as social factors. These factors acted as independent variables in the model. The factors were synthesized to generate a geospatial model which acts as a dependent variable. The most peculiar fact about the model is encountering the effect of urbanization and social effects on physical factors ensuring sustainability between the three (Figure 2.1)

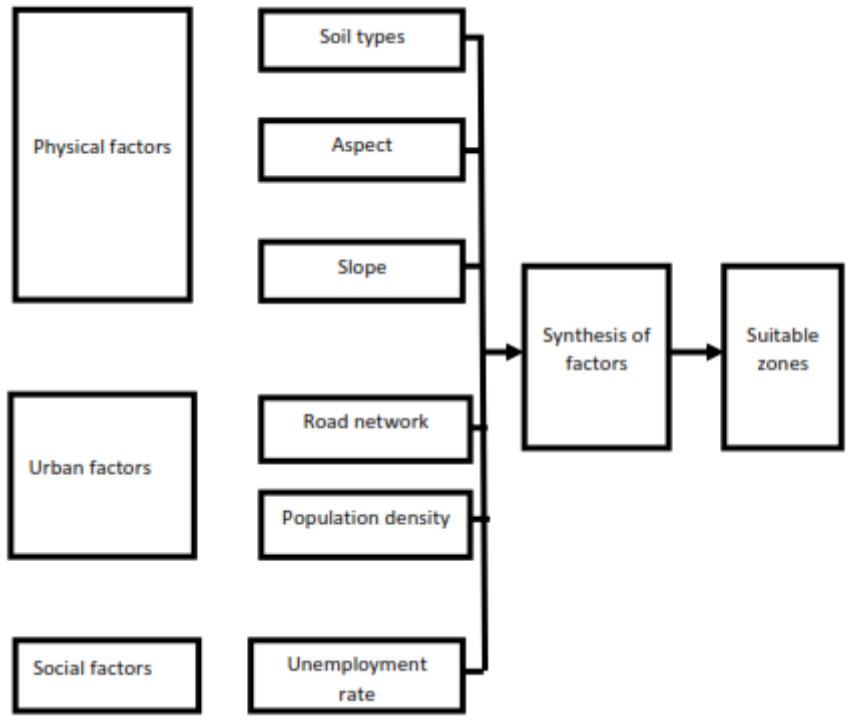

Figure 1: The Conceptual framework showing the integration of physical, urban and social factors for urban agriculture (Source: Modified according to HERNANDEZ, 2020**)**

3. Methods

This section entails the research methods adopted in undertaking this study. The selection of the case, data collection, and data analysis methods.

3. 1 Location of the Study area

This study is performed in Dar es Salaam city, Tanzania. Dar es Salaam is located along the coast of the Indian Ocean and it is the biggest city in Tanzania by population, trade and infrastructure. It is estimated to have a population of 5383728 in 2022 (NATIONAL BUREAU OF STATISTICS, 2022) (Figure 3.1).

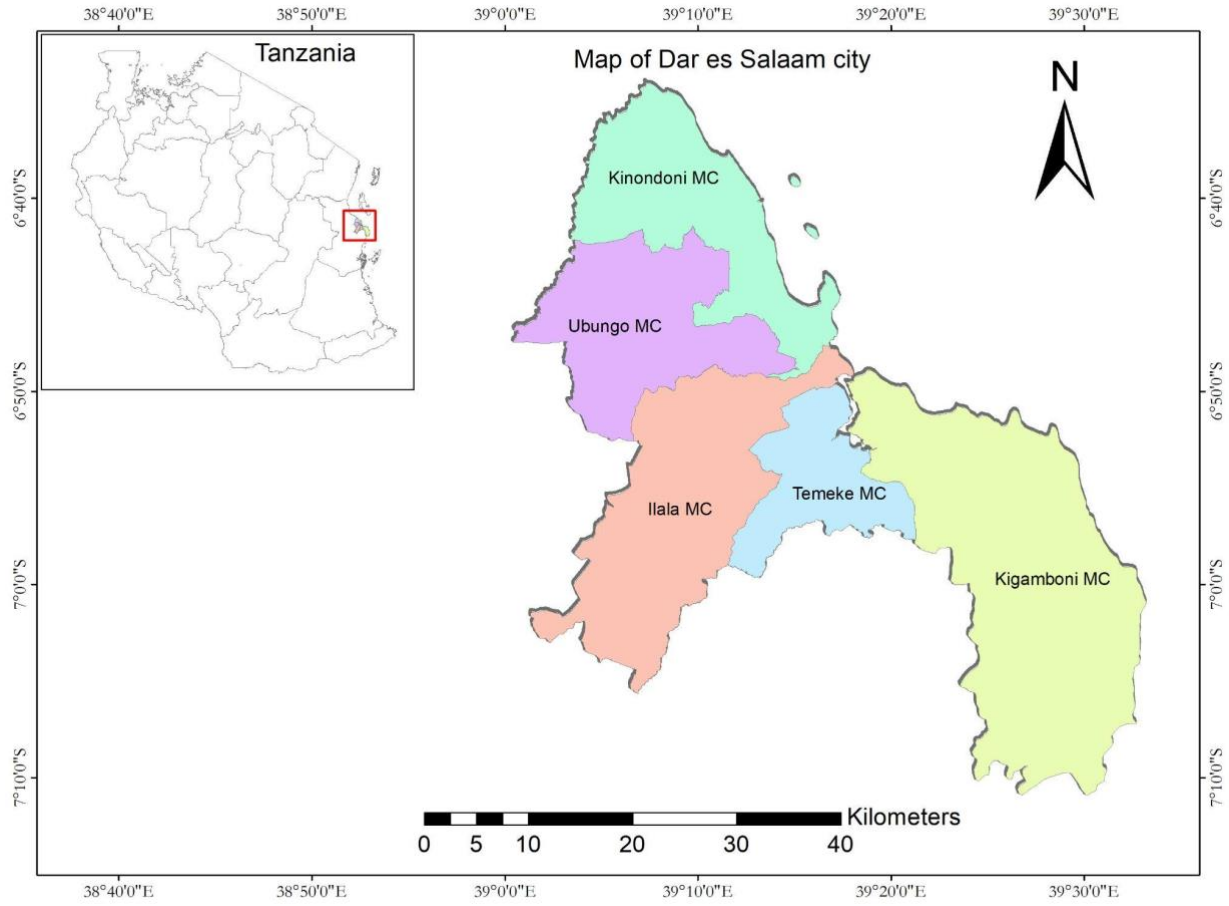

Figure 2: Location of Dar es Salaam city in coastal Tanzania (Source: Own map presentation, data basis according to NATIONAL BUREAU OF STATISTICS, 2022**)**

3.2 Data collection

The data needed in this study are slope, aspect, Population density, Unemployment rate, Road network, and soil types of Dar es Salaam city. The slope and aspect data were derived from the Digital Elevation Model (DEM) downloaded from the USGS Earth Explorer. The population density, road network and unemployment rate data were requested from the National Bureau of Statistics (NBS) of Tanzania. The soil types data were requested from the Ministry of Agriculture office in Tanzania. That being said, all the aforementioned data are secondary.

3.3 Data analysis method

After data is acquired, the core analytical method employed is the Multi-Criteria Evaluation (MCE). The data acquired is taken as the criteria/ inputs to the model. The data is standardized to the common scale using a feature priority rescaling formula for slope, aspect, population density, unemployment rate and road network (Equation 1). The soil types are reclassified according to their suitability in agriculture.

$$S = \frac{Fi - Fmin}{Fmax - Fmin} \quad \text{.....Equation 1}$$

Where,

S= Standardized layer of evidence

Fi = i^{th} ordinal object features

Fmin = Minimum ordinal object feature

Fmax = Maximum ordinal object feature

The data is then weighted using the Analytical Hierarchy Process (AHP). AHP embarks with generating a pairwise comparison matrix using a 9-point scale. Two criteria are compared at a time, normalized then averaged to compute weights. The weights must be undertaken for a consistency test before the next stage. The accepted consistency ratio should be <1%. The whole AHP was automated using the Idrisi TerrSet software. The last step is aggregating the standardized layer and its weight using Weighted Linear Combination (WLC) (Equation 2).

$$* = \sum_1^n (S * W) \quad \text{..... Equation 2}$$

A* = Aggregate of the criteria

S= Standardized score

w = weight of the criteria

3.4 Challenges

The challenges encountered in this study are as follows

- The availability of the data is quite challenging as some of the potential data were not provided and some were provided late. Interpersonal communication between the team and designated data providers eased the process.
- Some of the data were given on a varying administrative scale, making inconsistency in the scale of the data. For example, the population data is given at the ward level, while the unemployment rate is given at the district level. We couldn't have the data on the same scale hence some data were analysed at a district level while others were at a ward level.

3.5 Data Sources

This study being geospatial in nature necessitated the utilisation of secondary data. The data come from official sources in local and international authorities. The local data has been requested from the National Bureau of Statistics (NBS) and the Ministry of Agriculture of Tanzania. Some of the data have been downloaded from the United States Geological Survey (USGS).

4. Findings and discussions

Results suggest delineating six possible criteria to be used for geospatial modelling. They include slope, aspect, soil type, population density, road network and unemployment rate (Figure 4.1). The slope of Dar es Salaam city ranges from 0 to 2.4 degrees. The steeper the slopes, the more agriculture favourability is achieved. This is to ensure suitable sunlight, especially in tropical regions. Hernandez (2018) recommended that to sow in furrows, harvest must be done in the direction of opposite slopes. The aspect ranges from -1 to 358.6 degrees. The highly favourable regions are the regions of North (0–22.5; 337.5–360) and South (112.5–247.5). The least favourable regions are

the regions of the West (22.5–112.5) and East (247.5–337.5). The regions of the north-south directions are favoured to allow constant light as it is crucial for ensuring plant growth. Soil types range from cambic arenosols to ferrallic cambisol and haptic lixisols. The most nutritious soil types are ferrallic cambisol followed by haptic lixisols and lastly cambic arenosols (DRIESSEN / DUDAL 2001).

The population density ranges from 563,459 to 580,000,000 square units. The denser the population, the more favourable the model. The model has to ensure sustainability is achieved in denser areas by population by practising urban agriculture. The larger the population makes the struggle for food security in Urban areas. So, the aim is not only to perform urban agriculture but the dense areas could be touched with the food supply to ensure sustainability. The road network of Dar es Salaam city is well established in almost every part of the city with a few exceptions in the southern part. The road network has its relevance in urban agriculture in ensuring connectivity in the supply of materials and food supplies to people and the farming fields. The unemployment rate ranges from 11.9 to 19.8. The more unemployed the people, the more favourable the model. Unemployed people can utilize urban agriculture as a means of establishing their lives economically. The criteria were then rescaled to a common scale of 0 to 100. A score of 0 signifies the least favourability to a score of 100 signifying the favourability of the criteria (Figure 4.2). The standardized maps now decipher the same level of judgment in all the criteria.

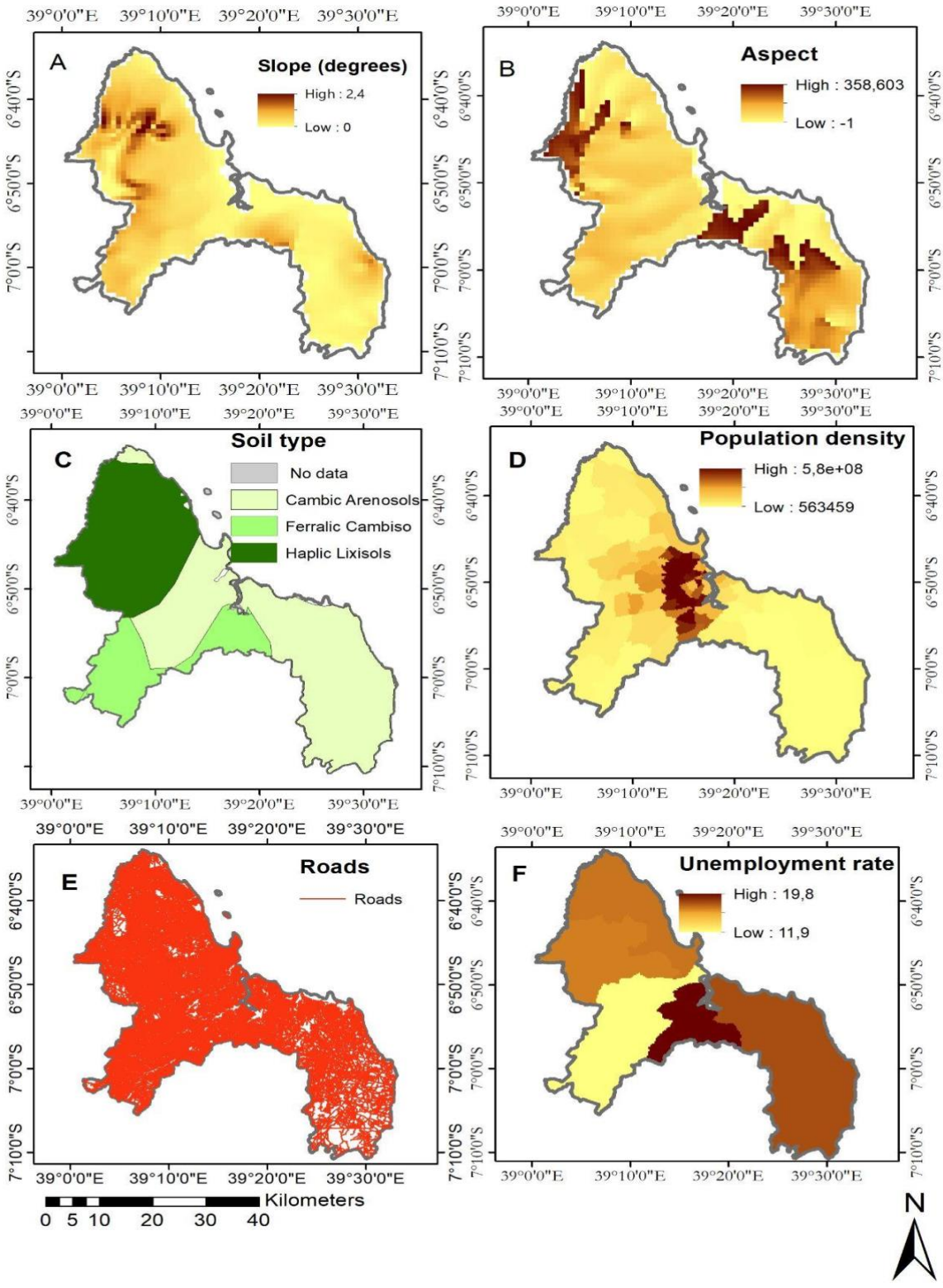

Figure 3: Layers of evidence for Urban Agriculture, created by MWENDENUSU et al. 2022

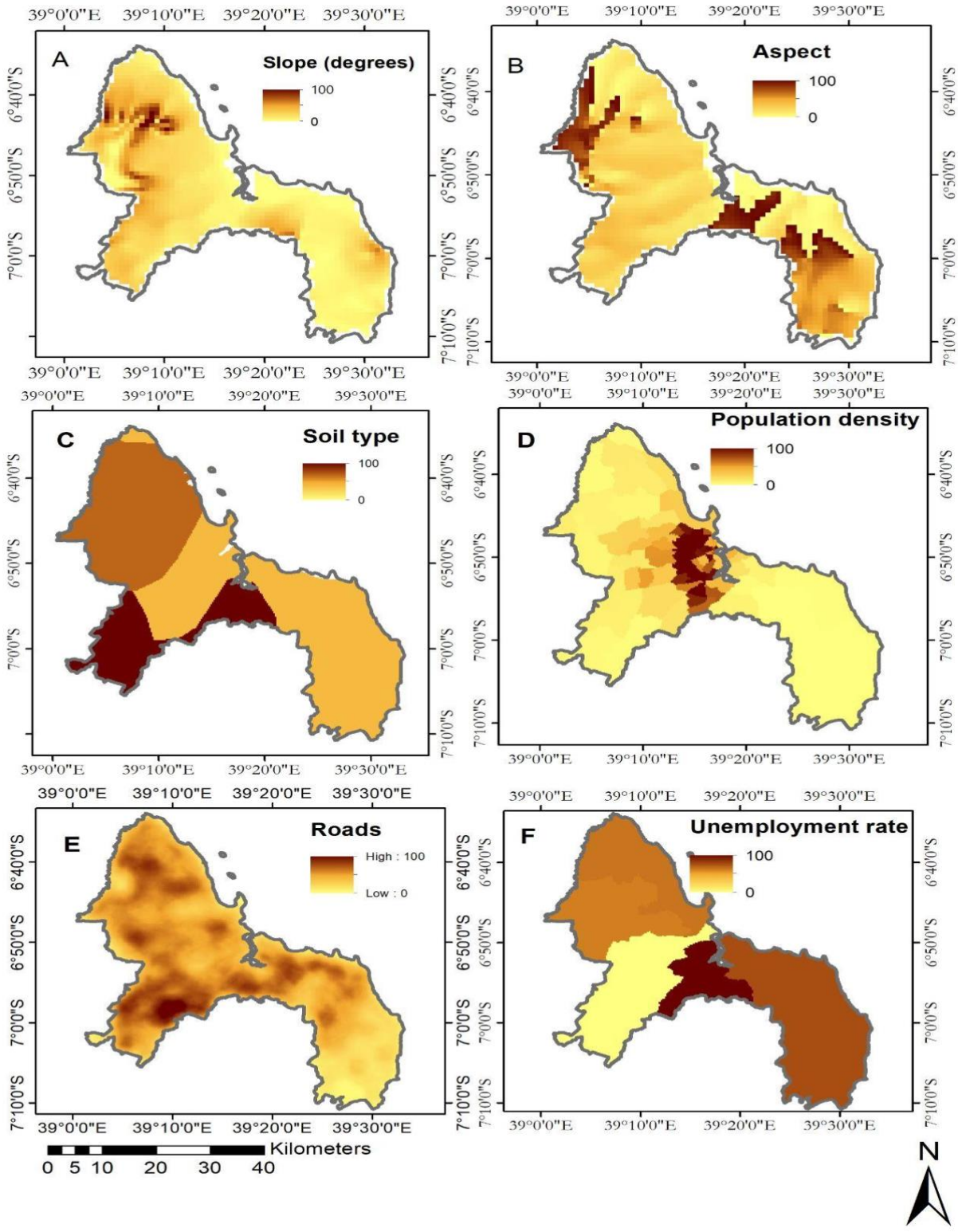

Figure 4: Standardised Layers of Evidence for Urban Agriculture, created by MWENDENUSU et al. 2022

Results from AHP suggest the level of importance of the criteria in contributing to the model. The level of importance is according to the order of slope > population density > aspect > unemployment > soil types > road network (Table 4.1). To assess the consistency level of the weights, a consistency ratio of 0.03 was computed revealing a very good accepted ratio since it is less than 0.1. Physical factors were highly prioritised since they are subjected to lesser changes.

Criteria	Slope	Population density	Aspect	Unemployment rate	Soil types	Road network
Weight	0.45	0.24	0.14	0.09	0.05	0.03

Table 1: Level of importance of the layers of evidence (results based on analysis)

The suitability map reveals areas which should be taken under close consideration as far as urban agriculture is sustainably practiced (Figure 4.3). These areas are denoted from low suitable to high suitable. Suitable zones cover 27%, moderately suitable zones cover 45% while low suitable zones cover 28% of Dar es Salaam city.

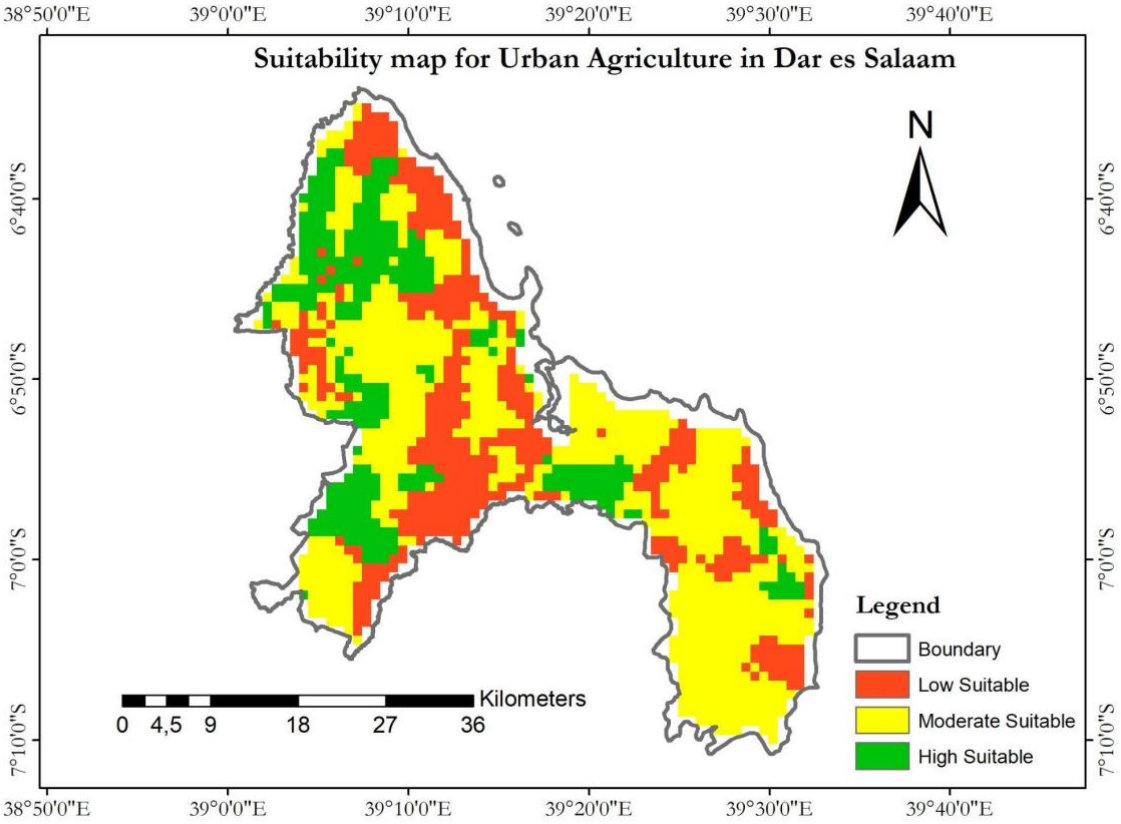

Figure 5: Suitability Map for Urban Agriculture, created by MWENDENUSU et al. 2022

High-suitable zones signify areas in Dar es Salaam where urban agriculture could be practiced sustainably with physical, social, and urban factors being taken into consideration. In other words, these areas have steeper slopes, have ensured constant sunlight, have high road connectivity to ensure supply of materials, have a high unemployment rate and high population density in which people in these areas could benefit from practicing urban agriculture. The level of suitability is moderate in these factors in the moderately suitable zones and low in low zones. This is a call to the areas to emphasize urban agriculture to people especially the youth to minimize the problem of unemployment and food insecurity to ensure sustainability. For the model to work efficiently, a conducive environment has to be made for people in Dar es Salaam city to emphasize them in practicing urban agriculture in the magnitude from the highly suitable areas to low suitable areas.

Heavy education should be imparted to the people of Dar es Salaam, especially to the youth. Simple local techniques which result in maximum productivity, simple machinery and techniques of

sustainable monitoring of the farm should be emphasized in an environmentally friendly manner. Production knowledge goes in hand with marketing techniques. Observations on youth civic engagement programs in the USA have viable impacts on social justice, food security, social interaction and interpersonal youth development (RUTH/ GAUS, 2021). The USA through the state government and Non-Governmental Organizations (NGOs) has made more investments in youth outreach programs through unpaid internships, fellowships, short-term assignments and paid assignments (MCCABE, 2014; FIFOLT et al., 2018). Dar es Salaam and Tanzania at large should also apply the same to invest in the youth in the age range of 12 - 18 at school for the future upwelling of people in a nation as urban agriculturalists. But also, the matured minds of the age range of 18 onwards can be changed through similar involvement. The Tanzanian government has made agriculture a subject at the secondary level. More improvements should be done to the syllabus to include Urban Agriculture. Since in the theoretical model, highly suitable areas are densely populated, more advanced techniques such as vertical farming and the like techniques which encounter the farm space problem have to be emphasized.

Since the targeted beneficiaries of the model are mostly unemployed people in Dar es Salaam, they need financial assistance to grasp the knowledge they will be imparted into practice. The financial assistance will aid in equipment and materials for production and supply. A crucial role has to be played by financial service providers in close collaboration with the local government authorities be it, in terms of loan assistance or in terms of grant assistance. Rather than obtaining limited funds to family and friends as a normal practice for most of the farmers in the country, sufficient funds should be provided to the local farmers in the city from the financial service providers. Most people have an unrecognized status which builds a huge gap between the financial service providers and the farmers. Preliminary initiatives should be made to the local government authorities to register youth and recognize them which will ease the financial authorities in providing financial assistance.

5. Conclusion and recommendations

The main objective of the research was to perform a geospatial analysis of urban agriculture practices in Dar es Salaam city. The first specific objective was to identify possible criteria to be used for sustainable urban agriculture. The second objective was to integrate the possible criteria. The third objective was to identify suitable zones for performing urban agriculture.

Six possible criteria were identified for sustainable urban agriculture in Dar es Salaam. These include physical factors (slope, aspect and soil types), urban factors (population density and road network) as well as social factors (unemployment rate). These acted as layers of evidence in generating a geospatial model. As a prerequisite for integrating the layers of evidence, the criteria were weighted to generate their level of importance using AHP. Results suggested that slope to the weight of 0.45, population density to the weight of 0.24, aspect to the weight of 0.14, unemployment rate weight of 0.09, soil types have a weight of 0.05 and road network weight of 0.03. Suitability analysis revealed 27% of Dar es Salaam to be highly suitable, 45% to be moderately suitable and 28% to be least suitable. Despite the geometric increase in population, these highly suitable zones can be taken into high consideration in performing urban agriculture to ensure food sustainability as well as minimise the rate of unemployment. Further research needs to be done on an individual/ward level due to a lack of adequate reliable data in all administrative levels of the cities.

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The Influences of formal and informal urban planning tools, regulations and practices shaping Urban Agriculture

A case study of Berlin, Shanghai, and Dar es Salaam

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1. Introduction

Even though urban agriculture (UA) is by no means a new trend the practice has, in recent years experienced a rise in attention in academic fields like geography or urban planning and has also been reconsidered as a useful tool by city administrations around the globe to solve various issues of urbanization. The advantages of UA include among others a higher socio-economic stability among city dwellers, an increase in food security, a positive influence on the micro-climate in the city in the face of rapid climate change as well as higher social cohesion and integration through cultural exchange (MALONEY 2013; MEENAR 2017). Additionally, the trend towards UA reflects a higher environmental awareness and a desire for a healthier living standard among the population by making use of short value chains and local production.

There is a wide range of definitions that try to pin down what exactly constitutes UA. In the broadest terms UA "encompasses a variety of economic and social activities related to food production, distribution, processing, eating and disposal [and] includes among other things, community gardens and urban farms, and their associated distribution mechanisms […]." (POLLANS 2014: 200). These activities are of course highly dependent on general policy, informal urban planning, municipal zoning, as well as specific formalized laws and regulations. Even though many cities began to realize the aforementioned potential benefits of local food production they are often still ill-equipped with appropriate land-use planning laws and policies (LOVELL 2015), that would allow and further promote the use of highly contested urban land for agriculture. Our research aims to identify how formal and informal urban planning tools and practises are hindering or facilitating the integration of UA in three different geographical contexts around the globe.

The first part will establish the current state of research when it comes to the general connection between Urban Planning / land use planning mechanisms and UA and will thus lay out the theoretical foundation that is necessary for the analysis of the case studies. The three case studies are (a) Berlin, (b) Dar es Salaam and (c) Shanghai. Each city was empirically analyzed and mapped with the help of publicly available datasets, in order to find out about different land use categories, motivations for urban farming as well as the distribution/location of UA sites within the city limits. Through this analysis the implications of different formal and informal urban planning practices on UA were laid out in order to find out which kind of planning mechanisms are shaping the identified state of UA (distribution, typical features regarding motivations etc.) in the different case studies.

2. State of Research & Theoretical Foundation

UA can be regarded as "a permanent and dynamic part of the urban socio-economic and ecological system, using typical urban resources, competing for land and water with other urban functions, influenced by urban policies and plans, and contributing to urban social and economic development" (PÖLLING et al. 2017: 366). In this way it is not an abstract thought construct, but

rather an actual urban livelihood, an ordinary and lived reality, which produces and is produced by cities around the globe. Some experts argue that there are many differences between UA in global south and north, especially regarding the motivations, with UA in the global south mainly being motivated by food security and income generation, while in the global north the main motivation seems to be community building, intercultural exchange and social well-being. There is however also the notion that differences between global north and global south are becoming less pronounced and that a more nuanced understanding of a global UA that goes beyond a productivist/post-productivist dichotomy might help illustrate processes that characterize current urban developments (WINKLERPRINS 2020). Instead of looking at UA in a materialistic sense and describing the output, the goal of this paper is to shift the focus to planning theory. By analysing where exactly UA is practiced and how access to the resource land is gained in the three very different cities Berlin, Dar es Salaam and Shanghai one of the goals is to overcome the global north/global south divide that has shaped research on UA for a long time.

2.1 The Role of Planners in UA

In planning theory UA, such as community gardening, rooftop gardening or animal husbandry is rarely given the same importance as other open green space and the result is a lack of inclusion in the city planning process or zoning to protect these practices (LOVELL 2015: 2503). This can also be seen in planning education and research, where UA only receives marginal attention, which is the reason that planners, as well as municipal offices often times do not have a complete understanding of the planning and policy implications of agriculture within the limits of a city (MEENAR et al 2017: 393). Just a few years ago Jerry Kaufmann, who is credited to have written the first ever planning guidance on food and the city expressed himself as follows:
"Food is a sustaining and enduring necessity. Yet among the basic essentials for life—air, water, shelter, and food—only food has been absent over the years as a focus of serious professional planning interest. This is a puzzling omission because, as a discipline, planning marks its distinctiveness by being comprehensive in scope and attentive to the temporal dimensions and spatial interconnections among important facets of community life". (American Planning Association Policy Guide on Community and Regional Food Planning (APA 2007) as cited by VILJOEN/BOHN 2021: 32).
While, in recent years, some municipalities have taken action to fund programs, donate land or establish protective zoning, others still have opaque and poorly defined regulation (MEENAR 2017: 394). The arising/existing policy vacuums can be sources of ambiguity for practitioners, who are seeking clear regulations and stable places to farm (MEENAR 2017: 394).
There is evidence that although urban agricultural activities have mostly been established through grass-roots efforts in a bottom-up way, the incorporation of this land use into planning and policy (as a top-down approach) might be able to maximize the multifunctional benefits (LOVELL 2015: 2515). Table 1 shows examples of three different top-down planning strategies that support UA in the third column, as well as the benefits that arise from this in the second column.

Function	Description and Justification	Supportive Planning Strategies
Production	UA produces fruits, vegetables, mushrooms, herbs, medicinal plants, meats, milk, cheese, eggs, and other products.	Provide suitable, accessible, and safe land with good solar access and an irrigation source.
Biodiversity	Agricultural systems can support a wide range of species, including some native plants, as crops or associated plants.	Convert some open space areas of low diversity (i.e., turf) to community gardens and farms.
Urban Greening	Community and backyard gardens contribute to the greening of urban areas, improving aesthetics and well-being.	Support efforts to convert vacant and derelict lands into productive green spaces for use by residents.

Table 1: Examples of how urban planning can support various functions of UA (Source: LOVELL 2015: 2503)

In Berlin for example a lack of supportive planning strategies can be observed in the case of community gardening, which can be classified as a subcategory of UA and is analyzed in chapter a of this paper. Strategic planning papers like the 'Flächennutzungsplan für Berlin – FNP-Bericht 2020', the ‚Stadtentwicklungsplan Klima KONKRET' as well as the ‚Strategie Stadtlandschaft Berlin' only mention UA as a side note to other green space development, without specific goals or action recommendations. Nonetheless there is a lot of informal support for community gardening in Berlin, with projects mainly being cultivated by different non-government associations, initiatives and groups of volunteers on vacant lots or other available green spaces. The example of 'Himmelbeet' shows that this kind of bottom-up placemaking through citizen-control has the potential to challenge issues of exclusion, by bringing together people of different socio-economic or ethnic backgrounds (KARGE 2018). On the other hand, these kinds of projects run the risk of being displaced or underfunded, as they are simultaneously tolerated and receiving soft support by the state, while at the same time there is a lack of official regulations and laws to actually protect them. When it comes to the provision of space for urban farming, the government can, in this case, be seen as an intermediary, that is not providing land, but rather communicating between private gardeners/volunteers and the tight land market in Berlin.
In Shanghai UA is well developed, but takes a different form than in Berlin, with arable land being located mostly on the outskirts of the city, in so called 'peri-urban' areas (WHITE 2017: 4) and a more economic motive in farming. Even though there are also issues of arable land being displaced

for commercial and industrial development the Shanghai Master Land Use Plan 2017-2035 provides a framework for a more formalized and integrated development, with non-cultivation use being strictly prohibited in some areas and supplemental land being supplied in other areas.
The last case study in Dar es Salaam shows that while a high percentage of the city's population is employed in the production of food there is no clear government documentation or legal environment, which leads to agricultural activity being mostly done in an unregulated manner. As a result, land used for these activities is at risk of being replaced by infrastructure.

2.2 Formal urban planning tools and UA

Zoning and land-use laws are formal urban planning tools regulating land-uses in order to ensure a sustainable urban development (ARL 2022). Zoning and land-use laws vary significantly in different geographical contexts but mostly have the same components, dividing municipal land into land-use zones, each with prescribed rules regarding the type of use and design requirements, such as (VOIGT 2011 547):

- Building height limitations
- Yard restrictions
- Restrictions on selling goods
- Requirements for how far buildings must be set back on the property
- Etc.

This of course has a profound impact on UA, even if it is not explicitly mentioned in the regulations/laws, if for example certain structures like green houses are not compatible because of their size or placement. Because zoning "ideally functions to ensure compatibility and stability amongst land uses, balancing the needs and desires of the community" (MALONEY 2013: 2568) it is also a perfect tool to coordinate the benefits and problems of UA that is being practiced close to residential, commercial or other uses
Additionally, UA is often time practiced without permission or long-term commitment of the landowner or manager, with marginalized groups being particularly vulnerable to problems of land access and security (LOVELL 2015: 2511). A reworking of zoning laws might help UA to move from its place as a temporary/interim use to a more formalized and secure one, when appropriate and realize its potential regarding for example food security or social cohesion. In this context the following table proposes different policies and actions in order to promote UA by adjusting zoning or land-use planning regulations.

Objective	Policies/Actions
Encourage appropriate agricultural uses of urban land.	• Adopt zoning regulations that clearly define UA to include the cultivation of fruits, vegetables, flowers, nuts, and like products, as well as raising farm animals. • Adopt zoning regulations that discourage health and nuisance hazards sometimes associated with agricultural activities, which may include setback requirements, yard size requirements, complaint procedures, or permitting procedures. • Appoint a government employee in an appropriate agency who can serve as the point person on urban agricultural questions for residents.
Promote more widespread use of UA.	• Identify additional zoning districts that would be appropriate in which to allow UA. • Expand community gardening opportunities.
Encourage residents to use UA as a tool for economic development.	• Adopt zoning regulations that allow UA as a home occupation in appropriate districts. • Allow the on-site and off-site sale of products from UA where appropriate.

Table 2: Exemplary steps to protect and expand UA (US- American context) (Source: VOIGT 2011: 562)

In general, it can be said that, zoning laws around the globe have reached a high level of complexity, which often makes UA more difficult and as a result municipalities often prohibit all agriculture or fail to mention whether agriculture is allowed or prohibited (MALONEY 2013: 2572). As a possible solution zoning regulations could treat UA as a district, or as a set of uses that are permitted, conditional or forbidden, while of course also taking into account the different needs and desires of the specific community (MALONEY 2013: 2571). For zoning conditions like planting crops, raising animals or selling produce there is no 'best practice' that is applicable to every city, which is why it is important for planners to recognize the benefits or disadvantages of UA, in order to make informed decisions for their specific location. Working closely with different stakeholders, including potential urban farmers, is the key to revise the old and often inadequate municipal zoning regulations.

2.3 Informal urban planning tools and UA

Besides zoning and land-use planning as formal planning tools, informal planning at the local level plays an important role steering sustainable urban and rural development. Basically, informal planning tools, such as master plans or urban development plans prepare alternative planning and are taken into account in the preparation of formal planning (land use plans) (PAHL-WEBER et al. 2008: 49). In the German context especially urban development concepts gained importance steering the sustainable urban redevelopment of German cities, integrating various measures for a

long-term strategy for the entire city (ibid.). Typical examples of such urban development concepts are transport and mobility or free space concepts. In this context it is of great importance whether informal planning tools, such as urban development concepts aim at strengthening the integration of UA and what measures are implemented in order to reach this goal. Informal planning tools obviously do not have the power to ignore or overcome regulations by formal planning but influences decision-making in formal urban planning and strengthens specific land uses with a set of different measures (financial support, strengthening specific constellations of actors etc.).

3. Case Studies

3.1 Berlin

Methods and Data: Berlin

Berlin is the capital city of Germany with 3,677,472 inhabitants and spans over an area of 891.1 km² (BERLIN-BRANDENBURG STATISTICS OFFICE 2022). Settlement areas make up 55 percent of the city's administrative area with 493.4 km². Traffic areas contribute to Berlin's infrastructure with 135.5 km² which equals 15 percent of the city's administrative area. 157.8 km² or respectively 8 percent are forest area. Agricultural land is supposed to be 35.7 km² according to the BERLIN-BRANDENBURG STATISTICS OFFICE (2019). Therefore, agricultural land makes up 4 percent of Berlin's administrative area. Per definition by the statistics office agricultural land is: "[…] an area for the cultivation of field crops and an area that can be grazed and mowed, including areas cultivated with special plants"' (BERLIN-BRANDENBURG STATISTICS OFFICE 2017: 26).
To identify and locate urban agricultural sites in Berlin we used volunteered geographic information from Open Street Map, the services database BerlinFinder and the map of Berlin community gardens. Open Street Map provides keys and tags to label data entries by volunteers and has a wiki page dedicated to food security that touches upon UA and provides us with keys and tags to query to locate UA sites in Berlin. The BerlinFinder application allows the user to search for addresses, stores and service providers in Berlin. We tried different search terms such as "UA", "urban farm" and "urban gardening" and scraped the results using Octoparse 8, including names, addresses and weblinks of the UA sites. Web scraping is a method to extract data from websites and save it to a file for further analysis (ZHAO 2017: 1). Octoparse 8 is an application that enables this technique of data collection. The map of Berlin community gardens is an open database dedicated to the compilation of community urban gardening projects in Berlin. The database builds upon multiple sources such as activist mappings and Berlin UA literature. Moreover, users can extend the database. In addition to the names, addresses and weblinks of the urban community gardens the status and type of the garden are available and were again scraped by us using Octoparse 8.
Eventually, we compiled our results in a spreadsheet and geocoded the addresses, giving us approximate markers for UA sites in Berlin. Duplicates were then identified and dropped in case of similar or equal names and locations. Finally, we added UA sites that were not in our dataset yet but known to us due to prior knowledge or manual findings via google satellite imagery. The final dataset consists of 276 sites including their name, coordinates, address, web page and source. Additionally, we included the garden type and status information found in the map of Berlin community gardens. However, the map of Berlin community gardens lacks definitions of the different garden types. On the one hand, this makes it difficult for us to use and extend this field for the other sources and on the other hand makes our garden type categorization opaque. Despite these major constraints we decided to keep the categorization of garden types for our dataset, since a manual categorization of all 276 UA locations was not feasible in the scope of this project. Therefore, we decided to fill in the garden type for the UA sites with additional categories as well as categories used in the map of berlin community gardens that seemed fitting. We decided on the category based on the webpage of the project. In the last step of our data preparation the locations

of UA in Berlin were plotted in QGIS. Then, we matched each project site to a land-use category according to the official Berlin zoning plan available in the Berlin Open Data Portal.

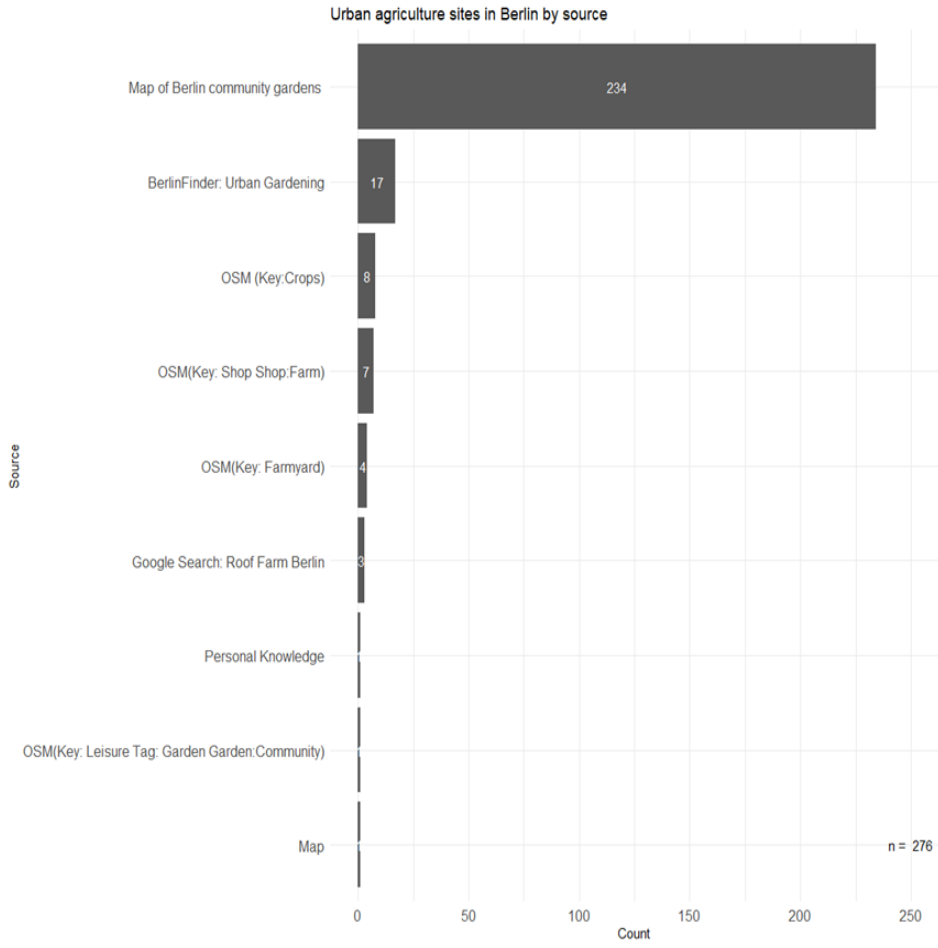


Figure 1: UA sites in Berlin by source, Source: KIEHN 2022

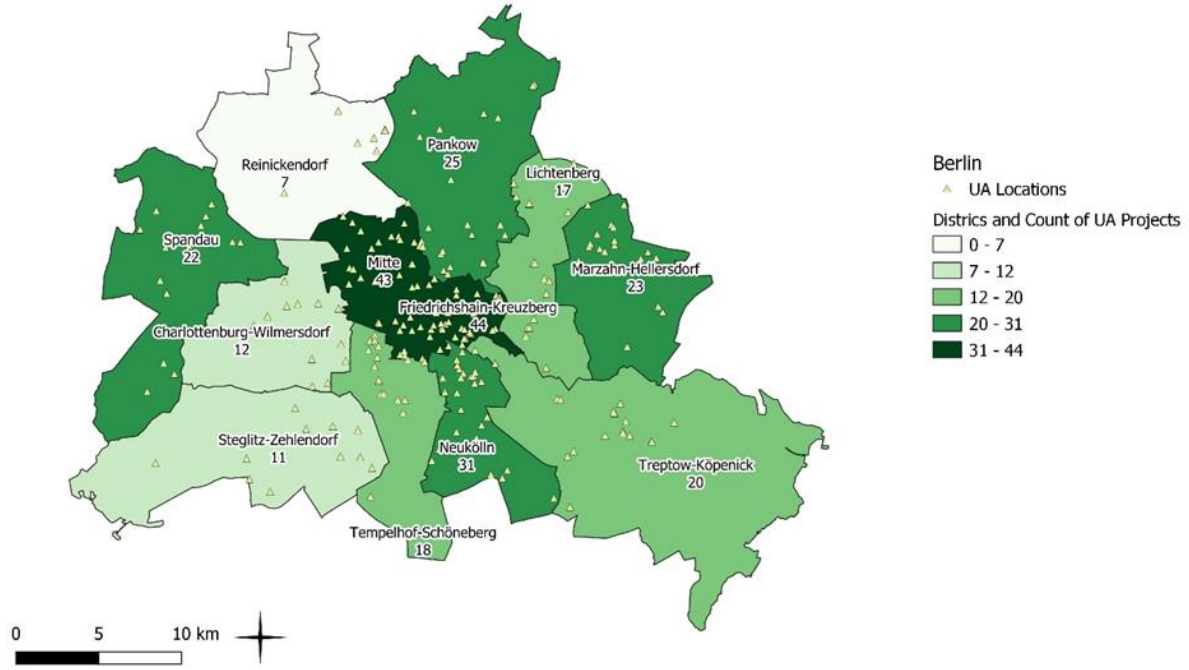
Figure 1 shows the distribution of sources in our dataset. The map of Berlin community Gardens is by far the biggest contributor to our dataset, making up 234 (= 85 percent) of the 276 total entries. The BerlinFinder application yielded 17 other sites for our dataset. Open Street Map (OSM in Figure 1) added 20 sites to our dataset with the key "Crops" being the most fertile. Personal knowledge about sites and innovative projects, i.e., roof farms, as well as one sighting in satellite imagery (Map in Figure 1) complete our dataset.

Finally, we want to emphasize that our dataset builds upon publicly available and volunteered data. We, therefore, suspect it is skewed towards community projects, since these are most often found online, especially in the map of Berlin community gardens, which is the major source of our dataset. Therefore, our study cannot highlight all UA practices in Berlin and leaves out, for example, private or individual-driven practices and sites of UA.

A major difficulty was to categorize a significant number of sites in detail. We used a mostly automated approach to collect many sites in a rather short time. However, this made it almost impossible to come up with detailed categorization, like for example suggested by VERZONE (2021), as the number of sites were too large for individual examination in a reasonable timeframe. As researchers we must accept that a city-wide online data acquisition leaves out details that can only be obtained from the ground. Additionally, despite our efforts to collect as many sites of UA as possible to paint an excessive picture of UA in Berlin, we suspect that our dataset is nevertheless skewed towards community projects and cannot highlight private practices of UA.

Results: Berlin

Map 1 shows the distribution of the UA sites in our dataset for the administrative districts in Berlin. The central districts Mitte and Berlin Friedrichshain-Kreuzberg show the biggest share of UA sites in Berlin with 43 and 44 respectively, despite their comparatively small area. Bordering district Neukölln comes in third with 31 sites, most of them found in the central city area near Friedrichshain-Kreuzberg. The main share of UA sites in our dataset are in the city center. However, fringe districts Spandau and Marzahn-Hellersdorf show that UA is also practiced at the outer edges of the city. Interestingly, the former West-Berlin districts found between city center and urban fringe show the least amount of UA in our dataset with Reinickendorf in the north having only seven sites of UA according to our dataset.



Map 1: Count of UA sites in Berlin districts, Source: KIEHN 2022

The land use categories associated with the UA sites in our dataset can be seen in figure 2. With 52 UA sites green spaces are the most prominent category in our dataset, closely followed by residential areas, W1 (GFZ (= ratio of the gross floor area of all buildings on a plot of land to the area of the plot of land.) over 1.5) with 51 UA sites. Mixed use areas and residential areas, W2 (GFZ up to 1.5) come in third and fourth with 48 and 47 UA sites respectively. After this group of land use categories, a drop off in UA sites can be seen. Superordinate main roads have 24 UA sites in our dataset and public utility areas 14. Other land use categories show less than ten UA sites in Berlin. Residential areas with an imposed smaller GFZ show less UA sites than residential areas with bigger GFZ. Also, our dataset shows only one UA site for the category agricultural area.

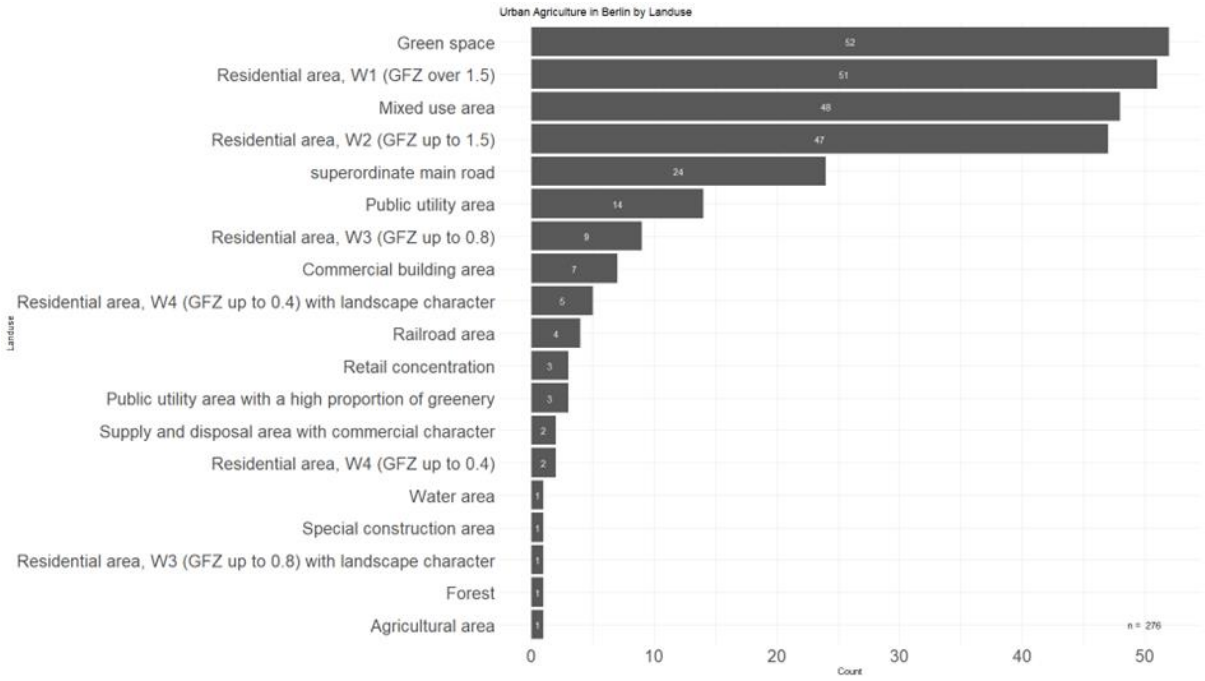


Figure 2: Count of UA sites in Berlin by land use category, Source: KIEHN 2022

In the following part, typologies are created for the most prominent land use categories: green space, residential areas W1+W2 and mixed-use areas as well as residential areas W3+W4.
Green spaces are a broad category that differ in their intended use and can be parks, cemeteries, allotment gardens, meadows or large sport facilities (SENATE DEPARTMENT FOR URBAN DEVELOPMENT 2018: 20). Of the 52 UA sites 24 (=46 percent) belong to the garden type "Community Garden". Therefore, a very common typology of UA in Berlin are green spaces where the growers are a collective of local amateurs or apprentices that produce food or plants for their own consumption. A central motive for the communities is fun. Other key motives are related to gardening as a practice, social factors such as public spirit, communication and contact within a group, spatial motives about the area and neighbourhood and lastly parenthood (ROSOL 2004: 217). In relation to the motivations listed by VERZONE (2021: 47) well-being, personal fulfilment and social motivations describe these motivations best. Other garden types in green spaces include intercultural gardens with 7 (=13 percent) sites, educational gardens and farm gardens with respectively 5(=10 percent) sites. Again, the growers are a collective consisting of amateurs and apprentices. In the case of educational gardens, maybe even some professionals. The motivations of the growers in these garden types could be more related to environmental and pedagogical goals. However, social factors play a big role in these garden types, too.

Land use category	**Green space**
Sites	Parks, cemeteries, allotment gardens, meadows, large sport facilities
Growers	Amateurs, Apprentices, (Professionals)

Motivations	Social, well-being, personal fulfilment, environmental, pedagogical
Production Entities	Collective

Table 3: Land use category green space in Berlin (results based on analysis)

Residential areas W1 refer to the densely built-up old quarters of Berlin's inner city and its outskirts. The core characteristics of this type of area are block or perimeter block development with five or more stories as well as large inner courtyards. Areas named as residential W2 in the land use plan include the large housing developments of the 1970s to 1990s. Besides four or five stories block or perimeter block development these areas also refer to taller individual buildings that offer quite generous open spaces (SENATE DEPARTMENT FOR URBAN DEVELOPMENT 2018: 12). Of the 98 UA sites in these two land use categories 61 (=64 percent) again belong to the garden type community garden. Intercultural gardens come in second with 13 (=13 percent) sites again, followed by educational gardens with 7 (=7 percent). Therefore, growers, motivations, and production entities are similar to the previous land use category only differing on their sites. We suspect most of the UA sites to be in inner courtyards and front yards.

land use category	**Residential areas W1+W2**
Sites	Yards of collective housing
Growers	Amateurs, Apprentices, (Professionals)
Motivations	Social, well-being, personal fulfillment, environmental, pedagogical
Production Entities	Collective

Table 4: Land use category residential areas W1+W2 in Berlin (results based on analysis)

Mixed-use areas are areas with high and medium density predominantly located in the core area of Berlin. Like the name suggests, mixed-use areas are designated to support a mix of different functions such as retail, public and private administration, cultural facilities and residency (SENATE DEPARTMENT FOR URBAN DEVELOPMENT 2018: 14). Of the 48 agricultural sites in this land use category 32 (=67 percent) are again community gardens. Intercultural gardens account for five (=10 percent) sites. Therefore, sites, growers, motivations, and production entities are similar to the previous land use category.

land use category	**Mixed use area**
Sites	Yards of collective housing and institutional buildings
Growers	Amateurs, Apprentices, (Professionals)
Motivations	Social, well-being, personal fulfillment, environmental, pedagogical
Production Entities	Collective

Table 5: Land use category mixed use area in Berlin (results based on analysis)

Residential areas W3 are characterized by older multi-family villas, newer small multi-family houses (town villas), groups of houses and rows of terraced houses, as well as other forms of open space-related, but dense, development with two to three, rarely four stories mostly found in the outskirts of Berlin. Extensive areas of single-family residential development on the urban periphery are shown as residential W4 which are also mostly found in the outskirts of Berlin. The complementary landscape character to these land use categories describes a formative vegetation structure or a transition to open landscape or to large urban green spaces (SENATE DEPARTMENT FOR URBAN DEVELOPMENT 2018: 13). Of the 17 UA sites in these land use categories nine (=53 percent) are community gardens, three (=18 percent) are educational gardens and two (=12 percent) intercultural gardens. Therefore, growers, motivations, and production entities are similar to the previous land use category. We suspect most of the UA sites to be at single-family housing yards, collective housing inner courtyards and front yards.

land use category	**Residential areas W3+W4**
Sites	Yards of collective housing and single-family housing
Growers	Amateurs, Apprentices, (Professionals)
Motivations	Social, well-being, personal fulfillment, environmental, pedagogical

Production Entities	Collective

Table 6: Land use category residential areas W3+W4 in Berlin (results based on analysis)

Berlin - Influence of formal and informal urban planning tools

The amount, distribution and form (e.g., motivation, growers etc.) of urban agricultural sites in Berlin is influenced by a set of various formal and informal urban planning instruments. The following section will introduce and discuss the different influences of the most important instruments, laying the foundation for a potential adjustment of these instruments in order to further promote the integration of agriculture into the urban space.

Influence of formal urban planning tools

Formal urban planning instruments are regulated by urban planning legislation, which in Germany is based on the Federal Building Code (BauGB). In particular land-use regulations and restrictions in preparatory and binding land-use plans *(in German: Flächennutzungsplan and Bebauungsplan)* significantly influence the amount, the distribution and character of an urban agricultural site, as these plans are legally binding determinations on how individual plots of land can be used. In this context the binding land-use plan determines the type and extent of buildings and the land on which buildings can be built on (BECKMANN et al. 2000). The allocation of land uses categories is regulated by the so-called weighting process ("Abwägungsprozess"), in which public and private interests are weighed out against each other (Beckmann et al. 2000). Different designation options for land uses are provided by the federal land utilization ordinance (BauNVO) (ibid.).

Consequences of a missing land use category for UA in the German land utilization ordinance

Despite the growing recognition of the important contribution of UA to urban sustainability and food security in the urban planning discourse (BORN/PÖLLING 2014) and in German municipalities, there is no designation option for UA as a land-use in preparatory and binding land-use plans (German: BauNVO). This is the reason why urban agricultural sites are, as the results in Figure 2 indicate, officially located on various land use categories, such as residential areas. The effect is a missing protection of urban agricultural sites, resulting in an outstanding high amount of UA sites as intermediate uses on other land-use categories (VON DER HAIDE 2014: 34). In this case the land use as an agricultural site is only tolerated and often limited to the duration until another development fitting the land use category is approved by the local planning authority (SENATSVERWALTUNG FÜR STADTENTWICKLUNG 2006). It can be assumed that the lack of a land use category for UA in the land utilization ordinance hinders the development of UA projects in the urban context, as no land plots are reserved for this specific land use, wherefore urban agricultural projects are legally competing with other land uses. However, this causal relation cannot be proofed, as there is no quantitative data on the amount of UA sites in cities that introduced a land-use category for UA, such as Philadelphia or Toronto, which can be compared to Berlin, where there is not such a category introduced.
Other studies from different geographical contexts are though as well underlining the missing ordinance category as a hindrance for UA, such as (CASTILLO et al. 2013), in which 54 percent of interviewed planners and 28 percent of interviewed farmers in the Chicago metropolitan area mention the lack of (clear) ordinance as the primary barrier to UA in their considered area (CASTILLO et al. 2013). The establishment of a new ordinance category for UA is currently part of the urban planning discourse and dialogue (see SCHÄFER 2009: 26 in VON DER HAIDE 2014: 43),

further information on if and when this ordinance category may be introduced in Germany have not been found up to the date of the report. Further research needs to be done on the concrete effects of a land use category for UA, for example by drawing first conclusions from north American cities, where UA is already part of a land use category.

Consequences of use restrictions in residential areas

The GIS analysis of the Berlin case study clearly indicates that the majority of UA sites are located in residential areas of different density (W1/W2/W3/W4). With the location of these sites in residential areas concrete uses of buildings and land plots are prohibited, as the federal land utilization ordinance states a specific list of uses allowed in every land use category (see §1-15 BauNVO). In this context commercial agricultural and farming uses *(German: Gartenbaubetriebe)* are prohibited in purely residential areas (§3 BauNVO) and exceptionally permitted in general residential areas. It can be assumed that the low number of commercial UA sites and thus the high number of UA sites with social, well-being or environmental motivations, identified in the preceding analysis is partly caused by the restriction of commercial agricultural and farming uses in residential areas, as these uses are prohibited in here. In this context commercial UA projects are solely fully permitted in mixed areas (§6 BauNVO), where they compete with more profitable uses, such as office buildings.

Consequences of height restrictions in land-use categories

Beyond the above stated restrictions of building uses in every designated land-use category, other restrictions are connected to a specific land-use category. In this context the *degree of land use (German: Maß der baulichen Nutzung; §16 BauGB)* regulates the permitted volume of a building on a land plot by a cubic index (LEIBNIZ-ZENTRUM FÜR AGRARLANDSCHAFTSFORSCHUNG (ZALF) 2014: 26) and therefore directly influences the height of buildings. If the maximum degree of land use is fully utilized, enhancements in the form of an additional floor or a greenhouse on the roof are not permissible. The GIS analysis clearly indicated the low number of UA sites on roof tops, it therefore can be assumed that most land plots reached the maximum degree of land use, making height enhancements in form of a rooftop greenhouse legally not permissible. Furthermore, the alteration of height by installing a rooftop greenhouse can potentially lead to an amended building class classification (German: BauO Bln), resulting in potentially stricter requirements regarding fire safety, such as escape routes or safety properties of walls and ceilings (LEIBNIZ-ZENTRUM FÜR AGRARLANDSCHAFTSFORSCHUNG (ZALF) 2014: 26). These adjustments require considerable financial commitments and therefore more than often not profitable.

Influence of informal urban planning tools

Besides formal planning tools shaping the development of UA, informal planning tools are of great importance supporting or hindering the development of specific forms of UA in Berlin. In this context the following paragraph briefly analyses which informal planning tools and measures may have resulted in the development of specific forms of UA in Berlin

Consequences of the integration of UA into urban development concepts

Since the 2010s the municipality of Berlin started to increasingly integrate UA and farming into their urban development concepts and guiding principles. Most prominent example is the integration of UA into the green area framework "Urban Landscape Berlin – natural, urban, productive" (German: "Stadtlandschaft Berlin – natürlich. urban. Produktiv"), from 2014, in which UA is explicitly mentioned as a productive use of urban green space, whose value for the city has not been fully acknowledged and therefore needs to be strengthened (SENATSVERWALTUNG FÜR STADTENTWICKLUNG UND UMWELT 2014). The framework serves as a guiding principle for all

planning institutions in the city of Berlin, but also introduced "flagship initiatives", such as the reference project UA on the Tempelhofer Feld or the actor platform "productive landscape", aiming at intensifying the dialogue on UA, providing advisory services (ibid.: 71/72). It is difficult to determine the quantitative effect of such policies and concepts on the development of UA sites in Berlin, but nonetheless it can be assumed that such guiding concepts initiating specific measures have a positive, boosting effect on UA.

Consequences of specific informal urban planning tools on UA

After outlining the important role of urban development concepts as city-wide guiding principles, initiating various measures on the local level, the following paragraph aims to illustrate the power of specific informal planning measures, strengthening specific forms of UA.
The preceding GIS analysis clearly shows the relatively high number of intercultural gardens (13 percent) in central locations of Berlin. It can be reasonably assumed that the identified relatively high number of intercultural gardens is a result of a specific policy and development program, namely the urban development support program "Social integrative city" (German: "Städtebauförderungsprogramm Soziale Stadt") (VON DER HAIDE 2014: 34), financed by the federal government, federal states and municipalities with the broad aim of strengthening the social cohesion and quality of life in a neighbourhood (FEDERAL MINISTRY FOR HOUSING, URBAN DEVELOPMENT AND BUILDING 2022). Key component of the program is the establishment of neighbourhood management centres (German: Quartiersmanagement), a public institution implementing several measures in order to strengthen the social cohesion. The establishment of intercultural gardens by the neighbourhood management centres is, as experts state, a very common implemented measure to create a meeting place for the community aiming to reach the above stated overarching goal of the support program (VON DER HAIDE 2014: 40) and yet another example illustrating the direct implications of urban planning tools on the character of urban agricultural sites.

Influences of urban planning practices on urban agricultural sites

Besides the previously illustrated effects of formal and informal urban planning tools on UA sites, urban planning practices, which are not part of a binding law or concept can shape the characteristics, distribution and amount of UA sites. The following paragraph will briefly introduce the consequences of a common practice done by urban planning administration bureaus in Berlin, resulting in an outstandingly high number of UA sites in Public green spaces (52). (ROSOL 2011: 244) explains this with the bad economic situation in Berlin in the early 2000s districts were forced to push volunteering as the only alternative to an unwanted selling off public green spaces or the introduction of entrance fees for parks. In light of this situation, community gardens were seen by the districts as an attractive way of keeping green spaces attractive and promoted UA there. It can be therefore argued that the high number of UA sites in (public) green spaces is a result of this urban planning practice from the early 2000s.

3.2 Shanghai

Methods and Data: Shanghai

The remote sensing data for this paper were obtained from the remote sensing monitoring database for land use and land cover of the Chinese Academy of Sciences (CNLUCC). From the National Resources and Environment Database, the Chinese Academy of Sciences used Landsat remote sensing image data as the main source of information and established a national scale of 1:10 through manual visual interpretation. The database's land use and land cover remote sensing monitoring data classification system is a two-level classification system: Level 1 is divided into six

categories that are mainly based on land resources and their use attributes: arable land, forest land, grassland, water, construction land, and unused land. Level 2 is divided into 25 types of land that are mainly based on the natural attributes of land resources, as shown in Table 7.

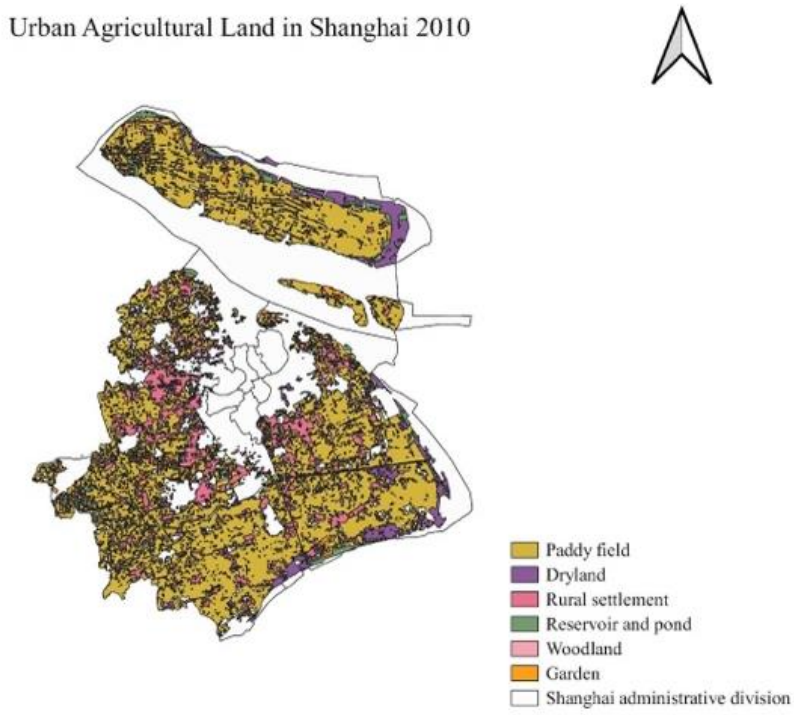
Arable land	Paddy fields, dry land
Forest land	Woodland, shrubland, open woodland, gardens
Grassland	High-cover grassland, medium-cover grassland, low-cover grassland
Water	Rivers and canals, lakes, reservoirs and ponds, permanent glacial snow, tideland, mudflats
Construction land	Urban sites, rural settlements, other construction sites
Unused land	Sandy, Gobi, saline, marshy, bare ground, bare rocky ground, other

Table 7. Classification system for remote sensing monitoring data on land use and land cover in China, Source: CHINESE ACADEMY OF SCIENCES, 2021

As there are no accurate statistics on or definitions of UA in China, this paper combines the concept of UA and the data sources mentioned above to arrive at six types of land that can be classified as secondary urban agricultural land: paddy fields and dry land, woodland, garden land, reservoir ponds, high-cover grassland, and rural settlements. Garden land refers to unforested plantations, trails, nurseries, and various types of gardens (orchards, mulberry gardens, tea gardens, hot crop forestry gardens, etc.). High-cover grassland refers to natural grassland, improved grassland, and mown grassland covering >50% of land. This type of grassland generally has good moisture conditions and dense grass cover and is mainly used for livestock farming. Reservoir ponds are artificially constructed pieces of land below the perennial water level in water storage areas and are mainly used for farming and agricultural irrigation.

The case study on UA in China comes from Shanghai. Shanghai is one of the most developed cities in China, where UA is relatively well developed and plays a leading and exemplary role. Although six secondary land types, which can be classified as UA, have been identified above, there are five final land types for UA in Shanghai because there is no high-cover grassland in the remote sensing data for Shanghai. After obtaining the administrative map of Shanghai and the 2010 and 2020 land use data of Shanghai from the Chinese Academy of Sciences' remote sensing detection database,

it was possible to create the following two maps that show the distribution of urban agricultural land in Shanghai in 2010 and 2020 using QGIS.



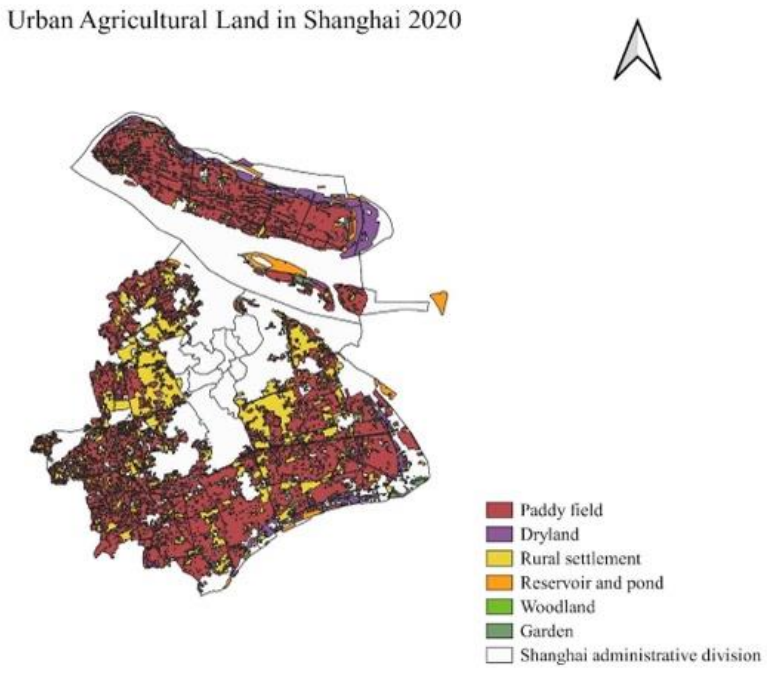


Figure 4 and Figure 5: The distribution of urban agricultural land in Shanghai in 2010 and 2020, Source: HOU 2022

Results: Shanghai

According to Figures 4 and 5, the area of urban agricultural land in Shanghai is decreasing and is mainly located in suburban areas. The second land survey in Shanghai shows that, by 2010, the city had 189,759 ha of arable land, with only 0.008 ha of arable land per capita in Shanghai, which is less than half of the national per capita level (the national per capita level of arable land is approximately 0.1). However, the total scale of construction land in Shanghai exceeded 40% of the city's land area, which is higher than that of international metropolises such as Greater London, Greater Paris, and the Tokyo Circle. Comparing these findings with the projections of the state council-approved Outline of the National Overall Land Use Plan (2006–2020; 2008), it is clear that the situation concerning arable land protection in Shanghai is serious and that there is limited room for increasing the amount of land available for construction. Nevertheless, data from China's third land survey in 2020 show that Shanghai's arable land area was 161,978 ha, which remains 15% less than in 2010. There is little difference in the area of other agricultural land between the two land surveys, with data from the third land survey, as of November 2021, showing 15,066 ha of garden land, 22,995 ha of ponds and water, 78,775 ha of rural settlements, and 55,610 ha of forest land in Shanghai (Shanghai Municipal Planning and Resources Bureau, 2021; Shanghai Information Office, 2014).

Shanghai - Influence of formal urban planning tools

The urban planning tool that has the most direct influence on the location and size of Shanghai's urban agriculture is the Shanghai Urban Master Plan. This is because the master plan is not only a comprehensive and specific arrangement made by the Shanghai Municipal Government to determine the future scale and development direction of the city and to achieve the city's development goals based on national economic and social development plans and local conditions, but it is also a legally binding document with direct approval by the central government. Therefore, the Shanghai Urban Master Plan will be used as the only urban planning tool to analyze its influence on urban agriculture.

Ensure food security

The land survey data used above is updated every ten years and has been an important basis for the preparation of urban master plans. It is also clear from the above data that there has been an increase in the amount of land used for construction and a decline in the area of agricultural land in Shanghai. However, as the population grows and the demand for food increases, the national government has started to strictly limit the conversion of agricultural land to non-cultivable land for the purpose of ensuring national food security. To this aim, Shanghai uses the 2017-2035 Land Use Master Plan as a tool to strictly control the expansion of non-cultivable land and provide a legal basis for the implementation of the arable land protection system.

First, Shanghai has already designated 134,667 ha of arable land protection space, including 100,000 ha of permanent basic farmland, 2,000 ha of reserve land under the supervision of the ministry, and 32,667 ha of reserve land under municipal control, ensuring the highest level of protection, strictly prohibiting noncultivation use, and strictly enforcing the mechanism of occupancy and replenishment allocation to guard arable land quantity and quality. Second, Shanghai will supplement arable land through multiple channels, delineate key spaces for new arable land, continue to promote the reduction in inefficient construction land, make land space available, and increase the area of supplementary arable land. Third, arable land, especially permanent basic farmland, will be provided with special protection, and tough measures will be taken to resolutely curb the "non agriculturalization" of arable land and strictly control "non foodisation" (SHANGHAI MUNICIPAL GOVERNMENT 2019).

Foundation of the economic development

Furthermore, for Shanghai, the land use master plan is also laying an important foundation for the economic development of UA. Xi Jinping proposed the rural revitalisation strategy, whose aims are to strengthen the construction of rural infrastructure and public service systems, provide better living conditions in rural areas, and build liveable and beautiful villages, in the report of the 19th Party Congress on 18 October 2017. On 22 February 2022, the Chinese government issued Document 1: *Opinions of the Central Committee of the Communist Party of China and the State Council on Key Efforts to Promote Rural Revitalisation in 2022*. The document states that, on the premise of ensuring food security, rural revitalisation focuses on developing the economy and raising farmers' incomes. The document recommends continuing to promote the integrated development of primary, secondary, and tertiary rural industries; encouraging localities to expand the multiple functions of agriculture and tap into the multiple values of the countryside, focusing on the development of industries, such as agricultural product processing, rural leisure tourism, and rural ecommerce; and applying internet technology to rural governance processes, such as commercialisation or government services (XINHUA NEWS AGENCY 2022).

As China's economy has always been structured in an urban-rural dichotomy, the concepts of rural revitalisation, rural areas and farmers mentioned above all equally refer to the rural areas and the farmers in those areas, which are mainly located in the suburbs of Shanghai. This is because one of the disadvantages of the urban-rural dichotomy is that urban and rural areas are different development systems, urban land and rural land planning generally come from different planning projects, and urban agricultural land is classified as rural rather than urban land, even though urban agricultural land is mainly located on the suburbs of the city. As a result, it is very common that the development of urban agriculture has been limited in Chinese cities. Due to lack of integrated planning of infrastructure and public facilities between built and agricultural land in the city (ZHANG et al. 2022:65). The above policies are specifying the planning objectives for land use planning of agricultural land, i.e. to improve the living environment, promote the integration of primary, secondary and tertiary industries, and promote the economic development in rural area.

Based on the national policy of rural revitalization, the first step for Shanghai to develop its rural economy is to use the land use master plan to bring the city and suburbs closer together and overcome the drawbacks associated with the urban-rural dichotomy. In 2016, Shanghai underwent another zoning adjustment that abolished suburban counties and placed them under urban jurisdiction as districts. As of 2016, there were 107 towns in Shanghai with an average resident population of approximately 122,000, 21 towns with a resident population of over 200,000, and 45 either built, under construction, or planned large residential areas involving 22 towns with an average planned population of 33,000. According to the land use master plan of Shanghai, Shanghai will be led by new towns, core towns, and central towns forming 23 town circles dismantling the traditional town system, reducing the development gap between urban and rural areas, and unifying the allocation of public resources at the administrative level. Thus, with the zoning adjustment, agricultural land and construction land in Shanghai were planned in a unified manner, and the land use master plan can be seen as a tool that provides an important foundation for promoting the integrated development of urban and rural areas and reducing the gap between urban and rural development.

Zhujing Town, Jinshan District, Shanghai is a good example of the impact of land use planning on the economic development of urban agriculture in Shanghai. As shown in Figure 6, Zhujing Town is located in the south-western suburbs of Shanghai, and in combination with Figure 5 it can be seen that Zhujing Town has a certain proportion of agricultural land. Zhujing Town covers about 1% of Shanghai's area and includes 11 villages and 18 communities, such as Zhujing Village, Damang Village and Xinjing Village, with a resident population of 0.04% of Shanghai's total population and an economy that is mainly agricultural and industrial (processing of agricultural

products). Under the guidance of Shanghai's Master Land Use Plan, the Shanghai government released another Master Land Use Plan for Zhujing Town (2017-2035) in 2019.

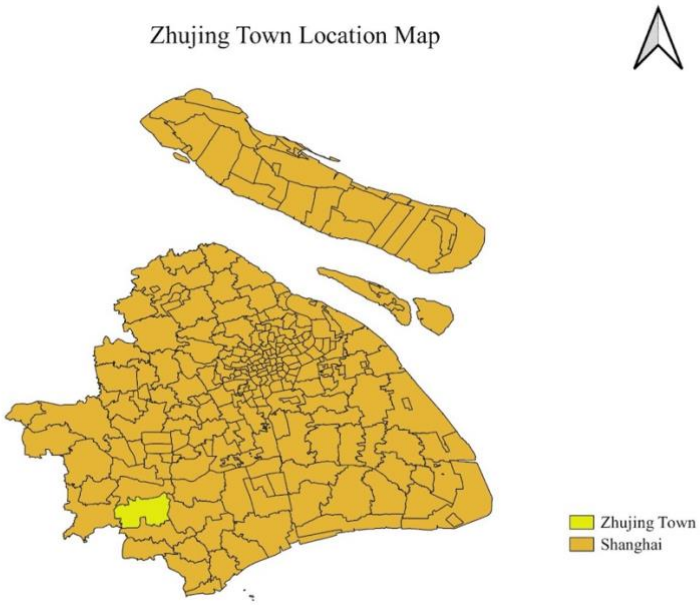


Figure 6：Zhujing town location map, Source: HOU 2022

The land use master plan for Zhujing town clearly states the unchangeable arable land area and the geographical location. Based on the type of land use and the ecological environment of Zhujing Town, the plan also states that the development of Zhujing Town should be oriented towards the development of green ecology. In addition, the construction of regional interconnecting roads will increase the transport links between Zhujing Town and the urban areas of Shanghai, providing more possibilities for the development of tertiary industries in Zhujing Town.

According to the Zhujing Town Land Use Master Plan (2017-2035), every village in Zhujing Town has undergone or is undergoing a series of projects to improve the human living environment, water system construction, farmland renovation, road optimisation and public facilities improvement. For example, the area of education and elderly facilities in public services has been greatly improved; the water system has been built to create ecological public space based on the rich local water system, presenting the local characteristics of water township culture; road optimisation is not only the construction of new main roads to make Zhujing Town more accessible to the Shanghai area, but also pays much attention to the planning of local slow traffic. All planning aspects provide a good physical space for the development of secondary and tertiary industries in Zhujing, especially tourism.

The second step in the development of Shanghai's rural economy is to develop agriculture based on land-use master plans, considering local characteristics. Take daijing village as an example. Due to the topography, the farmland in daijing village is not suitable for growing rice and other crops. The government has set up a tourism company to complete the "Haishanghuakai" park project and develop eco-tourism in conjunction with the good hydrological and ecological environment of the area. On the other hand, Xinjing Village mainly grows rice, and through a partnership with the Shanghai Academy of Agricultural Sciences, rice seeds suitable for the area have been cultivated. The government acts as an intermediary to help establish and promote the rice brand and works with online platforms to sell the rice and processed food products, and related agricultural products

are also sold in the tourist areas of the surrounding villages. With its more attractive natural scenery and cultural traditions, the land use plan for Damang Village focuses on the development of family farms, green ecology and eco-tourism. The local government has also signed contracts with a number of organisations in Shanghai to establish a retirement home and other facilities in the village. These three villages are adjacent to each other, forming a small town circle that not only allows for better economic development, but also has some radiating power to the surrounding region (CAO/ GENG 2018:12).

Limitation of the land use master plan

From the above examples, it is clear that land use master planning has contributed to the development of UA in Shanghai. Such planning promotes the development of urban and rural integration and provides a significant basis for industrial integration. However, to a certain extent, the transfer of land use rights, especially those of agricultural land, is limiting the effectiveness of the implementation of the land use master plan.

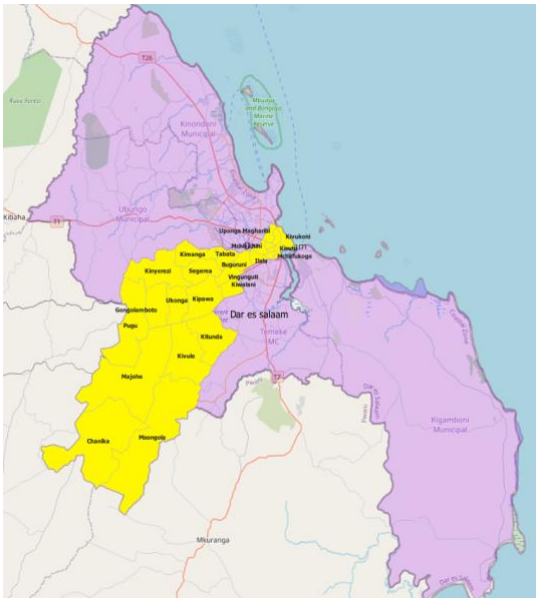
Firstly for the scale of agricultural land, in the context of China's current urbanization, agricultural use of urban land is hardly significantly competitive with other development types such as industrial, commercial and residential. Although some urban governments have attempted to lease public urban land for short periods of time for agricultural production, once the leases expire, these lands are likely to be occupied by other types of development, which are driven by economic interests (LI et al. 2016: 12); therefore, the scale of agricultural land is becoming smaller. Second, for farming households in China, regarding the occupation of agricultural land, suburban farmers have always expected compensation that is much higher than their farm incomes. For example, an empirical study involving 459 Shanghai farmers confirmed that more than half of the farmers would withdraw from land contracting rights owing to the government's removal of agricultural subsidies or better economic incomes (MA et al. 2019: 102). Although the withdrawal of farmers from land contracting is likely to benefit urban farming at scale and increase economic returns, the number of farmers withdrawing from land contracting is currently much smaller than the number of land transfers. The lack of scale in urban farming and the low economic incomes have led to a high incidence of land transfers. Some scholars have argued that studies on suburban agriculture in Shanghai have confirmed the negative impact of farmland transfers on food production (NIU et al. 2018; LI et al. 2021). Lastly, based on survey data from 400 urban family farms, some scholars have also concluded that stable years of farmland management rights significantly improved overall efficiency (JIN 2018: 2), so long-term stable land tenure for investors is more likely to be fostered, and that the current management of agricultural land transfers in Shanghai is not yet sufficiently regulated and lacks relevant laws and regulations (LU et al. 2019: 4).

3.3 Dar es Salaam

Methods and Data: Dar es Salaam

The third case study investigates space typologies of UA in Dar es Salaam, the largest city of Tanzania. According to the 2012 census, it had a population of about 4.4 people and was the economic center of Tanzania. It is also the city with the second-fastest growth rate in the world and is predicted to become a megacity by 2035. The five administrative districts of Dar es Salaam are Ilala, Kinondoni, Temeke, Ubungo, and Kigamboni (ROSEN 2019). Regarding its physical, social, economic, environmental, and spatial characteristics, Dar es Salaam is one of Tanzania's most diversified cities. The built-up area, population density, and rate of spatial development in various areas of the city vary as a result of this diversity. The city population has risen enormously, with peri-urban wards in particular having witnessed significant growth. Built-up area changes and the emergence of urban sprawl at the borders of Dar es Salaam clearly follow the pattern of demographic change (MSUYA et al. 2021).

The study was conducted in Ilala district in Dar es Salaam (Map 4). This district was selected because it includes what is usually known as "downtown," which houses most of the city's businesses, financial institutions, and administrative buildings, but it also stretches farther west to sub-urban areas. Ilala covers 273 km² of land with a population of 1,220,611 people according to the 2012 National Tanzanian Census (MALEKELA/NYOMORA 2018).

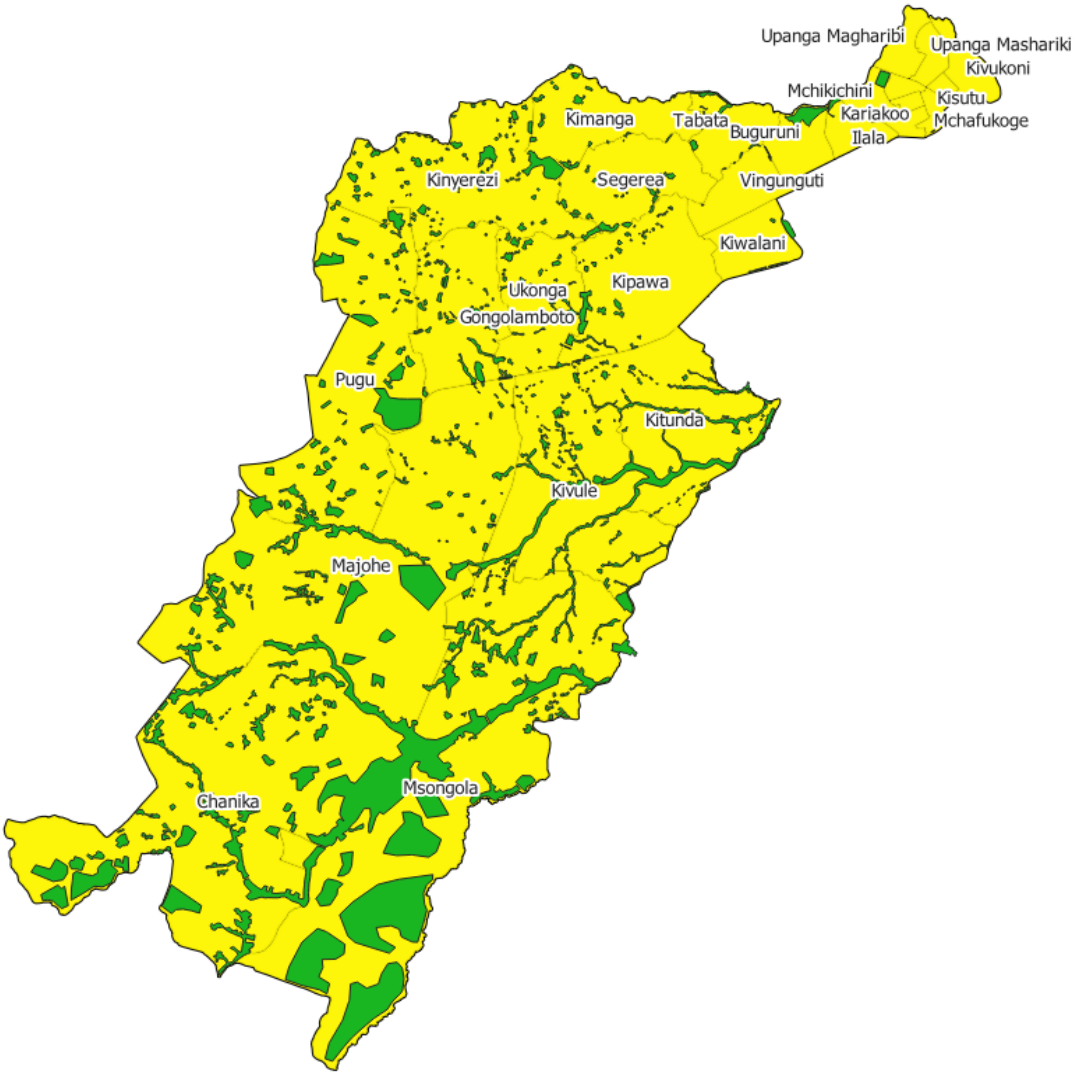


Map 4: Study area map (Ilala district), Source: OPEN STREET MAPS 2022

Primary data was obtained through analysis of high-resolution imagery by identifying plots and the traditional ridge and furrow, drawing on the experiences of agricultural employees and other associated institutions, and eventually using Geographical Information Systems (GIS) to visualize and analyse the results were all parts of the technique.
The main issues were the absence of official information on urban farms because, despite being a frequent activity, it is not covered under the master plan's section on land use categories. On top of that the activity is an integral part of all other land uses. Therefore, it is impossible to obtain the exact number of urban farms in Dar es Salaam.

Results: Dar es Salaam

The following map shows the sites of urban agricultural activities in the investigated district of Ilala based on the analysis of high-resolution imagery.



Map 5: Urban farming site in Ilala district – Dar es Salaam, Source: MAJULA 2022

Agriculture production takes place in open locations all across the city. Main space typology of urban agriculture are locations along the water channels, undeveloped land as well as buffer zones. These agricultural open spaces are either privately or institutionally owned land to which farmers have gained access through formal or informal arrangements with the landowners. Production also occurs in public open spaces such as railway reserves, river reserves or under main power lines and the authorities are now only tolerating it. There are no specific locations designated for UA with the proposed master plan.

Urban agricultural activities involve the raising of animals as well as the cultivation of crops. UA is used for both subsistence and commercial purposes, and it has advanced to the point where it is seen as a survival strategy for the urban poor and an economic need for the wealthy (DICK FOEKEN 2004).

Figure 3: Vegetable farming on undeveloped residential plots, Source: MAJULA 2022

Dar es Salaam - Influence of formal and informal urban planning tools

Influence of formal urban planning tools

Even though UA is recognized as playing a significant role in the provision of food and income in Dar es Salaam, its implementation is mostly unregulated, unplanned, and overwhelmed by a variety of issues, including an ambiguous and poorly enforced legal environment for urban farmers (SCHMIDT 2012).
There is no single clear document governing the management and regulation of UA in Tanzania. While addressing these core goals, some policies incorporate some rules related to UA. For instance, The Town and Country Planning (Urban Farming) Regulations of 1992 deal specifically with UA in the country. It defines UA, establishes conditions, and lists the various actions that come under it. Provisions that have an impact on UA in terms of tenure, land rights, and general behaviour have been noted in the policies (WIT 2013).
In this context the proposed master plan of Dar Es Salaam 2016-2036 does not provide a land use category for urban agriculture, in sharp contrast to the rejected draft of the master plan 2012- 2032 and does therefore not designate any specific locations for UA (NYITI 2022).

Influence of informality in urban planning on UA

The GIS analysis clearly indicated that the majority of UA sites in the observed district of Ilala are located on unused public spaces, such as railway reserves, along rivers or under main power lines. UA on these land plots is mainly operated without legal permission and can therefore be considered as informal UA. The identified distribution and land use models of UA sites are therefore a direct result of practises of informal land uses. SELOD (2018) defines informal land use, as land accessed or developed outside the formal process by violating zoning regulations and directly connects it to unclear and weak property rights (land tenure informality). In this context the emergence of an informal land market is a direct response to a specific "unavailability or unaffordability of formal and an "inadequate legal framework" or a "costly/ difficult process of formalization or regularization" (ibid.).
The informal land used for UA is directly connected with several advantages and disadvantages for farmers and the overall sustainable development of the city. Basically, informality in the urban context and specifically the informal use of land for UA is a response to upstream distortions and market failures and provides "access to the city" for poorer parts of the urban population (SELOD 2018). It enables quick and simple access to temporarily unused land plots for local farmers and is therefore significantly contributing to local food security or serves as an important source of

income (LADO 1990). On the other hand, informality comes along with insecure tenure models and a significant uncertainty e.g. on the durability of their land use (DESSIE 2013).
Concerning the overall development of the city scholars claim that informal land use practices can serve as a push for sustainable development (AZUNRE 2021), as unused public spaces on which another land use is hardly possible due to its topographic features or noise emissions, are used as productive green spaces.

4. Conclusion

The present study aims to analyze the shaping effects of formal and informal urban planning tools, regulations and practices on the form of urban agriculture in Berlin, Shanghai and Dar Es Salaam. In this connection strengthening as well as hindering mechanisms of formal and informal urban planning tools, regulations and practices regarding the further integration of agriculture in the urban setting are identified.
In order to facilitate a profound understanding of the influence of urban planning tools and practices on the integration and development of UA at the specific case study locations, the first part of the thesis points out important information regarding the role of urban planning facilitating UA, as well as the relations between land-use/zoning regulations and UA. After laying the theoretical foundation, the paper presents three different case studies, firstly analysing dominating typologies of UA sites, regarding location or "motivations", followed by a broad analysis of connections between formal and informal urban planning tools and practices shaping the identified state of UA in each city. This approach therefore gives important insights of the strengthening or hindering workings of specific urban planning tools, answering the central research question of this paper. The following table summarizes the identified main results of the study regarding the dominant typologies of UA in the respective regions and central formal and informal urban planning tools, regulations and practices partly causing the dominance of the identified typologies.

Berlin:

Shaping formal and informal urban planning tools, regulations and practices	**Dominant typologies of UA / Effects of the stated urban planning tools, regulations and practices**
FORMAL URBAN PLANNING TOOLS & REGULATIONS	
Lack of a land use category for UA in the land utilization ordinance Consequence: no designation option for UA as a land-use in preparatory and binding land-use plans causing a missing protection of urban agricultural sites	Location of UA sites on various land-use categories High amount of UA sites as *intermediate uses* on other land-use categories Assumingly hindering effect regarding the development of new UA projects in the urban context, as no land plots are reserved for this specific land use (legal competition with other land-uses)
Commercial urban agriculture (German: Gartenbaubetriebe) solely fully permitted in mixed areas as it is prohibited or only exceptionally permitted in residential areas	*Low number of commercial UA sites* and thus the high number of UA sites with social, well-being or environmental motivations

Regulation of the permitted volume of a building on a land plot by a cubic index	Low number of UA sites on roof tops, as presuming the maximum degree of land use is fully utilized
INFORMAL URBAN PLANNING TOOLS	
Inclusion of UA in the urban development concept green area framework "Urban Landscape Berlin – natural, urban, productive"	Boosting effect on the development of UA, though hardly quantifiable effect
Urban development support program "Social integrative city" supporting the social cohesion and quality of life in a neighbourhood through "intercultural gardens"	Relatively high number of „intercultural gardens"
URBAN PLANNING PRACTISES	
Outsourcing the maintenance of green spaces due to financial restraints in the municipality in the 2000s, pushing volunteering practices, such as UA	Boosting effect on the development of UA, though hardly quantifiable effect

Shanghai:

Shaping formal and informal urban planning tools, regulations and practices	**Dominant typologies of UA / Effects of the stated urban planning tools, regulations and practices**
FORMAL URBAN PLANNING TOOLS & REGULATIONS: LAND USE MASTER PLAN (2017-2035)	
No integrated land use planning between urban and rural areas	Urban land and rural land planning generally come from different planning projects Urban agricultural land is classified as rural rather than urban land, even though urban agricultural land is mainly located on the suburbs of the city Lack of integrated planning of infrastructure and public facilities between and agricultural land in the city
Rural Revitalisation Policy	Developing the rural economy Promoting integrated urban-rural development Narrowing the gap between urban and rural areas

Dar Es Salaam:

Shaping formal and informal urban planning tools, regulations and practices	**Dominant typologies of UA / Effects of the stated urban planning tools, regulations and practices**
FORMAL URBAN PLANNING TOOLS & REGULATIONS	

No land- use category for UA in the proposed master plan of Dar Es Salaam 2016-2036 No single clear document governing the management and regulation of UA in Tanzania	Implementation of UA is mostly unregulated and unplanned on various land-uses and locations Assumingly hindering effect regarding the development of new UA projects in the urban context, as no land plots are reserved for this specific land use
INFORMAL PRACTISES	
Dominance of informal land-uses (operation without legal permission)	Location of UA on unused public spaces, such as railway reserves, along rivers or under main power lines (operation without legal permission) **Positive consequences:** provides "access to the city" for poorer parts of the urban population ensuring food security, use of mostly unused spaces as productive green space **Negative consequences:** unclear and weak property rights (land tenure informality)

Due to very different functions of each planning system and also varying degrees of implementation of planning regulations (e.g., informal land use practises in Dar es Salaam) a well-founded comparison of planning regulations and policies was hardly feasible. Nonetheless, identified practises, such as the informal land-use for UA in Dar es Salaam could serve as an inspiration for highly regulated planning contexts, such as Germany (Berlin) or the PRC (Shanghai). In this context the spontaneous, informal acquisition of temporarily unused land plots for UA can significantly steer sustainable urban development and ensure an efficient use of urban areas. The growing discourse regarding more space for informal urbanism is already noticeable in Germany but could further be strengthened. Further research also needs to be done regarding the effects of a land use category for UA and possible opportunities for integration in planning law in for instance in Germany.

Overall, the presented thesis delivered an up-to-date overview on dominating typologies of UA in three different geographical settings, analysed important urban planning tools and regulations and their effects on UA in the chosen case study regions. By giving an overview on strengthening and hindering urban planning tools, regulations and practices the thesis could give first insights on which of these tools, regulations and practises need to be adjusted, abolished or strengthened in order to steer the reinforcement of UA.

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Urban Planning Versus Urban Agriculture in Dar es Salaam

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1. Introduction

Africa as a whole is rapidly shifting from rural to urban communities. By 2050, the UN predicts that Africa will have 22% of the world's urban population, with 1.1 billion urban dwellers (UN, 2019 p. 25). The difficulty of creating inclusive and sustainable cities in this environment of rapid urbanisation is perhaps the most important development challenge of the twenty-first century. Given this, ensuring food security in urban areas is essential to advancing the sustainable development agenda's core values of health, prosperity, equity, and environmental sustainability (CABANNES AND MAROCCHINO, 2018; BATTERSBY et al., 2016). Following the majority of people already residing in urban areas, including secondary cities, small towns, and large metropolitan areas, a greater emphasis on urban planning as a means of influencing the development of food systems is crucial (STAMOULIS et al., 2018 cited in HAYSOM, 2021).

Urban Agriculture (UA) has been reported to have a significant share of the food supply in many African cities (COFIE et al, 2003 / SIMATELE AND BINNS, 2008 / MODIBEDI, 2018). It is also considered as one of the industries with the fastest rate of employment creation and revenue generation in the majority of developing nations (MKWELA, 2013). In addition to producing food and food-related items within cities or on their outskirts, urban agriculture also offers non-food goods and services to city dwellers worldwide (MHACHE AND LYAMUYA, 2019). Another viewpoint on UA, which can be seen in the literature, supports it as a solution to a variety of urban problems, such as urban food insecurity and poverty, particularly in developing nations (MODIBEDI, 2021 / SWANEPOEL, 2021), and urban greening (SCAR et al., 2019).

In Dar es Salaam, UA has historically had a significant impact on the city's overall food chain as well as the livelihoods and diets of its residents. It is reported that 90% of leafy vegetables and 60% of milk consumed in the city comes from urban and peri-urban agriculture (JACOBI et al., 2000 / MCLEES, 2011 P. 607 / MLOZI et al., 2014 cited in MALEKELA AND NYOMORA, 2018 P. 51). Furthermore, a study conducted in 2007 found that 74% of city people kept livestock, and 70% of the milk consumed in Dar es Salaam was produced locally. Studies and reports show that the proportion of households engaging in urban agriculture increased from 18 to 67% between 1967 and 1991 (HALLORAN AND MAGID, 2013 P. 571). In 2012, the number of households engaged in crop production in the city was 75,948, while 84,631 kept livestock (URT, 2014). A study by MALEKELA AND NYOMORA in 2018 revealed that 84% of farmers they interviewed asserted to engage in UA for food and income. Additionally, from the same study, 47% of surveyed local markets indicated to obtain food products from UA. Supermarkets also reported sourcing 60-80% of vegetables and 57.1% of eggs from UA (p. 50).

Although UA and peri-urban agriculture have received more attention in food security policy contexts, UA has mainly been overlooked or deliberately opposed in urban planning in Sub-Saharan African (SSA) countries (PADGHAM et al., 2015 / HALLORAN AND MAGID, 2013 / REDWOOD, 2012 cited in DAVIES, 2021). City administrations in SSA have expressed some resistance to promoting UA from a policy standpoint, as they are concerned about hygiene and the

usage of space in cities (SCHMIDT, 2012). In some metropolitan areas, authorities have explicitly banned agricultural activities (SIMATELE AND BINNS, 2008 / TORIRO, 2019 cited in DAVIES, 2021). However, there are few African cities that have made commendable efforts to incorporate UA into planning. For instance, in South Africa, Cape Town was the first city in the country to develop an Urban Agriculture Policy.

Urban agriculture tends to have varying definitions depending on the nature of urban spaces, both geographically and conceptually (PADGHAM et al., 2015 / FOLLMANN et al., 2021). Urban planners and other stakeholders have frequently advocated a definition of urban agriculture that takes the African regional context into account, separating it from a Eurocentric perspective (HALLORAN AND MAGID, 2013). Historically, the terms "urban" and "agriculture" have never been related; for urban planners, this creates a dilemma (ibid.). This is because the word "agriculture" conjures up pictures of vast expanses of land under cultivation. Furthermore, this might also be a result of the modernistic understanding of traditional agriculture in rural areas, as well as industrialisation and service sector development in cities.

Influenced by *inter alia*, varying definitions and views towards UA, there is still a significant gap between how decision-makers and farmers view urban agriculture, despite the fact that its benefits to food security, urban greening, and informal employment have been acknowledged. Urban authorities continue to view urban agriculture as a less significant urban and land use activity (HALLORAN AND MAGID, 2013 / MKWELA, 2013 / UCLG, 2010). In the majority of African nations, land use planning procedures and their results (i.e., land use plans) infrequently establish the circumstances, benchmarks, and frameworks necessary to coordinate, regulate, and support urban agriculture (UCLG, 2010). Similarly, due to its informal nature, Dar es Salaam's urban agriculture has gotten relatively little political backing and recognition from the central and municipal governments, despite making a major contribution to human health, livelihoods, and food security (SCHMIDT, 2012 / MHACHE AND LYAMUYA, 2019 / KATERA, 2021). Although numerous international and foreign organisations have attempted to legitimate and institutionalise urban agriculture in Dar es Salaam, not much has changed politically during the past 30 years (MCLEES, 2011 / HALLORAN AND MAGID, 2013 / MKWELA, 2013). The blatant denial of such land use by some planners in Dar es Salaam, as well as their unfavourable attitude toward it, serve as examples of this. In addition, a lot of farmers who depend on using open spaces for urban agriculture to make their main or only living are frequently ignored (MCLEES, 2011).

A lot of studies about UA have been conducted in Dar es Salaam. However, their focus has been on the contribution of UA to the economy of the city and the benefits to residents, including practising farmers (MLOZI, 1996 / SCHMIDT, 2011 / MALEKELA AND NYOMORA, 2018 / MHACHE AND LYAMUYA, 2019). It is worth noting that in many studies, limited agricultural land, lack of security of tenure and limited integration of UA in land use planning processes and structures have repeatedly been mentioned as major challenges facing the sector (SAWIO, 1998 / UCLG, 2010; MCLEES, 2011 / MKWELA, 2013 / MAGIGI, 2013 / KATERA, 2021). Nevertheless, very few studies specifically link UA with policies and/or city plans, especially linking it with master plans, except for very few like a study by HALLORAN AND MAGID (2013) and MKWELA (2013). Nevertheless, Halloran and Magid's study featured only one master plan (2012-2032), which, by the way, was not approved during the time they conducted their study, while Mkwela focused on analysing UA-related policies. These authors also take into account other plans and initiatives that have tried to legitimise UA in the city, such as the Sustainable Dar es Salaam City Project (SDCP) and the Sustainable Cities International Network Africa Programme (SCINAP).

Although we also appreciate and recognize national and international efforts to legitimise UA in the city, our paper focuses only on master plans. The decision to focus on master plans only and not any other plan/policy is based on the fact that master plans are regarded to be the overall guiding tool for land use in urban areas, within which agriculture is one. This being the case, it's

our understanding that any other plan and or strategy towards any land use development in the city should be a product of what is stipulated in the master plan. In other words, principally, we believe that any land use development on the ground should have already been stated and planned for in the master plan. This paper therefore aims at complementing and adding to Halloran and Magid's study and others that have been conducted with regard to UA in Dar es Salaam by specifically reviewing the three Dar es Salaam master plans to trace how and to what extent UA has been featured in the same.

As mentioned above, most studies only provide general accounts with regard to the inclusion of UA in city plans. The literature review indicated this knowledge gap, which our study aimed to fill. Reviewing the master plans facilitated the realisation of the actual position of UA in the plans, and, as a result, enabled the study to draw conclusions accordingly. This paper adds to other scholars' thoughts and arguments, which are based on either empirical or desk UA studies of cities.

2. Methods

Data and information presented in this paper is mostly secondary; gathered from scholarly works and other national and international reports. Specifically, the paper reviews all Dar es Salaam Master Plans that have been established post-independence era; i.e., Dar es Salaam City Master Plan (1968); Dar es Salaam Master Plan (1979); and the current master plan (2016-2036) that was approved in February 2020. Dar es Salaam was selected as a case study based on the fact it is the largest and fastest growing city in the country (URT, 2022). The paper adopted a critical review and analysis of articles based on UA studies, with a special focus on studies conducted in SSA and Tanzania. While reviewing the master plans, the paper looked at specific mentions and/provisions of UA in the documents. Master plans were chosen as main documents to be reviewed for the study as the focus was checking whether or not UA is sufficiently included in the city's main guide for land use development. Additional materials including published articles and reports were reviewed with the purpose of obtaining a general overview/analysis of UA situations and practices from researchers' perspectives. Documents and articles reviewed and cited were selected due to their richness in information and relevance to this paper. The authors acknowledge drawbacks of this method, including biases in interpreting texts and words.

3. UA in Dar es Salaam City

3.1 General UA practices

Urban agriculture forms a significant part of economic activities as well as an important part of the local food system in Dar es Salaam (SCHMIDT, 2012 / URT, 2020). Types of UA activities include production of vegetables (eg. Chinese, cabbage, tomatoes, amaranths, spinach, etc.), and fruits such as pineapple and pawpaws. Additionally, eggs, milk, poultry and meat are also produced and supplied locally. In 2012, it was reported that 13% of the population in Ilala Municipality was engaged in UA, and over 10,000 hectares of land was devoted to urban agriculture (SCHMIDT, 2012 P. 133). Moreover, approximately 60% of arable land in Kinondoni and Temeke Municipalities was under cultivation (ibid. p. 133).

In Dar es Salaam, UA is practised mainly within households, in open spaces within the urban areas, and in the outskirts of the city. UA practised within households (often in backyards), also known as home gardening, is considered one of the least endangered types of intra-urban agriculture. It is generally practised by middle- and high-income households, since they have access to lease land. Although backyard urban farming is still largely unregulated, municipal authorities and planners do not have a bad opinion of it (HALLORAN AND MAGID, 2013).

Another type of intra-urban agriculture is open space urban agriculture, often found on marginal places such as river valleys or flood plains, along roadside ditches, railroad tracks and under power lines (SAWIO, 1998/ HALLORAN AND MAGID / 2013/ MHACHE AND LYAMUYA, 2019). Open space agriculture is practised by the urban poor who do not have access to land (SCHMIDT, 2012). Many open spaces in medium- to high-density areas are currently deemed inappropriate for urban agriculture due to urban development, worries about soil and water contamination, and dangers like flooding. In their study, Halloran and Magid quoted the following response received from one of the officials in Temeke Municipality:

"In most cases urban agriculture has been in the leftovers, the land pockets. Most areas which are not suitable for urban development are being constantly used for agricultural purposes. the land for agricultural purposes is constantly being reduced because it is not formalised to be purely for agricultural purposes".

On the other hand, peri-urban agriculture is practised on the outskirts of the city - about 15 to 25 kilometres from the city centre. Urbanisation is, however, argued to be posing a threat to peri-urban agriculture (HALLORAN AND MAGID, 2013 / MAGIGI, 2013).

3.2 Access to land and security of tenure

Despite the significant contribution of urban agriculture to urban livelihoods, limited access to land and insecurity of tenure still poses the greatest challenges to urban farmers. Farmers on open spaces are reported to obtain land for cultivation through different means. These include unclaimed land by government and private entities; granted access to idle land by companies such as Tanzania Electricity Supply Company (TANESCO) and railway corporation (TAZARA), granted permission by Municipalities, and sometimes along river valleys with no formal permission at all (MCLEES, 2011). The National Samples Census of 2003 indicated that only 5% of the estimated 36,551 farmers surveyed in Dar es Salaam had certificate of ownership while the remaining 95% were reported to own land through customary law, rented, borrowed, shared or purchased from other inferior right holders (MKWELA, 2013 P. 163).

The susceptibility of farmers is also influenced by where they are located in the city. Urban agriculture is observed to be practised often where there is no development planning pressure. The survival of urban farming activities is dependent on the difficulty of developing the land on which they are carried out, such as marginal land. This being the case, urban agriculture stakeholders in Dar es Salaam believe that farming activities will always be vulnerable when they take place in areas where land use planning is taking place; in other words, where the municipalities have an interest in changing land use (MCLEES, 2011 / HALLORAN AND MAGID, 2013).

Nevertheless, regardless of rapid population growth in some parts of the city, urban experts argue that urban agriculture will persist. Production sites may vanish from one location while appearing in another. For example, studies show that, while the locations of agricultural areas have changed significantly over time, the total amount of cultivated open space has remained essentially constant (DRECHSEL AND DONGUS, 2010 cited in FOLLMANN et al., 2021). Despite the fact that the majority of farmers lack solid tenure, UA is neither a diminishing nor ephemeral phenomenon. With this fact, planning for UA is inevitable.

3.3 Inclusion of UA in Dar es Salaam Master Plans Post Independence Era

Although the focus of this paper is on master plans, we could not ignore other existing frameworks guiding UA in the country. Tanzania has put in place urban policies that support urban farming. A good example of this case can be drawn from the URBAN PLANNING (URBAN FARMING) REGULATIONS, 2018. The regulations state that farming shall be permissible in urban areas for the purposes of providing household food security, alleviating poverty, creating employment,

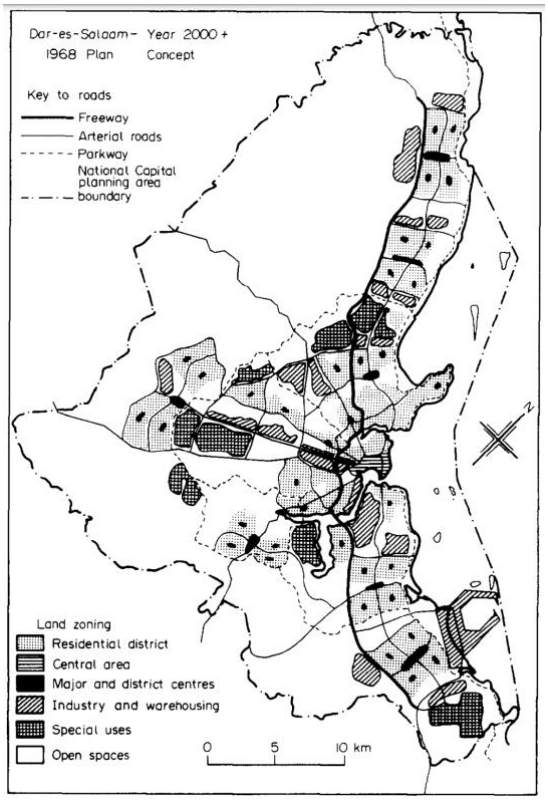
establishing and sustaining agricultural businesses within urban areas for urban greening and beautification, and for wastewater recycling. Section 3 of the regulations also provides for the obligations and restrictions of the planning authorities, which set the tone for the governance of urban farming practices in their administrative areas. Furthermore, the URBAN PLANNING (PLANNING SPACE STANDARDS) REGULATIONS, 2018 provide planning standards for agricultural facilities, including UA. The regulations provide that within urban areas, UA should occupy at least 1 to 3 acres of land, while those in peri-urban areas should occupy a minimum of 3 acres of land. Having a favourable institutional framework in place is only one step forward in promoting UA; implementing the policies, however, has been a challenge in the country. However, it is important to note that other policies and regulations cut across the whole country, while Master Plans are city-specific, making them (supposedly) more efficient.

A master plan is an overarching planning document and spatial layout which is used to structure land use and development. They are designed for the physical, social, and economic development of a city (NALATHIGA, 2016). Master plans have emerged as the standard instruments of planning to be developed by urban local governments in many countries/cities. They are forward planning tools that anticipate urban development and make provisions for it on city space in terms of (a) the allocation of land for various uses, (b) the regulation of its development and (c) the provision of civic infrastructure (ibid). Like many other countries Tanzania also adopted Master Plans to guide land development in cities. Taking into consideration the main objective of this paper as explained before, these are reviewed in the following sub-sections.

3.3.1 The 1968 National Capital Master Plan: Dar-es-Salaam

With funds from the Canadian Government, the 1968 master plan was developed by a Canadian-based company called Project Planning Associates Ltd. between 1967 and 1968, when Dar es Salaam was still the capital of the country. During this time, politicians and bureaucrats were given sole authority over routine implementation choices and plan specifics by the masterplan consultants (RONDINELLI, 1976). This was also a time when methodological optimism prevailed, i.e., just one year into implementing the Arusha Declaration and seven years after the country's independence. The project manual, critical route programme, thorough pre-plan survey, data, and novel modelling methodologies served as the plan's guides. It was presumed that the plan articulated an excellent spatial framework and policy guidelines for the growth of Dar es Salaam to the year 2000 (ARMSTRONG, 1987).

Despite the Arusha Declaration identifying agriculture as the backbone of the nation, urban agriculture was still not seen as a crucial function for making the city work. The master plan reflected more on the then altered social and political conditions within the country. It sought to satisfy the needs of a new and young sovereign nation while eradicating the exclusive racial and economic restrictions of its colonial past. At the time, detaching the city from its 1949 master plan was a primary concern of the then-nationalist politicians. To prevent urban sprawl, however, a green belt girdling the city was designated (marked as open spaces in Map 1), in which development would be both limited and tightly controlled (AMSTRONG, 1987). In this case, the green belt was only proposed as a protective layer that would stop the city from developing informally. Put another way, urban agriculture was not an issue at the time as the young nation had so many other pressing matters to address, as mentioned above. In addition, large farms initially owned by the colonial settlers still existed. These and other farms in villages were mainly used for agricultural production—both food and non-food produce.



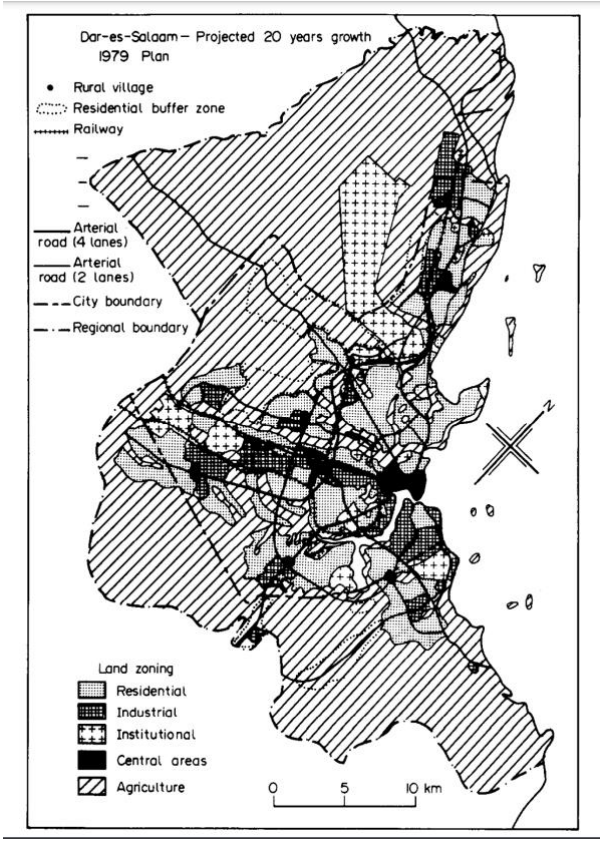
Map 1. 1968 National Capital Master Plan: Dar es Salaam (Source: ARMSTRONG, 1987*)*

3.3.2 The 1979 Dar es Salaam Master Plan

Another Toronto-based consultant named Marshall Macklin Monaghan produced the 1979 Dar es Salaam Master Plan; this time with funding from the Swedish Government. This preserved the connection between urban planning in Tanzania and Canada, which also included the mid-1970s Dodoma Capital and Arusha Master Plans. At this point, Dar es Salaam had ceased being the capital city of the country for about five years. Developing the master plan took two years to complete, and afterwards the plan was considered to be more flexible, pragmatic, and realistic compared to its ambitious forerunner. Due to its methodology, the 1979 Plan is positioned within the new planning generation that emerged in the wake of the planning industry's confidence crisis in the late 1960s and early 1970s. The rigid and excessively detailed long-range scenarios that the previous generation favoured were rejected by this generation of planners. This generation of planners was in favour of planning that involved less thorough pre-plan survey and analysis, attempted to set up practical programmes in light of existing realities, and placed an emphasis on control and implementation rather than just designing the plans (ARMSTRONG, 1987 / URT, 1979).

The 1979 strategy had a number of other significant deviations from the previous master plan, or at the very least, changes in emphasis. Firstly, it attempted to achieve a much greater degree of flexibility; for example, it had no rigid schedule for projecting population growth. The plan simply identified three broad development stages based on the population level to be attained. Areas of the city were to be developed and implemented for each stage to accommodate a population growth of 1.2, 1.5, and 2.4 million inhabitants respectively to Dar-es-Salaam's projected population size in the year 2000. Moreover, this was the first Dar es Salaam master plan to feature UA in its proposed land use. As indicated in Map 2, the entire city's periphery was set aside for agricultural land use. The master plan had also boldly proposed 47 priority programmes to be implemented alongside estimated funds required for their execution; unfortunately, UA was not one of the programmes (ARMSTRONG, 1987 / URT, 1979). This indicates that even at the time, UA was not a

priority in Tanzania, perhaps it wouldn't have even made it to the top 50 if there were three more to be added to the list of priorities in Dar es Salaam city.



Map 2: 1979 Dar es Salaam Master Plan (Source: URT, 1979; ARMSTRONG, 1987***)***

3.3.3. Dar es Salaam Master Plan 2016–2036

The DAR MASTER PLAN 2016–2036 is the result of a local and international consortium of consultants that included Afri-Arch Associates, Q-Consult Ltd., and Dodi Moss SRL of Milan, Italy, as well as Buro Happold Ltd. of London, UK. This master plan took the longest time to establish, with its first draft being ready in 2012 and an improved draft later in 2016, which continued to undergo improvements until it was approved by the government in February, 2020.

On the one hand, Section 7.3 (p. 63) of the master plan identifies broad land use categories in Dar es Salaam as being: residential, commercial, institutional, industrial, transportation, open spaces, and hazardous areas. Residential use was reported to be the city's most dominant land use covering 65.13% of the overall land uses. UA only exists on the extended list of land uses of the city, as seen on Table 7.1 (p. 71) of the master plan. It was paired with "sparse development" to form "UA and sparse development," which was reported to cover 18.31% of the existing land use in the city. Unfortunately, the existing land use map 7.6 (p. 70) of the master plan does not include "UA" in its legend. It's possible that it was swallowed by another item that was listed on the legend as "un/underdeveloped areas," which is almost the same as its previous "other half," that was named: "sparse development." This represents a mismatch between what has been provided on the existing land use map and what is happening on the ground with regard to UA in the city.

Land Use Category	Specific Type of Land Use	Area in Hectares	Percentage
Residential	1) Planned low density	15038.9	9.12%
	2) Planned medium density	5136.1	3.12%
	3) Planned high density	3105.8	1.88%
	4) Planned and undeveloped areas	6635.14	4.03%
	Planned Settlement Sub Total	**29915.94**	**18.15%**
	5) Formalized settlements	2087.6	1.27%
	6) Regularized informal settlements	2621.7	1.59%
	7) Upgraded settlements	1904.7	1.16%
	8) Consolidating settlements	22664.3	13.75%
	9) Consolidated informal settlements	18417.9	11.17%
	10) Scattered informal settlements	29738.32	18.04%
	Informal Settlement Sub Total	**77434.52**	**46.98%**
Sub Total		**107,350.46**	**65.13%**
Commercial	Service Trade	22.4	0.01%
	Commercial	1123.9	0.68%
Sub-Total		**1146.3**	**0.70%**
Institutional	1) Institutions/offices	3597.9	2.18%
	2) Military	4288.14	2.6%
Sub Total		**6826.1**	**4.14%**
Industrial	1) Power substations	33.2	0.02%
	2) Warehouse	58.6	0.04%
	3) Light industry	414.9	0.25%
	4) Heavy industry	1977.9	1.20%
	5) Harbour	428.4	0.26%
Sub Total		**2913.0**	**1.77%**

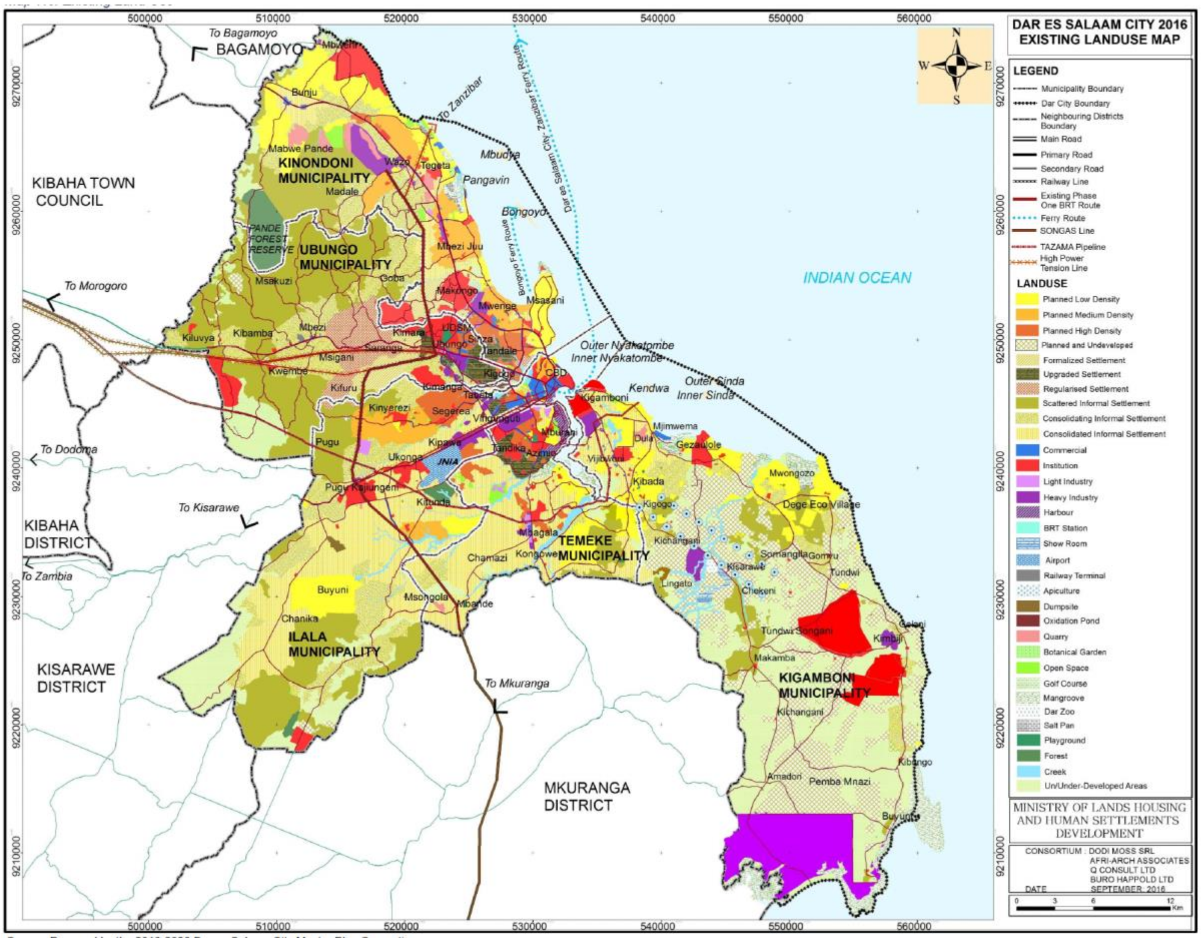
Land Use Category	Specific Type of Land Use	Area in Hectares	Percentage
Transport	1) Roads and infrastructure	2270.1	1.38%
	2) Railway terminal	45.6	0.03%
	3) Bus terminal	45.3	0.03%
	4) Parking	8.3	0.01%
	5) Airport & Airstrip reserve	795.2	0.48%
Sub Total		**3164.5**	**1.93%**
Waste management	1) Pugu dumpsite	89.9	0.05%
	2) Oxidation ponds	49.7	0.03%
Sub-Total		**139.6**	**0.08%**
Mining	1) Quarry	718.9	0.44%
	2) Salt pans	131.6	0.08%
Sub-Total		**850.5**	**0.52%**
Environmental Conservation	2) Mangrove	5498.7	3.34%
	3) Creeks and river valleys	3014.4	1.83%
	4) Forests	2012.9	1.23%
Sub Total		**10526.0**	**6.40%**
Open and recreational areas	1) Sports fields and play grounds	242.0	0.15%
	2) Zoos	148.1	0.09%
	3) Open spaces	573.7	0.35%
	5) Public Gardens	58.3	0.04%
	6) Cemeteries	67.8	0.04%
Sub-Total		**1089.9**	**0.67%**
Urban agriculture with sparse development		**30169.0**	**18.31%**
GRAND TOTAL		**164,819.8**	**100%**

Table 1 (7.1 in the master plan): Dar es Salaam Existing Land Use Composition, 2016
(Source: DAR MASTER PLAN 2016-2036)

Notwithstanding the above, the master plan outlined the following as the main challenges facing UA in Dar es Salaam on Section 7.4.5.1 (p. 64):

i. *Although urban agriculture plays a vital role in providing food and generating income to residents, of the city, the practice is mostly unregulated and unplanned;*
ii. *Insecure tenure arrangements and expropriation of farmlands for urban development purposes;*
iii. *Loss of agricultural land due to rapid urbanisation and urban sprawl; and*
iv. *Public health concerns over contamination of urban agricultural products from vehicular lead emissions on roadside crops, and irrigation with water from polluted sources like the Msimbazi River.*

From the above outlined challenges, one would expect to see vivid initiatives in the Master Plan, such as areas zoned specifically for UA 'if' its benefits are well appreciated and there's a genuine intention to solve the associated challenges. The absence of clear land use plans for UA, despite the challenges the sector faces being mentioned, leaves these questions unanswered: Why was UA not mapped as a stand-alone land use like others? Why was it paired with sparse development? Why was UA land use not given the significance it deserved in this master plan?



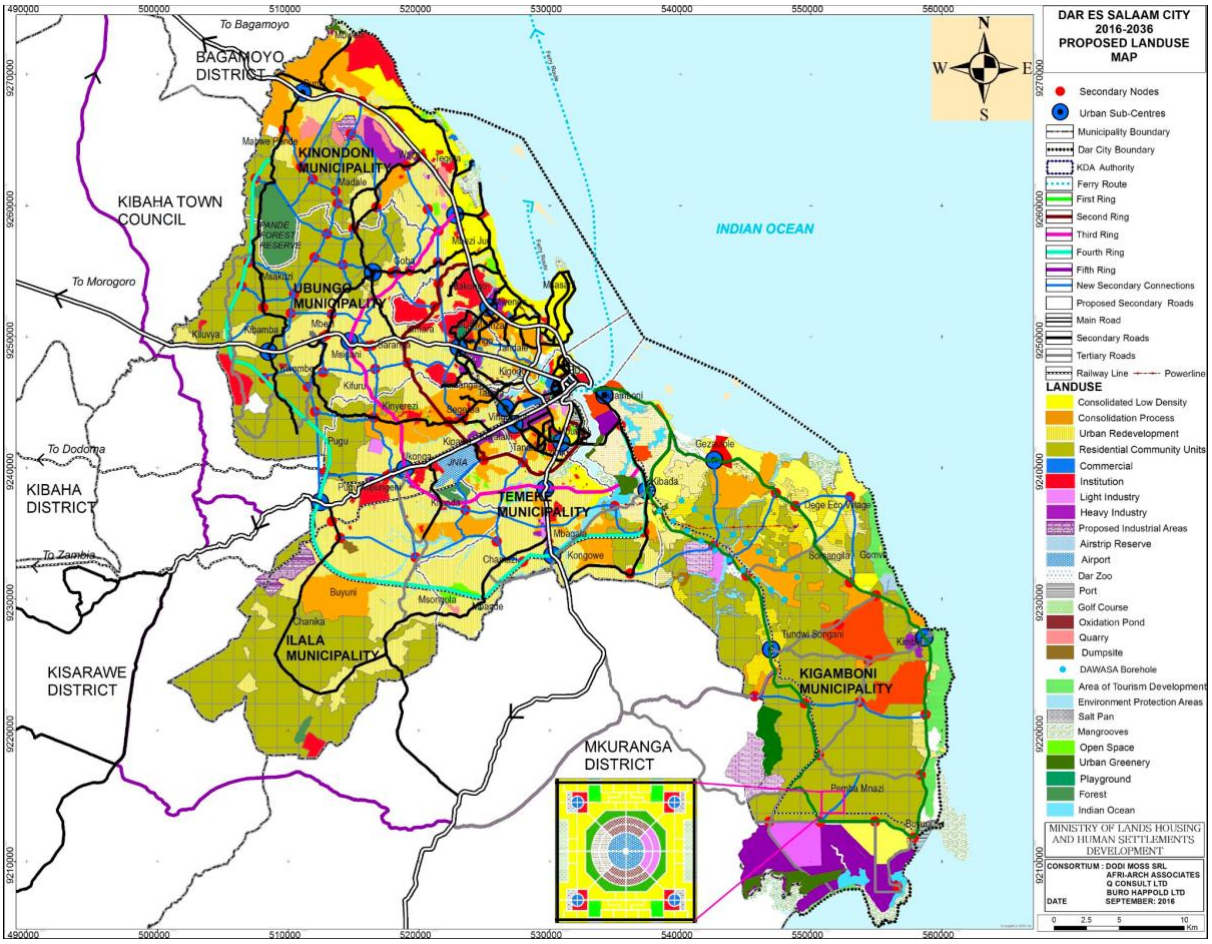
Map 3 (7.6 in the master plan): Dar es Salaam Master Plan 2016–2036: Existing Land Use
(SOURCE: DAR MASTER PLAN 2016-2036)

On the other hand, the master plan's proposed land use table 14.3 (p. 185) recommends that UA make up only 2.07% of the overall proposed land use in the city, while residential use was slightly reduced to 62.48%. Interestingly, the proposal has renamed "un/underdeveloped areas" to "residential community units" which this time was separated with UA. The proposed land use map did not have major variations except for minor change items in the legend, as explained above (see map 3). Various working drafts of the master plan prior to its approval were reviewed in order to make sense of the changes observed above. The analysis suggests UA was initially reported to be as low as 0.01% of overall existing land uses in the city, consisting mainly of a dairy farm and bee forest in Tundwi Songani and Kinyerezi, respectively as seen on technical supplement 6 of 2018 (p. 5) in the 2018, DRAFT DAR ES SALAAM MASTER PLAN 2016–2036. Despite the fact that the UA proportion reported was almost negligible to even map, it currently appears the whole of Tundwi Songani has been proposed to be an institutional area, posing the question: has the dairy farm been completely disregarded? Why did the consultants not propose a zone for UA in this area? Answering these questions will inform the positionality of UA in future Dar es Salaam master plans. There is a clear indication that UA is diminishing and dramatically disappearing in the proposed land use maps of the Dar es Salaam master plans. This presents a unique opportunity in capitalising on the promoting home gardening or backyard farming, considering the fact that residential land use dominates Dar es Salaam's urban fabric.

PROPOSED LANDUSE			
Land Use Category	**Specific Type of Land Use**	**Area in Hectares**	**Percentage (%)**
Residential	Consolidated Low Density	5416.6	3.29
	Consolidation Process	9544.25	5.79
	Urban Redevelopment	35750.35	21.69
	Proposed New Residential Communities	52274.92	31.72
Sub-Total		**102986.12**	**62.48**
Commercial	Commercial facilities	2262.09	1.37
Sub-Total		**2262.09**	**1.37**
Institutions	1) Institutions/offices	5728.04	3.48
	2) Military	4074.85	2.47
Sub Total		**9802.89**	**5.95**
Industry	Warehousing	768.98	0.47
	Service Trade Industry	22.36	0.01
	Heavy Industry	1935.4	1.17
	Light Industry	931.81	0.57
	Proposed Industry	2470.98	1.5
Sub-Total		**6129.53**	**3.72**
Transport and infrastructure	Roads and infrastructure	9914.83	6.02
	Airports	795.12	0.48
	Parking	8.27	0.01
	Bus terminals	45.25	0.03
	Railway Terminals	45.61	0.03
	Port	810.03	0.49
Sub Total		**11619.11**	**7.05**
Waste management	Oxidation ponds	248.9	0.15
	Solid waste landfills	828.92	0.5
Sub-total		**1077.82**	**0.65**
Mining	Quarries	718.9	0.44
	Salt Pans	131.64	0.08
Sub-Total		**850.54**	**0.52**
Environmental Conservation	Mangrove forests	5498.69	3.34
	River valleys and creeks	3014.36	1.83
	Kimbiji well farm protected area	1973.75	1.20
	Forestry	2012.85	1.22
Sub-Total		**12499.65**	**7.58**
Open Spaces/Recreation	Playgrounds	242	0.15
	Zoo	148.11	0.09
	Open spaces	13663.44	8.29
	Parks and gardens	58.32	0.04
	Cemeteries	67.84	0.04
Sub-Total		**14179.71**	**8.60**
Urban Agriculture		3412.34	2.07
TOTAL		**164819.8**	**100**

Source: Prepared by the 2016-2036 Dar es Salaam City Master Plan Consortium

Table 2 (14.3 in the master plan): Proposed land use (Source: DAR MASTER PLAN 2016-2036*)*



Map 3: Dar es Salaam Master Plan 2016–2036: Proposed Land Use (Source: DAR MASTER PLAN 2016-2036)

It is important to note that technical supplement 5 of the 2018, DRAFT DAR ES SALAAM MASTER PLAN 2016–2036 reported on municipalities reserving areas for urban, peri-urban, and rural agriculture in the city. Selected areas were preferred to be along rivers, valleys, and road sides. The draft had recommended the following priority actions for municipalities' uptake and implementation:

i. Assess the carrying capacity of land and its suitability for agriculture, with regard to anticipated climate changes;
ii. Identify the area of land required for agriculture and;
iii. Support municipal councils' urban agriculture strategies

This indicated that efforts were being made to integrate UA into the city, but its feasibility has not been materialised or documented in the approved Dar es Salaam Master Plan 2016–2036. Moreover, this suggests that UA in Dar es Salaam can only thrive in the informal sector and that the current master plan has fallen short in favouring its prosperity in the city. In order to address this pressing issue with context-specific, innovative approaches for the city, a comprehensive analysis is necessary.

4. Conclusion

Dar es Salaam has come a long way since the nation's independence in 1961. The city has experienced its share of ups and downs as a result of shifting dynamics on the political, social-cultural, economic, and physical levels. Through it all, the city has remained resilient and has continued to be the economic capital of the country. The presence of a national level institutional framework that supports UA offers a basis for establishing a positive trajectory towards promoting UA in the city. However, the inclusion of UA-related issues in Dar es Salaam master plans has been slow and almost regressive.

The study revealed that both the 1979 and 2016–2036 Dar es Salaam master plans touched on matters related to UA, but it was the former that demonstrated more UA inclusiveness in its proposed land use plan. Despite this inclusion, UA was not listed in the 47 priority programmes that were to be implemented by the city. This was presumably one of the major setbacks for the city, as land was readily available for UA at the time. The current master plan exhibits remarkable deficiencies in integrating UA into its proposals. This is happening whilst there are a lot of studies detailing the importance of UA in the country and Dar es Salaam specifically, as discussed in the previous sections. These studies have also been emphasising the absence of clear land use plans as one of the challenges facing UA, something that the current master plan also appeared to recognize. Regardless of all these realisations and available information, less efforts were made in integrating UA into the current Dar es Salaam master plan. Findings from research appear to have less influence in the decision of respective authorities to significantly include UA in the development of the master plan. This leaves a question about whether the respective authorities have a clear set of actions for UA in Dar es Salaam.

One significant challenge put forward by this study is that residential land use competes vigorously with UA uses. Consequently, its future is subjected to the whims of informal practices. These include practising UA along road reserves; river and valley sides; railroad tracks; and under power lines in the city by the poor urban farmers who lack security of tenure. The study challenges future master plans to incorporate programmes for promoting home gardening or backyard farming, considering the fact that residential land use dominates Dar es Salaam's urban fabric. This necessitates additional research into innovating viable residential UA options in Dar es Salaam.

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